THE PLANT DISEASE BULLETIN

Issued By

THE PLANT DISEASE SURVEY

SUPPLEMENT 14

Diseases of Fruit Crops

in the United States in 1920

April 1, 1921

BUREAU OF PLANT INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE

PLANT DISEASE SURVEY

1920

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DISEASES OF FRUIT CROPS IN THE UNITED STATES

IN 1920

Prepared by
H. W. Anderson,
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FOREWORD

The sources of information utilized in preparing the 1920 summary of fruit diseases were as follows:

1. Reports of state collaborators whose names appear on the opposite page. No reports on fruit diseases were received from Colorado, Florida, Louisiana, Maine, Montana, Nevada, Porto Rico, South Carolina, nor Utah.

2. Special reports of pathologists in the Bureau of Plant Industry and elsewhere. Among those who furnished valuable information may be mentioned C. L. Shear, Charles Brooks, D. F. Fisher, H. Atherton Lee, B. T. Galloway, and J. W. Roberts.

3. Reports of inspectors of the Bureau of Markets. The data secured from their certificates of inspection were arranged in a tabular form when possible.

4. Miscellaneous reports and records of the Plant Disease Survey. Articles from recent publications were used when these related to conditions in 1920.

Whenever possible the subject matter was treated under the following heads:

1. Geographic distribution and relative prevalence.
2. Nature of injury.
3. Dates of first appearance.
4. Relation of weather to prevalence.
5. Varietal susceptibility.
6. Control.

It was not possible to use this arrangement in all cases either because the heading did not apply to the disease under consideration or the information was not available from reports received.

General summaries of certain diseases were attempted in conformity with the plan of 1919. It is hoped that this plan may be followed more extensively in the future so that all the records which have accumulated in past years in the files of the Plant Disease Survey may be made available to workers throughout the country.

Crop production statistics were taken from the Monthly Crop Reporter Vol. 6, December 1920, of the Bureau of Crop Estimates. No attempt was made to give detailed losses in most instances since these will soon appear in tabular form as Plant Disease Bulletin Supplement 18. In those cases where losses were estimated, the basis for determining the loss was that followed in Supplement 12, i.e., the actual production is taken as 100% minus the sum of percentage of loss from all diseases of the crop in question.

Some alterations of the estimates submitted by the collaborators were deemed necessary in certain cases. Changes were avoided whenever possible but in some cases it was evident that differences between adjoining states, for example, were too great to be attributed to different environmental or cultural conditions. It was also evident in some few cases that collaborators made their estimates on the losses observed in neglected orchards or in a section of the state where the disease was most severe without taking the total crop into consideration. The effort has been to smooth out the inconsistencies as far as possible, with the least disturbance to the collaborators' figures. The figures in all cases are **thought** to be conservative.

It is hoped that in 1921 some more definite methods of estimating actual losses from some of our more common diseases may be suggested by the collaborators.

General Statement Concerning Reports on Weather Conditions by the Collaborators

The information from the collaborators concerning weather relations was rather meager in 1920. From our own experience in making out the reports in past years it is thought that this is largely due to the fact that by the time the collaborator summarizes his report in the winter he has only a vague recollection of the weather conditions during the growing season, or his observations on weather conditions have been quite local. The following suggestions may, therefore, be of value to those who wish to keep in touch with the weather conditions in their respective states.

The Weather Bureau issues two publications which can be obtained by the collaborators and which will give them detailed data on weather conditions. These are:

1. Climatological data. This is a monthly summary of weather conditions in each state, with the exception of some of the New England States which are grouped, and Delaware and Maryland, which have a single report. Daily temperature and precipitation records from a large number of stations in each state

are given. These may be obtained from the weather bureau headquarters of the respective states, and usually appear within two or three weeks after the month for which the records are made.

2. National weather and crop and snow and ice bulletin. This gives a weekly summary of weather conditions throughout the country and is especially valuable on account of the maps which give the precipitation and temperature records for the week for the entire country. Telegraphic reports from each state weather station are included, thus presenting a weekly summary of the weather conditions by states. This may be obtained by writing to the Weather Bureau at Washington.

It takes only a few minutes to look over these weather reports when making out the disease summaries and exact and complete information is there presented for all portions of the state and country.

DISEASES OF POME FRUITS

APPLE

Scab caused by *Venturia inaequalis* (Cke.) Wint.

As usual scab was generally prevalent throughout the apple growing region of the United States. As compared with former years, it was more serious than the average year but probably caused less general damage than in 1919. In the New England States scab was slightly more serious, while in New York and Pennsylvania it was less severe than in 1919. Along the Coastal Plain of the South Atlantic States very little loss occurred, while in the Appalachian region south of Pennsylvania the loss was even more severe than in 1919 when it was much worse than the average. Dry weather following the blooming period was unfavorable for scab development in the Great Lakes region, especially in New York, Michigan and Wisconsin, but a wet summer favored a late infection in some of these states. An unusually cold, wet early spring in the Ohio and Upper Mississippi Valleys resulted in a heavy initial infection, especially in Ohio, Indiana and Illinois. This, combined with other factors, caused a heavy dropping of blossoms and young fruit. In the Gulf States the damage from scab was about average, while in the North Central States west of the Mississippi River the loss was somewhat greater than in 1919.

The estimated percentage loss from scab in 1920 was 5.6% as compared with 3.9% in 1919. The loss to the total crop was about 16,259,000 bushels in 1920 as compared with 6,544,000 bushels in 1919.

The loss in the Northwest was not very great, owing to the fact that little scab was present in the commercial apple section of Washington, but the losses in western Oregon, especially in the Willamette Valley, were heavy for that section.

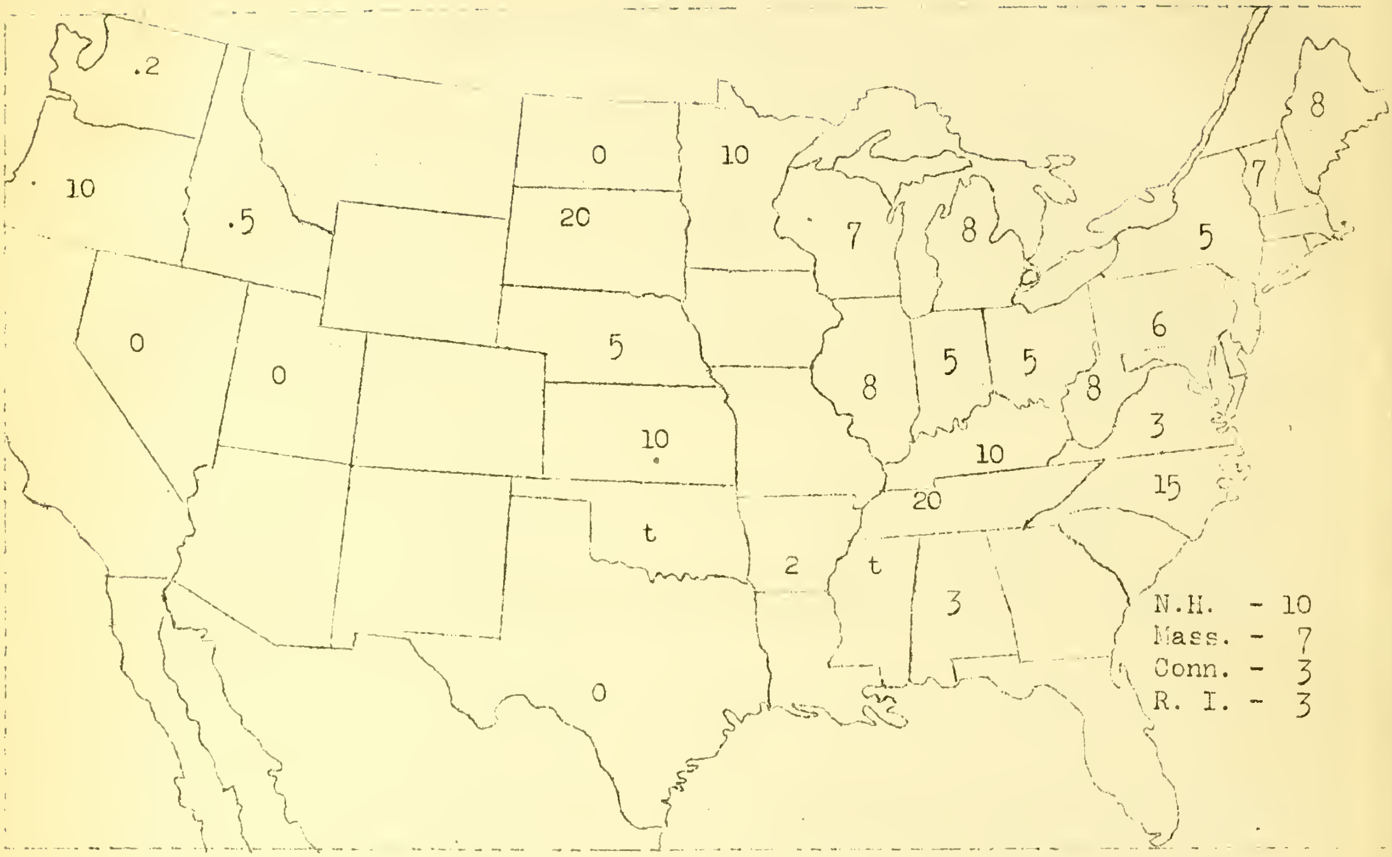


Fig. 1. Estimated percentage loss from scab in the United States 1920.

Table 1. Losses from scab caused by Venturia inaequalis during calendar year 1920, as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of scab		Remarks as to seriousness of scab	Origin of shipment	Percentage of scab		Remarks as to seriousness of scab
	No. cars	Percent			No. cars	Percent	
			Quite serious				Some badly
Canada	2	5-15	in 1 car	Oregon	5	3-38	scabbed apples
Ill.	1	12	Associated	Pa.	4	5-18	
			with blotch	Unknown	4	8-23	Estimates include
Maine	1	30					other blemishes
Md.	1	20		Va.	8	5-17	
Mass.	1	18	Associated with	Wash.	2	18-20	
			other blemishes	W. Va.	1	45	Velvety scab
Mich.	3	6-15		N. Y.			(Sooty fungus ?)
N. Y.	27	3-32	Estimates in-				
			clude other				
			blemishes				

Total 60   Total number of cars inspected.......... 3384*

*Approximate

Prevalence of scab is reported as follows by the collaborators from the North Atlantic States: Vermont (Lutman)- Some infection locally on all susceptible varieties; probably a little more than normal. New Hampshire (Butler)- Worse than average, causing considerable damage to susceptible varieties. Massachusetts (Osmun)- Very abundant throughout the state on susceptible varieties; worse than last year and worse than average. Connecticut (Clinton)- A little worse than last year and more than average. New York (Chupp)- Not as severe as last year and less than average; more important later in the season. Most injury in the Lake Ontario region. New Jersey (Cook)- Widely distributed but in most cases not severe; less than last year. Pennsylvania (Thurston)- Less than last year; most important on commercial orchards in the South.

Collaborators from the South Atlantic States report as follows on the relative prevalence of scab: Delaware (Mann)- Quite severe on susceptible varieties (July). Maryland reported more than usual; "Scab has been on the increase for two years". Virginia (Fromme)- The commercial crop as a whole is very much better than last year; scab is very severe, however, in home orchards and those which did not receive proper spraying; less than last year but more than the average. West Virginia (Giddings)- More than last year and much worse than average. North Carolina (Jehle)- More than last year; prevalent and severe at elevations above 2000 feet.

In the South Central States the disease was severe in the Appalachian regions of Kentucky and Tennessee, extending into northern Alabama. Tennessee (Essary)- Unusually abundant this year. (Hesler)- Scab worse than average. Pedicel infection of the fruit has been heavy this year. Alabama (Thiel)- Present throughout the state; losses from 2-5% in the northern part. Texas (Taubenhaus)- No scab in state. Arkansas (Elliott)- Severe on unsprayed fruit; less severe than average. (L. Pierce)- Practically no scab on fruit in well sprayed orchards of Benton and Washington Counties.

In the North Central States east of the Mississippi scab was especially serious owing to an unusually cold, wet spring during the cluster bud stage. Later a dry period in the northern tier of states checked the disease to some extent. Ohio (Selby)- Has been very general and severe on both fruit and foliage; probably most severe epidemic since 1916. Indiana (Gardner)- Worse than last year in south half of state; very light in northeast corner of the state where it is usually most severe. Illinois (Anderson)- Worse than last year and more than average. Especially bad in central and western part of state. Heavy drop of blossoms and small fruit due to early infection. Michigan (Coons)- Less scab than usual, to be accounted for by drought for one month following blossoming time (July 1). Epidemic in northern half of Lower Peninsula. No first class apples in ordinary, poorly cared for orchards of northern counties; southern counties excellent, sprayed or not (final report). Iowa (Melhus)- Less than in 1919. Wisconsin (Vaughan)- Less than last year and less than average. Hot, dry weather while leaves were forming and fruit setting. Minnesota reported more scab than usual, especially important in the southern half of the state.

The collaborators from the North Central States west of the Mississippi River report as follows: Minnesota (Leach)- Severe local epidemics are common; some orchards are very heavily infected. North Dakota (Bolley)- Not observed in the state. South Dakota (Hichel)- Quite common; especially good year for development of scab. Nebraska (Goss)- Present in the usual amount, not serious. Kansas (Melchers)- Common in all unsprayed orchards; will cause 10% damage.

Few reports have been received from the collaborators in the Northwest. Such as have been received indicate a light loss to the commercial crop. Idaho (Hungerford)- More than last year; in north Idaho only. Washington (Heald and

Dana)- Slight reduction since scab is absent from the commercial apple sections of the state. Oregon (Barss)- Much worse than last year; serious in western Oregon, especially in the Willamette Valley, where many young orchards are just coming into bearing and where the growers have not yet learned the habit of timely and thorough spraying. In many of the commercial orchards 50% of the crop will be culls. California (Smith)- Slightly under normal.

The following additional reports have been received: Nevada (Lantz)- Not known to be present in the state. Oklahoma (Learn)- Just one report so far this year (July 1). Mississippi (Neal)- One report from Pontotoc County. Georgia (McClintock)- None observed to date (July 7). Manitoba (Bisby)- A small amount of scab occurred on leaves and fruit of apples at Winnipeg. Spraying has not been practiced and scab was not serious enough to warrant it.

Relation of Weather Conditions to Scab Infection.

A systematic attempt to correlate weather conditions with the amount of scab throughout the country would be of great value to those interested in the disease. Unfortunately, the reports from the collaborators were not complete enough in this particular to form a basis for summarizing. The climatological data for the important apple-growing states as furnished by the Weather Bureau were carefully examined with the hope that these, in conjunction with those furnished by the state collaborators, would furnish the desired information. Some difficulty was experienced on account of the fact that scab infection may take place over a comparatively long period, and the exact dates of probable infection were not given by many collaborators.

The month of April, during which the ascospores usually begin to shoot, was unusually wet throughout the entire country, but it was also a very cold month so that the development of the host was considerably delayed. The weather was favorable for scab so far as precipitation was concerned but it is probable that in the majority of states no infection took place at this early date on account of the delayed development of the host.

In May there was considerable variation in the different sections of the country. In New England cold weather continued and the conditions for April prevailed for the first half of the month. It was generally wet and conditions for scab infection were good toward the latter part of the month. This accounts for the rather severe scab conditions in Maine, New Hampshire, Vermont and parts of Massachusetts. Across the northern section of the country, including New York, Pennsylvania, Michigan, Wisconsin, Iowa, northern Ohio, Indiana and Illinois there were drought conditions during the greater part of May. This prevented a severe primary infection in this region and such scab as developed appeared later in the season. This same condition prevailed in the Atlantic Coast States, especially in Maryland, New Jersey, Virginia and North Carolina. The month was also quite cool in all these states. These conditions were unfavorable for scab except in local areas where there were sufficient cloudy days to allow the disease to become established. In West Virginia the rainfalls were so distributed as to give better conditions for infection. The rainy periods were about a week apart throughout the month.

Over the Southern States and extending as far north as central Ohio, Indiana and Illinois, the precipitation was heavy throughout the greater part of May and the weather as a whole was cool, thus presenting ideal conditions for the development of scab. Scab showed up rather late in the North Central States, due to the very cold weather, but was very severe when it finally appeared. In Arkansas and Missouri especially favorable conditions for scab prevailed in May. In both states precipitation was very heavy and the weather was cool and cloudy.

The conditions which brought about late infection in certain states are given in the reports of the collaborators which follow.

Weather Conditions as Reported by the Collaborators.

Vermont (Lutman) July 15 - Around Burlington much worse than last year; rainy weather in early May and late June seems to be the cause.

Massachusetts (Osmun) July 15 - Weather conditions have favored the development of the fungus. (Krout)- Weather conditions have been favorable for scab.

New York (Chupp) July 1 - Relatively, however, the disease is unusually rare, due to abnormally dry weather. Final report - Dry in spring with late summer rains.

Virginia (Fromme)- Wet May and June, moderate to cool.

Tennessee (Hesler)- Wet season, continuous rains May 15 to June 20 and again in August. Cool spring. All favored the development of scab.

Arkansas (Elliott)- Weather unfavorable for the disease. (See report on conditions in Arkansas during May.)

Ohio (Selby)- The prevailing excessive humidity and subnormal temperature during the season of 1920 has led to the fullest growth of the fungus.

Illinois (Anderson)- Cold, wet weather during the cluster bud stage in central and western Illinois favored the development of scab, and prevented the growers from making their spray applications at the proper time. The remainder of the season was not especially favorable for scab.

Michigan (Coons) July 1 - Less scab than usual, to be accounted for by one month of drought following blossoming time.

Wisconsin (Vaughan)- We had a number of days of hot, dry weather while the leaves were forming and fruit setting, resulting in less scab than usual. (Keitt)- An additional early treatment on May 24 was of little value, due to the unusually long dry period that followed (Sturgeon Bay observations).

Oregon (Barss)- Unusually abundant; spring rains into June favored scab in all of western Oregon except in extreme south.

Discharge of Ascospores.

Three states report on the actual time of ascospore discharge in the spring This information is of great value in determining the time when infection may be expected during the average season. Collected over a number of years it will determine whether or not there is a correlation between first ascospore discharge and the developmental stage of the host.

Wisconsin (G. W. Keitt from abstract in Phytopath. Jan. 1921)- At Madison the first discharge was noted on April 23 and the last on June 12. The heaviest discharge occurred between May 11 and May 24. The apple buds separated in the cluster about May 17 to May 19. Developments were probably considerably influenced by a dry period from May 1 to 9. At Sturgeon Bay the first discharge was noted on May 20 and the last on June 30. The heaviest discharges occurred between June 8 and June 17. The apple buds separated in the clusters about May 29-30. Developments were probably considerably influenced by a long dry period in early May and another from May 24 to June 6.

New York (Chupp)- According to observations of the field men, infection occurred on April 27-29, May 10-11, June 17-19. There were no long rainy periods.

Illinois (Anderson) - Discharge of ascospores was noticed on April 20 but infection on the leaves did not show up until May 14. The long period of incubation was probably due to the unusually cold weather which prevailed the latter part of April and the first week in May, during which time the temperature was always below 65°F. and was usually below 60°. Discharge was especially vigorous during the middle of May when heavy rains occurred. This resulted in a serious fruit infection in many orchards.

Table 2. Dates of earliest appearance of scab according to collaborators.

State	Date first noticed		Locality	
	1919	1920	1919	1920
Maine (Stevenson)	--	June 11	--	Corrina
New Hampshire	June 8	July 15	--	Gonic
Vermont	July 1	--	--	--
Massachusetts	--	May 20	--	Amherst
Connecticut	--	June 25	--	Melford
New York	April 21	June 7	--	Orleans County
Pennsylvania	June 12	May 14	Adams County	York County
Virginia	June 3	May 21	Staunton	Blacksburg
Tennessee	June 1	May 10	--	Cleveland
South Carolina	July 1	--	--	--
Georgia	June 1	--	--	--
Oklahoma	June 5	--	--	--
Arkansas	May	--	--	--
Ohio	June 7	June 2	--	Athens County
Indiana	May 24	May 28	--	Morgan County
Illinois	May 1	May 14	--	Savoy
Wisconsin	June	May 25	--	Madison
Minnesota	May 28	June 20	--	Lake City
Missouri	July 7	--	--	--
South Dakota	May 26	--	--	--
Kansas	May 20	--	--	--
Washington	May 19	--	--	--

Varietal Susceptibility.

The lists of susceptible and resistant varieties appearing in the reports of the Plant Disease Bulletin in past years, as well as in the current numbers, show considerable discrepancy. This is also true of lists published by the workers in the state experiment stations. These discrepancies are not necessarily the result of faulty observation, but may be due to one or more of the following causes:

1. The varieties compared in a given locality. For example; if Stayman Winesap and Winesap occur in the same orchard, the Winesap is so much more susceptible than Stayman that one is inclined to list Stayman as very resistant. Fromme, in Virginia, shows that in his check blocks in a spraying experiment, where these two varieties were used, Stayman had 18% of scabbed fruit while Winesap had 66%. On the other hand, if York Imperial or Grimes were grown by the side of Stayman, the latter would probably show much more scab than the other varieties and would thus be listed as susceptible.

2. The time of infection. Yellow Transparent is often listed as resistant but this variety scabs very badly during some seasons. This is true of several of the early varieties.

3. The severity of infection. During some seasons and in some localities only the very susceptible varieties scab, thus giving the impression that the less susceptible varieties are relatively resistant.

4. It is possible that geographic location may have some influence but it is probable that this has much less influence than the factors given above.

Lists assembled over a number of years, together with notes on the climatic conditions and the relative amount of scab during the season will be of great value in the final estimate of the relative susceptibility of varieties. For this reason collaborators from all the states are urged to continue to send in reports on observations made each year. Observations made in a single orchard of a number of varieties would be of special value.

Table 3. Susceptibility of varieties by states, 1920.

			Susceptible		
N. H.	McIntosh	Wis.	Fameuse	Tenn.	Champion
	R. I. Greening		McMahon		Paragon
	Gravenstein		Wealthy		Kinnard
	Crab		McIntosh		
	Baldwin (slightly)			Ind.	Moyer
		Md.	Rome Beauty		Salome
Mass.	McIntosh		Ben Davis		Ben Davis
			Winesap Family		Winesap
Conn.	McIntosh				Rome Beauty
	Fall Pippin	Va.	Winesap		Delicious
			Black Twig		Fameuse (snow)
N. Y.	R. I. Greening		Delicious		
	McIntosh		Jonathan	Ill.	Rome Beauty
			Virginia Beauty		Kinnard
Pa.	Transparent		King David		Cornell
	Greening		Ben Davis		Fameuse
	Ben Davis				Sherwoods Favorite
	Rowe	Tenn.	Early Harvest		
	Grimes		Early Ripe		Early Harvest
	Smokehouse		Delicious		Huntsman

Susceptible (Cont.)

Pa.	Stayman	Tenn.	Jonathan	Ill.	McIntosh
	Baldwin		Yates		Red June
			Red Rees		Ben Davis
Wis.	Lubsk Reinnette		Senator		

Resistant

Va.	York	Ind.	Stark	Ill.	Jonathan
	Grimes		Flora Bell		Yellow Transparent
	Stayman		Bellflower		York
			Stayman		Duchess
Tenn.	Yellow Transparent		York		
	Winesap		Black Twig	Wis.	Jonathan
	Red June		Jonathan		Winesap
	Grimes		Grimes		Tolman Sweet
	York				Windsor
		Ill.	Stayman		
Ind.	Yellow Transparent		Grimes	Md.	York
					Grimes

Table 4. List of susceptible and resistant varieties as reported in 1920.

Susceptible

Baldwin - slightly, N.H. Pa.	Grimes - Pa.	Rome Beauty - Ind. Ill.
Ben Davis - Pa. Va. Ind. Ill.	Jonathan - Va. Tenn.	Rowe - Pa.
Black Twig - Va.	King David - Va.	Salome - Ind.
Champion - Tenn.	Kinnard's Choice - Tenn. Ill.	Senator - Tenn.
Delicious - Va. Tenn. Ind.	McIntosh - N.H. Mass. Conn.	Smokehouse - Pa.
Early Harvest - Tenn. Ill.	Wisc. N.Y. Ill.	Stayman - Pa.
Early Ripe - Tenn.	Moyer - Ind.	Transparent - Pa.
Fall Pippin - Conn.	Paragon - Tenn.	Virginia Beauty - Va.
Fameuse - Ind. Ill. Wisc.	Red Rees - Tenn.	Winesap - Va. Ind.
Gravenstein - N.H.	R.I. Greening - N.H. N.Y. Pa.	Yates - Tenn.

Resistant

Black Twig - Ind.	Stayman - Va. Ind. Ill.
Duchess - Ill.	Stark - Ind.
Early Harvest - Ind.	Tolman Sweet - Wis.
Flora Bell - Ind.	Windsor - Wis.
Grimes - Ill. Va. Tenn.	Winesap - Tenn. Wis.
Jonathan - Ind. Ill. Wis.	Yellow Transparent - Tenn. Ind. Ill.
Red June - Tenn.	York Imperial - Va. Tenn. Ind. Ill.

Control Measures for Apple Scab.

Connecticut (Clinton)- In all cases controlled by spraying.

New York (Chupp)- The delayed dormant has been proved as one of the important scab sprays. Five applications were necessary for clean fruit.

New Jersey (Haskell)- Mr. Repp, one of the largest growers in New Jersey, is using self-boiled lime sulfur as a summer spray. The calyx spray is commercial lime sulfur, but the later ones are self-boiled. It costs a little more but does the work, does not injure fruit or foliage and shows up better on the trees so that one can tell just where the spray has been applied.

Virginia (Fromme)- Good, thorough spraying has held scab in most cases. Dry lime sulfur and commercial lime sulfur sprays gave equally good control, averaging about 95% clean fruit, while the checks showed 66% scabby fruit.

West Virginia (Giddings)- Good control with lime-sulfur and Bordeaux.

Tennessee (Hesler)- In most commercial orchards spraying has evidently been done too late, especially the "pink" application, which in many cases was omitted entirely.

North Carolina (Elliott)- Almost complete control by petal-fall spray. Lime sulfur used.

Ohio (Selby)- Good fruit conditions are generally reported where a pre-bloom spray of Bordeaux mixture was applied; favorable report is made in one or more cases from pre-blossom spray of lime sulfur. The early or pre-pink application of Bordeaux gave excellent results in Gallia County. In many cases north of the central region the delayed dormant spray, successful in 1919, made a failure in scab control for 1920.

Indiana (Gardner)- Lime sulfur spray gave good control. Dust poor in badly affected regions.

Illinois (Anderson)- Orchards well sprayed with lime sulfur were fairly clean. Very poor control with dust. Considerable scab developed where the pre-bloom spray was not applied. On account of the extremely wet conditions prevailing when this spray was due, thus preventing or delaying spraying, considerable loss resulted in many commercial orchards. In one orchard 90% of the crop was lost because of failure to spray at this period. Considerable foliage injury resulted from applying sprays after the leaves had become scabbed.

Michigan (Coons and Nelson)- Dusting not successful in northern epidemic area.

Wisconsin (Vaughan)- Small loss in well sprayed orchards. Pink spray most important.

Oregon (Barss)- Sprays carefully applied were very successful even this year, but large acreages in Willamette Valley coming into bearing not given skillful care.

The following report covering the cooperative dusting experiments of the Advisory Board of the American Phytopathological Society was received from Dr. N. J. Giddings, project leader:

"Dusting and Spraying for Control of Orchard Diseases
and Insects - Committee Report.

"At the St. Louis meeting of the American Phytopathological Society, this project was selected by the Advisory Board as one which should receive special attention, and a leader was appointed to secure all possible cooperation among the various interested pathologists.

"A conference was called at Washington, D. C., on March 11, 1920, in order to discuss the work and draw up plans which might be of value to all. As a result of this conference some suggestive outlines for work with peaches and apples were sent to pathologists and entomologists who were thought to be interested in such work.

"This outline was sent to men in twenty-six states and replies from twenty-three of these states indicated interest in the project, while eighteen were quite favorable toward the work. Experiments were actually conducted in at least nine states, including Indiana, Michigan, New Jersey, New York, Connecticut, Pennsylvania, Maryland, West Virginia and Virginia. Seven of the cooperating states have already submitted data giving results for the 1920 season, and reports are expected from the others.

"From the states reporting definite figures for 1920, there was good control of scab in five orchards and extremely poor control of apple scab in five orchards, while Nova Scotia reported comparatively poor scab control from the use of sulphur dust but good control with copper lime dust. There are reports from other orchards and other states in which the amount of scab was 10% or less and the results were conceded by all concerned as unreliable in such cases. Michigan reported good control with dust in one orchard; Virginia reported good control with dust in two orchards; Pennsylvania reported good control with dust in two orchards; Pennsylvania reported poor control with dust in one orchard; Connecticut reported poor control with dust in two orchards; and West Virginia reported poor control with dust in two orchards. Indiana reported that as a result of three years' work they are not ready to recommend dusting since the liquid has proven somewhat more efficient and dusting has been found somewhat more expensive.

"Copper lime dust was tried in West Virginia and Virginia but with very unsatisfactory results.

"A number of new dust mixtures were tested in West Virginia and of these the one which seemed most desirable in all respects was sulphur-lime sulphur-arsenate in the proportions 75-15-10. This dust will doubtless be tested out more extensively in West Virginia during the coming season and it is hoped that similar dust combinations may be tried in some other states.

"Because of the large number interested in this problem it is hoped that experimental work may be conducted in a larger number of states during the season of 1921.

(Signed) N. J. Giddings
Project Leader"

Blotch caused by Phyllosticta solitaria E. & E.

Apple blotch has not been reported from any additional states during the past year. It is still confined to the region south of the 42nd parallel and east of the 100th Meridian, as pointed out in Plant Disease Bulletin Supplement 9. However, the disease is evidently becoming more generally prevalent on the outskirts of the heavily infested area. It is more generally distributed along the eastern edge in Virginia and New Jersey and along the northern edge in Pennsylvania, Ohio, Indiana, Illinois and Iowa, than formerly.

In a former number of the Plant Disease Bulletin (Suppl. 9: 96-98 1920) there was presented a summary of the facts concerning the spread of this disease northward. Since the appearance of this summary a special survey was made in northern Illinois to determine the extent of the northward invasion. Several new records were obtained and it was shown that the disease was well established in isolated orchards well to the north of where it had been previously observed. In practically every case it was found to have established itself on one susceptible variety, Northwestern Greening, and where blotch was found on any other variety the initial infection in the orchard could always be traced to Northwestern Greening.

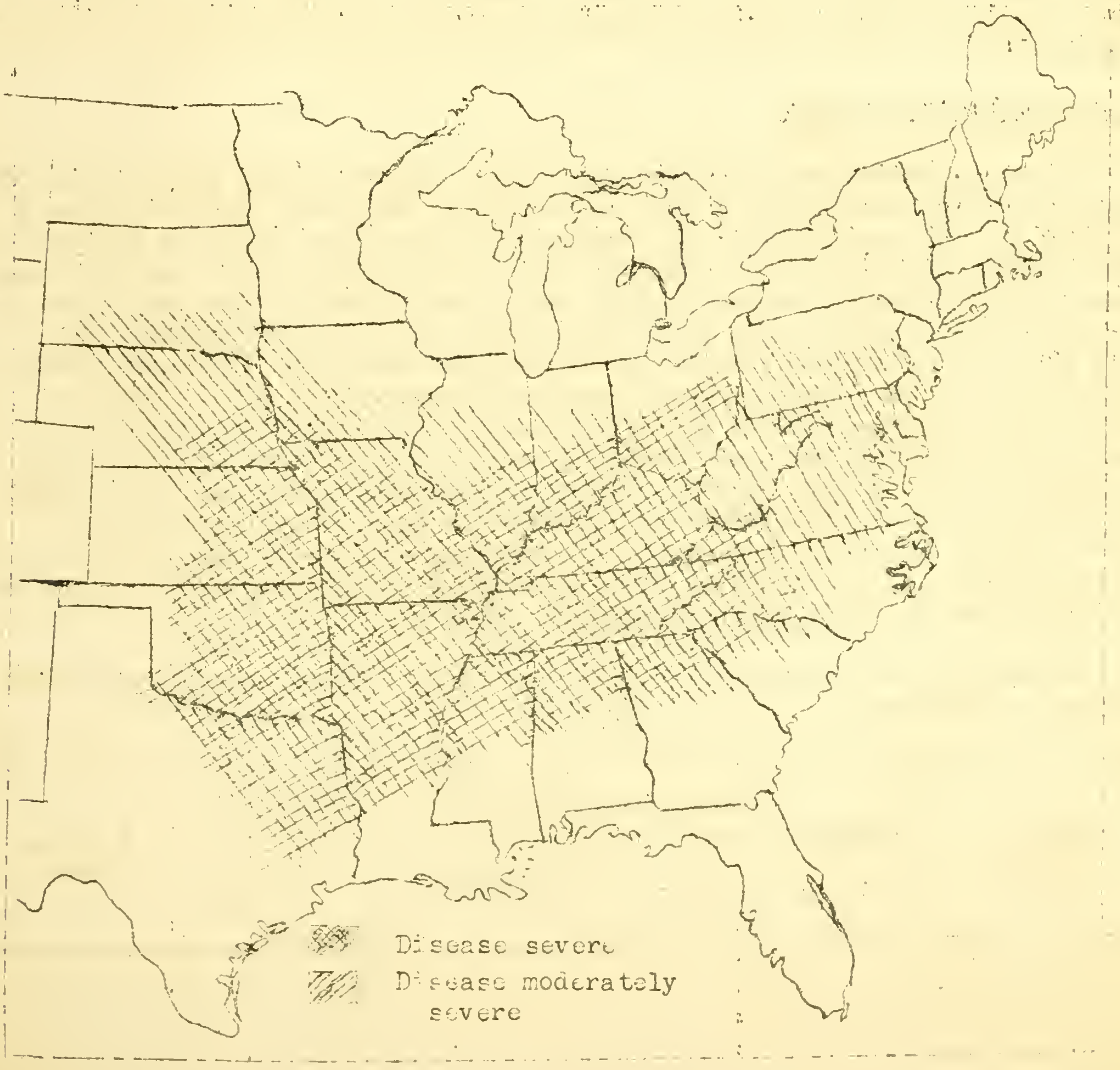


Fig. 2. Occurrence of apple blotch in the United States,- revised to 1920.

The fact that certain very susceptible varieties are serving as blotch "carriers" has given rise to the question as to whether or not it would be practicable to prevent the further advance of the disease in the border sections by paying particular attention to the "carriers". Growers should be warned against the varieties and the planting of these should be discouraged. Wherever they are found the orchardist should be warned to expect the appearance of blotch on this variety, or, if it is established, he should be instructed as to the best method of keeping the disease in check. Two examples in this connection may be given from Illinois; in one orchard a row of Missouri Pippins were growing along the edge of a large Ben Davis and Maiden Blush orchard. The Pippins were thoroughly covered with blotch and the fruit was worthless. Only a few of the Bens were blotched and the disease had not yet reached the Maiden Blush which were on the other side of the Bens. The orchard was not in a blotch section and the grower was not familiar with the disease. He explained that he had rarely harvested the Missouri Pippins because there was little market for them and so few of them. When his attention was called to the blotch and the danger explained, he had the entire row of trees cut down within forty-eight hours. In another case a single badly blotched Northwestern Greening was found in an orchard north of the blotch area. The owner was not familiar with blotch although he had seen the "black spots" on the fruit of the Northwestern Greenings. He was, however, familiar with the losses which the southern Illinois growers suffered from the disease and immediately cut out the offending tree.

Losses from blotch in 1920.

Although blotch was worse in many of the blotch states than during the average year, the total loss is not large, due to the fact that there was a light crop in this section and the comparative losses are small on account of the very large crop in sections outside the blotch region. The New York and Michigan orchards, which produced about one-third of the entire apple crop of the eastern United States this year, were entirely free from blotch. The average percentage loss in fifteen of the blotch states for 1919 was 4% while for 1920 it was 6.3%. This increase in percentage loss is due in part to raising the figures in several of the states where it was felt that the estimates of 1919 were too low. This was especially true of Kentucky which was raised from 1% in 1919 to 10% in 1920. While the blotch was undoubtedly worse throughout the blotch area in 1920 than in 1919, these changes in estimates should be taken into account. From the reports of the collaborators and our knowledge of the disease, this correction is thought to be justified and it will give a better basis for future estimates.

Table 5. Losses from apple blotch in 1920. States grouped according to prevalence of disease.

Groups of states	Character of injury	Percentage loss of total crop for area	Importance of industry in area. % U. S. crop produced: Total	Com'l	Percentage of total U. S. crop lost in area from blotch	Bushels lost
A.- Okla. Tex. Miss. Ala. Ga. Tenn. N.C. S.C. Kans. Ark. Ky. (La. crop unimportant)	Severe	5% to 10%	12.1	5.7	1.4	4,032,500

Groups of states	Character of injury	Percentage loss of total crop for area	Importance of industry in area % U. S. crop produced. Total	Importance of industry in area % U. S. crop produced. Com'l	Percentage of total U. S. crop lost in area from blotch	Bushels lost
B.- Ill. Nebr. Mo.	Moderate	3% to 4%	5.	7.2	0.2	579,000
C.- Pa. O. Ind. W. Va.	Slight	1%	20.9	14.6	0.3	825,000
D.- N.J. Del. Md. Va. Ia.	Trace	Less than 1%	11.7	13.5	Trace	--
E.- 20 remaining apple-producing states	None	0	50.3	59.	0	0
Loss to total U. S. apple crop from blotch in 1920					1.8	5,194,000

Table 6. Percentage of blotch as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of blotch: No. cars	Percentage of blotch: Percent	Origin of shipment	Percentage of blotch: No. cars	Percentage of blotch: Percent
April 17 - May 19, 1920			July 6 - Dec. 10, 1920		
Illinois	1	50	Arkansas	1	10
Unknown origin	1	23	Illinois	3	8-22
			Missouri	1	2
Total	2		Tennessee	2	35-57
			Virginia	5	5-33
			Total	12	

Grand total.............................. 14
Total number of cars inspected..........3304 (Approx.)

Dates when first observed:

Arkansas	- May	Virginia	- June 23
Indiana	- May 28, Morgan County	Missouri	- July 1, Higginsville
Illinois	- May 28, Anna	Pennsylvania	- July 17, Lackawanna County
Tennessee	- June 12, Knoxville		

Varietal Resistance.

It may be said that apples show a sharper varietal resistance to blotch than to any other disease with the possible exception of cedar rust. While no varieties are known to be immune, many are so resistant as to be classed as immune from a commercial standpoint. Apparent resistance of certain varieties is often due to limited observations, since during some seasons varieties which are susceptible may escape infection.

The following reports on susceptible and resistant varieties have been received from the collaborators this year:

Susceptible		
"All Sweet Apples" - Pa.	:	R. I. Greening - Ind.
Arkansas Red - Ind.	:	Rome Beauty - Ill.
Ben Davis - Pa. Ill. Va. Tenn. Ohio Ind. Ia.	:	Smith Cider - N.J. Pa. Ill. O. Ind.
Benoni - Ill.	:	
Black Ben - Tenn.	:	Stark - Ind. Ill.
Delicious - Tenn.	:	Yellow Transparent - Ark.
Duchess - Tenn. Ind. Ill.	:	
Early Harvest - Tenn.	:	Resistant
Huntsman - Ill.	:	
Limbertwig - Va. Tenn. Ark. Ill.	:	Grimes - Tenn. Ill. Ind.
Maiden Blush - Pa. Ill. Tenn.	:	Ingram - Tenn.
Mann - Ohio & Ind.	:	Jonathan - Tenn. Ill. Ind.
Missouri Pippin - Ind. Ill.	:	Red June - Tenn.
North Western Greening - W.Va. Ill. Ind. Ia. Md.	:	Stayman Winesap - Ill.
Paragon - Tenn.	:	Winesap - Tenn. Ill.
Red Astrachan - Ark.	:	York - Tenn. Ill.

Blotch Control.

Blotch is considered one of the hardest diseases to control where it has once become thoroughly established. This is largely due, no doubt, to the fact that the cankers in which the fungus winters become so numerous as to supply an unlimited amount of inoculum. Little attention is paid these cankers by the growers and no attempt is made to control the disease until the trees come into bearing and the results of infection show in the fruit. The time of infection in different localities and on different varieties has not been accurately worked out so that the proper time for the applications of the blotch spray is not as accurately known as in the case of scab. During the last three years the tendency has been to apply the first blotch spray within two weeks or eighteen days after the petals fall instead of three weeks, as was formerly the practice. This has resulted in better control on early varieties in the southern part of the blotch region. More information is needed on the time of infection in the various blotch states and the relative value of Bordeaux and lime sulfur. The collaborators report as follows on blotch control:

Alabama (Thiel)- Where spraying was carried on, the disease was checked but not controlled entirely.

Mississippi (Neal) Not serious in well sprayed orchards.

Arkansas (Elliott)- Very severe on fruit not properly sprayed. Good results with Bordeaux.

Ohio (Selby)- Bordeaux mixture, 4-5 applications gave good results.

Indiana (Gardner)- Good control with Bordeaux spray, 2-4-6-10 weeks and lime sulfur 2-4-6-10 weeks.

Illinois (Anderson)- Where orchards were well sprayed with either lime sulfur or Bordeaux early in the season (2 weeks), the fruit was in fair condition. Failure to apply blotch spray early (within 3 weeks) results in poor control. In general, blotch was not controlled satisfactorily even in the best sprayed orchards. This was due in part to very heavy rains following the two weeks spray where this was applied and consequent washing off of spray material. It was at this time that the first infection occurred.

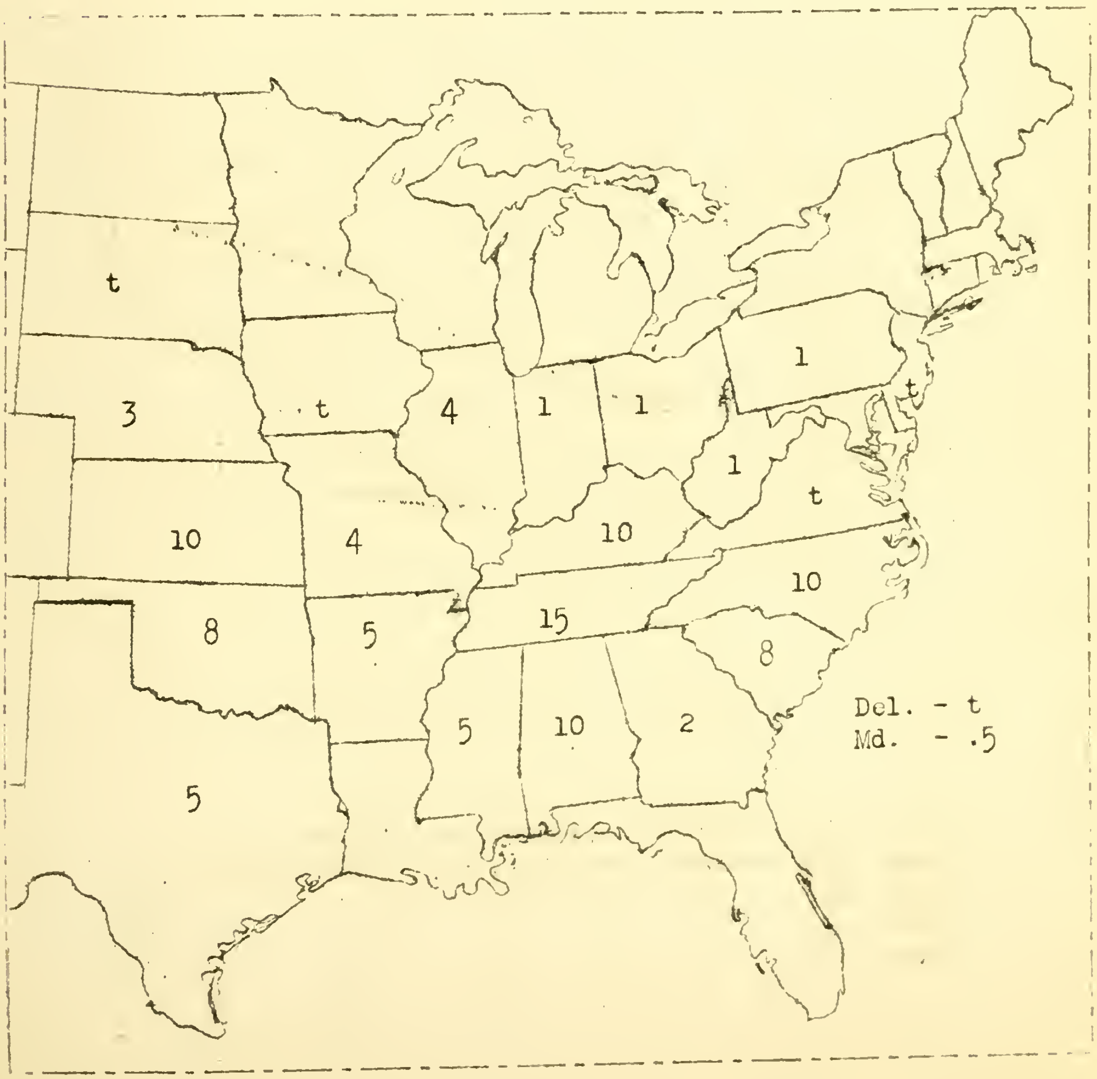
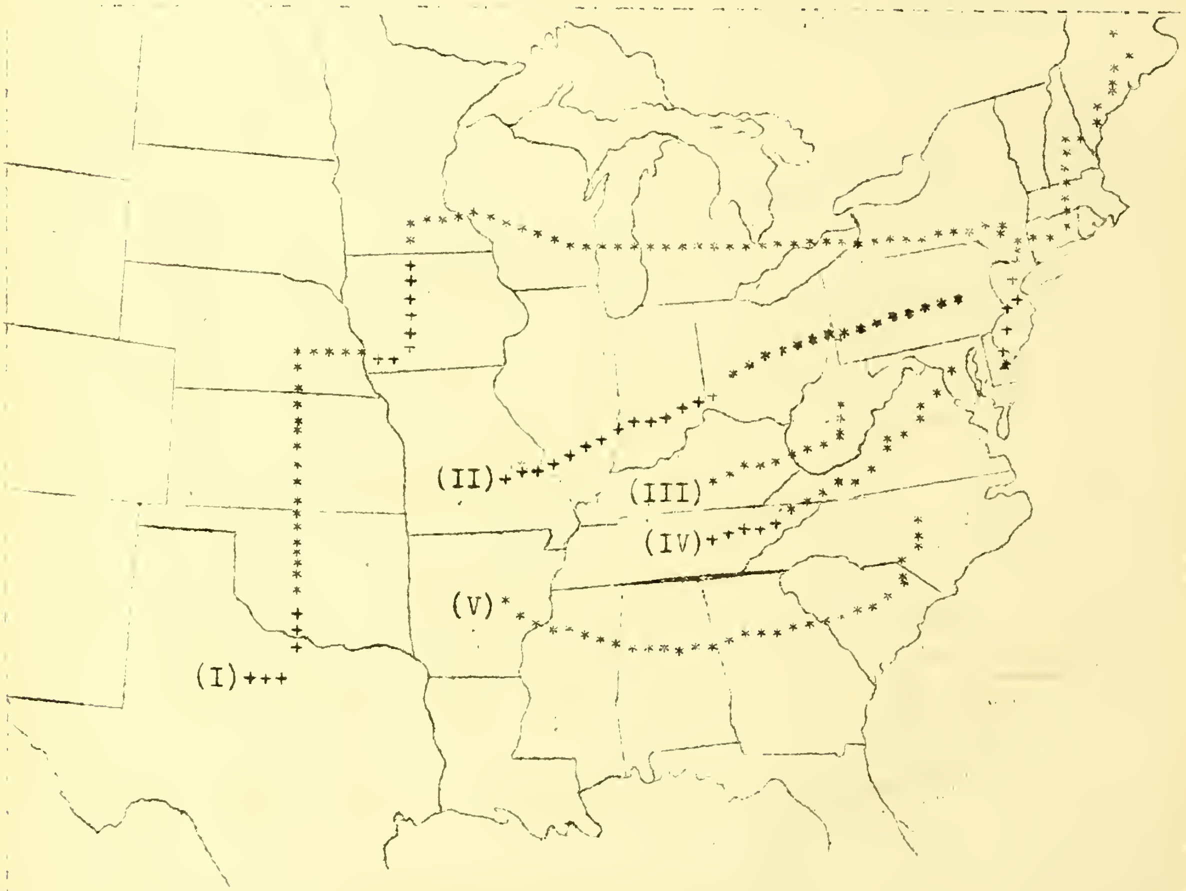


Fig 3. Estimated percentage loss from blotch, 1920.

Bitter rot caused by <u>Glomerella cingulata</u> (Stonem) S. & S.

As in 1919 heavy loss from bitter rot was confined to only a few of the bitter rot states. The disease was as a whole less destructive in 1920 than in the previous year. New Jersey, Tennessee, and Ohio were the only states reporting the disease worse than last year, and in the last state the loss was negligible, according to Selby. Virginia and North Carolina, where epiphytotics of bitter rot occurred last year, escaped with only mild outbreaks this season. Following the group system of last year (see Fig. 4), the states of group I suffered practically no loss, most of the states not reporting the occurrence of the disease. New Jersey, however, reports more loss than usual.

In group II, including Missouri, Illinois, Indiana, Ohio and Pennsylvania, the three middle states suffered a negligible loss while the disease seems to have been of about the average importance in Pennsylvania and quite



Group I. Occurrence, losses negligible.
Group II. Average annual losses for group about 4.5%.
Group III. " " " " " " 2.0%.
Group IV. " " " " " " 5.5%.
Group V. " " " " " " 12.0%.

Fig. 4. States grouped according to average percentage losses from bitter rot.

severe in parts of Missouri. In group III, including Kentucky and West Virginia, conditions were not different from 1919. Kentucky reports a general prevalence and, while no exact figures are at hand, the losses were probably greater than in the previous year, while in West Virginia about the average losses occurred.

Group IV includes Tennessee, Virginia and Maryland. In this group Tennessee seems to be the only state where losses were greater than in 1919.

In group V the average loss was in the neighborhood of 3%, which is much lower than for last year and the average. None of the states in this group approached the losses of 1919.

The state collaborators report as follows on bitter rot in 1920:

Massachusetts (Osmun)- Unimportant, prevalence about as usual.

Connecticut (Clinton)- Of little importance, one complaint only.

New Jersey (Cook)- Throughout the state. Appeared earlier than usual (date not given). More than last year.

Pennsylvania (Thurston and Orton)- Severe in Union, Erie, Fayette and Lehigh Counties. Reported from Armstrong, Berks, York, Montgomery, Huntingdon, Center and Adams Counties; mostly on unsprayed home orchards.

Maryland (Temple)- More than in 1919. General.

Delaware (Manns)- Bitter rot severe on some varieties.

Virginia (Fromme)- Much less than last year and less than the average year. Late appearing.

West Virginia (Giddings)- Same as last year and about average. Unimportant.

Kentucky (Valleau)- Very common in all parts of the state.

Tennessee (Hesler)- Worse than average and about the same as last year. Locally serious on summer varieties and generally serious on winter varieties. Generally prevalent except in mountains.

North Carolina (Jehle)- Less than in 1919 and less than average. Occurs all over the state.

Georgia (McClintock)- Same as last year and about average. Not serious. Occurs throughout the state.

Mississippi (Neal)- About the same as in 1919. In northern counties.

Texas (Taubenhaus)- Traces. Unimportant.

Arkansas (Elliott)- General throughout the state. (L. Pierce)- Slight in Benton and Washington Counties. Very little weather favorable to the development of the disease during the summer.

<u>Ohio</u> (Selby)- More than last year but not important. Mostly in southern counties but one Erie County report.

<u>Illinois</u> (Anderson)- Slightly more than last year. Local damage high but of little importance as far as the entire state was concerned. Confined to southern counties. Considerable bitter rot observed in local markets.

<u>Missouri</u> (Hopkins)- Severe.

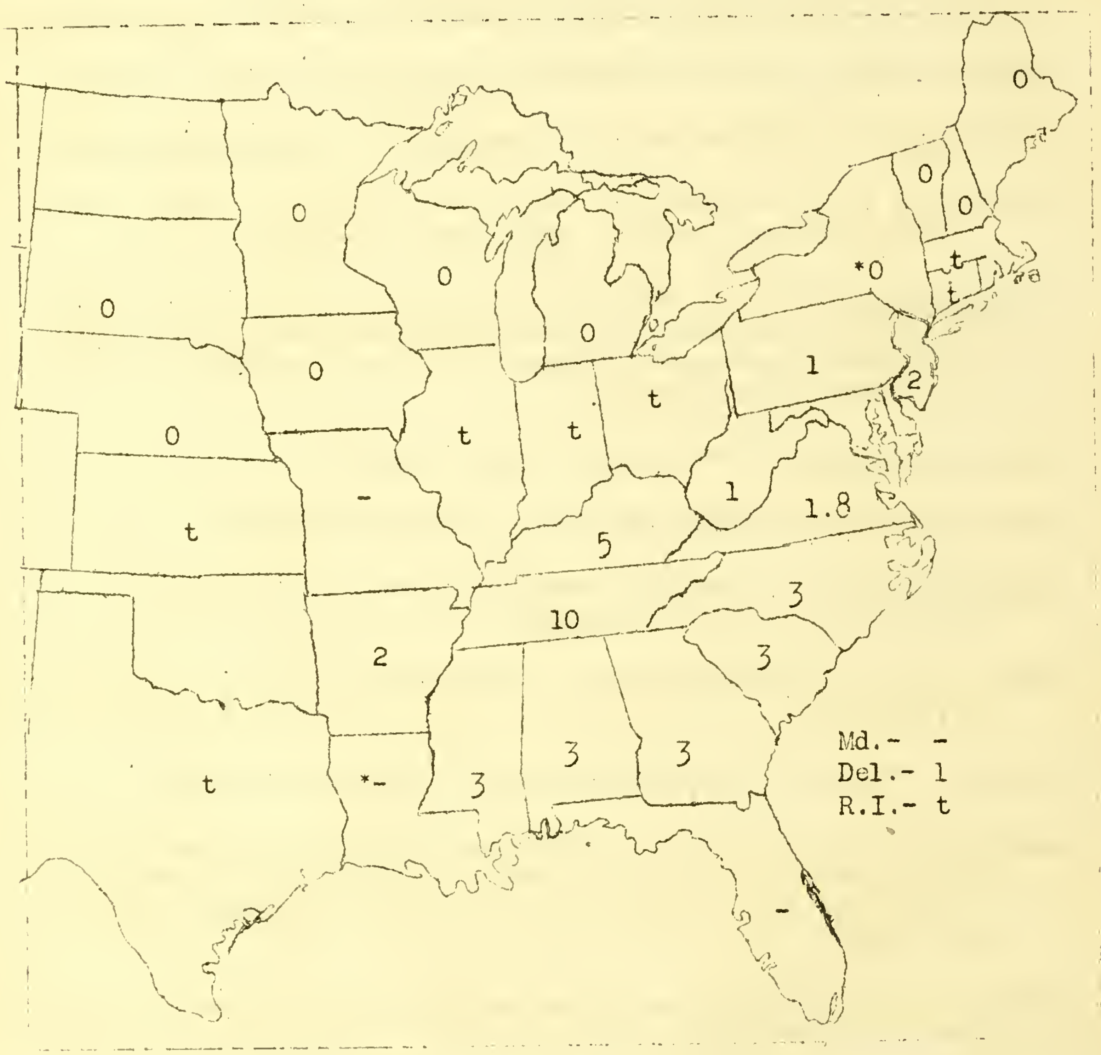


Fig. 5. Estimated percentage losses from bitter rot, 1920.

<u>Losses from Bitter Rot.</u>

Ten of the leading bitter rot states were Virginia, New Jersey, North Carolina, Georgia, Kentucky, Tennessee, Alabama, Mississippi and Arkansas. These states showed a loss of 2,678,000 bushels from the disease in 1920. The total loss from all the states for 1920 was about 2,921,000 bushels, or slightly over one percent of the crop. The loss in 1919 approximated 1.21%, or 2,019,000 bushels. The corrected losses for each state will appear in Supplement 18 of the Plant Disease Bulletin.

Table 7. Losses from bitter rot as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of shipment	Range of percentage of decay: No. cars	Range of percentage of decay: Percent	Origin of shipment	Range of percentage of decay: No. cars	Range of percentage of decay: Percent	Remarks as to seriousness of decay
Jan. 6-10, 1920			Aug.21-Nov.3,1920 (Continued)			
Virginia	2	6-3				
			New York	1	15	
			Pennsylvania	2	2	
Aug.21-Nov.3,1920			Virginia	1	10	Associated with blue mold rot.
Arkansas	2	6-14				

Total number of cars with decay....... 8
Total number of cars inspected........ 3384

Bitter Rot in Relation to Weather Conditions.

The weather conditions favorable for bitter rot are hot, wet weather during July and August. "Muggy weather" is the term adopted by pathologists to describe the ideal weather for the development of this disease. July was a comparatively cool month over all the bitter rot states, but there was an abundance of rainfall in most sections, with the exception of the southern Illinois and eastern Missouri region and parts of Virginia. Especially heavy rainfall occurred in North and South Carolina and across the northern ends of the southern tier of states. Southern Ohio also had abundant precipitation. During the first three weeks of August heavy rainfalls occurred over most of the bitter rot section with the exception of Illinois, Indiana and eastern Ohio. There was also a dry area in eastern Virginia and along the coast southward. While the precipitation records for the months of July and August would seem favorable for an epiphytotic of bitter rot in the eastern section, the cool weather which has generally followed the rains probably influenced the disease unfavorably. In Indiana and Illinois the dry weather of August probably held the disease in check.

The regions most favorable for the development of bitter rot from the weather standpoint were those of eastern North and South Carolina, western Tennessee and across the northern ends of the Southern States.

Nature of Injury from Bitter Rot.

The question of the presence or absence of distinct bitter rot cankers has been one of considerable interest to students of the disease. It is suggested that the collaborators make a special effort during 1921 to locate cankers in orchards where the disease is especially prevalent and report their findings to the Plant Disease Survey office. It is interesting to note that Jehle in North Carolina and McClintock in Georgia report injury from cankers on the limbs. Fromme in Virginia reports "fruit rot - no cankers". Hesler in Tennessee reports "cankers not abundant so far as I have observed". Anderson in Illinois has searched for distinct bitter rot cankers for several years and has never found them even when the fruit was badly rotted in the orchards. Do the cankers occur in certain localities and not in others, or are they confined to certain varieties or do they occur under the influence of certain climatic conditions?

Dates of first observation of bitter rot:

New Jersey	- Earlier than usual	Pennsylvania	- July 24, York County
Arkansas	- June	Missouri	- August, St. Charles
Illinois	- July, Flora	Virginia	- August 1, Crozet
Tennessee	- July 16, Jackson	Mississippi	- October 20, College

Varietal Susceptibility.

Susceptible:

Pennsylvania - Northwestern Greening
Winter Banana
York Stripe
Ben Davis
Chenango

Tennessee - Yellow Transparent
Early Harvest
Ben Davis
Kinnard
Paragon
Duchess
Red June
Limber Twig
Jeffrey

Illinois - Lowell
Ben Davis
Huntsman
Grimes

Maryland - Bismark
Smokehouse
Smith Cider

Resistant:

Maryland - Grimes
Jonathan
Stayman
Winesap
York

The inspectors of the Bureau of Markets report bitter rot on Collins Red (Arkansas apples), York Imperial, Winesap (Pennsylvania apples), Maiden Blush, Rambo, "Streak", Chenango, Wealthy, Gravenstein and "Pippin" (Virginia apples).

Control Measures for Bitter Rot.

Few of the collaborators mentioned control measures for this disease in their reports. It would be interesting to learn in which states bitter rot sprays are applied as a general part of the spray program and in which states it is the practice of growers to apply the sprays only when the disease begins to appear. For example, it is the habit of some Illinois growers to watch certain trees where the disease commonly first appears and if bitter rot appears on them they start spraying.

The following reports on control were received from collaborators:

New Jersey (Cook)- Not serious in well sprayed orchards.

Virginia (Fromme)- Copper lime dust and potato dust gave practically no control. Bordeaux mixture very satisfactory.

North Carolina (Jehle)- Controlled by spraying in many orchards.

Arkansas (Elliott)- Good results with Bordeaux.

Illinois (Anderson)- Hand picking when the disease first appears is generally practiced even in large commercial orchards. Bordeaux applied to susceptible varieties, usually after the first appearance of the disease.

Fire blight caused by Bacillus amylovorus (Burr.) Trev.

All states where apples are grown in any quantity reported blight as present in 1920. East of the 100th Meridian there are three distinct belts as regards the severity of the disease (see Fig. 6).

The northern belt, which suffered most severely from blight, includes the New England States (with the exception of Maine), New York, the Great Lakes Basin, Minnesota, Northern Iowa, and eastern North and South Dakota. The greatest injury in this belt was reported from Wisconsin and Minnesota where an epiphytotic developed late in the season, killing many young trees. This same condition was also reported from parts of New York.

The central belt includes the North Atlantic States, south of Rhode Island. It extends westward across Pennsylvania and West Virginia and includes most of the Ohio Valley and the central part of the Mississippi Valley. West of the Mississippi it includes southern Iowa and northern Missouri and Oklahoma, Kansas and Nebraska. In this belt blight was very mild in the eastern sections, while in the Ohio Valley region it was locally serious, and west of the Mississippi less severe than usual.

The southern belt includes the South Atlantic and Gulf States. Here blight was more severe than in the central belt but not much worse than usual; however, blight is usually a serious factor in these states.

The Rogue River Valley region in the Northwest had an unusual amount of blight as did also sections of California. While prevalent in other sections of the Northwest, blight was reported as about normal. Nevada and

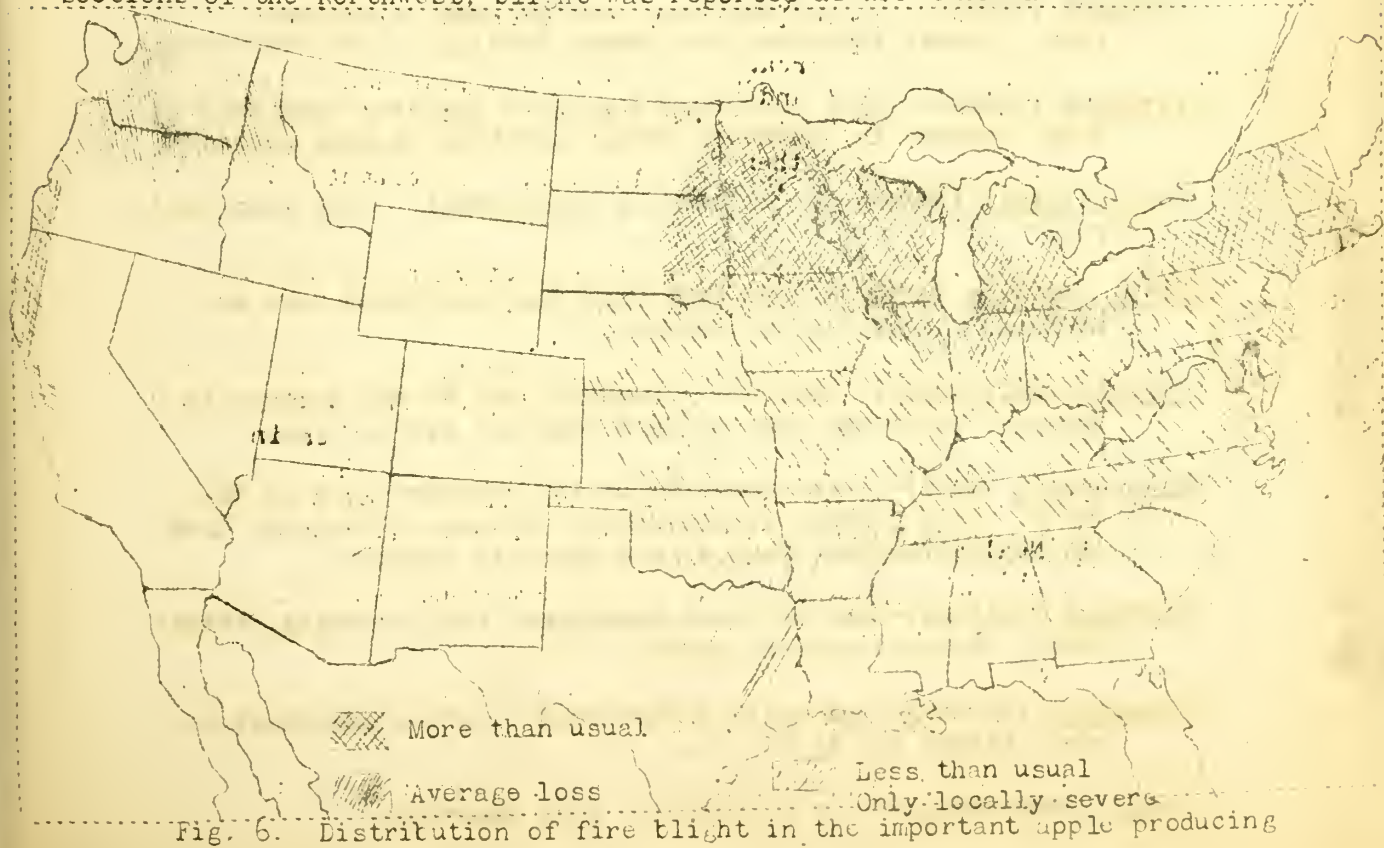


Fig. 6. Distribution of fire blight in the important apple producing states in 1920.

Utah report the disease as worse than last year.

The reports of the state collaborators regarding the severity of the disease follow:

Vermont (Lutman)- Very common locally in large orchards; almost all trees that have much fruit have a considerable percentage of fire blight of the fruit twigs.

New Hampshire (Butler)- Mainly in the form of blossom blight. Injury unimportant.

Massachusetts (Osmun)- Very abundant in most sections. Worse than usual. Moderately important.

Connecticut (Clinton)- More than usual and worse than last year.

New York (Chupp)- Monroe County: "More severe than last year". Orleans County: "Very severe in young orchards." Ontario County: "More destructive than usual." Albany County: "Severe infection." Genesee County: "Unusually severe." Rensselaer County: "Local-severe damage."

New Jersey (Cook)- Less than last year. Throughout state.

Pennsylvania (Thurston and Orton)- Much less than usual.

Delaware (Manns)- Practically none. Delaware and Eastern Shore of Maryland (Roberts, June 2)- "Practically no fire blight".

Maryland (Temple)- On the decrease; not as much as average year. Always important and severe locally. Root rot serious.

Virginia (Fromme)- Much less than last year and less than average year. Severe in southwest corner of state in home orchards.

West Virginia (Giddings)- Relatively unimportant. Less than last year.

North Carolina (Jehle)- Less than last year but about same as average. Generally distributed.

Georgia (McClintock)- Serious. Abundant, due to wet weather in spring. About the same as last year and average year.

Mississippi (Neal)- Very prevalent in the northern part of the state. This disease is especially serious in orchards that are not cultivated, pruned, and properly sprayed.

Kentucky (Valleau)- Not of great importance but generally distributed. Same as average year.

Tennessee (Hesler)- Generally distributed. Not as important as scab, blotch and bitter rot.

Texas (Taubenhaus)- Very prevalent. Very important.

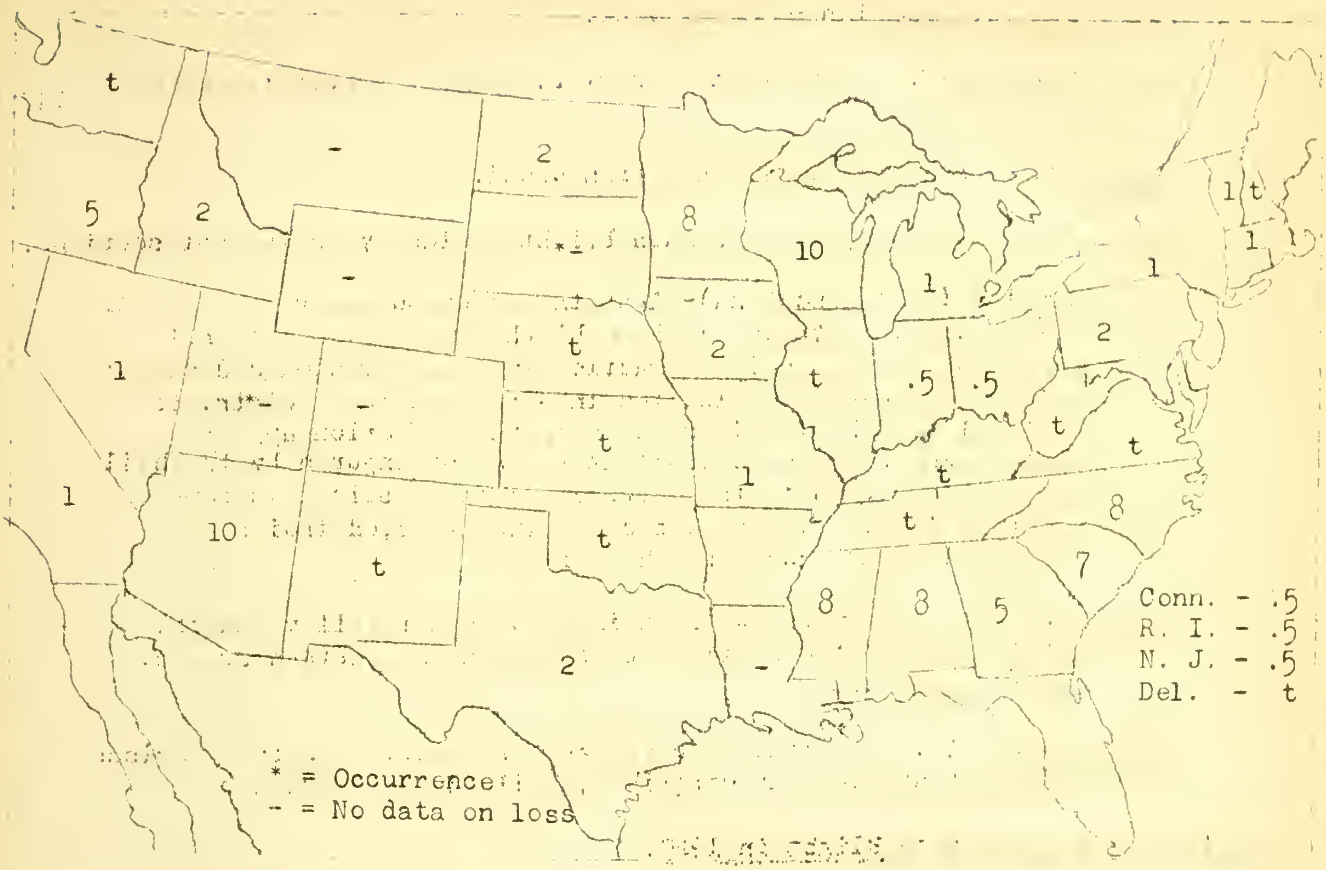


Fig. 7. Percentage losses from fire blight in 1920.

Arkansas (Elliott)- Severe.

Ohio (Selby)- More than average. Developed late in season.

Indiana (Gardner)- Worse than last year. Not serious.

Illinois (Anderson)- Very little early in the season. More serious locally later in the season. Not important.

Iowa (Melhus)- More severe than usual in northern half of state, less than usual in southern.

Wisconsin (Vaughan)- Unusually severe this season. Many young trees have been nearly killed. Developed late in season. (July 1, 1920)

Minnesota (Leach)- General throughout the state and very severe; probably the worst epidemic in several years.

Missouri (Hopkins)- Thought to be moderate.

North Dakota (Bolley)- Very destructive to Siberian Crabs. Observed at Wahpeton, Grand Forks, Fargo and Hillsboro.

Nebraska (Goss)- Present in usual amounts.

Kansas (Melchers)- Probably less than usual. Damage a trace.

New Mexico (Leonian)- Very slight.

Utah (Richards)- Important this year. Severe as blossom blight in some areas.

Nevada (Lantz)- More abundant than usual.

Idaho (Hungerford)- Not as much blight as last year in most sections.

Washington (Heald and Dana)- Less than previous years.
(C. W. Hauck, Yakima)- "Fire blight during 1920 was not serious on the whole. Practically the only damage done was to pears which were located in a few scattered districts affected by hail. In such areas the infection appeared first in the damaged fruit at the point injured by the hail and soon spread to the spurs and later resulted in some terminal blight. In such cases the affected fruits shriveled and exuded blight ooze."

Oregon (Barss)- Severe outbreak in Rogue River Valley and the bottom irrigated sections of southern and eastern Oregon. Worse than usual.

California (E. H. Smith)- Worse than last year. A rather serious late attack in many districts, following late rains.

Relation of Weather to Blight in 1920.

The unusually cold, dry May throughout the upper Mississippi Valley, the Ohio Valley and Great Lakes Basin was very unfavorable for blight in these regions. This was also true in most of the Atlantic States. In the middle of May, when apples were in full bloom through central Ohio, Indiana and Illinois, there was a killing frost. This seemed to have checked any tendency toward early blight of blossoms and twigs in these regions. In the southern ends of these states some blight appeared before this cold period.

In Vermont, Lutman states that "rainy weather during early May and during the blossoming season of the early apples may have been responsible" for the severe blight in that state. McClintock in Georgia states that the wet weather during the spring was responsible for the heavy blight infection.

The striking thing in the behavior of blight during the season of 1920 was the serious epiphytotic which developed late in the season in the upper Mississippi Valley and in New York. By consulting the records of the first appearance of blight, it will be seen that in most cases it was not observed until June or July. The weather records for June show that in Minnesota and Wisconsin there was an unusually heavy precipitation during the latter part of the month, especially June 14-16 and 26-29. Blight began to show up seriously in these states about July 1.

Control of Fire Blight.

Few efforts were made to control this disease according to the reports of the collaborators. Hesler in Tennessee recommended the cutting down of pear trees in the neighborhood of commercial apple orchards on the basis of his observations that the hold-over cankers on the pear furnish the inoculum for infection in the spring on apple. Selby in Ohio states that "several growers, by prompt cutting and burning of infected parts of pear trees, were able to prevent extended infection by the blight organism on pear and apple". Gardner in Indiana reports that "one grower found that thorough spraying for aphis control was effective against blight". Lantz in Nevada states that "some growers attempt to control the disease by pruning the diseased twigs". Barss in Oregon attributes the severe outbreak in the Rogue River Valley to lack of attention to hold-over cankers in 1919.

Table 8. Nature of injury from blight.

State	Type of injury	State	Type of injury
Vt.	Blossom and spur blight	Ga.	Twig blight and cankers
N.H.	Blossom blight	Miss.	Blossom and twig blight
Mass.	Blossom and twig blight, cankers	Tenn.	Twig and fruit blight, cankers (small limbs)
Conn.	Twig blight on Greenings	Ohio	Twig blight after blossoming
N.Y.	Killing young trees, collar rot, cankers	Ill.	Twig and fruit blight
		Mich.	Blossom blight
Pa.	Twig blossom blight. Blight working further down the branches than usual.	Wis.	Young limbs and some whole trees killed
		Minn.	Twig and limb blight
Va.	Chiefly twig blight	Utah	Blossom blight
Md.	Roots killed	Nev.	Twig blight
W. Va.	Mostly twig blight	Wash.	Blossom twig blight
N. C.	Blossom & twig blight, cankers	Ore.	Blossom blight and limb cankers

Earliest dates on which blight was observed:

Mass. - About May 20
N. Y. - June 21, Monroe County
Pa. - May 17, Adams County
Va. - May 10, Ruther Glen
W. Va. - June 1, Morgantown (Sheldon)
Ga. - Very early
Miss. - July 1, Starkville
Tenn. - May 27, Anderson County
Ark. - April
Ohio - June 12
Ill. - Late
Wis. - July 1, Grant County
Minn. - June 15, Annadale
Mo. - June 5, St. Joseph
N. Dak.- June
Nev. - June 14, Reno
Ore. - May, Medford

Varieties reported as susceptible to blight - 1920:

Hoover - Tenn
Jonathan - Ark. Ill. Md.
Limbertwig - Tenn.
Lowrie - Tenn.
McMahon - Wis. Ohio
Maiden Blush - Ark.
Patton Greening - S. Dak.
Siberian Crab - S. Dak.
Spitzenburg - Idaho, Wash. Ore.
Transcendent Crab - Wis.
Wealthy - Wis. N. D. (less than crab)
Willow Twig - Ill.
Yates - Tenn.
Yellow Transparent - Va. Tenn. Ill. Va.

Vaughan in Wisconsin reports Northwestern Greening as quite resistant.

Blister canker caused by Nummularia discreta Tul.

This disease was reported in 1920 from most of the states in which it is known to occur. In addition Hesler in Tennessee reports it for the first time from that state. Its wide distribution in that state and neighboring states indicates that it has been prevalent there for a number of years. It is probable that it also occurs quite commonly in the Gulf States although it has not yet been reported from Georgia, Alabama, Mississippi or Louisiana. It is suggested that the collaborators in these states examine old Ben Davis orchards for blister canker.

The accompanying map shows the distribution of blister canker and indicates the regions in which it is especially serious. It was prepared by going over all the reports which have accumulated in the Plant Disease Survey office. The first report dates back to 1903 when Evans, in Missouri, showed it to be quite prevalent in that state.

The fact that the Ben Davis variety is so very susceptible has led to an attempt to correlate the relative abundance of this variety with the prevalence and severity of the disease. On the accompanying map the percentage of the whole crop represented by Ben Davis is given for each state where this variety is used to any extent. It is seen that those states having the largest plantings of Ben Davis are generally the states in which blister canker is reported as especially prevalent. The states suffering most injury from blister canker are Ohio, Indiana, Illinois, Kentucky, Missouri, Arkansas, Kansas and Nebraska. The disease is most severe in the southern half of Ohio, Indiana and Illinois, the northwestern section of Arkansas and the eastern half of Kansas and Nebraska. These are the regions where the Ben Davis variety is grown most extensively and past reports from these states show that almost all the loss is on this variety.

Nebraska probably suffers most severely of any of the states from blister canker. This disease is generally considered to be worse in sections having scant rainfall and especially subject to summer droughts, than where the rainfall is more abundant and evenly distributed.

No reports of blister canker have ever been received from states west of Nebraska and Kansas. That the disease is not yet established in the Northwest seems certain from the careful surveys which have been made from time to time by competent pathologists. The conditions in Colorado are not so well known. This state is planted extensively with Ben Davis and Gano, both very susceptible to the disease. However, the fact that the orchards in that region are comparatively young may explain the absence of the disease. The influence of irrigation on this disease is not known. It is predicted that blister canker will cause considerable trouble in the Colorado region when it once gets established.

The reports from state collaborators follow:

New York (Chupp)- Reported in both Hudson River and Lake Ontario regions. Of minor importance.

West Virginia (Sheldon)- Becoming rare about Morgantown. However, it still persists on a few old trees.

Tennessee (Hesler)- Scattering cases found in various parts of the state. Not a real factor but becoming important. One prominent grower says it is the worst enemy of the apple here. (This is the first report of the disease from Tennessee)

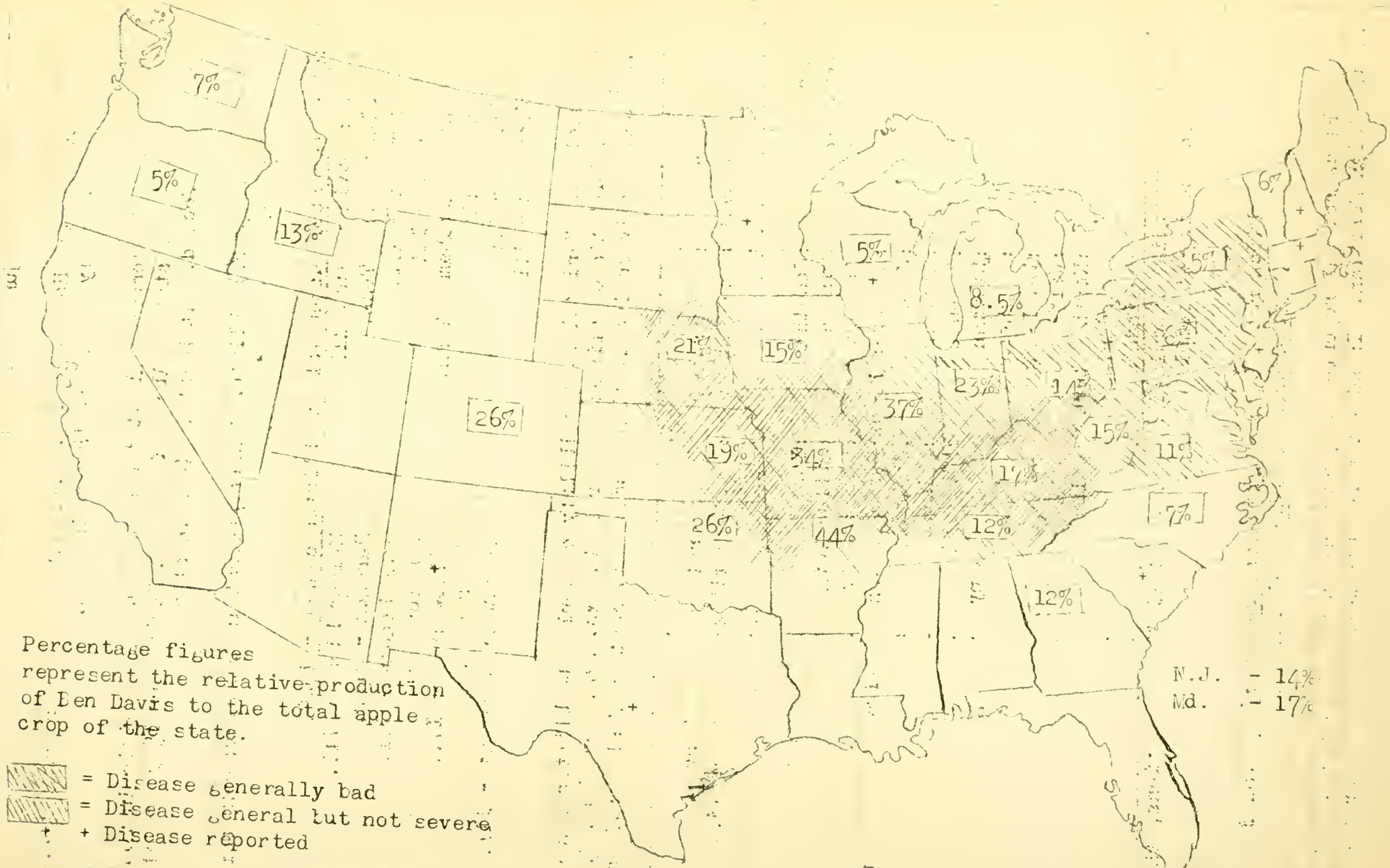


Fig. 8. Occurrence of blister canker in the United States and the percentage of Ben Davis grown in each state.

Arkansas (Elliott)- Generally distributed. Ten percent of trees injured and 2% loss to apple crop.

Ohio (Selby)- Has shown increased attack on older apple trees, especially to the southward in Ohio.

Illinois (Anderson)- About the same as usual. Mainly in south half of state. About 20% of Ben Davis over 15 years old infected. At least 1% loss in state.

Nebraska (Goss)- Blister canker present in most orchards this year.

Varieties reported susceptible to blister canker - 1920:

Ben Davis - Tenn. Ill	Maiden Blush - Ill.
Black Bens - Tenn.	Paragon - Tenn.
Chenango - Ill.	Rome Beauty - Ill.
Fameuse - Ill.	Senator - Ill.
Father Abraham - Tenn.	Willow Twig - Ill.
Gano - Ill.	Yates - Tenn.
Grimes - Ill.	Yellow Transparent - Ill.
Jonathan - Ill.	

Table 9. Varietal susceptibility of apples to blister canker as shown in Cooper's bulletin on blister canker (Neb. Exp. Sta. Res. Bul. 12. 1917). It is based partly on inoculation studies and part on field studies.

Very Resistant	Moderately Resistant	Moderately Susceptible	Very Susceptible
Oldenburg	Jonathan	York	Delicious*
Wealthy	Winesap	Willow Twig	Ben Davis
	Arkansas	Rome Beauty	Gano
	Arkansas Black	Maiden Blush	Yellow Transparent
	Janet	Champion	
	Minkler	Grimes	
	Fameuse	Missouri	
	Stayman Winesap	Northern Spy	
		Chicago	
	Va. Beauty	Yates	
	Wolf River	King David	
	Northwestern Greening	Walbridge	
	Malinda		

*Based on artificial inoculations only, not field observations, therefore, evidence is not complete.

Black rot caused by Physalospora cydoniae Arnaud
(Sphaeropsis malorum (Berk.) Pk.)

Black rot was reported as prevalent in all the apple growing states east of the 100th Meridian. In addition reports were received for the first time from Oregon and California. C. R. Stillinger has investigated this disease in the West and has recently reported his findings. (Phytopath. 10: 453-458. 1920.) He states that Hahn in 1914, in an unpublished thesis, describes a canker of apple trees in California which was caused by a fungus indistinguishable from Sphaeropsis malorum but referred to Diplodia natalensis Evans, on account of the common occurrence of two-celled pycnospores. Stillinger found the true black rot of the fruit to be quite common in Oregon although he was unable to find the canker form. This is not surprising since in many regions of the Mississippi Valley the true New York apple tree canker is rarely found. Barss in Oregon reports "black rot fungus fruiting abundantly on apple bark injured by low temperatures of last December all through the Willamette Valley. No report of serious fruit infections". R. H. Smith in California reports that black rot is "found occasionally along the coast; of some economic importance in Santa Cruz districts". It would seem from these various reports that black rot is not at all rare in the Northwest and that it has occurred in that region in a mild form for a number of years. It is commonly reported on apples from these regions by inspectors of the Bureau of Markets. It would be of interest to know more concerning its distribution in the interior Western

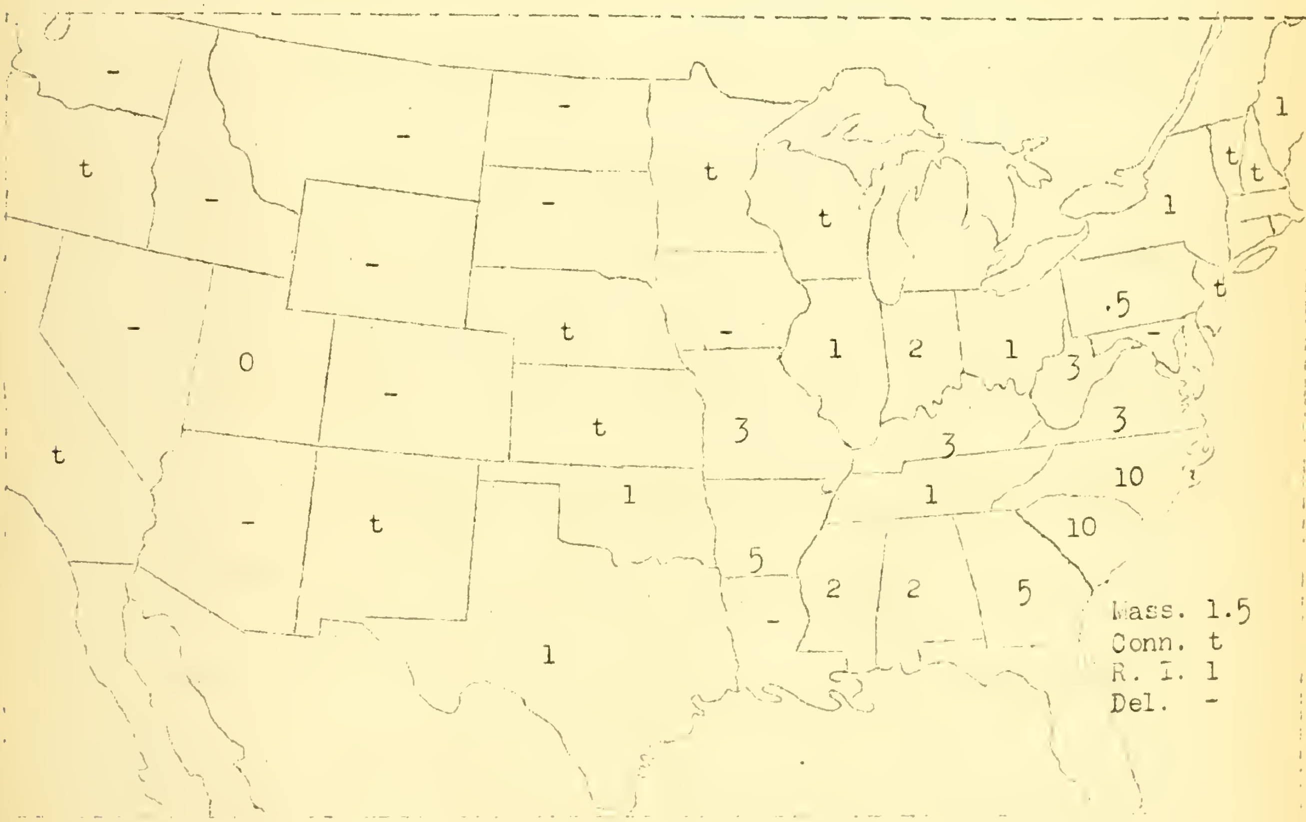


Fig. 9. Estimated percentage losses from black rot, 1920.

States from which it has not been reported yet. It is suggested that the collaborators of these states examine the fruit in the field and in the markets, as well as the trees in the orchard, during the coming season.

The severity of black rot and frog eye leaf spot in the East during 1920 corresponds closely to the conditions in 1919 except that it seems to have been more severe in Virginia and North Carolina as a leaf spot, and less severe in Pennsylvania, where it caused great damage in 1919. As usual most damage was reported in the South Atlantic and Gulf States and fairly heavy infection in the Mississippi Valley.

A noticeable feature of the 1920 reports was the wide prevalence of "blossom end rot" with black rot following. This condition was reported as common in Ohio and Tennessee and was observed in Illinois and Pennsylvania. A more detailed discussion of this type of injury will be given later under the head of "nature of injury".

The percentage loss from black rot throughout the United States was about 1.3% or a total crop loss of 3,660,000 bushels. The loss in 1919 was 1.36% estimated as 2,260,000 bushels. Six of the leading black rot states, New York Virginia, West Virginia, North Carolina, South Carolina and Georgia, show a loss of 2,485,000 bushels or over two-thirds of the entire loss. The corrected loss for each state will appear in Supplement 18 of the Plant Disease Bulletin.

New Hampshire (Butler)- Less than 1919.

Massachusetts (Osmun)- Worse than average and worse than in 1919. Second in importance to scab. (Krout)- Very abundant on leaves and limbs in most unsprayed orchards; some trees being almost defoliated by it.

Connecticut (Clinton)- Considerable infection on foliage early in season.

New York (Chupp)- About same as usual. Important as a canker form. General.

New Jersey (Cook)- About same as usual. Throughout state.

Pennsylvania (Thurston and Orton)- Considerably less. General.

Maryland (Temple)- Same as usual. 5% loss. Home storage losses are greatest.

Virginia (Fromme)- More than in 1919 and more than average. General, especially on leaves. Important.

West Virginia (Giddings)- Same as last year and same as average. General. Of considerable importance.

North Carolina (Jehle)- More than last year and more than average. Important. Throughout the state.

Georgia (McClintock)- About same as last year. Little importance. Generally distributed.

Alabama (Thiel)- Present in the state.

Mississippi (Neal)- About same as usual. Unimportant. Local, mostly in western counties.

Kentucky (Valleau)- Very common.

Tennessee (Hesler)- Generally distributed (as leaf spot and fruit rot). Not serious generally.

Arkansas (Elliott)- Generally distributed.

Indiana (Gardner)- State-wide as a fruit rot and on foliage. About same as last year and average year.

Illinois (Anderson)- Slightly more than usual. Leaf spot more common in southern Illinois where some damage resulted. Blossom end rot observed in many orchards of Ben Davis.

Minnesota reported the leaf spot as local and unimportant, but more than usual.

Kansas (Melchers)- Only a trace in a few orchards.

Oregon (Barss)- Black rot fungus fruiting abundantly on apple bark injured by low temperatures in Willamette Valley. No report of serious fruit infections.

California (E. H. Smith)- Found occasionally along the coast; of some economic importance in Santa Cruz districts.

Table 10. Losses from black rot as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
January 3 - May 20, 1920 (1919 crop)			
Kansas	1	28	
Illinois	1	4	
Missouri	1	7	Mostly blue mold rot.
New York	5	2-10	Blue mold present in nearly every car.
Oregon	3	1-11	Blue mold in one car.
Virginia	12	2-13	Considerable blue mold present.
Washington	6	3-14	" " " "
West Virginia	2	5-10	
Canada	1	13	Black rot and Rhizopus rot.
Unknown origin	1	6	
Total	33		
July 7, 1920 - January 5, 1921 (1920 crop)			
Arkansas	1	57	
	2	14-17	
California	1	3	
Delaware	5	7-17	Some blue mold present.
Illinois	8	2-17	
Maryland	13	2-15	Considerable blue mold present.
Michigan	7	2-15	" " " "
New Jersey	1	5	
New Mexico	1	5	
New York	1	40	Mostly pink mold rot.
	28	2-25	
Ohio	5	5-32	
Pennsylvania	9	2-30	Considerable blue mold present.
Tennessee	2	2-4	

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
July 7, 1920 - January 5, 1921 (1920 crop) (Continued)			
Virginia	3	30-47	Pink mold present in one car.
	24	2-23	Considerable blue mold present.
Washington	1	2	
West Virginia	20	2-17	Blue mold in some cars.
Unknown origin	1	65	Black rot, blue mold and Rhizopus.
	6	3-10	Blue mold in three cars.
Total	139		

Grand total ......172.
Total number of cars inspected.........3462*

*Approximate.

Nature of Injury from Black Rot.

It is evident from the reports of the collaborators that the type of injury most prevalent in the different sections is quite distinct. In Virginia, West Virginia, North Carolina and parts of Pennsylvania, the leaf spot or "frog eye" seems to be the most important phase of the disease, although the rotting of the fruit is important in some sections. In the Southern States the canker form as well as the fruit rot appears to be important. In the northern section of the Mississippi Valley the canker form is of little importance, the leaf spot causes practically no damage, while the fruit rot is quite serious, especially where primary injury to the fruit occurs through the attack of insects, hail etc. In these sections the fungus is commonly found fruiting on twigs killed by blight and in old blight cankers. In New York and parts of Ohio and Indiana the canker is more common than farther west. Hesler, who has investigated this disease for a number of years, states that the canker form is rare in Tennessee.

The reports of the Bureau of Markets indicate that black rot on the fruit occurs most commonly on apples from New York, Maryland, Pennsylvania, Virginia, West Virginia, Illinois and Ohio. The large number of reports from these states is, in part, due to the larger number of barrels shipped from the states. It is interesting to note that a number of reports of black rot on northwestern apples are found in the 1920 records of the inspectors.

Defoliation as a result of the leaf spot was reported as especially prevalent in Massachusetts (Krout and Osmun), North Carolina (Jehle), Virginia (Fromme), and southern Illinois (Anderson). Fromme states that the effect of leaf spot is very noticeable the year following the injury, in the reduction in quantity and size of fruit. This point should be borne in mind by the collaborators in making their reports.

A type of injury which has received unusual attention this year is that commonly called "blossom end rot". This is thought to be primarily due to sprays, probably arsenicals, and manifests itself as a black circular area about the calyx end. It is most common on Ben Davis in Illinois and appears especially where the trees have been undernourished, as is true of other types of spray injury. While this is probably a spray injury, it has been noted by several of the collaborators that black rot almost invariably follows such injury. Hesler in Tennessee states that Delicious, Ben Davis, Black Bens, Red June and Winesaps are subject to this end rot.

Dates of earliest observations of black rot:

In most cases the collaborators failed to state whether their observations were on the "frog eye" of the leaf or rot of the fruit. The early reports are, without question, of the leaf spot. It would be well for the collaborators to indicate in their reports on this point the nature of the injury first observed.

State	Date	Place
New York	June 2	Monroe County
New Jersey	June 25	Beverly (Haskell)
Pennsylvania	July 10	Center County
Virginia	May 21	Blacksburg
Georgia	April 30	Fort Valley (Roberts)
Mississippi	April 24	New Albany (Roberts)
Tennessee	May 27	Lancing
Arkansas	May	
Ohio	June 1	
Indiana	May 28	Morgan County
Illinois	May	Anna
Missouri	May 17	Springfield

Control of Black Rot.

No special spraying operations for the control of black rot were reported by the collaborators for 1920. Several stated that the disease was not prevalent in well sprayed orchards. It is evident that the regular spraying operations are depended upon to control black rot.

From observations in Illinois it is evident that the use of nitrate of soda will reduce the amount of blossom end rot and thus reduce the chance of secondary infection. In one orchard where the owner had applied sodium nitrate to about two-thirds of his orchard and none to the other third, blossom end rot was prevalent in the untreated part to the extent of at least five percent, while in the nitrated part none could be found.

Any factor which reduces the amount of injury to the fruit will materially reduce the fruit rot. The amount of rot on the fruit in Illinois is directly proportional to the percent of codling moth and curculio injury in most orchards.

Hesler in Tennessee states that these varieties which blight badly are the varieties which suffer most from "frog eye" since the fungus winters on the blighted twigs and the spores are washed from these on the leaves.

Rust caused by Gymnosporangium juniperi-virginianae Schw.

In 1920 apple rust was far less prevalent and less destructive than in 1919. The only region which suffered any great loss was the Virginia-North Carolina district. Even in Virginia the percentage loss dropped from 15 in 1919 to 5 in 1920. Severe losses were sustained in Arkansas where eradication of the cedars had not been practiced.

No new records of the distribution of rust were obtained. A complete summary of the rust situation in the United States is given in the Plant Disease Bulletin, Supplement 9, and the reader is referred to this for more detailed information concerning the distribution of the disease.

The following reports were received from the collaborators concerning the distribution and relative prevalence of the disease in 1920:

Massachusetts (Osmun)- About as usual. Unimportant.

Connecticut (Clinton)- Average same.

New York (Chupp)- About same as average year; both on fruit and foliage. On Long Island and in Hudson Valley only.

New Jersey (Cook)- Same as usual in a few localities only.

Virginia (Fromme)- Very severe again in the Shenandoah Valley region except where protection has been obtained by cedar eradication. Unusually severe in counties east of the Blue Ridge. Damage as a whole was less, owing to eradication of cedars in important commercial section.

West Virginia (Giddings)- Very general over state. Unimportant this year. Less than average and less than last year.

North Carolina (Jehle)- About same as last year and average year. Unimportant.

Kentucky (Valleau)- Common over most of the state. Apparently not serious.

Tennessee (Hesler)- General over state. Important only in local areas.

Georgia (McClintock)- General over state. Unimportant.

Alabama (Thiel)- Present in the state. No data on damage.

Mississippi (Neal)- Local. Unimportant. Less than last year and less than average.

Alabama (Elliott)- Extremely severe in regions where cedars are plentiful. Trees defoliated in July and August. Mostly in northwestern part of state.

Ohio (Selby)- More than usual. Mostly in the Ohio Valley region.

Indiana (Gardner)- Mostly in southern half of state where red cedars are abundant.

Illinois (Anderson)- About same as usual. Mostly in extreme south (Union and Johnson Counties). Some in western section.

Iowa (Melhus)- Less than last year.

Minnesota (Leach)- Not very prevalent; over southeast quarter of state.

Wisconsin (Vaughan)- Less than average, along Mississippi River bluffs.

Kansas (Melchers)- Present but no damage to speak of.

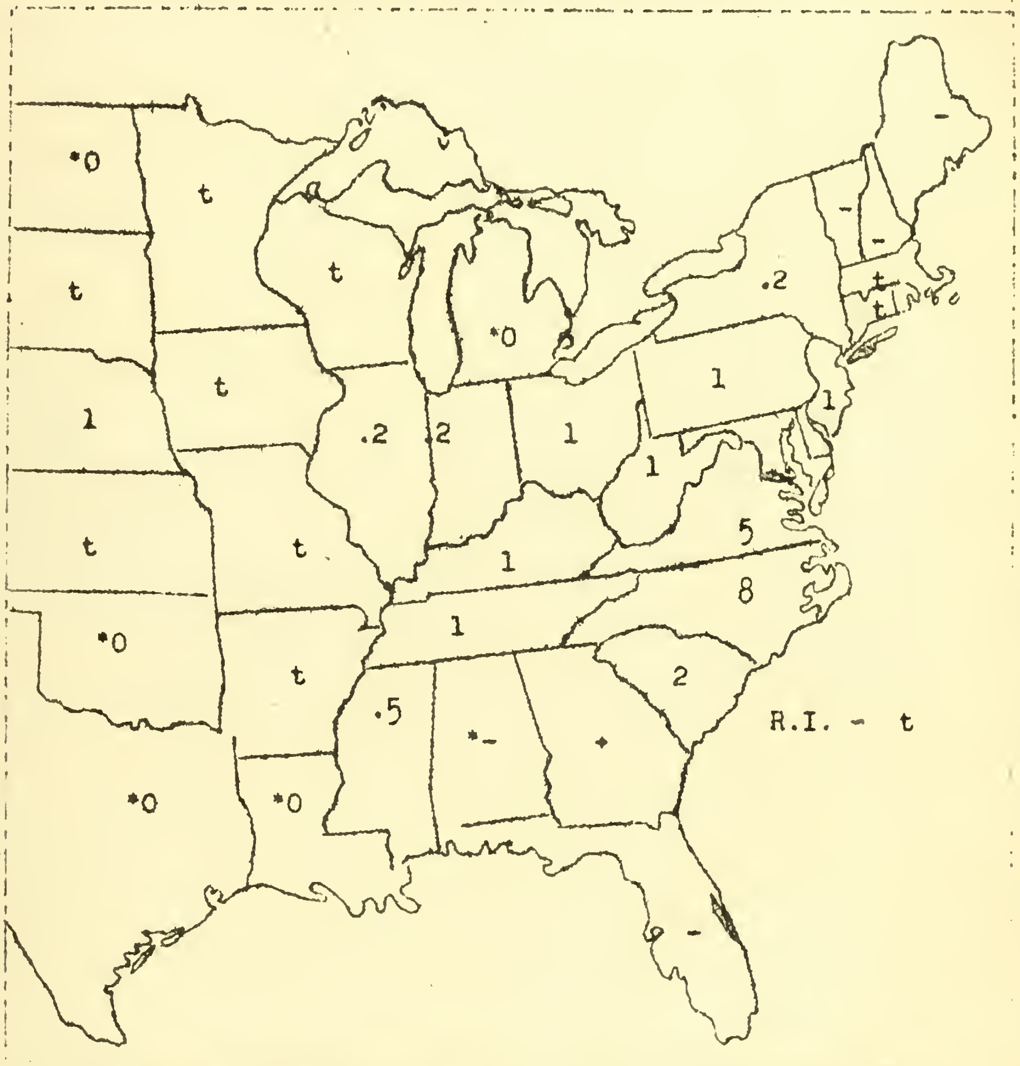


Fig. 10. Percentage loss from apple rust as estimated for 1920.

Nature of Injury from Rust.

Three types of injury result from the attack of Gymnosporangium juniperi-virginianae; (1) Injury to the foliage, resulting in reduced assimilating surface. In some cases defoliation results; thus Elliott in Arkansas reports that "trees (Jonathans) were defoliated in July and August". In other cases a scorching of the leaves similar to spray burn occurs. This condition was reported by Fromme on Black Twigs in Virginia. The foliage injury resulted in dwarfing the tree and reducing the size and quantity of the fruit. (2) Injury to the fruit. It appears that fruit infection is common on some varieties and rare on others. There is also great variation in this respect from season to season. Melchers in Kansas reported leaf infection as common but "fruit is never affected". In southern Illinois leaf infection was very common and abundant but the fruit was rarely rusted. (3) Injury to twigs. Twig infection is much like fruit infection in the matter of wide variation. Hesler reported twig infection common on Red June in Tennessee. It was also common on Smith Cider in Illinois and Virginia. On commercial varieties, however, it does not seem to be of any importance.

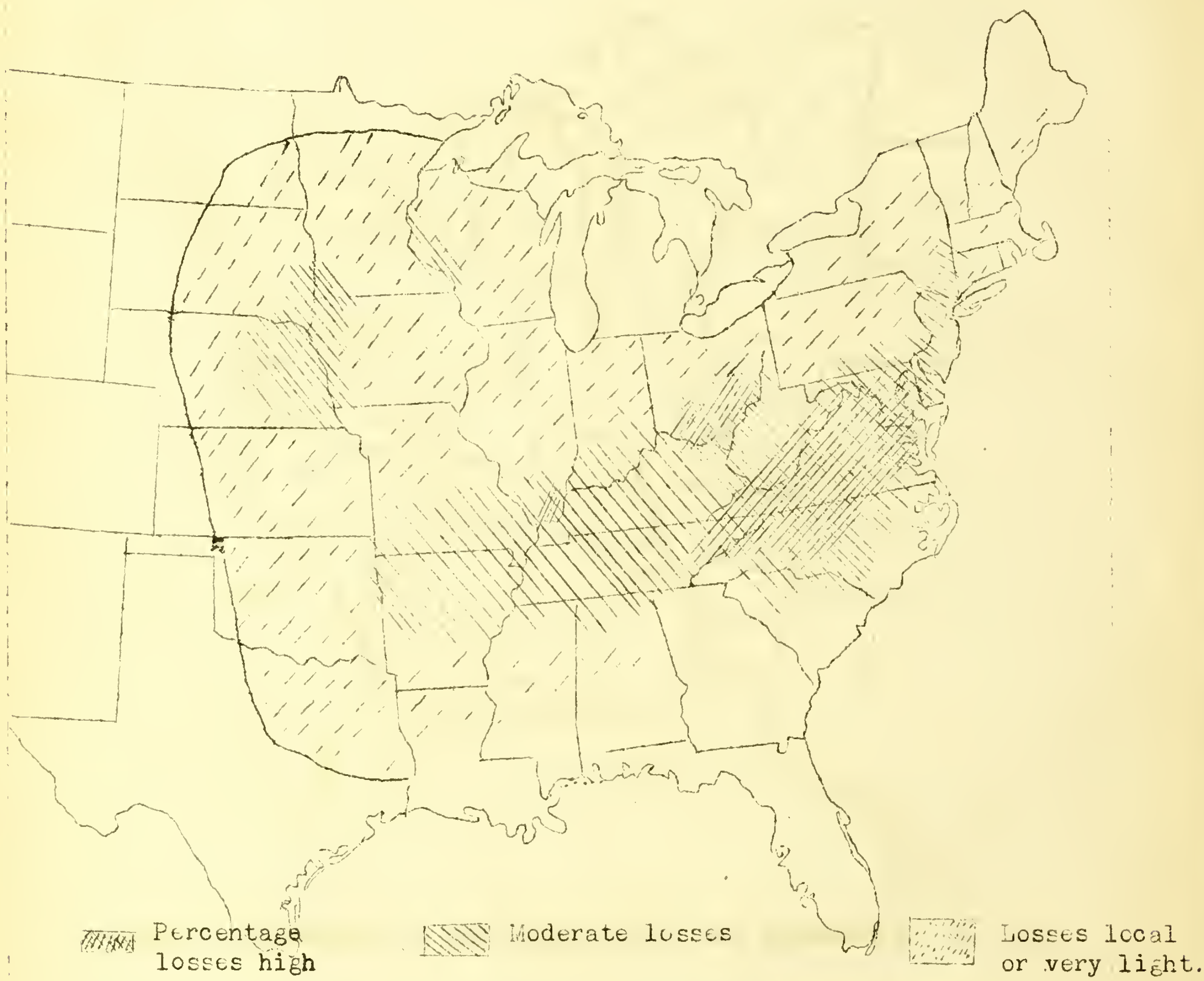


Fig. 11. Occurrence of apple rust in 1920 and distribution of red cedars.

Relation of Weather to Rust in 1920.

In the principal rust region, West Virginia, Virginia and North Carolina, May was unusually dry, cool month. This, together with extensive cedar eradication, explains the percentage reduction in rust in these regions. In Ohio the northern section was dry during May but in the southern section, where most of the rust occurs, the precipitation was above normal. This was true also in southern Indiana and Illinois. Excessive rainfalls occurred in the northwestern section of Alabama and this was probably responsible for the heavy infection in this state where the cedars were not eradicated.

More information is necessary concerning the time of infection of the rust fungus before accurate statements can be made concerning the relation of the weather to the prevalence of the disease.

Dates of first observations of rust on apple:

In addition to the information furnished by the collaborators as given below, Hesler in Tennessee made a number of observations on the development of the spore horns of the cedar apples and the time of opening of the aecia.

"Development on cedar - Knox County, Tennessee.
March 20: Galls with horns just beginning to break through.
March 24: Horns 1/16" long.
March 28: Horns 3/16" long. Rain fell night of 27 and on morning of 28 at 9 a.m. trees still wet.
April 2 : Horns 1/4 to 3/4" long and had discharged a crop of sporidia.
"Development on apple.
June 3 : Pycnia, no aecia (Sevier County).
June 20 : Aecia just beginning to show.
July 6 : Aecia just breaking through.

"Subsequent to April 2, galls apparently functioning repeatedly, single galls producing several crops of sporidia (number not determined)."

State	Date first observed	Place
Connecticut	July 12	Old Saybrook
New York	July 6	Poughkeepsie
Pennsylvania	July 22	Lebanon County
Virginia	June 2	Harrisonburg
Tennessee	June 3	Pigeon Ford
Illinois	May 23	Anna
Minnesota	July 2	
Wisconsin	About June 1	Gays Mills
Missouri	July 17	Southland

Varietal Resistance to Apple Rust.

A summary of survey data concerning susceptible and resistant varieties from 1905 to 1919 appeared in last year's fruit disease summary (Pl. Dis. Bul. Suppl. 9: 108, 109. 1920). The following susceptible varieties were mentioned in the 1920 reports:

Ben Davis - Tenn.
Benoni - Ill.
Champion - Tenn.
Jonathan - Ill. Ind.
Red June - Tenn.
Rome Beauty - Md.

Commerce - Tenn.	Senator - Tenn.
Delicious - Tenn.	Stayman - Penn.
Early Harvest - Tenn.	Wealthy - Mass. N.Y. Tenn. Ill. Ia. Minn.
Fanny - Penn.	York - Penn. Md.

Hesler in Tennessee makes the observation that "in one orchard Champion and Ben Davis were very susceptible while Delicious was moderately susceptible". Patten and Northwestern Greening were mentioned as showing some resistance in Minnesota.

Table 11. Summary of a questionnaire to growers in Virginia as to varieties affected and not affected in 1920.

No. growers reporting	Affected	No. growers reporting	Not affected
6	York	3	Winesap
4	Ben Davis	1	Delicious
1	Jonathan	1	Stayman
1	Shockley	1	Black Twig
1	Rome Beauty	1	Borum

Control of Apple Rust.

The only method of control reported by collaborators was that of cedar tree eradication from the neighborhood of orchards. That this method is materially reducing the rust in large commercial apple growing sections is indicated by the reports of this year. Thus in New York Chupp stated that "removal of all cedar trees for one half mile from an orchard reduced the rust about 90%". Fromme in Virginia stated that "Frederick County cut practically all cedars and has practically no infection. Damage less, owing to eradication of cedars in important commercial sections." The small amount of damage by rust in Arkansas in spite of an ideal season for its development, can be attributed to the cedar eradication in that state. Elliott stated "extremely severe in regions where cedars are plentiful, 85% of cedars cut in commercial apple sections". In West Virginia, where eradication of the cedars has advanced farther than in any other state, the damage this season from rust was reported as "unimportant".

Efforts to eradicate cedars in Union County, Illinois, were made by the State Department of Agriculture. The cedars were declared a nuisance and were ordered removed by January 1, 1921, in the neighborhood of Anna. The success of this movement cannot be determined for several seasons.

For further data concerning eradication see Plant Disease Bulletin, Supplement 9, pages 10-12.

Crown gall caused by *Bacterium tumefaciens* Sm. & Towns.

Crown gall occurs wherever apples are grown in the United States. The prevalence of the disease in various sections of the country is indicated by the fact that nearly every state in the Union has reported it as "general" or "common" during the past fifteen years. It is a serious nursery trouble in all sections and the wide dissemination of nursery trees, together with the fact that it has a wide range of hosts, has assured a general distribution of the disease. The reports in 1920 do not indicate any serious trouble from the disease but this is not surprising, considering the difficulty both in locating the diseased trees and in determining the amount of damage.

The effect of crown gall on young orchards has been investigated and reported on by the Iowa Station (Ia. Agr. Exp. Sta. Res. Bul. 50). The results show that planting crown galled trees does not decrease the stand; that crown galled trees did not grow nearly so rapidly as healthy trees; that it is not uncommon for galled trees to recover after they are set in the orchard; that large galls seem to be more injurious than small ones; and that soft galls are more injurious than hard ones. Unfortunately, no data on yield from galled and healthy trees are yet available. It is commonly claimed by nurserymen that trees suffering from crown gall yield as well, if not better, than healthy trees.

The actual loss to nurseries from crown gall is not reported generally by the collaborators. This information can be secured, in many states, from the state nursery inspectors. It is suggested that collaborators make an effort to secure data from these inspectors in 1921. The loss in this branch of the industry must have been very large during the past year on account of the high price of trees and the scarcity of nursery stock. In one of the largest nurseries of the Mississippi Valley section it was estimated that 10 to 20% of the apple trees were discarded on account of crown gall in 1920. They estimated the money loss to be about $40,000.

From unpublished data which Dr. I. E. Melhus, of Iowa, kindly furnished, it is shown that the average loss in a nursery where counts of discarded trees were made was 19.24%. About 20,000 trees are usually set per acre in the nursery plantings. Melhus finds that the stand when the trees are ready for lifting is 57.2% of this, or 11,440 trees on account of loss of plants from various causes. If the loss from crown gall averages 19.24% the number of trees discarded per acre would be 2,196. At present nurseries are selling their entire output and could sell more; thus they lose the equivalent of the sale price of about 2,200 per acre.

It is probable that crown gall is decreasing in many sections of the country as regards orchard crops, on account of the more thoroughly organized nursery inspection service in most of the apple growing states, and the realization on the part of nurserymen that they cannot sell diseased stock to most commercial orchardists.

Varietal susceptibility is not mentioned by the collaborators except that Hesler in Tennessee stated that the aerial form on Early Harvest is common all over the state. This is also true of southern Illinois. Greene and Melhus, in the bulletin referred to above, stated that when Wealthy and Jonathan were planted in infested soil, Wealthy showed 62% crown gall while Jonathan showed only 13% at the end of four years. Nurserymen state that this difference in susceptibility is noticeable in the nursery.

The so-called "aerial crown gall" has received more attention than usual in the 1920 reports. Whether or not this type of gall is always due to Bacterium tumefaciens is still an open question as far as the apple is concerned. It is found on Chenango in Illinois wherever this variety is grown and is regarded by orchardists as a characteristic feature of this variety. It is also quite commonly found on Early Harvest as was mentioned earlier.

In New York Chupp reported crown gall as not important and probably the same as the average. At Riverhead "one tree was pretty well covered with galls". (aerial galls ?) In Tennessee Hesler reported the disease "severe in nurseries as well as in orchards; aerial form bad on Early Harvest all over state; a big problem here". Taubenhaus in Texas regarded crown gall as "fairly important" and generally distributed, especially on nursery stock. In Arkansas

Elliott reported 10% of the crop injured. Melhus in Iowa, who has made a special study of the disease, stated that 22% of the apple nursery stock is suffering from crown gall, and that the loss is 12% for 1920. This high estimate, by one who has made a careful study of the disease would indicate that the loss is being greatly underestimated in other sections of the country. In Idaho the disease was considered as "not serious". Heald and Dana in Washington stated that the "aerial form is not uncommon on the west side".

Sooty blotch and fly speck caused by Leptothyrium pomi (Mont. & Fr.) Sacc. and Phyllachora pomigena (Schw.) Sacc.*

The following reports from state collaborators concerning these diseases have been received:

Pennsylvania: Quite generally reported on York, Stayman, Spy, Greening, Rome Beauty, Fallawater, Wealthy. Worse than usual on account of late rains. Important in unsprayed orchards. Not important where late sprays were applied.

West Virginia: General throughout the state. About the same as average. Important commercially. Easily controlled by the usual sprays.

Maryland: One percent injury.

Tennessee: Considerable damage to quality. Often 100% of fruit on the local market affected.

Arkansas: Abundant on unsprayed fruit.

Ohio: More than usually prevalent. Damage small. Wet season has been favorable for the fungi. July copper sprays gave excellent results.

Indiana: Worse than last year. Not of great importance.

Illinois: Of no importance to the commercial crop. Some locally important. Poor site and indifferent spraying and pruning responsible for most of the trouble.

It is evident from these reports that sooty blotch and fly speck caused very little trouble in 1920. It was found generally distributed as usual and was perhaps more prevalent in New York, Pennsylvania and Maryland than usual.

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*A general summary of this disease was given in Plant Disease Bulletin Supplement 9: 122-215. 1920.

Table 12. Losses from sooty blotch caused by Leptothyrium pomi, as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of sooty blotch: No. cars	Percentage of sooty blotch: Percent	Origin of shipment	Percentage of sooty blotch: No. cars	Percentage of sooty blotch: Percent
Jan. 1 - Apr. 5, 1920			Sept. 11 - Dec. 28, 1920		
Maine	2	12-63	(Continued)		
Massachusetts	1	17	Maryland	1	57
Virginia	4	6-32	New Hampshire	1	19
West Virginia	1	25	New York	2	10-14
Total	8		Pennsylvania	2	2
			Virginia	3	3-27
Sept. 11 - Dec. 28, 1920			West Virginia	4	4-45
Delaware	1	10	Total	14	

Grand total........................... 22
Total number of cars inspected......... 3384

Powdery mildew caused by Podosphaera leucotricha (E. & E.) Salm.

Powdery mildew was prominent in several states east of the Mississippi this year but as usual caused no serious trouble except in nurseries where it checked the growth in some instances. In New York it was reported as more common than in 1919 but not of much importance. It occurred mostly in the Lake Ontario region and appeared in Monroe County June 18. In some sections it was serious enough to dwarf the growth of the new shoots. It was reported from West Virginia as not causing much damage this year. Maryland reported the disease locally severe on nursery stock. In Ohio Selby reported it as more prevalent than in 1919. At Ladoga, Indiana P. J. Anderson observed mildew on Missouri Pippin, causing some dwarfing of shoots. In Idaho Hungerford stated that it was present in neglected orchards, but less serious than last year.

In the Northwest, where mildew is usually a rather serious factor in the orchard, the damage was less than in 1919. Heald and Dana reported less than average in Washington, while Barss reported it "general, as usual, throughout Oregon". In both these states it is fairly well controlled by the usual lime-sulfur scab sprays.

D. F. Fisher, in Farmers' Bulletin 1120, 1920, writes in regard to the nature of the injury:

> "The disease frequently stunts the fruit and produces a disfiguring russeted appearance. ***** The chief loss, however, results from its attack upon the foliage, which, in severe cases, so devitalizes the tree that it fails to produce fruit buds and causes a crop failure the succeeding season."

He reported as most susceptible, Jonathan, Yellow Bellflower, Yellow Newton, Esopus (Spitzenburg), Black Ben, Grimes and Rome Beauty. White Pearmain and Winesap are given as quite resistant. His report on mildew during the season of 1920 follows:

> "In the irrigated apple-growing districts of Central Washington powdery mildew gave promise of developing to an alarming degree in the early part of the season, but the advent of a period of very hot, dry weather checked the spread of the disease about the first of July. The foliage was therefore not abnormally affected, except in certain sections where the disease has been established a long time. But the exceptional prevalence of mildew during the early part of the season, at and immediately following the blossoming period, when fruit infection takes place, resulted in the disfiguring of a considerable portion of the crop through russeting of the apples. This injury was common on Jonathans, Grimes, and Black Ben Davis as well as other susceptible varieties."

Chas. W. Hauck, Acting District Horticultural Inspector of the Washington State Department of Agriculture, writes regarding powdery mildew:

> "The weather conditions in the spring of 1920 were not conducive to its development. Furthermore, we have been successful in spreading pretty thoroughly the gospel according to D. F. Fisher, of the Division of Fruit Disease Investigations, and as a result the growers have been combating this disease with much success. Whereas, last year the spurs showed the effects of the severe damage done during the previous summer, this year the spurs appeared to be in good condition and indicate that relatively little damage is to be expected from mildew during the coming season."

Fruit spot caused by Phoma pomi Passer

Phoma fruit spot seems to have attracted little attention in 1920 as compared to 1919.

Clinton in Connecticut reported an average amount, with no figures as to percent. Chupp in New York stated that the disease was about the same as last year. It was confined to the Hudson Valley. A trace was present in most orchards although some orchards ran as high as 20%. The earliest report was from Columbia County on June 13. In Delaware Manns stated that the disease marked some of the early varieties from which the last scab spray was omitted. In West Virginia, where there was a heavy loss in 1919, the disease was reported as unimportant and less than during the average year, mainly in the northern section of the state. The condition in Arkansas was also in sharp contrast to last year when a 25% loss was reported on some varieties. Elliott reported very little in the state and only 1% of the crop injured. In the Ozark section of Arkansas and Missouri Pierce reports the disease as very slight, causing less than 1% loss, whereas, in 1919 there was a depreciation of fully 60% of the crop of all susceptible varieties. The disease was also reported in Ohio and Illinois with no serious loss in either state. Good control by spraying was reported from Arkansas.

Anthracnose caused by Neofabraea malicorticis (Cord.) Jackson

This disease is found only in the Northwest where it is especially serious west of the Cascade Mountains in Washington and Oregon. During 1920 the disease caused very severe injury in this region. The reason for this unusual severity is explained below.

Oregon (Barss)- Great severity and general distribution of this disease throughout western Oregon. Damage to trees and crop was severest in years. The severe freeze of last December rendered bark tissues subject to a spread of infections at a rate often many times greater than usual. A big crop and scarce labor last fall resulted in great delay or even abandonment of fall anthracnose spray with consequent rapid increase in number of infections.

Washington (Heald and Dana)- More than average year. Disease on the increase probably on account of the severe winter.

Table 13. Losses from anthracnose caused by Neofabraea malicorticis, as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
February 5 - May 5, 1920			
Oregon	12	1-14	Associated with blue mold in 2 cars.
Washington	8	1-23	
Total	20		
December 13 - 30, 1920			
Oregon	4	3-25	Associated with blue mold in 2 cars.

Grand total 24
Total number of cars inspected........3384

European canker caused by Nectria galligena Bres.

A summary of the occurrence of this disease in the United States appeared in the Plant Disease Bulletin, Supplement 1, page 14, 1919. In 1920 it was reported from only three states, New York, Virginia and Illinois, and in none of these was it regarded as important. These are the first reports of European canker from Illinois and Virginia. It was found in a single tree at Meekin, Stephenson County, Illinois. In Virginia Fromme reported it from Jonesville. No doubt this fungus is present in other states but is so rare that it escapes observation.

Root Rots Caused by Various Fungi

Xylaria root rot. This is still regarded as one of the most serious problems for the fruit grower in the Shenandoah Valley and other parts of Virginia, North Carolina and West Virginia. The pathologists who attended the fruit disease conference in the Valley in August will agree with Fromme that this disease is the most serious with which he has to contend, as far as apples are concerned. It seems probable that this will prove to be the case in other sections of the country, especially to the west of the Appalachian Mountains in Kentucky and Tennessee. Valleau in Kentucky reports that Xylaria root rot is "probably the most serious apple disease" and "apparently in all sections where apples are grown". This is the first report of the disease received from Kentucky. Hesler in Tennessee reported the disease as "of some importance" and suggested that it is "a problem that needs attention not only in Tennessee but elsewhere". In Illinois the territory where the disease was found was extended during the past year by finding a rather seriously infested orchard in Jackson County. It is a comparatively rare disease in the state and is found only in the extreme southern end. New York (Chupp)- According to the reports of field assistants, this trouble (Xylaria and Armillaria root rots) is becoming more serious each season. From one tree to 10% of the trees in 50% of the orchards are affected. Close plowing, winter injury, etc., have more influence seemingly than weather. Reported more often on Twenty Ounce, Baldwin, Duchess and Kings, in the order named. Elliott in Arkansas stated that the disease is general but not severe.

Armillaria root rot reported as follows:

New York (Chupp)- See above under Xylaria root rot.

Arkansas (Elliott)- Reported Clitocybe and Armillaria root rots as common.

Oregon (Barss)- General causing occasional damage in most orchard sections. Trees girdled below ground and die. All fruit crops susceptible.

Texas root rot (*Ozonium omnivorum* Shear). The only state reporting on this disease in 1920 was Texas, where it is regarded as very important. Taubenhaus estimates the loss at 2%.

Root rots undetermined.

Illinois (Anderson)- A serious root rot, caused evidently by some "mushroom" type of fungus, was found causing the death of about 10% of Ben Davis trees in a large commercial orchard at Princeton, Illinois. This orchard was planted on the site of an oak forest and a large oak woods bounded it on two sides. No fruiting bodies were found. The fungus strands were white and rather delicate - less than 1/8" in diameter.

Pink rot caused by *Cephalothecium roseum* (Fries) Cda.

This rot was reported as more abundant than usual in Tennessee, Ohio, and Illinois. It caused "considerable loss, following scab" according to Hesler in Tennessee. In Illinois it was very common on apples in the local markets on account of the abundance of scab. The reports of the inspectors of the Bureau of Markets on this disease are given in the accompanying table.

Table 14. Losses from pink mold rot caused by Cephalothecium roseum, as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
Feb. 19 - May 19, 1920			
New York	3	4-22	
Unknown origin	2	40-58	Associated with blue mold rot.
Total	5		
Sept. 28, 1920-Jan. 6, 1921			
Illinois	1	13	Pink mold and blue mold rots.
Michigan	1	11	" " " " " "
New York	3	50-65	Considerable amount of other decays
	6	27-40	present, principally blue mold,
	15	2-20	black, and brown rots.
Virginia	2	7-38	Some black rot present.
West Virginia	1	3	Following scab.
Total	29		

Grand total........................ 34
Total number of cars inspected....... 3462*

Rhizopus rot caused by Rhizopus sp.

Table 15. Losses from Rhizopus rot caused by Rhizopus sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay.
February 11-March 30, 1920			
Massachusetts	1	55	Some blue mold also present.
Canada	2	12-50	Blue mold in one car, black rot in the
Total	3		other.
July 13 - Nov. 4, 1920			
Delaware	3	4-32	Blue and gray mold rot in one car.
Illinois	2	3-11	Brown rot in one car.
Maryland	2	2	Black and brown rots in one car.
New York	2	3-13	Mostly black rot in one car.
Pennsylvania	1	5	
Virginia	1	4	Mostly blue mold rot.
Unknown origin	1	65	Mostly black rot with some blue mold.
Total	12		

Grand total........................ 15
Total number of cars inspected..... 3462*

*Includes the reports examined for the period February 24, 1920, to January 10, 1921.

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt.

No doubt this rot was general throughout the fruit regions of the country, but few of the collaborators reported it as especially injurious. The scarcity of reports this season indicates that it was of little importance from the field standpoint. Its importance from the storage and transit standpoint is indicated by the reports of inspectors given below. The fact that other rots were reported as common in most cases where cars were inspected, leads one to believe that the quality of the fruit was below normal and conditions of storage were poor. In Arkansas the disease was reported as common, with 1/3 of 1% loss to the crop. Washington - less than usual. In New York it was reported from Dutchess County as "showing up severely on a few trees of Chenango". This variety is notoriously susceptible to brown rot in Illinois - Anderson. Oregon reported it as very slight and not of economic importance, occurring as a fruit rot mostly on injured fruit.

Table 16. Losses from brown rot caused by Sclerotinia sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay		Remarks as to seriousness of decay
	No. cars	Percent	
Jan. 29 - Apr. 22, 1920			
California	3	6-25	
Maine	3	4-20	Mostly complete decay.
New York	2	17-23	Serious decay.
Virginia	4	3-9	
Washington	2	10-20	Some blue mold in one car.
Canada	3	20-35	
Total	17		
July 23, 1920 - Jan. 5, 1921			
Delaware	2	7-25	Blue mold present in one car.
Illinois	1	11	Brown rot and Rhizopus rot.
Maryland	2	2-9	
Michigan	1	1	Brown rot and blue mold rot.
Missouri	1	2	
New York	2	40-57	Mostly pink mold rot.
	12	2-19	Considerable blue mold present.
Ohio	1	10	
Pennsylvania	1	7	
Virginia	5	2-25	Considerable other rots present, mostly blue mold rot and black rot
West Virginia	3	3	Some blue mold rot present.
Canada	1	73	" " " " "
Unknown origin	3	3-7	
Total	35		

Grant total........................... 52
Total number of cars inspected........ 3462*

*Approximately

Blue mold rot caused by Penicillium expansum (Ld.) Emend. Thom.

The loss from blue mold is usually insignificant as far as the apple crop on the trees is concerned but it becomes a very important factor from the time the fruit begins to be handled until it is finally consumed. In storage and transit it is the most important by far of all the rots. It is impossible to secure accurate estimates of losses in local markets and home storage, but there is little question but that this amounts to over ten percent of the crop thus handled. The losses as reported by the inspectors of the Bureau of Markets indicate the seriousness of this disease.

Table 17. Losses from blue mold rot caused by Penicillium expansum, as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
Jan. 2 - June 17, 1920			
California	2	25-55	
	10	3-21	
Colorado	4	25-47	Advanced stages of decay.
	41	2-20	
Illinois	4	32-62	
	5	4-9	
Kansas	1	10	
Maine	17	2-30	
Maryland	2	10-13	
Massachusetts	2	5-55	
Missouri	4	3-21	
Montana	1	2	
Nebraska	1	3	
New York	4	32-67	
	22	2-23	Other decays present in some cars.
Ohio	2	30-40	
Oregon	8	25-47	
	137	1-23	
Pennsylvania	3	4-6	
Virginia	31	2-18	Black rot present in several cars.
Washington	7	50-67	Some complete decay.
	56	25-45	Considerable complete decay.
	1269	1-24	" " "
West Virginia	3	7-20	
Unknown origin	3	50-58	Pink mold rot in one car.
	5	20-40	Some pink mold rot in one car.
	9	3-17	
Canada	6	37-58	Considerable complete decay.
	8	2-17	
Total	1667		
July 10, 1920 - Jan. 10, 1921:			
Arkansas	1	10	
California	7	2-7	

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
July 10, 1920 - Jan. 10, 1921 (Continued)			
Colorado	6	4-22	
Delaware	5	7-18	Considerable black rot present.
Idaho	13	2-33	
Illinois	10	2-20	
Indiana	1	3	
Kansas	1	25	
Maine	2	4-32	
Maryland	21	2-33	Considerable black rot present.
Michigan	36	2-15	
Missouri	1	19	
New Hampshire	1	3	
New Mexico	1	2	
New York	8	25-57	Considerable other decays present,
	144	1-23	principally black rot.
Ohio	7	2-18	Black rot present in four cars.
Oregon	28	2-25	
Pennsylvania	2	30-60	Bad decay, some black rot.
	11	2-18	
Utah	3	4-12	
Virginia	32	2-47	
Washington	56	1-15	
West Virginia	21	2-25	Considerable black rot present.
Unknown origin	1	65	Black rot and Rhizopus also presen
	11	2-10	
Canada	1	72	Mostly brown rot, some blue mold.
Total	431		

Grand total........................... 2098
Total number of cars inspected........ 3462*

*Approximate.

Jonathan spot (non-parasitic)

This trouble seems to have caused very little injury during 1920 and few reports were received from the collaborators. New Jersey reported Jonathan spot as due to _Alternaria_ sp. and states that it is widespread. _Indiana_ (Gardner) reported it worse than usual, occurring on ripe fruit on the trees. It was observed on Jonathan, King and Black Twig. _Ohio_ reported less than usual. _Illinois_ reported very little in the orchards but it was quite commonly observed on fruit in the market. The high price of containers forced growers in this section to attempt to sell their fruit in bulk. The fruit was allowed to stay on the trees longer and was frequently kept out of storage for a considerable time. This resulted in more Jonathan spot appearing on market fruit early in the season. _Wisconsin_ reported less than average and regards the disease as of very minor importance this season. In _Idaho_ it was stated that the disease was common but less than last year. No estimate is given of the loss or its relative importance. Washington reported the disease as among those present.

Table 18. Losses from Jonathan spot (probably non-parasitic), as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: No. cars	Percent	Origin of shipment	Percentage of decay: No. cars	Percent
Jan. 28 - Mar. 12, 1920			Sept. 23, 1920-Jan. 5, 1921		
Washington	4	15-27	(Continued)		
			Virginia	1	15
Sept. 23, 1920-Jan. 5, 1921			Washington	4	5-20
Illinois	1	14	New York	1	8
Maryland	1	7	Total	13	
Oregon	1	1			

Grand total.............................. 13
Total number of cars inspected.......... 3384

Bitter pit (Stippen, Baldwin spot)- non-parasitic

This disease is becoming more generally recognized by pathologists in its many manifestations and variable characters on different varieties. It seems to be quite generally distributed over the United States but is most prevalent in the East, especially in New York, and the Northwest.

New York - Much less than usual; not important this season. New Jersey - Very abundant, especially on Baldwins. Tennessee - Unimportant. Observed on many varieties in the market, especially Baldwins, Pippins and Yellow Newtons. Maryland - More than usual. Arkansas - Severe in some Grimes orchards. Ohio - More than usual. Weather favorable for large fruit which was responsible for condition. Indiana - On Stark, Grimes and Baldwin. Washington - About same as average year. Five percent loss to crop. Everett district, mostly on Baldwin, King and Spitzenberg; Yakima district, Grimes and Black Twig; Prosser district, Gano and Ben Davis. Idaho - Less than last year. Not common.

Table 19. Losses from bitter pit (non-parasitic), as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of shipment	Percentage of decay: No. cars	Percent	Remarks as to seriousness of decay
Jan. 13 - Apr. 26			
California	3	3	
Massachusetts	1	17	Associated with other blemishes.
New York	3	5-13	
Oregon	2	3-20	
Washington	9	3-25	
Total	18		

Origin of shipment	Percentage of decay		Remarks as to seriousness of decay.
	No. cars	Percent	
July 28 - Jan. 3, 1921 *			
California	1	14	
Maryland	1	15	Mostly blue mold rot.
New Hampshire	3	6-20	
New York	3	5-12	
Tennessee	1	12	
Virginia	1	82	Associated with storage scald.
Washington	5	2-5	
West Virginia	1	12	
Total	16		

Grand total........................... 34
Total number of cars inspected.......3384

D. F. Fisher, Wenatchee, Washington, writes as follows on bitter pit:

"Losses were greater than for several years past, especially in cases of light crops of Black Ben Davis. some orchards running as high as 75% to 90% culls on account of bitter pit."

Water core (non-parasitic)

The following note on this disease was received from Dr. Charles Brooks and D. F. Fisher, of the Department of Agriculture:

"The losses from this disease were greater than usual - Jonathan, Stayman, Rome and Winesap being the principal varieties affected. Probably 75% of the Winesaps were affected. Most of the water core was of the 'invisible' type, not extending to the surface, and hence could not be excluded from market fruit under the state law. This caused some apprehension in the trade but did not prove to be a serious matter in the case of the Winesaps, which constitute the bulk of the storage fruit. The water-cored condition disappeared from the Winesaps after a few weeks in storage, in most cases, and there was no ill effect upon the keeping quality of such fruit. But in the case of the softer textured apples, such as the Jonathan and Rome, water core did not disappear or abate in severity during storage, but instead predisposed the fruit to 'internal breakdown'. The latter condition was therefore abnormally prevalent on these varieties, and was frequently complained of as 'the apples turning black or brown inside'. Both water core and internal breakdown were especially prevalent on the larger sized apples."

Reports of water core have been received from New Jersey - Rare; Ohio - General; Wisconsin - Minor, except on Northwestern Greenings, which are quite susceptible; and Washington.

Internal breakdown (non-parasitic)

D. H. Rose in the Division Letter Bureau of Markets, 23: 8. Jan. 20, 1921, writes:

> "Internal browning and mealiness of apples has been quite common during the present shipping season, especially in Northwesterns, Jonathans, and Stayman Winesaps. In many cases it has been so bad as to look more like freezing than like the condition known to inspectors as internal breakdown. In a lot of Jonathans examined by Dr. Garrick and the writer in October, before there was any possibility of freezing in the orchards or in transit, most of the symptoms of freezing were found, except deep browning under bruises. It was noted, however, that many of the apples looked sound from the outside, but, on cutting, were found to have a quarter inch ring of apparently sound flesh outside of a browned, mealy interior.
>
> "In connection with this disease Charles Brooks makes the following statement: 'I understand that there has been an unusual amount of water core this year, particularly on Winesap. If the Jonathans were originally affected with this trouble, it is possible that there might be after effects, similar to what you describe.' This fits in well with observations made in Chicago and other markets, that, in Jonathans, internal breakdown and water core are often associated."

Idaho (Hungerford) reported much more of this trouble in 1920 than was observed in 1919. He describes it as a "breakdown of the fruit at picking time or soon after. Over-irrigation seems to increase the injury. Jonathan and Winesap especially susceptible to injury." The trouble is also reported from Ohio.

D. F. Fisher reported as follows concerning this condition in the Northwest:

> "While other factors may be involved and the influence of a previous water-cored condition has been pointed out, the most important single factor causing internal breakdown was undoubtedly the over-maturity of the apples when picked. The fall of 1920 was unusually cloudy and rainy for this 'dry climate', and coloring of the apples was slow. Hence, there was a general tendency for growers to delay picking as long as possible, waiting for color that would put a higher percent of the fruit in the Extra Fancy market grade. The crop of Jonathans and Romes was quite uneven and generally light. The size of the apples, therefore, was large, many overgrown specimens being produced under these conditions. Such apples are recognized as inherently of poor keeping quality. When picking was delayed these apples were in no condition to withstand storage since they were already soft and at the eating stage in many cases. A large proportion, therefore, reached the end of their storage life and were destroyed by internal breakdown within as short time as from three to four weeks."

Scald (non-parasitic)

Scald, being primarily a storage and market trouble, was not reported by the majority of the state collaborators. The following note was received from Dr. Charles Brooks concerning this condition:

> "Apple scald is causing an unusual amount of loss this year; the severity of the trouble apparently being due to the fact that the apples were unusually warm when they went into storage and have in many cases been held rather beyond their season."

The loss from scald as determined by the inspectors of the Bureau of Markets is given in the following table.

Table 20. Losses from scald (non-parasitic), as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of scald		Remarks as to seriousness of scald
	No. cars	Percent	
Jan. 10 - June 11, 1920			
California	7	5-20	
Idaho	2	55-78	
	6	7-27	
Illinois	2	13-40	
Maine	1	55	Bad scald.
	2	2-18	
Maryland	1	65	Bad scald.
	1	5	
Massachusetts	1	25	
Missouri	1	2	
New York	1	100	Covering 1/5 to 3/4 of surface.
	5	14-50	Some bad scald.
Oregon	7	25-53	Some severe scald.
	54	2-23	
Pennsylvania	3	50-70	Severe scald.
	2	3-20	
Virginia	8	55-100	Various degrees of severity.
	19	5-43	" " " "
Washington	20	50-100	" " " "
	52	25-48	" " " "
	247	2-23	" " " "
West Virginia	2	50-85	Slight to severe.
	5	12-35	
Canada	2	8-18	
Unknown	23	15-27	
Total	454		
Sept. 30, 1920 - Jan. 5, 1921			
California	1	1	
Oregon	1	75	
Virginia	1	23	Slight scald.

Origin of shipment	Percentage of scald: No. cars	Percentage of scald: Percent	Remarks as to seriousness of scald.
Sept. 30, 1920 - Jan. 5, 1921 (Continued)			
Washington	3	5-17	Mostly slight scald.
West Virginia	1	40	Mostly severe.

Grand total...................... 461
Total number of cars inspected... 3462

Winter injury, killing or injury of trees by low temperature.

The most severe winter injury in the history of the fruit industry of the Northwest occurred in Idaho, Washington and Oregon last year when very low temperatures were reached during December 1919. Many trees were killed and whole orchards succumbed in some cases. All gradations of injury from total death of trees to slight cankering and loss of fruit, occurred. The following special reports of C. W. Hungerford and D. F. Fisher give an idea of the extent of the injury:

"The temperatures during December 1919 were the lowest ever recorded for many of the fruit producing sections of the Northwest. At Lewiston, Idaho, where the temperature reached 27° below zero, there was very serious injury to cherries, peaches, walnuts, chestnuts, apricots and apples. The peach and apricot crop for this year was practically a failure. The cherry crop reduced about 50% and many of the trees injured beyond recovery. The walnut and chestnut trees were killed back to within a few feet of the ground and very serious injury resulted to many apple orchards.

"In one orchard of Yellow Newtown apple trees about six acres of trees were practically destroyed. The bark on the southwest side of nearly all of the trees was dead and blistered when they were inspected May 13, 1920. The bark on the other side of the trees was a normal green color and apparently uninjured. The majority of the trees started growth on the main trunk but very few on the branches.

"In this orchard the influence of lack of sufficient irrigating water during the growing season upon the susceptibility of the trees to injury was very clearly shown. An irrigation flume ran along one side and through the middle of the orchard. All of the trees adjacent to this flume were uninjured." -- C. W. Hungerford, Moscow, Idaho.

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"The severe freezing weather of the early part of December, 1919, caused heavy loss through the killing or damage of large numbers of fruit and nut trees all over the Pacific Northwest, but more particularly west of the Cascade Mountains. The Wenatchee-North Central Washington district, the most important apple-growing section, escaped with little or no damage, although the minimum temperature reached 20°F. This freedom from injury is doubtless attributable to the thoroughly dormant condition of the trees at the time of the freeze. The Yakima Valley, with more diversified fruit interests, suffered heavy damage through the killing of large acreages of peach trees and the loss of the crop over a larger area where the trees themselves were not killed. In parts of this district the minimum temperature reached 36°F, and here damage was experienced on all fruit trees. Winesap and Wagener apples suffered severely, some trees being killed, while the crop was materially shortened by the failure of the apples to attain normal size, due to a diminished vitality of the trees. Cherry (sweet) trees were badly damaged and the crop was generally lost. In the Walla Walla district Italian prune trees were severely affected.

"In the Hood River Valley (Oregon) apples and pears suffered severely but the pears have shown a greater recuperative power than the apples. At the time of the freeze Anjou pears were recognized as having suffered little damage, but Bosc, Clairgeau, Comice and Bartlett were seriously injured, and in many cases trees were believed to be dead which have since recovered. The crop was not damaged on the Anjous but on other varieties a few fruits only were borne on terminals in the tops of the trees. Of the apple varieties the Yellow Newtown appeared to be most susceptible to injury, while the Ortley and Red Cheek Pippin were markedly resistant. Few Winesaps are grown in this district. The injury appeared to be confined mostly to the lower areas of the district and on the trees was most severe at the snow line, diminishing in severity upwards.

"Farther west, in the non-irrigated districts of both Oregon and Washington, the damage was greatest on low bottom lands, where minimum temperatures as low as 24°F were recorded. This extreme was many degrees lower than any recorded since the coming of the white settlers to this section. Heaviest damage occurred through the killing of orchards of walnuts, apples, prunes and peaches, the trees being killed to the snow line. All fruits suffered severely upon the low bottom land where they had not reached a stage of dormancy sufficient to withstand the cold. Temperatures considerably below zero were recorded in the orchard sections at higher elevations, but due to better air drainage, and especially to the fact that the preceding summer was very dry and these trees therefore went into winter thoroughly dormant, very little injury occurred here. The orchards on the low bottom land, on the other hand, had not suffered such severe drought and had been maintained in a vigorous growing condition by intensive tillage. With the coming of the heavy rains the trees on low land were maintained in a succulent condition that was absent from the hill orchards. These rains, combined with mild temperatures, continued almost until the freeze so the trees were afforded no chance to develop dormancy. Fortunately, a large percent of the total fruit acreage is located on the higher lands, where severe injury did not occur. The type of injury occurring most frequently in the hill orchards was 'winter sunscald' on the south side of the bodies above the snow line, but in the bottom land orchards cambium injury frequently girdled the trees at the snow line, diminishing in severity toward the top of the trees. In general the fruiting wood was not injured, or but slightly so, and frequently the buds were not damaged, especially on prunes and apples. In the case of most varieties of cherries, pears and peaches, however, the fruit buds were killed. The Royal Ann cherry and Anjou pear produced a fair crop and generally appeared more hardy than other varieties. Bartlett pears produced a few fruits on terminal growth high up in the trees.

"The influence of vitality in withstanding the damage was strikingly demonstrated in many cases. Old, devitalized Italian prune trees failed to survive the season but vigorous young trees growing alongside regained full vegetative vigor and matured a full crop. Trees that had been well fertilized (not over-stimulated) were only slightly injured while unfertilized trees adjacent were killed. Trees that had been prematurely defoliated through spray injury the previous season were killed, while those not subjected to such injury came through.

"The snow-blanket on the ground varied in depth from 10" to 36" and this precluded any root injury. This also gave a chance to renew the tops of the trees killed to the snow line by stump grafting or from shoots from adventitious buds below. This is being done with special promise in the case of walnuts and some apples. Trained-up Loganberry and other vines were killed to the snow line and the crop was reduced 40-50% thereby. Nor was the damage confined to fruits for ornamentals; oaks, and other forest trees were badly damaged or killed." -- D. F. Fisher, Wenatchee, Washington.

Washington (Heald and Dana)- The highest amount of injury ever known in some sections, resulting in die back and reduced vitality with lower yield. The important apple sections report 12-30% of all apple wood killed. Due to early December (1919) temperatures (29-31° below zero).

Oregon (Barss)- The below zero temperatures of last December caused the death of some apple trees, especially Baldwins in low situations in the Willamette Valley. Newtowns were also severely damaged. Many orchards of different varieties were seriously affected and in some cases will be pulled up. The great majority of orchards, however, will pull through with little permanent evidences of injury and a good crop is anticipated this fall in many sections. In general, hill orchards escaped serious damage.

The accompanying map with a table showing the temperatures in some of the principal fruit sections of the Northwest is presented to show the extent of the disastrous freeze of 1919-20.

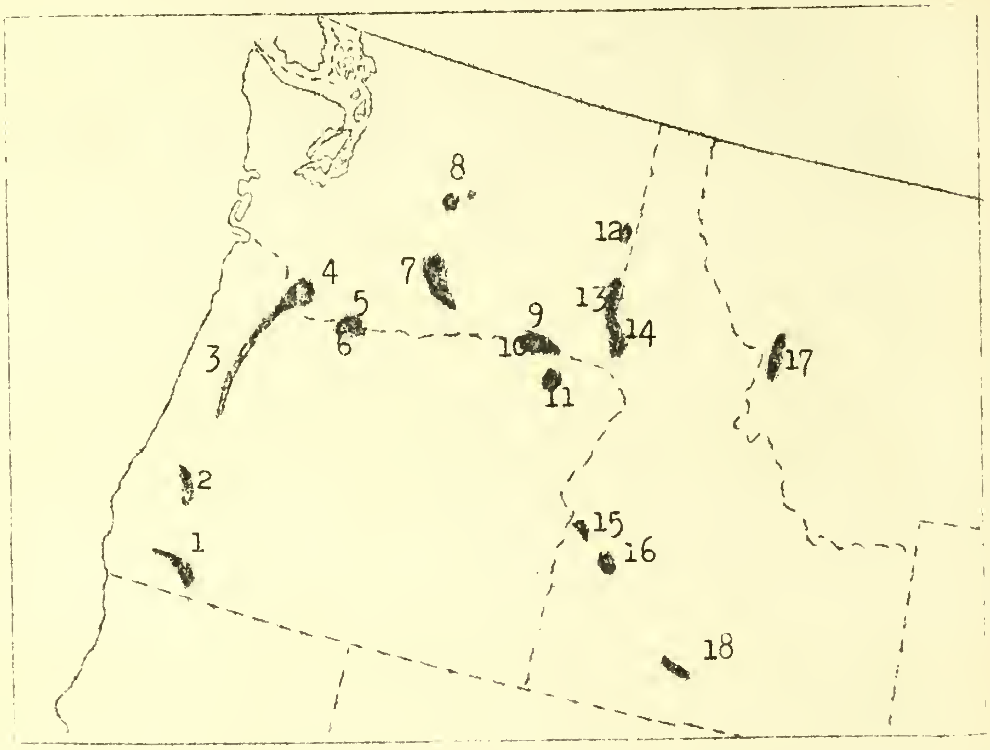

Fig. 12. The principal fruit areas of the Northwest.

Table 21. Minimum temperatures in the principal fruit areas of the Northwest.

Fruit section	Minimum temperature December, 1919.
1. Rogue River Valley	-10 to -15
2. Umpqua Valley	0 to 2
3. Willamette Valley	-6 to -22
4. Vancouver (Clark County)	-10 to -15
5. White Salmon	-14
6. Hood River	-10 to -15
7. Yakima Valley	-24 to -36
8. Wenatchee Valley	-12 to -20
9. 10. Walla Walla Valley	-14 to -36
11. Grande Ronde Valley	-22 to -24
12. Spokane	-15 to -25
13. Palouse-Pullman	-24 to -25
14. Lewiston-Clarkston	-23 to -27
15. Payette	-26
16. Boise	-14 to -16
17. Bitter Root Valley	-25
18. Twin Falls	-8 to -15

No serious general injury was reported from the eastern half of the country, due to the fact that no extremely low temperatures were reached.

The following reports are from the collaborators of these sections:

New Hampshire (Butler)- No trees killed but considerable injury to individual limbs, Baldwins being especially affected.

Connecticut (Haskell and Stoddard)- Cases of collar injury were noted on the southwest side of about seventy-five apple trees of the variety Opalescent. In many cases the bark was loosened half around the tree. Healing was going on, but poorly. In the same orchard alternate rows of another variety, Williams, were unaffected.

New York (Chupp)- A slight amount both in the Hudson and Lake Ontario fruit district. Not important.

New Jersey (Cook) Winter injury common.

Ohio (Selby)- Winter injury has occurred as a result of ice coating, low temperatures and delayed maturity of apple trees; it has been found in poorly drained locations, and, while less than on cherry and plum trees, has been more than normally serious.

Frost injury - killing of blossoms.

Frost and freezing temperatures were recorded for the entire northern Mississippi Valley and Ohio Valley and northward on May 14 and 15. This cold spell extended eastward, including West Virginia, Pennsylvania, and parts of Maryland and Virginia. Fortunately the season throughout the entire northern United States was about two weeks late and little damage was done north of the 41st parallel. In central Illinois, Indiana and Ohio, however, the apples were in full bloom at this time. It was thought at the time that this would result in an almost complete killing of the fruit. This proved to be true in the case of some varieties but others seem to have escaped with very little injury. In a number of commercial orchards, however, the crop was so reduced as to make harvesting unprofitable. While considerable local damage resulted, sufficient fruit escaped to make the total damage rather low. A heavy yield of those varieties which escaped the frost reduced the loss to many commercial growers who had a number of varieties. An earlier cold spell, resulting in freezing temperatures on April 5, did some damage to apples in Arkansas, Tennessee, Kentucky and southern Illinois and Missouri. The damage to apples, however, was slight as compared to that done to earlier fruit crops such as peaches, plums and cherries.

Frost injury of fruit and leaves.

Russet bands as a result of early frosts were reported from Virginia, Ohio, Indiana and Illinois.

Selby in Ohio reported: Curious manifestations of freezing injury have been noted in Ross and Athens Counties and doubtless occur elsewhere. Along with serious loss from freezing have come clusters of dwarfed leaves with delayed formation of buds, and scattered fruits having one side scarred. Variable injury is noted on different branches of the same tree. Frost rings upon apple are observed in these districts as in most others.

Hail injury

Indiana (Gardner)- Very severe throughout state.

New York (Chupp)- Hail injury reported as serious in Orange County.

Illinois (Anderson)- Hail injured some apples but did more damage to peaches in the region about Cobden, Union County.

Idaho (Hungerford)- Considerable loss in the Lewiston orchards.

Storage rots of apples

Dr. Charles Brooks writes concerning storage rots in general for 1920:

> "More than the average amount of rot has developed on stored fruit. This condition may be partly due to the fact that the warm weather during picking season made it unusually difficult to secure prompt cooling of the fruit after it went into storage."

Miscellaneous fruit rots and spots

Alternaria rot, caused by Alternaria sp., is mentioned by Cook in New Jersey as frequently following blossom end injury (blossom end rot) caused by arsenicals. Core rot due to Alternaria was mentioned by Hungerford as causing serious trouble in Idaho; in some varieties the entire apple rots on the tree. This type of the disease was also reported from Washington and was commonly observed in Illinois.

Phytophthora rot, caused by Phytophthora cactorum (Lebert & Cohn) Schr., was reported by Clinton as occurring in stored McIntosh apples in Connecticut.

Jonathan freckle (non-parasitic) was reported from Washington by Heald and Dana. "Distinct from Jonathan spot; entirely superficial." Brooks believes this to be caused by the same conditions which bring about Jonathan spot.

Spot necrosis is reported from Washington. The possible cause and the nature of the injury are not given.

Spongy dry rot, caused by Volutella fructi Stev. & Hall, was reported as causing considerable rot in storage in Massachusetts. It was found on a number of apples in the local markets in Illinois. The apples were said to be from Canada but their origin was doubtful.

Miscellaneous bark cankers

Brown bark spot (Heald and Dana) Washington - This disease kills trees and produces a die-back.

Rough bark (cause unknown)- Reported by Heald and Dana from Yakima County, Washington and from Coeur d'Alene, Idaho.

Cytospora canker and Valsa die-back. Chupp in New York stated Cytospora was reported once as a twig canker following some other weakening factor. Selby in Ohio stated that Valsa die-back due to Valsa leucostoma (Pers.) Fr. was observed in Mercer County. New Mexico (Leonian) reported Cytospora leucostoma weakened trees. It is getting quite abundant in the state. Healthy trees are not affected as a number of inoculations have shown. Ohio Valley (Anderson)- "I have observed a Cytospora on injured or weakened or dead twigs and branches of apple trees throughout the Ohio Valley. It is very common everywhere. The perfect stage is a Valsa which I have referred to Valsa ambiens Fr., but with some question as to the correctness of my determination". Arizona (J. G. Brown)- Reported die-back due to Cytospora rubescens from Apache County. Minnesota also reported canker as due to Cytospora.

Plenodomus canker (Plenodomus fuscomaculans). One report from Michigan.

Measles (Cause unknown)- Was reported from New Mexico. (Leonian)- This is getting to be quite a serious apple trouble throughout the state". See Supplement 9 for further data on this disease.

Spray injury

The usual amount of spray injury was reported in 1920 and few points of interest were mentioned. New Jersey reported spray injury common. Tennessee reported that "lead injury" was important on susceptible varieties, causing calyx end injury on Ben Davis and Delicious, often followed by black rot. "Lime sulfur injury" in this state caused "leaf injury, marginal and tip, slight on fruit (Ben Davis and Delicious). In one case where found, I think was due to use of spray gun with low pressure, and resultant overdrenching"--Hesler. Ohio (Selby)- Reported arsenical and "spray gun injury". Illinois (Anderson)- Reported serious injury to the foliage in many orchards due to the fact that the spray was applied after the primary scab infection (which was very heavy), resulting in burning over and around the infected spots. In some experimental blocks serious leaf burning resulted from the application of magnesium arsenate. Lead arsenate caused considerable blossom-end injury, especially on undernourished Ben Davis trees. Bordeaux injury was evident in many orchards in southern Illinois where early applications were made in an attempt to control blotch. Michigan (Coons)- Reported spray burn where magnesium arsenate Bordeaux was used; also some lime sulfur russeting. Minnesota reported local spray injury. Idaho (Hungerford)- "Serious injury noted this year upon Baldwin trees sprayed with Scalecide spray late in November 1919. All trees in one orchard were killed." Washington reported lime sulfur sun scald.

Collar rot (causes not definitely determined)

Ohio (Selby)- Cause freezing and subsequent infection. Especially so on Grimes and Baldwin; serious losses in South.

Illinois (Anderson)- Cause unknown, probably winter injury. Primarily a Grimes trouble but occurs on other varieties. Loss to crop for state 1% annually.

Washington (Heald and Dana)- Non-parasitic. Very serious in Okanogan and Yakima Valleys. Mostly on Winesap and Spitzenberg.

The following report has been received from C. W. Hauck, Yakima, Washington:

"Our most serious problem is collar rot. It is creating great havoc in our orchards and every year we lose quite a number of trees. During the past season this trouble appeared to be getting worse and one of our most frequent questions is 'What shall we recommend as a remedy or a preventative?'"

Bastard toad flax on apple roots.

This parasitic flowering plant (Comandra pallida A. DC.) was found by D. F. Fisher at Wenatchee on apple roots. The wide range of this plant in the Northwest would indicate that it might prove of some importance as a parasite. The amount of injury to the host is problematical.

PEAR

Blight caused by Bacillus amylovorus (Burr.) Trevisan

Blight was reported from most of the states where pears are grown. It was not as serious in some sections as in 1919, but was reported as worse in most of the Southern States, in Connecticut, New York, Indiana and Ohio. The percentage loss to the crop was generally quite large and an average of 10% would be conservative. East of the Rocky Mountains the pear crop was estimated at 10,000,000 bushels in 1920. The loss from blight in this section would probably reach 1,000,000 bushels this season.

Massachusetts (Osmun)- About the usual amount.

Connecticut (Clinton)- More than usual and more than last year, 5-10% loss.

New York, producing 2,375,000 or about one-fourth of the 1920 crop east of the Rockies, reported a loss of 10-20%. It was worse in this state than last year. The first observation was made on May 27 in Nassau County.

New Jersey (Cook)- Common but less severe than usual.

Pennsylvania (Thurston and Orton)- Less than last year and much less than the average year. Less than in our history of the disease in Pennsylvania.

Virginia (Fromme)- Especially severe this year in the southwestern part of the state.

West Virginia (Sheldon)- A number of trees near Morgantown were much injured.

Kentucky (Valleau)- All pear trees observed badly blighted.

Tennessee (Hesler)- It is commonly taken for granted that blight has driven the commercial pear out of the state during the last several years. The disease was severe this year wherever the pear is found.

Georgia (McClintock)- Limiting factor in pear production. Loss of 50% this year. Some varieties show resistance. (Roberts)- Between Macon and Atlanta practically all the new growth on all trees in the section killed by blight. (Observations made April 27, 1920).

Arkansas (Elliott)- More severe than usual, 100% of crop injured. First observed in April.

Ohio (Selby)- More than usual but small percent of the crop injured.

Indiana (Gardner)- Worse than last year and more than average.

Illinois (Anderson)- Severe locally but not much blossom blight, thus assuring a fairly good crop. Weather not generally favorable for disease later in season.

Michigan (Coons)- Epidemic which began early checked by hot weather and loss not much greater than average.

Missouri (Hopkins)- Moderate.

New Mexico (Leonian)- Slight, in spite of the fact that it was very severe the past year and many of the old cankers were left upon the trees and still active during the present season.

Arizona (Brown)- Five percent loss from blight.

No reports were received concerning blight in the Great Plains region. There are, however, comparatively few pears grown in this region.

In the Northwest blight was not an important factor during 1920 according to reports received. This is no doubt due to the rigid inspection of orchards in that region and the cutting out of the disease when it first appears. Hungerford in Idaho reports the disease as serious only in neglected orchards. Growers in general are succeeding in keeping it out of their orchards.

In Oregon Barss reported the disease worse than usual and stated that the damage was large in Jackson County. It was general in the irrigated sections except Hood River where it was rare, if present at all.

In California according to J. P. Benson the disease was quite severe in Fresno County. Pears are not grown on a commercial scale there, however.

It is hoped that before many years varieties of pears may be secured which are resistant to blight and leaf spot (*Fabraea maculata*) and, at the same time, possessing desirable market qualities. This work is being actively pushed by the Oregon Experiment Station through Mr. F. C. Reimer of Talent, Oregon, and by the United States Department of Agriculture through Dr. B. T. Galloway, Office of Foreign Seed and Plant Introduction. A recent summary of this line of investigation by Dr. Galloway appeared in the Journal of Heredity 11: 25-32, 1920. Resistant stock material has already been obtained by the introduction of several oriental species, *Pyrus ussuriensis*, *P. betulaefolia* and P. calleryana. Of these the last appears to be one of the most promising as a stock on account of its resistance to both blight and leaf spot, and its congeniality to our common varieties when grafted or budded on it. Concerning this Dr. Galloway writes:

> "It is a vigorous grower under all conditions. It holds its leaves well, and it can be budded any time from July 1 to September 1. All of our best kinds of pears so far tried take well upon it. The seedlings are easily grown and, when from pure types, run remarkably uniform."

While it is desired to secure resistant stock upon which to work our commercial pears, in order to reduce the chances of body and collar blight, it is still more desirable and essential to secure tops which are blight resistant. Dr. Galloway has kindly given us information concerning work along this line at Chico, California, where a large number of oriental pears introduced by the Office of Foreign Seed and Plant Introduction are being tested. He states that several varieties are now fruiting which are blight resistant and, at the same time, are equal to some of our best pears as far as quality of the fruit is concerned. These varieties are of oriental origin. It is hoped that budwood from these may soon be available for general introduction.

The only measures which were used to control blight during 1920 were cutting out the blighted twigs as they appeared and the use of resistant varieties. Selby in Ohio stated that "It is to be noted that where precautions have been taken to remove blighted twigs the early part of the season, very little loss has been experienced". McClintock in Georgia reported that "One Japanese sand pear and some of the hybrid pears supplied by Dr. Waite have shown marked resistance this season at the Station". The Bosc pears were reported most affected in the Rogue River Valley, Oregon.

The following note on pear blight control has been furnished by C. C. Cate:

> "Pear blight has been a serious disease in the Rogue River Valley since 1907. The first campaign on control was only partially successful, since in the cutting out practices mercuric chloride was used and attention was given to infections on aerial parts only. These failures led the writer to make thorough root and crown inspection a part of the regular program, and many cases of root and crown blight were discovered. In further work it was demonstrated that those sections in which careful root and crown inspection was carried out and all such cases of blight treated or cut out remained freest of blight. Early in the work the ineffectiveness of mercuric chloride in sterilizing wounds was suspected, other agents were tried and among them lysol and mercuric cyanide. The latter has since been shown by Professor Reimer to be very effective as a blight disinfectant when used on wood. As an additional means of assisting in the control of blight a combination spray of nicotine, oil emulsion and arsenate of lead was used to combat the insects which might be acting as carriers, the most important of which seemed to be thrips. The careful cutting out with attention to root and crown infections, the

discarding of mercuric chloride as a disinfectant, and the spraying program outlined have given good results in the control of blight in the Rogue River Valley."

Pear scab caused by Venturia pyrina Aderh.

This disease seems to be of little importance in most sections of the country since few reports have been received. It seems to cause most damage in the New England States. New Hampshire (Butler) reported considerable damage to the fruit. In Massachusetts it was important in 1920 on some varieties and caused about the same loss as last year. Connecticut (Clinton) reported it more prevalent than during the average year. It is reported on Flemish Beauty. New York (Chupp) had less scab than last year and it was important only in isolated cases. The first report was on June 7 from Orleans County. In Dutchess County several Flemish Beauty trees were severely affected. In New Jersey the disease was common but easily controlled by spraying. Pennsylvania reported almost no loss in sprayed orchards and probably less scab generally than usual. It was observed on twigs. In Ohio the disease was relatively more prevalent than in 1919. It was reported as present but not important in Michigan and Illinois. Washington (Heald and Dana) reported it as general west of the Cascades. Oregon (Barss) reported it as general in western Oregon, particularly in the Willamette Valley. First observed April 16 at Cottage Grove. Spraying usually successful if early sprays are timed right.

Table 22. Losses from scab caused by Venturia pyrina, as shown by examination of cars at destination by inspectors of the Bureau of Markets

Origin of shipment	Percentage of decay		Remarks as to seriousness of decay
	No. cars	Percent	
Delaware	2	76	Very badly scabbed.
Maryland	1	23	Spotting 1/3 to 1/2 surface.
Michigan	1	3	Affected slightly.
New York	1	25	
Total	5		
Total number of cars inspected	477		

Leaf spot caused by Fabraea maculata (Lev.) Atk.

This leaf spot was reported from New Jersey as less than usual, being most severe in the southern half of the state. In West Virginia Sheldon reported it as occurring on some very old and very large trees in the neighborhood of Morgantown, especially on sprouts and suckers. In Tennessee Hesler reported heavily infected fruit in the market which was said to have come from Delaware. Near Bloomington, Illinois, the disease was observed in a nursery, causing some damage to the foliage of the nursery stock. It was also noticed on some large pear trees at Normal, Illinois.

Leaf spot caused by *Mycosphaerella sentina* (Fr.) Schrot. (*Septoria pyricola* Desm.).

This leaf spot was reported from New York as rather generally prevalent, but causing no great damage. In Albany County it was very prevalent; most serious on Seckel, some of which were almost completely defoliated. It was first observed in Albany County on June 21. New Jersey reported it of little importance this year. Hesler in Tennessee also regarded it as unimportant this season. In Ohio Selby stated that it caused quite serious defoliation in one orchard observed. It was regarded as more prevalent than usual but causing no great loss. It was present in limited amounts in southern Illinois.

Black rot caused by *Physalospora cydoniae* Arnaud.

Black rot of pear was reported by the collaborators from only three states. It was reported as locally severe in Indiana, while in Ohio it was less prevalent than usual. In Illinois it caused a great deal of damage in the southern end of the state where it is always serious on fruit that has not been properly sprayed. The cankers caused by this fungus are more common on pear than on apple and the blight cankers are often covered with the black rot pycnidia. This may explain in part its more general prevalence on pear than on apple.

The reports of the market inspectors indicate the importance of this disease.

Table 23. Losses from black rot caused by *Physalospora cydoniae*, as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
Colorado	1	2	
Delaware	7	10-47	All stages of decay.
Illinois	1	14	Early stage of decay.
Indiana	1	42	
Kentucky	2	27-35	
Maryland	6	20-55	Other decays also present, mostly blue and brown rots.
Michigan	7	4-35	Associated with blue mold, brown rot, and Rhizopus rot.
Missouri	1	53	Mostly advanced stage.
New York	20	2-37	Considerable blue mold and Rhizopus rot.
West Virginia	1	6	Associated with blue mold rot.
Unknown origin	6	5-37	Some Rhizopus rot present.

Total 53
Total number of cars inspected....... 477

Other diseases.

Crown gall caused by Bacterium tumefaciens Sm. & Townsend. reported from Medina County, Ohio, Oregon and Washington. Hairy root was also reported from Washington.

Blossom blight caused by Monilia sp. (not Sclerotinia cinerea) reported from Oregon by Barss causing a spur blight at blossom time.

Incense cedar rust caused by Gymnosporangium libocedri was reported as causing very slight damage in western Oregon. First observed this year May 26 at Mystal Creek.

Brown bark spot, cause not given, reported from Washington. "Most severe case ever reported" (Heald and Dana).

Rough bark disease, cause unknown, reported from Washington.

Brown blotch, cause not given, was reported from New Jersey. "Easily controlled by spraying". (Cook)

Scaliness, cause unknown, reported from Michigan.

Rot, caused by Botrytis sp. was reported from Washington.

Bark canker caused by Myxosporium corticolum Edgerton was reported from Michigan.

Cracking of fruit probably due to weather conditions was reported from New York. (Chupp)- "Observed near Geneva; considerable loss in orchards. Specimen sent from Nassau County; reported from Columbia County. The cracking occurred in the absence of scab and other diseases." Cracking of apple fruit is common in Illinois some seasons when heavy rains follow a long dry period (Anderson).

Texas root rot caused by Ozonium omnivorum Shear was reported as serious in Texas where cotton dies.

Sooty blotch caused by Leptothyrium pomi (Mont. & Fr.) Sacc. was reported from only one state, Indiana, where the loss was given as negligible.

Black end caused by drought or excessive transpiration was more prevalent than usual in Oregon in the hotter sections of the state and on soils that dry out badly. Blackening of blossom end. Bartlett especially susceptible.

Blue mold rot caused by Penicillium expansum (Lk.) Emend. Thom. was found by the Bureau of Markets inspectors to be present on pears shipped from eleven states. It was probably the most common trouble in shipments, the percentages of decay ranging from 1% to 77%, with a general average of 10%, other decays being present.

Gray mold rot caused by Botrytis sp., was reported as occurring on pears in five cars shipped from California, New York, and Washington, decay ranging from 3% to 7%.

Brown rot caused by Sclerotinia sp., was present on pears in shipments from Delaware, Georgia, Illinois, Indiana, Maryland, Michigan, New York and Washington, the average infection for the twenty three cars inspected being very nearly 20%. This decay was in most cases associated with other rots.

Rhizopus rot caused by Rhizopus sp., was very common in shipments of pears from various parts of the country, the pears in one car from Virginia being a total loss. Other decays were present in all shipments.

Winter and frost injury to pears

Frost bands were reported by Hesler as severe in one orchard of ten acres at Humboldt, Tennessee. Frost injury was reported by Dana and Heald from two counties in Washington. In the region across central Illinois, Indiana, and Ohio, and in West Virginia and Virginia, where frost occurred on May 14 and 15, there was more damage to pears than to apples. In Arkansas pears were damaged by the frost of April 5. This was true to a less extent in Union County, Illinois.

Winter injury was reported from Ohio and New York. The injury to pears in the Northwest, due to the very severe winter of 1919-20, was not as serious as in the case of apples. See the special report of D. F. Fisher under winter injury to apples.

QUINCE

Fire blight caused by *Bacillus amylovorus* (Burr.) Trevisan

This disease is the limiting factor in quince production in many sections of the country, according to past reports. In 1920 it seems to have been unusually severe in the New England States, especially Connecticut and Massachusetts, and in New York. Clinton in Connecticut stated that it was worse than last year and more than average. He estimated a 10% loss for the year. In Massachusetts Osmun also reported it much worse than usual and stated that it was very important this season. It caused much more loss in New York than in 1919 with an estimated reduction of 3-5%. New Jersey reported less damage than for last year. It is reported from West Virginia by Sheldon as occurring on the quinces in the town lots in Morgantown, where an occasional diseased tree was found. Ohio reported more than usual, with a loss of 5-50%. There were three reports of the disease in Indiana. It was also reported from Texas, Illinois and Michigan.

Leaf spot caused by *Fabraea maculata* (Lev.) Atk.

This disease was reported from New Jersey, Ohio and Tennessee as occasional and of little importance. In Georgia, McClintock stated that it was more serious than last year and more than average, and that it was serious on nursery stock and in gardens causing premature defoliation. It was observed in two localities in Illinois, where it caused serious injury to foliage. At Lilly it has caused complete defoliation of a large quince orchard for four successive years, the leaves being nearly all off by the first of August. Ordinary sprays applied, according to the spray schedules of other stations, have failed to control this disease.

Quince rust caused by *Gymnosporangium germinale* (Schw.) Kern. (*Gymnosporangium clavipes* Cooke & Peck.)

This disease was reported as very common and important in Massachusetts. The loss was about as usual. Two reports were received from Connecticut, and it was reported as very common and destructive in Virginia. It is also reported from Michigan. This rust seems to be prevalent and destructive wherever the quince is grown in the neighborhood of the red cedar.

Other diseases.

Black rot caused by Physalospora cydoniae Arnaud, was reported from New Jersey and Ohio.

Bitter rot caused by Glomerella cingulata (Stoneman) Sp. & Von S., was reported from Lancaster County, Pennsylvania.

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt was reported from New York. (Chupp)- "A canning and preserving company of Rochester sent specimens of their stored quinces which were covered with the brown rot organism. The manager stated that a large percentage of their quince supply was rotting in this manner."

DISEASES OF STONE FRUITS

PEACH

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt.

The distribution of brown rot coincides with the geographic range of the host. As usual, it was far more destructive in the Southern States than elsewhere. In the North Atlantic States, including Delaware and Maryland, the blossom blight was even worse than in 1919, when it was epiphytotic. The fruit rot was not so important throughout this region. In the Gulf States and North and South Carolina there was an enormous loss from brown rot which, in most cases, was associated with curculio. North of the Ohio River the loss was very low, as was the case in 1919. In Tennessee and Kentucky there was some blossom blight and a fairly heavy loss from fruit rot. In New York the loss was very much less than in 1919. The Northwest had practically no loss from brown rot but California, which produced about a third of the total peach crop of the United States in 1920, had more brown rot, both as blossom blight and fruit rot, than usual.

The percentage loss for the different states is shown in the accompanying map. Attention must be called to the fact that curculio injury is so closely associated with brown rot that it is difficult to place a correct valuation on the relative importance of these two factors.

The following summaries from the reports of the state collaborators indicate the nature of injury and the severity of the disease:

Massachusetts and Connecticut reported traces of the disease as blossom and twig blight, but almost all the blossoms were killed in these states by an early freeze. New York (Chupp) reported a heavier loss than usual from blossom blight but much less fruit rot than last year. The blossom blight did not materially affect the yield. In New Jersey Cook reported blossom blight as severe but less than in 1919. Haskell stated that many orchards in southern New Jersey showed from 20-30% blossom blight, with small cankers developing on the twigs. Fruit rot was not especially severe. Pennsylvania suffered a heavy loss both through blossom blight and rotting of the fruit.

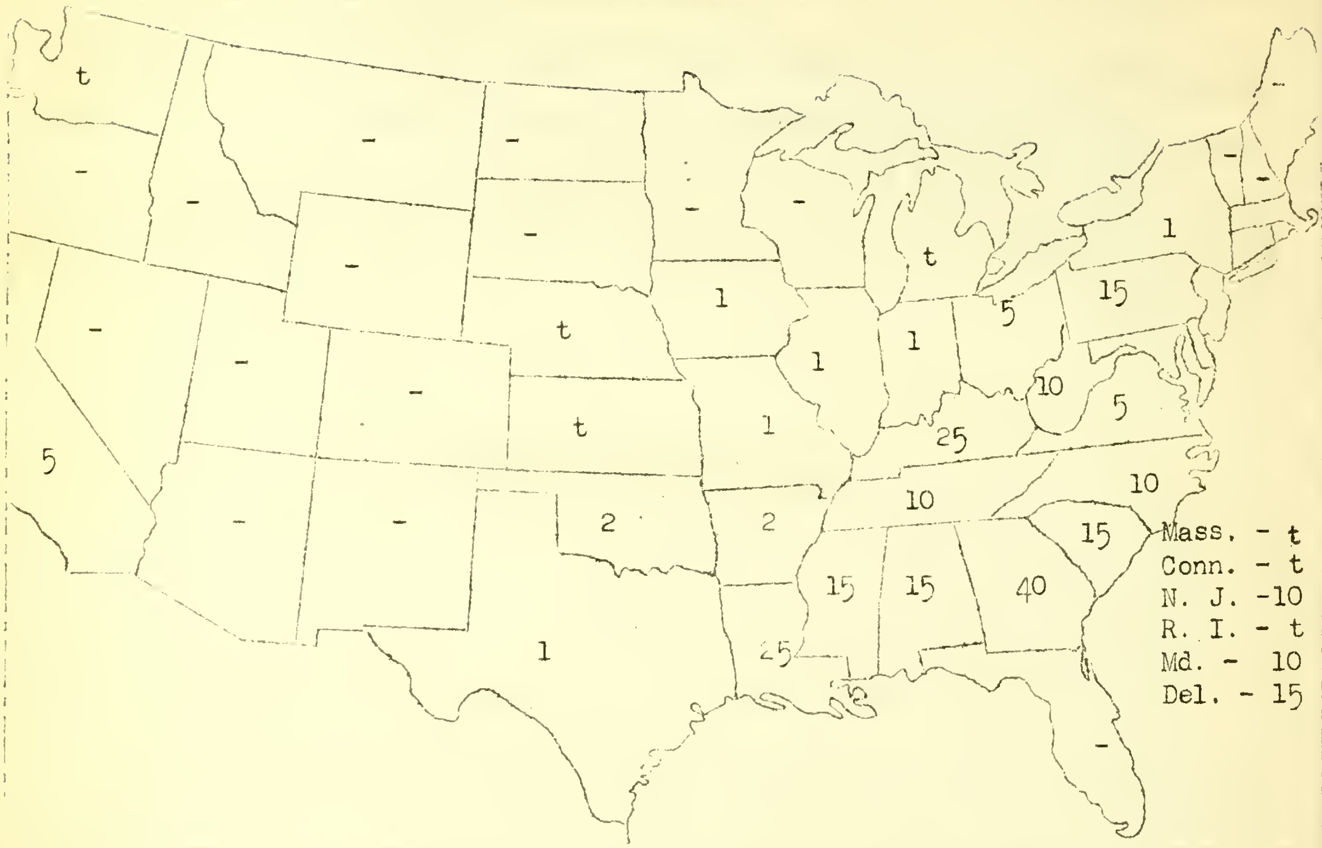

Fig. 13. Estimated percentage loss from brown rot of peach, 1920.

McCubbin reported as high as 62% of blossoms killed by blight in some orchards in southeastern Pennsylvania. Delaware, according to Manns, also suffered from blossom blight and many cankers were observed on the twigs. Rains late in the season caused considerable fruit infection. Maryland had more brown rot than usual, causing considerable blossom twig blight. In Virginia blossom blight did not cause nearly as much loss as in the northern states according to Fromme. Fruit rot was only moderately severe. Giddings stated that the loss in West Virginia consisted mostly in the rotting of fruit which was rather bad and worse than last year. North Carolina suffered more from fruit rot than from blossom blight. The most severe losses from any state were reported from Georgia, where the curculio was very destructive and thus increased the loss from brown rot on the fruit. In many parts of the state 50% of the crop was lost. There was also some damage from twig blight. Mississippi, according to Neal, had more brown rot than usual and twig and blossom blight were prevalent. The Arkansas peach crop was almost an entire failure on account of the April freeze. This was also true of Oklahoma and Kansas, where the buds were far enough advanced to be injured. Little brown rot developed in this section on the few peaches left. Valleau in Kentucky reported some blossom blight with little rot on early fruit but severe losses from rot on the late varieties on account of rainy weather. Twig blight was very severe in Tennessee according to Hesler. In some orchards 75% of the twigs were affected. There was also some blossom blight and moderate fruit rotting. Indiana and Illinois both reported very little loss from brown rot. This was due to the dry weather during ripening and picking time in most sections. Ohio suffered some loss, more than in 1919, according to Selby. In Ottawa County, Ohio, and adjoining regions, Rose reported, "It seems likely that the peach crop of this section is saved from loss due to brown rot by the relatively cool weather at picking time and the fact that much of it is marketed within the state of Ohio." California (Smith)- Reported that brown rot was worse than usual in that state and a rather serious factor in some regions. Twig and blossom blight, as well as fruit rot, caused heavy losses in Santa Clara County and the coast just below with scattered infections in the Sacramento and upper San Joaquin Valleys. There was practically no loss in Washington according to Heald.

The total loss from brown rot in the United States in 1920 is estimated at 6,199,000 bushels or 11.5% of the crop. The heaviest losses were in Georgia (2,763,000 bushels) and California (811,000 bushels). The corrected losses in each state will appear in the Plant Disease Bulletin, Supplement 18.

Control of Brown Rot.

Self-boiled lime sulfur seems to have been the most generally used spray for the control of brown rot in most states. Dusting is becoming popular in certain sections of the East but it remains to be seen whether this will prove successful against brown rot on the fruit. Atomic sulfur is used by some growers and some even advocate the use of summer strength commercial lime sulfur.

Cook in New Jersey stated that the blossom blight was held in check by the pink bud spray. Smith in California reported that the disease "was checked this year in Santa Clara County on apricots by spraying once, beginning when the scales begin to expand. The treatment was successful on precocious trees in orchards which were in full bloom when sprayed, 4-5-50 Bordeaux or lime sulfur being used." McClintock reported that "in the coastal plain of Georgia neither sprays nor dusts controlled curculio or brown rot satisfactorily". In Maryland dusting did not control brown rot as well as spraying with 8-8-50 self-boiled lime sulfur, according to Temple. Indiana reported good control with lime sulfur sprays except in Vanderburg County. In Illinois so little rot developed during the season and it was so dry as harvest time approached that growers did not apply the late summer sprays.

Relation of Weather to Brown Rot.

In those sections where blossom blight was most severe the month of April was unusually wet and cold. But this was also true in the Ohio Valley, where there was little blossom blight. Little information was given by the collaborators as to the relation of weather to the blossom and twig blight and it is desirable that this information be obtained.

The relation of fruit rot to weather conditions is well known. The heavy loss in Georgia this year is to be attributed in part to a wet summer. The very minor loss in Illinois was due, no doubt, to the fact that the summer was very dry in the peach growing sections.

Table 24. Losses from brown rot caused by Sclerotinia cinerea, as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
Alabama	5	27-42	Rhizopus present in some cars.
	13	2-23	
Arkansas	1	22	
California	2	5-7	
Delaware	2	35	
	3	3-15	
Georgia	30	50-82	Considerable advanced decay.
	119	25-49	Associated with Rhizopus rot in some cars.
	448	1-23	Some Rhizopus rot present.
Idaho	1	7	
Illinois	11	5-27	Some Rhizopus rot present.
Kentucky	2	50-57	
	2	2-4	
Maryland	5	25-42	
	18	1-20	
Michigan	4	37-60	Associated with Rhizopus rot.
	16	1-25	
Missouri	2	10-12	Considerable Rhizopus present.
New Jersey	2	30-50	
	1	1	
New York	37	50-97	Well advanced and associated with Rhizopus in many cars.
	59	25-47	Considerable complete decay.
	155	1-23	Considerable Rhizopus rot present.
North Carolina	29	1-30	
Ohio	1	62	
	9	2-15	
Pennsylvania	1	50	
	5	3-12	
Tennessee	5	2-10	
Texas	1	13	
Unknown origin	1	100	Complete decay.
	7	1-17	
Virginia	3	45-74	Considerable bad decay.
	17	1-27	
West Virginia	4	58-82	
	44	1-35	

Total 1065
Total number of cars inspected.................. 1298

Scab caused by Cladosporium carpophilum Thüm.

The usual number of reports were received indicating wide distribution of scab in the eastern half of the country in 1920. No reports were received from western states, where scab seems to be very rare. With the exception of a few states scab seems to have caused little or no injury and was generally less severe than last year. Indiana and Ohio reported more than usual. In some sections scab appeared quite late in the season and caused losses on late varieties. Taken the country over, the disease was a negligible factor in 1920. Connecticut reported less than last year and less than usual, but there was practically no peach crop on account of the freeze. New York had very little scab even on unsprayed trees. New Jersey reported a general prevalence of the disease. Pennsylvania reported less than in 1919 but 20% of the crop commercially injured. Scab was quite severe in Delaware, according to Manns. Maryland reported a 5% loss; especially bad on Salway; worse in the lower elevations. Fromme in Virginia reported a late development of scab. It was first observed at Shipman on July 15 and was very general on July 26 at Blacksburg. He estimated a 3% loss and a general distribution of the disease. West Virginia (Giddings) reported a general distribution. It was of considerable commercial importance. Valleau reported the disease as severe in Kentucky on all peaches observed. It was not regarded as of any importance in Tennessee. J. W. Roberts reported scab appearing on June 5 at Fort Valley, Georgia, and generally found on all varieties of unsprayed fruit. Very little loss resulted in Georgia according to McClintock. It was generally prevalent in Alabama and Mississippi, but not important. Ohio reported an unusually bad outbreak with an estimated loss of 10-25% of the crop. Indiana (Gardner) reported more scab than usual with a serious epiphytotic in the Vincennes peach region. Only local damage on late unsprayed varieties was noted in Illinois. The commercial crop was practically free from the disease. In Michigan scab was "common as usual". It was reported as severe in Missouri.

In most of the states it was stated that the disease was not important in the commercial orchards where spraying was practiced. The question of the dusting for peach diseases is still an open one, but very good results have been obtained in most regions in the control of scab and in some cases dusting has proved more effective than spraying. There is little doubt but that dusting will prove entirely satisfactory in the control of peach scab. In Maryland Temple reports about as good results with dust as with self-boiled lime sulfur.

Table 25. Losses from scab caused by *Cladosporium carpophilum*, as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay		Origin of shipment	Percentage of decay	
	No. cars	Percent		No. cars	Percent
Illinois	1	2	Virginia	2	2-18
Kentucky	1	17	West Virginia	4	10-22
Maryland	1	65			
Total				9	
Total number of cars inspected				1298	

Leaf curl caused by *Exoascus deformans* (Berk.) Fckl.

Leaf curl was epiphytotic during the spring of 1920 in most of the states where peaches are grown. It was worse than in 1919 in sixteen out of twenty-one states reporting, and only two of these states reported it as less prevalent. When it is considered that 1919 was among the worst leaf curl years, the seriousness of the situation may be realized. The ease with which this disease can be controlled, however, has made the loss in the commercial orchards of very minor importance. It is probable that, had no spraying been done for the control of leaf curl, there would have been a fifty percent loss to the peach crop of the country in 1920. The relatively small losses recorded for the different states do not, therefore, indicate the seriousness of the disease. For this reason Table 26 is given below.

Table 26. Prevalence, importance and dates of appearance of peach leaf curl as reported by collaborators, 1920.

State	Prevalence compared with: Last year	Prevalence compared with: Average year	Importance	Earliest appearance: Date	Earliest appearance: Place
Mass.	More	More			
Conn.	Same	Less	Not important.	6/21	Marbledale
N. Y.	Less	Less	Only in unsprayed orchards.	5/24	Albion
N. J.	More		Locally serious		
Pa.	More	More	Only in unsprayed orchards.	5/14	York County
Del.	More	More	In orchards unsprayed, or not sprayed in time.	5/25	
Va.	More	More	Little in commercial orchards.	5/14	Crozet
W. Va.	Same	Same	Serious in unsprayed orchards.		
Miss.	More	More		4/24	New Albany
Okla.	More	More			
Ky.	More	More	Serious		
Tenn.	More	More			
Ohio	More	More			
	Much	Much	Limiting factor.		
Ind.	More	More			
	Much	Much	Serious in unsprayed orchards.		
Ill.	More	More		5/11	Lilly
Mich.	More	More	Serious in unsprayed orchards.		
Iowa	More	More	Moderately serious.		
Mo.	More	More	Serious	5/1	Columbia
Ariz.			Unimportant		
Idaho	Less				
Ore.	Same	Same	Much damage.		
Calif.	More	More	Very serious.		

Delaware and Maryland suffered an especially severe epiphytotic, due in part to the fact that many commercial growers sprayed too late to control the disease. New York is among the few states reporting less curl than last year, but from several sources it was learned that it was locally quite severe, especially on unsprayed orchards. In New Jersey Haskell reported the disease as most serious in the southern part of the state. Pennsylvania reported more curl than usual but sprayed orchards are not seriously affected. Temple in Maryland stated that the disease was as prevalent as in 1919, even where dormant sprays were applied. Fromme reported curl as locally serious but not in commercial orchards in Virginia.

In the Georgia peach belt curl was evidently not any more severe than in 1919, but was reported by McClintock as serious in unsprayed orchards.

In the Gulf States west of Georgia the disease was severe in the northern end of the states, and appeared quite early. In the Ohio Valley the epiphytotic was the worst ever recorded. The commercial growers suffered in this region where they failed to spray and in many cases reports were received of serious damage even in sprayed orchards. Gardner stated that the disease was especially bad in Indiana and widely prevalent. "Loss of half of the crop was caused in one forty-acre orchard, because the owner failed to spray this year; the loss was due not only to defoliation but to direct attack upon the small fruits." Oregon (Barss)- Everywhere. Much damage. California (Smith) reported "a very bad attack in most districts, in spite of a dry winter, on account of heavy rains at blossoming. Many report failure of early spring spray to check it, though fall spraying, as for Coryneum, was successful for curl". Also reported from Fresno County, California, by J. P. Benson, county agent.

The total loss from leaf curl for the United States in 1920 is estimated at 1,583,000 bushels or about 3% of the crop. California suffered the most severe loss on account of the large production in that state and the unusual severity of the disease this season. Over 800,000 bushels were estimated lost in that state. The corrected losses for all states will be found in the Plant Disease Bulletin Supplement 18.

Relation of Weather in 1920 to Curl.

The widespread epiphytotic of leaf curl in 1920 was no doubt due to the very wet and generally cold April. The winter of 1919-20 was generally mild and the abnormally heavy precipitation and long continued rains during April favored infection and prevented early spraying in many cases. Fortunately, in many sections defoliation resulted so early that the trees were able, in part, to outgrow the effects of the fungus due to continued favorable weather.

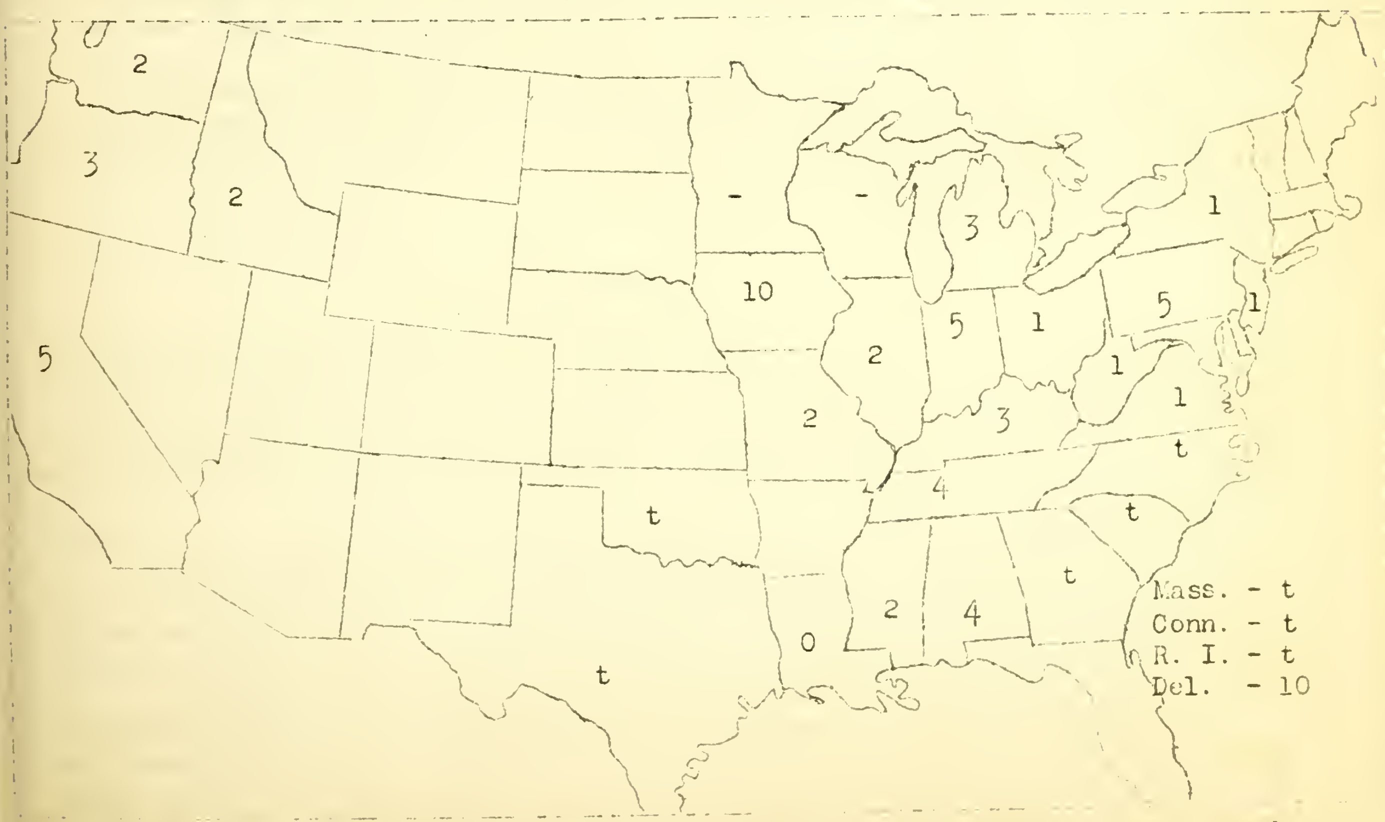

Fig. 14. Estimated percentage loss from peach leaf curl in the United States, 1920.

Varietal susceptibility.

Georgia (McClintock)- All varieties of peach are attacked.

Indiana (C. L. Burkholder)- Crawford most susceptible, complete loss of crop in two counties. Elberta next in susceptibility. In the same two counties the yield was reduced from three bushels to one peck. Belle of Georgia showed about the same susceptibility as Elberta. About ½% of the crop of Champion was lost. Carman, Admiral Dewey, Smock and Salway are resistant.

Illinois (Anderson)- In an orchard where Champion and Elberta were grown side by side, Champion was suffering severely from leaf curl while Elberta showed very little. This observation was made when the disease first appeared in the spring. The orchard was not visited later.

Control of Leaf Curl.

It is the general opinion of the collaborators that the dormant spray of lime sulfur applied either in the fall or early in the spring will control leaf curl. However, there were several reports, especially from Maryland, Kentucky and Illinois, that indicated some failures to control it even with the usual lime sulfur applications. The failure to control in several states is stated to be due to the fact that the spring application was made too late. In California, E. H. Smith stated that the spring application did not control the disease satisfactorily while the fall application was successful. In Oregon Barss stated that spraying in the winter with Bordeaux will control but many growers neglect to spray with large resulting losses.

Burkholder in Indiana and Hesler in Tennessee reported the failure of Scalecide to control leaf curl. This information is important since this spray is often used as a dormant spray for scale and indicates the desirability of using the standard commercial lime sulfur.

Black spot caused by *Bacterium pruni* EFS

This disease has been reported in past years from all the peach-growing states of importance east of the 100th Meridian with the exception of Kentucky, Tennessee and Kansas. There is little doubt but that it occurs also in these three states. It is not found in the northern New England States nor in the Northwest and California peach sections. It was reported from Arizona this year for the first time.

The disease was worse in 1920 than in 1919 throughout most of the states where it is known to occur. The condition in the Atlantic States south of Virginia is not known on account of meager reports. It was especially serious on the foliage and twigs in the East but seems to have caused little damage to fruit, while in the Ohio Valley, where a big peach crop was harvested, it was quite serious on the fruit, especially in northern Indiana and Illinois.

Connecticut (Clinton)- Reported it as worse than last year and more than average, appearing especially on weakened trees. Chupp in New York stated that it is evidently rare in that state and caused no serious damage in 1920. New Jersey (Cook)- Reported it as most severe in the southern half of the state and about the same as in 1919. In Delaware Manns stated that the "disease is becoming more severe each year. Many trees are defoliated and cambium severely injured by infection; many trees are killed outright". Maryland reported the usual amount of damage. Virginia (Fromme)- Reported severe defoliation in some orchards but no fruit spots seen. The disease was worse than average and worse than last year. "The injury was intensified and also confused by injury from late frosts." The earliest reported appearance was on June 17 at South Richmond. No reports of the disease were received from the important peach region of Georgia, North Carolina and South Carolina. Mississippi (Neal)- Reported more damage than usual caused by severe spotting and premature defoliation. The first report of the disease was June 1 at Meridian. Texas reported the disease as important, causing shot hole of leaves and stem cankers. Arkansas (Rosen)- Reported "infections numerous and common in southwestern part of state where the frost of April 5 defoliated and otherwise weakened the trees". Ohio (Selby)- Reported the leaf spot as more prevalent than last year. R. C. Thomas stated "quite serious losses through defoliation have come to our attention". In Indiana, according to Gardner, the 1920 infection was the worst ever known, especially in the southwest corner of the state, where most of the commercial peaches are grown. It caused a severe spotting of the green fruit early in the season and serious defoliation. It was especially injurious where hail had bruised the fruit. Illinois (Anderson)- Reported most serious damage to fruit through spotting and cracking. There was only slight defoliation. The disease was worse than it has ever been since its appearance in the state in 1915. It was common in Missouri. The first report of the disease from Arizona was made by J. G. Brown, who states that a few trees in a garden at Tucson were found infected and a loss of 10% for that state is reported.

Susceptibility of Varieties.

R. C. Thomas in Ohio states that the lemon-free varieties are especially susceptible. C. L. Burkholder in Indiana states that J. H. Hale is the most susceptible variety. Elberta is not so susceptible. In Illinois J. H. Hale was found more susceptible than Elberta, although the latter variety was quite generally affected. The white-meat varieties were not found diseased but no extensive observations in badly diseased orchards were made.

Control of Black Spot.

The following interesting report was made by C. L. Burkholder, Department of Horticulture, Purdue Experiment Station, Indiana:

> "Summer sprays of self-boiled lime sulfur gave no control. Orchards having received several heavy applications of barnyard manure during their history showed remarkable resistance. Two or three applications of nitrate during the current season had no effect on the severity of the disease."

In Illinois, Anderson observed that in those orchards where nitrate of soda was applied and cultivation given, the disease was not checked. W. S. Brock, Department of Horticulture, Illinois Experiment Station, made extra heavy applications of nitrate of soda and cultivated thoroughly without any marked improvement over trees not receiving the fertilizer.

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Black mold rot caused by Rhizopus spp.

This rot seems to be more prevalent in western than in eastern fruit but the reports of the inspectors of the Bureau of Markets indicate that it is of great importance in all sections of the country. It is primarily a rot which develops in transit and on the fruit in the market. Only one report of this important disease was received from the state collaborators in 1920. Fruit from Illinois orchards was watched in the market and it was observed that Rhizopus rot developed to a greater extent than did brown rot. This disease should receive more attention from the pathologists. The fact that it is so often associated with brown rot makes the reports of the inspectors rather confusing as to the relative importance of the individual rots.

Table 27. Losses from black mold caused by Rhizopus spp., as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
Alabama	3	35-42	Associated with brown rot.
	4	3-13	" " " "
California	5	30-63	
	43	1-27	
Colorado	6	2-8	Some complete decay.
Georgia	3	50-60	Associated with brown rot.
	22	25-49	Associated with brown rot in most cases.
	73	1-23	Brown rot in many cars.
Idaho	1	2	
Illinois	4	2-27	
Indiana	2	2-50	
Maryland	3	2	
Michigan	2	45-47	With brown rot.
	5	2-13	
New York	17	55-98	Much brown rot.
	18	25-45	Associated with brown rot.
	54	2-22	" " " "
North Carolina	8	1-11	
Ohio	3	4-15	Associated with brown rot.
Pennsylvania	1	9	" " " "
Unknown origin	2	3-12	Brown rot in one car.
Utah	1	8	
Virginia	1	17	
West Virginia	1	30	Associated with brown rot.

Total.................................... 282
Total number of cars inspected......... 1298

Yellows, rosette and little peach (cause unknown)

Yellows was reported in 1920 from Connecticut, New York, New Jersey, Pennsylvania, West Virginia, Tennessee, Maryland and Ohio. It probably occurs in other states in the eastern part of the country. A special survey was made by the Pennsylvania Department of Agriculture in nine eastern counties to determine the extent and importance of yellows in that state. Below are given extracts from a report of this survey, together with the results of a questionnaire sent out to other states by the Pennsylvania Department of Agriculture. We are indebted to J. G. Sanders and W. A. McCubbin for this very excellent report.

> "During the recent summer this Bureau has made a hurried and limited survey of the Yellows situation in nine eastern counties, but particularly in Cumberland, Lancaster and Lebanon. In this survey 104 orchards were covered in nine counties, involving 111,437 peach trees. Of these 8,710 were definitely affected by Yellows (about 8%), and 5,277 were suspicious, a total of 13,987 or 12.5%. In other words, one tree in eight in these orchards was either diseased or suspected of the disease. The "Yellows" disease was found in plums in 179 trees. No percentage record of the disease in plums can be given.
>
> "Only 18 peach orchards were found in which yellows was not present to a greater or less extent. The amount of disease in one orchard ran as high as 95%, and 6 of the orchards had above 75% of yellows.
>
> "The loss to the peach growers at the low valuation of $5.00 per tree would thus amount to $69,935.00 to say nothing of the danger of spread, and the loss from the orchard due to increase in blank spaces beyond the profitable limit."

Table 28. Peach yellows survey in Pennsylvania, 1920.

County	Orchards covered	No. of trees in these orchards	Yellows trees found	Suspicious	Have any trees been removed for Yellows recently? Yes	No
1. Bucks	3	5650	486	2400	0	3
2. Chester	6	10546	256	72	4	2
3. Cumberland	25	30065	2133	698	8	17
4. Dauphin	2	2800	249	87	1	1
5. Lancaster	14	12746	742	237	10	4
6. Lackawanna	1	200			0	1
7. Luzerne	4	1800	6	4	0	4
8. Montgomery	8	17900	609	244	4	4
9. Lebanon	41	29730	4229	1535	32	9
	104	111437	8710	5277	59	45

Table 29. Summary of information obtained from various state officials on peach yellows by the Bureau of Plant Industry of the Pennsylvania Department of Agriculture, December 1919.

STATE	1 HAVE YOU SECURED COMMERCIAL CONTROL BY REMOVAL?	2 SPECIAL INSPECTION SERVICE, OR DEPENDENCE ON GROWERS RECOMMENDED	3 STATE OR COUNTY CONTROL ADVISABLE ?	4 HOW MANY INSPECTIONS PER YEAR?	5 WHAT PRECAUTIONS AGAINST NURSERY INFECTION?	6 IS IMMEDIATE REPLANTING SAFE?
Mich.	Yes	Special twp. insp. under State supervision. Growers useless	State control in each twp. or Co.	One week before ripening	Care in budding	Replant after
N. Y.	Yes	Special, not growers	State better than County	Two	Removal of diseased trees nearby	After winter
N. J.	Checked, not eradicated	State, not growers		August	Precaution in securing bud wood	Perfectly safe
Del.	Some results not thoroughly tried	State, not growers	State control with the assistance of Counties	Two, at least first year	Care in budding	Entirely safe
Md.	Yes	Special with owners cooperation	State	No set number	Nursery insp. of vicinity	After winter
Va.	No disease or little recently				Care in budding	
W. Va.	Yes	Special, at least at first	State in Counties	Begin in July and continue throughout the summer	Removal of neighboring orchard trees	Probably yes

Little peach was reported as more serious in New Jersey than last year and the cause of heavy loss. This is the only report of the disease in 1920.

Peach rosette was reported in 1920 from West Virginia, Georgia and Tennessee. In West Virginia it was observed by Prof. J. L. Sheldon on two trees in Morgantown. Hesler observed it in one orchard in middle Tennessee. It is regarded as serious in Georgia and slightly more prevalent than last year. McClintock states that it results in the death of the tree in one or two years.

Other diseases

Rust caused by Puccinia pruni-spinosae Pers. was reported from Georgia, little importance; general; late in season. Texas, unimportant; late in season; and Maryland, leaf injury on nursery stock.

Powdery mildew caused by Sphaerotheca pannosa (Fr.) Lev. was reported from Texas and Washington as not important this year.

Die back associated with Valsa leucostoma Fr. was reported as widely distributed in western New York on peach twigs, apparently following winter injury. It was also reported from Ohio and Indiana. In the latter state Burkholder states that the disease is severe in sod or neglected orchards and can be prevented by fertilizing and cultivating.

Coryneum blight caused by Coryneum beijerinckii Oudem. was reported as less severe than in former years but of importance in some sections of Idaho and Washington. Also reported from Oregon and Fresno County, California as causing slight damage.

Crown gall caused by Bacterium tumefaciens Sm. & Towns., while no doubt generally distributed, was reported in 1920 from only three states, New Jersey, Texas (very important; 2% loss) and Ohio. In Ohio, R. C. Thomas reports that in one orchard nearly all trees of Early Crawford and Trumbull were infected while no Elbertas were diseased.

Chlorosis is reported as a very important disease in Texas by Taubenhaus, who states that it is caused by excess of lime in the soil and occurs in all soils showing such excess.

Leaf spot caused by Cercospora circumscissa Sacc. (?) reported from Michigan.

Blue mold caused by Penicillium sp. was reported by the inspectors of the Bureau of Markets as present on peaches from California, New York and North Carolina. Five cars were inspected and decay arranged from 8-57% with an average of 18%. Brown rot or Rhizopus rot was present in each case.

Winter and Frost Injury.

In Connecticut, Rhode Island, Massachusetts and the states north, practically the entire peach crop was killed in the bud by low winter temperatures. The low temperatures of December, 1919, killed many peach trees in the Pacific Northwest. Hungerford reported "total loss of crop in Lewiston section; much loss in south Idaho". Heald and Dana stated for Washington: "Benton County reported 50% loss of wood; Yakima district nearly as bad". See especially the report of D. F. Fisher, under winter injury to apples.

The freeze of April 5 hit the Arkansas peach section when the trees were in bloom and almost completely wiped out the crop in that and neighboring states. Elliott in Arkansas stated that 99% of the peaches were destroyed by this frost. The Bureau of Crop Estimates gives Arkansas an estimated yield of 117,000 bushels in 1920 as compared with 1,280,000 bushels in 1919. The estimate for 1920 is probably much too high. Frost also destroyed the New Mexico crop.

Freezing of the buds was also reported as serious in all parts of New York with an estimated loss of 20-30%. West Virginia also reported serious frost injury.

The after effects of the severe winter of 1917-18 are still evident in many sections. Trees were so weakened at that time that, while living, they are in a devitalized condition. A few of these trees die each season and many are attacked by wood rotting fungi such as Polystictus versicolor and Schizophyllum commune.

PLUM and PRUNE

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt.

The range of this disease corresponds to the range of its hosts. All the states reporting on the malady state that it is very important and is usually the limiting factor in plum growing. In some states, for example Indiana and Illinois, commercial plum growing has been abandoned by most fruit growers on account of the severity of this disease and the difficulty of its control.

In most states the fruit rot was the most serious form of the disease in 1920 but Massachusetts, Kentucky, Illinois, Michigan, Wisconsin and Minnesota reported blossom and twig blight common. This seems to have been the most serious form of the disease in Wisconsin and Minnesota this season.

Vermont (Lutman) reported more than average amount of brown rot, causing 10% loss over the state. Massachusetts (Krout) reported the disease as prevalent throughout the state. Osmun reported it on twigs and fruit and stated that it is very important as a plum disease. New York (Chupp) reported the disease as about the same as last year but very important wherever plums are grown and causing a loss of 8-10% in the state. New Jersey has a few plum trees but the disease was very destructive in 1920 as well as in 1919. Pennsylvania reported a 25-30% loss to plums from brown rot. Kentucky reported blossom blight and some rotting of fruit. Not many plums are grown in Tennessee but the disease was common wherever plums were found. Georgia had a wet season and more brown rot than usual. A 75% loss was reported. Texas reported a 10% loss. Arkansas (Elliott) reported a 10% loss and a general prevalence of the disease. A very serious loss was experienced in Ohio where the weather was favorable for the disease. Indiana reported more than last year and more than usual, especially on door-yard trees. In Illinois few trees were seen where brown rot had not taken most of the crop. There was also considerable twig blight in some orchards. A 20% loss is estimated. Michigan reported cankers and twig blight due to the brown rot organism. Dry weather held the rot in check in Wisconsin so that there was not as much as usual. However, there was serious twig and blossom blight. The disease is especially important on European plums. Most serious in Polk, Pierce and Door Counties. Minnesota reported more than usual. Very important especially as blossom, leaf and twig blight. Not so much disease appeared on the fruit, owing to dry weather in July. It was very abundant, however, in Morrison County. Iowa reported brown rot as less severe in 1920 than in 1919. It is reported as serious in the Northwest on plums and prunes west of the Cascades. In Washington it was reported as one of the serious troubles of prunes in Clark County. Barss in Oregon reported more than 1919 but not unusually troublesome. Early rains cracked the ripe prunes and brown rot readily attacked many orchards. No reports were received from California, the big prune state.

Control measures for brown rot were not specifically mentioned by many of the collaborators. Selby in Ohio stated that July sprays of Bordeaux and lime sulfur glue were used with good results.

Dates of first observation of brown rot:

New York, June 21, Ontario County	Illinois, June 9, Rockford
Pennsylvania, August 14, State College	Wisconsin, May 25, Sturgeon Bay
Arkansas, June	Minnesota, May 27 (Blossom)
Ohio, June 15	June 10 (Fruit), Vergas

Table 30. Losses from brown rot of plum and prune caused by Sclerotinia cinerea, as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay				Remarks as to seriousness of decay
	Plum		Prune		
	No. cars	Percent	No. cars	Percent	
California	2	3-5			
Michigan	6	25-45			
	13	2-18			
New York	2	50-77	5	4-25	Associated with other decays.
	7	25-45			
	47	1-23			
Ohio	1	47			Associated with Rhizopus rot.
Virginia	1	80			Very severe decay.
Idaho			4	2-10	Associated with Rhizopus rot and blue mold rots.
Total					88
Total number of cars inspected					182

Pockets caused by Exoascus pruni (Berk.) Fckl. and E. communis Sad.

This disease seems to be on the increase, especially east of the Mississippi River. New York (Chupp) reported it more abundant than usual but not important. It was first observed in Jefferson County on June 2 and was reported from four other counties widely separated. Fromme reports it from two localities in Virginia. The first report was from Sealston where, on a large cultivated tree, the crop has been ruined each year for the past four years. In Tennessee Hesler stated that the disease was general, having been especially bad in higher altitudes. It was regarded as more prevalent in Ohio and was first reported June 6. Indiana had one report of pockets. It was reported by Anderson in Illinois for the first time. Every plum on four large trees near Urbana was diseased. They were first observed on June 1. Coons reported the disease as severe in Michigan this season. In Wisconsin, more than the average loss occurred, according to Vaughan. Minnesota stated that "plum pocket was fairly abundant and did considerable damage. Very important in some localities. The first report was on June 14 at Detroit". Iowa also reported more than the usual damage. This disease was not reported from the western states.

It is interesting to note that both peach leaf curl and plum pockets were worse this year than usual. It is probable that the very wet April weather which prevailed over most of the region where these diseases were prevalent was responsible for the epiphytotics. It may also be noted that all the reports as to the date of appearance were between June 1 and June 14.

Black knot caused by Plowrightia morbosa (Schw.) Sacc.

This disease probably occurs in all the states where plums are grown but it has not been reported from Georgia and Florida in the East, nor from the Pacific Coast States in the West, although it is found on cherry in the

Northwest. It seems to be of minor importance in the South and Southwest sections of the country. In 1920 it was reported from Connecticut, New York, New Jersey, Pennsylvania, West Virginia, Ohio, Illinois, Missouri and Minnesota. It was not regarded as especially severe in any of these states but in Pennsylvania Thurston and Orton stated that in one orchard in Carbon County 150 trees out of 350 were removed. All varieties were attacked. In Illinois it is especially prevalent in Vermilion County. In Minnesota it was very common on wild species of plums but rarely found in cultivated.

Black spot caused by Bacterium pruni EFS

Reports on this disease were received from only four states, New Jersey (one report), Pennsylvania (on fruit), Texas (important; causing shot hole and stem cankers; generally distributed), and Ohio (normal prevalence).

Leaf spot caused by Coccomyces prunophorae Higgins

This disease was reported from New York (not important), Pennsylvania, Ohio (more than usual), Wisconsin (general but unimportant), and Minnesota (general but of little importance).

Other diseases.

Scab caused by Cladosporium carpophilum Thüm. was reported from Wisconsin as more prevalent than usual but of minor importance, from Missouri where one report was received, Minnesota where it was more abundant than usual, slight losses resulting, and from Oregon.

Powdery mildew caused by Podosphaera oxycanthae (Fries.) De Bary was reported from Minnesota.

Blight caused by Coryneum beijerinckii Oudem. was reported from Washington.

Rust caused by Puccinia pruni-spinosae Pers. was reported as widely distributed but of little importance in Texas. It was also observed in Northampton County, Pennsylvania.

Crown gall caused by Bacterium tumefaciens Sm. & Towns. was reported from Oregon where it was general.

Bark disease caused by Valsa leucostoma (Pers.) Fr. was reported from Ohio.

Wood rot caused by Fomes pomaceus Pers. was reported from Minnesota. Another wood rot due to Polyporus chioneus was reported by Sheldon from West Virginia.

Leaf spot caused by Coccomyces sp. was reported from Oregon.

Shot hole was reported from Minnesota as fairly abundant and causing considerable injury. It is thought that the disease in most cases is due to a Phyllosticta.

Blossom blight caused by Monilia sp. (not Sclerotinia cinerea) caused some large losses in Oregon but on the whole the damage was not great.

Rosette, cause unknown, was reported from Georgia.

Silver leaf, cause unknown, was reported from Oregon. First report June 8 at Newberg where a number of three-year old trees with typical symptoms of silver leaf were observed.

Drought spots were reported as general on plums and prunes throughout Washington and Oregon. Appeared the last of July and early August. Much of the affected fruit matured well, showing little damage, according to Barss. A similar, if not identical, trouble was reported from Michigan by Coons as common on plums and cherries. "Caused a skin blackening with slight flesh involvment."

Armillaria root rot caused by Armillaria mellea Vahl. was reported from Oregon causing the usual scattered losses.

Heart rot caused chiefly by Trametes cornea was reported from Oregon where it is increasing on winter injured trees. As high as 93% affected trees have been found in an orchard but the injury on the whole is slight.

Leaf curl and fruit drop of prune was reported as serious in southern Idaho and attributed by Hungerford to lack of available moisture.

Winter injury and frost injury. Winter injury was reported from Oregon, Washington and New York, while frost injury to blossoms was reported from West Virginia and Washington. In general, some frost injury resulted in the same localities where peaches were injured by late frosts. (See under peaches.) For winter injury to prunes in the Northwest see the special report of D. F. Fisher under winter injury to apples, pages 54-56.

Table 31. Losses to plums and prunes from Rhizopus sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay			
	Plum		Prune	
	No. cars	Percent	No. cars	Percent
California	14	5	3	13
Michigan	1	30		
New York	7	20	2	21
Ohio	1	47		
Oregon			1	3
Washington			4	6
Unknown origin	1	7	1	4
Total				44
Total number of cars inspected...........				182

Table 32. Losses to plums and prunes from blue mold rot caused by Penicilium sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay				Remarks as to seriousness of decay
	Plum		Prune		
	No.cars	Percent	No.cars	Percent	
California	5	5			
Michigan	3	8			
Idaho			22	4	Rhizopus rot in several cars.
New York	6	30	1	17	Mostly brown rot.
Washington			2	3	
Unknown origin	1	7	2	3	Rhizopus rot in one car.
Total..............................			45		
Total number of cars inspected........			182		

CHERRY

Leaf spot caused by *Coccomyces hiemalis* Higgins

The year 1919 was considered one of the worst for this disease and a marked improvement over that year was noticed in the reports of 1920. The disease was much less serious in most sections of the country but seemed to have caused about the same loss in Michigan, Wisconsin and Minnesota. New York reported less leaf spot than last year but about the same as an average year. In southern New Jersey it was very serious in unsprayed orchards. Haskell reported a 25% defoliation on 150 sour cherry trees at Hammonton, New Jersey. Virginia reported less than last year but generally prevalent and ofte severe. Hesler in Tennessee reported a general distribution, with little crop injury. Gardner reported leaf spot as very destructive in Indiana and about th same as last year. In Illinois the disease was much less severe than in 1919 when a serious epiphytotic occurred. It was generally distributed, however. In Michigan Coons reported it as extremely common, with the loss of a whole cro of Morellos in one county due to slow ripening. Wisconsin reported the disease as about the same as an average year and severe where the trees were not sprayed. Iowa reported a trace of the disease. It is also reported from Washington.

Varietal susceptibility.

Hesler in Tennessee observed an orchard of 3000 trees of mixed varieties in which English Morello was extremely susceptible, Early Richmond moderately so, and Montmorency less than Early Richmond. The English Morello was almost completely defoliated. Coons in Michigan states that Morello was especially affected in 1920.

The following list of varieties, based on their relative susceptibility, was made from notes taken by Anderson in Illinois during 1919 and 1920 on a large variety plantation on the experiment station grounds. In the bad epiphytotic year of 1919 none of the varieties were able to hold their leaves except the Bing which, while the leaves were badly spotted, showed little defoliation. The letters in parentheses following the variety name indicate the species to which the variety belongs, (a) = *Prunus avium* (c) = *P. cerasus* and (c x a) = *P. cerasus* x *P. avium*.

Resistant	Moderately Resistant
Schmidt Bigarreau (a)	Yellow Spanish (a)
Olivet (c)	Napoleon (a)
Bing (a)	
Windsor (a)	
Gov. Wood (a)	

Susceptible

Montmorency Ordinare (c)	Rockport (a)	Suda Hardy (c)
Early Richmond (c)	Paul (a)	English Morello (c)
Dyehouse (c)	Terry Early (c)	Princess Christine (a)
May Duke (a x c)	Wragg (c)	Reine Hortense (c)
Royal Duke (a x c)	Ostheimer (c)	Margarite
Late Duke (a x c)	Lambert (a)	Black Tartarian (a)
Burbank (a)		

Nature of injury.

The primary result of infection by Coccomyces hiemalis is defoliation. This usually takes place with unusual promptness, considering the nature of the injury. On the sweet or large leaf species (Prunus avium) the spots are small and very numerous, sometimes covering almost the entire surface. A bronze, rather than a yellow color, is most often noticed as a result of infection, while on the sour cherries (Prunus cerasus), yellowing usually results. The spots are larger and less numerous on the leaves of the latter species. Some varieties retain their leaves much longer than others although they may be as heavily infected. Some varieties, after losing the first or lower leaves on a twig, start a new growth the same season, while others form their winter buds and go into the dormant condition.

The secondary effect is noticed on the fruit which remains quite small and does not ripen properly. Hesler stated that the fruit pedicels were commonly diseased in Tennessee this season. Of course the tree is weakened for the fruit crop of the following year. Serious stunting of cherry trees in the nursery results from this leaf spot.

Control measures.

Vaughan in Wisconsin stated that this leaf spot is effectively controlled with lime sulfur 1-40 and lead arsenate, combined with early spring plowing.

Black knot caused by Plowrightia morbosa (Schw.) Sacc.

Black knot has been reported from most sections of the country as occurring on either cultivated or wild species of cherry. However, no reports have ever been received from California. It has never been observed on cultivated cherries to a damaging extent in the western and mid-western states. In the eastern part of the country, however, it is frequently very destructive. There are reasons to believe that this fungus has several biologic forms. For example, in Pennsylvania and New York it has been reported as very common and destructive to sour cherries, while in Indiana and Illinois the sour cherry, growing alongside of badly diseased plum orchards and exposed to infection from all quarters, rarely shows the disease. In Idaho, where Prunus virginiana is badly infested, the cultivated cherries remain free from this disease. The same is true in some sections of Minnesota where black knot is found on at least three species of wild Prunus but rarely found on cultivated cherries. Attention has been called by Gilbert (Phytopath. 3: 246-247. 1913) and Stewart (Am. Journ. Bot. 1: 113-114. 1914) to the possibility of biologic strains, especially among wild hosts.

Reports of black knot on cherry in 1920 were received from Connecticut, New York (general; sour cherries more susceptible than sweet), Tennessee (general; slight importance), Arkansas (on wild cherry), Ohio, Minnesota (Prunus virginiana and P. serotina), Washington (choke cherry, P. virginiana).

It is advisable when reporting on this, as well as other diseases, for the collaborators to indicate whether the report applies to sour or sweet cherries, or to wild or cultivated species, and, when possible, indicate the species. The reports would be especially valuable if the relative prevalence of black knot on the various species in your state could be given.

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt.

Rot of cherries was not reported as generally serious in 1920. However, it was reported as especially severe in New Jersey, Ohio and Tennessee. Clinton in Connecticut stated that he received one report of a 50% loss by killing of fruit spurs and small twigs. New York (Chupp) reported less brown rot than last year and slight damage. In Pennsylvania, McCubbin estimated the loss at 15%. Virginia reported the disease as "very severe in occasional home plantings". Hesler in Tennessee stated that there was a severe outbreak in 1920 with twig infection common and fruit rotting badly. Elliott estimated a 5% loss in Arkansas. It was more prevalent than usual in Ohio on account of abundant rainfall in April and May. Melhus stated that it was less prevalent in Iowa, with an estimated loss of 1%. The disease was also less severe in Illinois on account of a dry May. Michigan reported the disease. Minnesota reported it as more prevalent than usual, but unimportant. In Washington, Heald and Dana stated the horticultural inspector reported a 50% loss in Lewis County.

Dates of first observation of brown rot:

Connecticut	- August 2	Virginia	- June 17 (Danville)
New York	- June 14 (Columbia County)	Ohio	- May 27
Pennsylvania	- July 25 (Kittanning)	Minnesota	- June 11 (Excelsior)

Table 33. Losses from brown rot caused by Sclerotinia cinerea, as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of shipment	Percentage of decay		Remarks as to seriousness of decay
	No. cars	Percent	
California	24	2-25	Associated with other decays.
Idaho	2	2-4	Associated with Rhizopus rot.
Michigan	3	50-70	Associated with other decays.
	5	25-50	" " " "
	4	10-25	" " " "
New York	7	2-25	" " " "
Washington	1	3-5	Associated with Rhizopus rot.
Unknown	2	5-9	Associated with other decays.
	Total		48
	Total number of cars inspected		135

Powdery mildew caused by Podosphaera oxyacanthae (Fries.) De Bary

This disease has been reported in the past from most of the states where cherries are grown. The reports for 1920 indicate that it is not serious in any of the states. In some states this is a rather important nursery disease since it occurs on the terminal leaves of rapidly growing shoots, the condition which exists in the scions in the nursery rows. Reports were received from New

York, Pennsylvania, West Virginia, Tennessee, Ohio, Indiana, Illinois, Michigan, Minnesota, Iowa and Washington.

Other diseases.

Blossom blight caused by *Monilia* sp. (not *Sclerotinia cinerea*) was severe in certain localities in Oregon. It probably occurred throughout western Oregon, causing blighting of blossom and spurs.

Fire blight caused by *Bacillus amylovorus* (Burr.) Trevisan. was reported from Ohio. It was found in Seneca County on June 2. It has been previously reported from Ohio (1910, 1911) from New Mexico (1918), and Washington (1915).

Shot hole caused by *Cercospora circumscissa* Sacc. was reported from Ohio; caused by *Phyllosticta prunicola* Sacc. was reported from Minnesota.

Blight caused by *Coryneum beijerinckii* Oudem. was reported from Washington as causing more injury than last year.

Coniothyrium blight caused by *Coniothyrium* sp., a new disease of the cherry, was reported by Coons from Michigan (Van Buren County).

Scab caused by *Cladosporium carpophilum* Thüm. was reported from Iowa.

Mushroom root rot caused by *Armillaria mellea* Vahl. was reported from Washington west of the Cascades.

Witches broom caused by *Exoascus cerasus* (Fckl.) Sadeb. was reported as being very common in western Washington.

Crown gall caused by *Bacterium tumefaciens* Sm. & Towns. was reported from Ohio, New York and Washington.

Gummosis, cause unknown, was reported as serious in Indiana. It was also reported from Washington.

Bacterial gummosis caused by *Pseudomonas cerasus* Griffin was reported from Oregon causing cankers and blossom blight and from Washington west of the Cascades on sweet cherries.

Winter injury was reported from Washington, Ohio, New York and Michigan. In Michigan it dates back to the bad winter of 1917-18. For injury in the Northwest see under winter injury to apples, Hungerford and Fisher reports, pages 54-56.

Frost injury to cherries occurred in much the same area as was subject to loss in the case of peaches and plums. (See pages 81 and 85.)

Table 34. Losses from blue mold rot caused by *Penicillium* sp., gray mold rot caused by *Botrytis* sp., and Rhizopus rot caused by *Rhizopus* sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of Shipment	Blue mold rot		Gray mold rot		Rhizopus rot	
	No. cars with decay	Average percentage of decay	No. cars with decay	Average percentage of decay	No. cars with decay	Average percentage of decay
California	5	5	18	8	41	8
Idaho	3	3	2	17	10	8
Michigan	11	43	2	31	5	49
New York	4	8			2	9
Oregon	1	1			4	6

Origin of shipment	Blue mold rot: No. cars with decay	Blue mold rot: Average percentage of decay	Gray mold rot: No. cars with decay	Gray mold rot: Average percentage of decay	Rhizopus rot: No. cars with decay	Rhizopus rot: Average percentage of decay
Washington	6	17	3	23	6	18
Unknown	1	2			2	8
Totals	31		25		70	
Total number of cars inspected................ 135						

APRICOT

Scab caused by Cladosporium carpophilum Thüm. was reported from Texas as generally distributed and fairly important. It was about the same as last year, causing a 1% loss.

Blight caused by Coryneum beijerinckii Oudem. was reported as occurring in Washington and serious in some sections of Idaho. It was also reported from Fresno County, California by J. P. Benson.

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt. was reported from California only, although it probably occurred to some extent in other states where this fruit is grown.

Shot hole caused by Cylindrosporium padi Karst. was reported from Texas as relatively important.

Winter injury. "Fifty percent reported killed in Benton County," (Washington). For injury in Idaho and the Northwest see winter injury to apple, pages 54-56.

Frost injury. "Frost has killed the apricot blossoms as well as some of the late peaches" (Weekly crop notes for New Mexico, March 28 to April 3, 1920). A peculiar effect of frost injury was observed in southern California by Arthur I. Rittue.

> "In January 1920 warm weather caused the trees to bloom; then a cold wave killed the blossoms, causing a condition of near 'sour sap'. The trees bloomed from three to four times before setting fruit. One rancher, when he saw the trees begin to bloom, stopped the flow of sap by chilling the roots through irrigation. He had practically no disease in his orchard. The disease shows as an excessive bleeding of the entire tree, a gummy substance coming through the pores and hardening on the branches and twigs."

Gummosis was reported by John P. Benson, county agent, Fresno County, California, as causing a medium amount of damage in that county. It was thought to be of bacterial origin.

Crown gall caused by Bacterium tumefaciens Sm. & Towns., was reported as very serious in California.

Arthur I. Rittue gives the following report:

> "Although found in many of the very old orchards on bearing trees, this disease is practically confined to nursery stock, due to the fact that infested trees are thrown out on arrival from the nurseryman, and before the stock is delivered to the rancher. The number of young trees thrown out of shipment from nurseries will vary from 5% to none. In some cases the disease has been so prevalent that entire beds of seedlings grown for root stock have been destroyed, the nurserymen finding crown gall on as high as 90% of the trees."

DISEASES OF SMALL FRUITS

GRAPE

Black rot caused by Guignardia bidwellii (Ellis) V. & R.

This disease was most destructive in 1920 along the Atlantic Coast and in the southwestern states. It is evident from the reports that it is not a serious trouble in the large commercial regions where spraying is generally practiced. Where serious damage occurs it is usually in unsprayed or home vineyards.

Lutman in Vermont stated that there were bad local cases. "A rare disease with us." In Massachusetts black rot was worse than last year and more prevalent than during the average year. It is regarded as important and a 5% loss is estimated. New York (Chupp) reported the disease as "not important". The injury is recorded as a "trace". "Eight or ten years ago there was much black rot but it seems to have disappeared almost entirely." New Jersey (Cook) stated that the disease was important and abundant, but not more so than usual. Pennsylvania reported it as quite prevalent with the largest amount of damage to home grapes; of less importance in the sprayed commercial vineyards of Erie County. Huntingdon County had 60% damage while several other counties reported from 10-20% damage. As high as 50% damage resulted in some vineyards in Virginia where, according to Fromme, the disease was worse than usual. It is regarded as the most destructive disease in this state. West Virginia (Sheldon) stated that from one-third to one-half of the grapes in the gardens about Morgantown were destroyed by black rot. Tennessee reported the disease as being of little importance, but generally distributed. In Texas Taubenhaus stated that it was very important, causing a loss of 4% of the crop. It was about as prevalent as the year previous. In Arkansas it was also common and very important. There was a 5% loss. On account of the wet season in Ohio, black rot was the most serious disease. It was worse than in 1919. Indiana reported only local outbreaks with the leaf spot, the only serious form of the disease. Illinois recorded less than the usual amount of black rot which was largely confined to home gardens. There was some injury to certain varieties in a large vineyard in Union County. Minnesota reported the disease in the southern end of the state mostly on wild grapes. Iowa

(Melhus) reported 15% loss locally, with a state reduction of 2% from black rot. Missouri reported the disease as present. There were no reports from the western grape-growing regions. The disease evidently does not occur in this region. It would be interesting to know the western limit of black rot and it is suggested that the collaborators in the West make a statement as to the conditions in their respective states.

Dates of the first appearance of black rot:

New York	- August 24	Arkansas	- June
Pennsylvania	- July 26	Ohio	- June 25
Virginia	- July 12	Minnesota	- June 10
West Virginia	- June 25		

The collaborators are requested to state on their reports whether the observations were made on the fruit or on the leaves.

It is significant to note that where spraying has been consistently practiced in past years, black rot is not a serious factor. Shear reports that "what little information we have direct is mostly from Virginia, where the rot in the latter part of the season was quite severe even in vineyards that were fairly well sprayed". The generally used spray for black rot is Bordeaux and in most cases this has been reported as successful in controlling the disease.

Downy mildew caused by Plasmopara viticola (B. & C.) Berl. & de Toni.

The season of 1920 was remarkable for the small amount of damage done by downy mildew. Only one state, Ohio, reported the disease of importance although Pennsylvania reported it locally severe. It was not reported from any of the western states. In the East it was reported from Vermont (below average), Massachusetts, Connecticut, New York, New Jersey, Pennsylvania (severe locally in widely separated districts, 3% loss), Tennessee, Texas, Ohio, Indiana, Illinois, Michigan, Wisconsin (mostly on wild grapes), Minnesota (more than usual but unimportant), and Missouri.

Dates of first observation:

Connecticut	- August 24	Ohio	- July 6
New York	- June 21	Illinois	- July 7
Pennsylvania	- July 27	Wisconsin	- July 15
Tennessee (at an elevation of 1800 ft.)	- July 11	Minnesota	- July 2

Powdery mildew caused by Uncinula necator (Schw.) Burr.

Reported from Pennsylvania (unimportant), Arkansas, Ohio, Illinois (more than usual, especially late in the season, causing early defoliation (?)), Iowa, Minnesota and Missouri. In California, John R. Benson, county agent of Fresno County, states that this disease caused the usual amount of damage. In Oregon it was about as usual and of considerable importance. It seems to have been of very little importance in the East.

Anthracnose caused by Gloeosporium ampelophagum Sacc.

Reported from New York (not important, rather common in Rensselaer County), Georgia (general, causing leaf spot), Arkansas (common, 1% loss), and Ohio (more prevalent than usual).

Other diseases.

Crown gall caused by *Bacterium tumefaciens* Sm. & Towns. was reported from Ohio and Washington.

Root rot caused by *Ozonium omnivorum* Shear was regarded as very important in Texas where Taubenhaus stated that it occurs in soils where cotton has died. He estimates a 5% loss.

Dead arm caused by *Cryptosporella viticola* (Reddick) Shear reported as quite serious this year in Erie County, Pennsylvania, causing a 2-5% loss. "Probably more important than before realized" (Thurston and Orton). It was also reported from Ohio, New Jersey (rare), and Illinois (Crawford County, where growers said it was causing considerable damage).

Leaf spot caused by *Cercospora viticola* (Ces.) Sacc. was reported from Ohio.

"Hard berry", cause unknown, was reported as causing a fifty percent loss in one vineyard in Washington. It was characterized by a hard mass in pulp about the seeds. (Frank)

Winter injury. In Washington the severe cold weather of December 1919 caused a loss of 100% of the European varieties and 10% of the American varieties in Benton County.

Table 35. Losses of grapes from gray mold rot caused by *Botrytis* sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
California	57	50-100	Associated with other rots in the
	80	25-50	majority of cars, in most instances
	208	1-23	blue mold rot.
Michigan	14	2-47	Blue mold rot in some cars.
New York	1	87	
	34	2-40	Considerable blue mold present.
Ohio	1	4	Blue and gray mold rots.
Spain	1	7	
Unknown	2	75-87	Associated with blue mold rot.
	15	2-35	Blue mold rot in all cars.
Total number of cars with gray mold rot......		413	
Total number of cars inspected...............		1573	

Table 36. Losses of grapes from Rhizopus rot caused by *Rhizopus* sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
California	9	55-87	Associated with other decays in
	30	25-47	nearly every car, mostly blue
	213	1-23	mold and gray mold rots.
Michigan	6	3-13	Associated with blue mold and brown rots.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
New York	3	4-13	Associated with blue and gray mold rots.
Canada	3	10-20	Associated with blue mold rot.

Total number of cars with Rhizopus rot 264
Total number of cars inspected......... 1573

Table 37. Losses from blue mold rot of grapes caused by Penicillium sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
California	62	50-100	Other decays also present, principally
	113	25-48	gray mold rot and Rhizopus rot.
	628	1-23	
Michigan	3	25-45	Some gray mold rot and Rhizopus rot
	58	2-20	present.
New York	3	50-65	Considerable gray mold rot and some
	9	25-45	Rhizopus rot present.
	100	2-23	
Ohio	3	4-7	
Pennsylvania	8	2-17	
Canada	9	3-22	Other decays also present.
Spain	13	2-9	
Unknown origin	5	5-15	

Total number of cars with blue mold........ 1014
Total number of cars inspected............. 1573

STRAWBERRY

Leaf spot due to Mycosphaerella fragariae (Schw.) Lindau.

As usual, leaf spot was reported from practically all the states where strawberries are grown. This disease is common in every state, according to past reports of the Plant Disease Survey. However, the damage resulting from its presence is usually slight. In the New England States the disease was less prevalent than usual. It caused some damage to the Glen Mary variety in Connecticut by attacking the fruit stems. It is also reported as a serious factor in New York causing a fruit pedicel injury which resulted in a partial loss of the crop in some regions. It was reported as abundant in New Jersey and in at least one case was destructive. Maryland estimated a 6% injury from leaf spot. In West Virginia leaf spot was reported as less injurious in 1920 than in 1919. The Southern States reported the disease as common but not of any great importance. In Mississippi, however, Neal reports that it was causing serious loss in Neshoba County. Elliott in Arkansas reported a 25% injury for this disease. Ohio reported an unusually severe epiphytotic this season but with slight loss. Warfield is regarded as especially susceptible. In Illinois the disease started very early on the new leaves due to the very wet, cold April but did not cause more than the usual amount of damage. William Belt was especially susceptible. Iowa estimates a 5% loss from leaf spot. It was more abundant than usual in Minnesota.

Judging from the reports of 1920 and former years, it would seem that no effort is made to control this disease in commercial plantings. It is probable that there has been an unconscious selection of those varieties which are least susceptible to this disease and in this manner resistant varieties have become generally planted. It is probable that the damage caused by leaf spot is not sufficient in most cases to justify spraying. Temple in Maryland gives the following varieties as susceptible: Sample, Early Osark, Rewastico; and as resistant: Chesapeake, Ekley, Parsons, Superior, Senator Dunlap, Stevens Tennessee.

Gray mold rot caused by *Botrytis* sp.

Massachusetts (Osmun) reported "much damage from this rot in the field; unusually wet weather has favored the development of the fungus". Damage to certain varieties, especially Premier, was reported from Connecticut. Reports were also received from New York (one patch complete loss), New Jersey (abundant), Maryland (very serious, 2% loss), West Virginia, Alabama, Louisiana, Ohio, Illinois, Michigan, Wisconsin, Washington and California. In Illinois, Anderson observed the rot very prevalent on fruit in many markets. This fruit had been received from the southern states and the fungus had evidently developed in transit. N. E. Stevens, who has made a special study of this disease in Los Angeles County, California, gives some interesting data on its prevalence. (See Plant Disease Bulletin 4: 22. 1920)

The reports of the inspectors of the Bureau of Markets summarized below indicate the seriousness of this rot. Most of the rot developing in transit and in the markets results from infection in the field.

Table 38. Losses from gray mold rot caused by *Botrytis* sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
Alabama	8	5-23	Rhizopus present in several cars.
Arkansas	6	25-51	" " " " "
	15	2-24	
Delaware	8	1-18	Some Rhizopus present.
Florida	1	95	Complete decay.
	3	28-37	
Iowa	2	4-9	
Kentucky	3	3-30	Some Rhizopus also present.
Louisiana	9	2-28	Rhizopus present in several cars.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
Maryland	6	4-23	
Michigan	21	2-32	Considerable Rhizopus present.
Mississippi	1	27	
North Carolina	1	15	Mostly Rhizopus rot.
Tennessee	12	30-56	Considerable Rhizopus present.
	25	2-22	

Total number of cars with gray mold rot ... 121
Total number of cars inspected............ 211

Rhizopus rot caused by Rhizopus nigricans Ehr.

This rot was reported from New Jersey (abundant), Maryland - Temple (caused great loss during the latter half of the ripening season, 3% loss), Delaware, Louisiana, Illinois (not as abundant as during previous seasons. Noticed on Mississippi berries in markets.) In South Dakota it was especially prevalent at Brookings where, according to C. W. Michel, it caused serious rotting in the horticultural plots due to especially favorable weather conditions. The following report on an unusual manifestation of the disease is taken from L. E. Melchers' abstract in Phytopathology, January 1921:

> "In 1919 and 1920, the writer observed that unripe strawberries in the field were being attacked by Rhizopus. The fruit was about three-fourths grown and the berries were in the white stage. Wherever the berries touched the soil, infection occurred. The decayed spots became soft and slightly brown. In some fields from 25-35% of the fruit was unsalable. Seasonal conditions, without doubt, have a great influence on the occurrence of this trouble. A few days to a week of cloudy, wet weather, just before the berries begin to turn pink, is the most favorable time for infection. A few bright days will stop this injury. Prior to 1919, no report seems to have been made which shows that Rhizopus has been found on unripe fruit in the field."

Table 39. Losses from leak caused by Rhizopus sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay	Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
Ala.	2	37-63		Ky.	4	3-32	Some gray mold
	13	2-27	Some gray mold	La.	39	1-31	" " "
Ark.	7	31-55	" " "	Md.	7	2-35	
	5	8-29		Mich.	7	8-32	Gray mold presen
Del.	21	2-30	" " "	Mo.	2	2-20	
Fla.	2	75-95	Very bad decay	N. Car.	1	15	Some gray mold
	5	25-45	Some gray mold	Tenn.	9	27-60	Gray mold presen

Origin of shipment	Percentage of decay: No. cars	Percentage of decay: Percent	Remarks as to seriousness of decay
Tennessee	15	2-21	Considerable gray mold rot.
Virginia	1	7	
Unknown origin	2	4-12	

Total number of cars with leak 142
Total number of cars inspected 211

Leaf scorch caused by Mollisia earliana (E. & E.) Sacc.

Leaf spots of strawberry have been reported in the past by various collaborators under several scientific names. The names which have been used are: Ascochyta fragariae Sacc., Ascochyta colorata Pk., Marssonia potentillae (Desm.) Fisch., and Marssonia potentillae var. fragariae Sacc.

The spot known as the Marssonia spot or leaf scorch, is usually distinguished from the spot caused by Ascochyta by the fact that the latter has a very definite white center, resembling more nearly the ordinary Mycosphaerella spot. Leaf scorch, on the other hand, shows at first an irregular, rather indefinite purple spot which later becomes cinereous. The recent investigation of Dr. R. E. Stone (Phytopath. Jan. 1921) shows that the perfect stage of Marssonia potentillae is Mollisia earliana. This has been reported in the past from Louisiana (Edgerton 1917), Delaware (Cook, 1907-08), New Jersey (Cook 1915 to 1918), Connecticut (Clinton, 1916), Indiana (Jackson, 1916).

Other diseases.

Leaf blotch caused by Ascochyta fragariae Sacc. was reported in 1920 from New York and West Virginia. It has been reported in the past from Delaware and Connecticut.

Chlorosis, cause unknown, was reported from Minnesota.

Crown rot caused by Corticium vagum var. solani Burt was reported as causing loss in various parts of Washington and Idaho. A crown rot was also observed in Indiana and Illinois by Anderson. While large sclerotia were observed at the crown of the plant, these were not typical of Rhizoctonia but more like Sclerotinia. The fungus was not determined.

Leaf blight due to Dendrophoma obscurans (E. & E.) And. was reported as general in Illinois, but not as serious as last year. It is not regarded as important.

Nematode caused by Tylenchus dipsaci (Kühn) Bastian was reported by Barss in Oregon as serious in the coast section of Lance County (several patches), and present in one planting at Corvallis. Forty percent affected plants in one bed.

Root rot, cause unknown. Many reports were received by Anderson from various sections of Illinois. No fungus could be found constantly associated with the disease although a Fusarium was isolated in some cases. Manns in Delaware stated that the plants collapsed after picking, with evidence of root rot.

Slime mold. Hopkins in Missouri had two reports with specimens of plants overgrown with slime mold (Mucilage spongiosa Leyss as determined by Dr. W. E. Maneval). Slime mold has been reported a number of times in past years on strawberries, especially from Nebraska. The most common species reported is Physarum cinereum (Batsch) Pers. Fuligo varians and Diachea lucopoda have also been reported.

CURRANTS

Leaf spot caused by Mycosphaerella grossulariae (Fr.) Lind. was reported from New York, New Jersey, Ohio, Illinois, Minnesota and Iowa. There seems to be no data as to the amount of injury this fungus causes.

Anthracnose caused by Pseudopeziza ribis Klebahn was reported in 1920 from New York, New Jersey, Ohio and Washington. It was recorded as more common in Ohio and Washington than in 1919.

Blister rust caused by Cronartium ribicola Fisch. von Waldh. was reported from Connecticut (not important as it is confined on cultivated Ribes to black and flowering currant - Clinton), New York, New Jersey and Minnesota (on Ribes cynosbati, R. floridum, R. grossularia, R. nigrum, R. oxycanthoides and R. vulgare). The chief importance of this rust is its relation to the white pine blister rust.

Angular leaf spot caused by Cercospora angulata Wint. was reported as common in Illinois, Minnesota, Missouri and Iowa.

Cane blight caused by Botryosphaeria ribis Gross. & Dug. was reported from New Jersey, Indiana and Illinois.

Winter injury was reported from Washington.

Rust caused by Puccinia pringsheimiana Kleb. was reported from Minnesota as causing local damage (on Ribes cynosbati, R. floridum, R. grossulariae, and R. oxycanthoides).

GOOSEBERRY

Leaf spot caused by Mycosphaerella grossulariae (Fr.) Lind. was reported from New York, New Jersey, Illinois, Minnesota and Ohio. It was not considered serious in any state.

Anthracnose caused by Pseudopeziza ribis Kleb. was reported from New Jersey, Indiana, Illinois, Minnesota, Washington and Oregon. In Illinois the gooseberry bushes are commonly defoliated early in the season due to the combined attack of leaf spot and anthracnose.

Powdery mildew caused by Sphaerotheca mors-uvae (Schw.) B. & C. was reported from Indiana, Michigan, Illinois, Minnesota, Idaho, Washington and Oregon. It was regarded as serious in some sections of Idaho and in some plantations in Oregon.

Rust caused by Puccinia pringsheimiana Kleb. was reported from New Hampshire, New York, Ohio, Michigan, Indiana, Minnesota and Iowa.

Winter injury was reported from Washington.

Dodder (Cuscuta sp.) was reported from Minnesota as causing local injury but generally unimportant.

CRANBERRY

End rot caused by *Fusicoccum putrefaciens* Shear is regarded as the most serious disease of the cranberry in the western cranberry section. A ten percent loss was reported by Heald and Dana from Washington. It was also serious in some places in Massachusetts, and especially on late varieties and late in the season, according to C. L. Shear.

Bitter rot due to *Glomerella cingulata vaccinii* Shear was reported from New Jersey.

Early rot (scald) caused by *Guignardia vaccinii* Shear was reported from a number of localities in New Jersey.

Blotch caused by *Acanthorynchus vaccinii* Shear was reported from New Jersey.

False blossom, of unknown cause, was reported from Washington.

The following report on other diseases was furnished by Dr. C. L. Shear:

> "Black rot due to *Ceuthospora lunata* caused considerable rot in late kept fruit in Wisconsin.
>
> "Hard rot and tip blight due to *Sclerotinia vaccinii* were common in Oregon and Washington.
>
> "Red leaf spot caused by *Exobasidium vaccinii* (Fckl.) Wor. was prevalent in Washington and Oregon.
>
> "Ripe rot due to *Sporonema oxycocci* Shear was very prevalent in Cape Cod berries which had been kept in cold storage during the winter."

DISEASES OF CANE FRUITS

The following quotation taken from a report of conditions in Wisconsin (Jones, L. K. A survey of disease and insect injuries of cane fruits in Wisconsin, 1919. Ann. Rept. Hort. Soc. Wis. 50: 143-150. 1919-1920) summarized the situation concerning the cane fruit industry in the western Great Lakes region:

> "The cane fruit industry in the state of Wisconsin has declined to such a large extent (about eighty per cent during the past ten years) that it was deemed advisable to make a survey to ascertain, if possible, the reasons for this decline.
>
> "It was found during the survey that diseases and insect injuries usually played an unimportant part in the decrease of acreage, although crown gall can be classed as the limiting factor in the growing of blackberries throughout the state and is also an important factor in limiting black raspberry plantings. Anthracnose on black raspberries, combined with crown gall, has been the chief factor in the decrease in acreage of this cane fruit. The decline of the red raspberry industry has been due, mainly, to economic factors, such as (1) labor at the time of harvest, and (2) other crops and occupations offering a more congenial as well as more remunerative work."

RASPBERRY

Anthracnose caused by Plectodiscella veneta Burkholder

This disease is generally considered as one of the most serious troubles of the black cap varieties. It is found wherever raspberries are grown in this country but appears to be worse in the Mississippi Valley and Great Lakes Region than elsewhere. It was not reported as more destructive in 1920 than in former years in most of the states but Indiana regarded it as especially serious this season. The following states reported the disease in 1920: New Hampshire, Massachusetts (worse than last year, important this season), New Jersey (sometimes destructive), Virginia, Tennessee, Arkansas (50% of the crop injured), Ohio, Indiana (worse than last year and worse than average, estimated loss of 10%), Illinois (about the same; serious factor in reducing crop, due to dry July weather; 10% loss), Michigan (common), Iowa (10% loss), Missouri, Wisconsin, Minnesota and Washington.

In Illinois, Anderson stated that good results were obtained by one grower who sprayed with lime sulfur, following the Michigan recommendations. No other reports on control were received.

Crown gall caused by Bacterium tumefaciens Sm. & Towns.

Crown gall is undoubtedly more serious on raspberries than any other fruit crop. It is often prevalent to such an extent that the patches have to be frequently renewed and many growers in the middle west have given up this crop on account of crown gall. Few reports of the disease were received, however, from the state collaborators in 1920. Massachusetts reported the disease as rather serious but about as usual. New York stated that crown gall was serious only in isolated cases. It is regarded as destructive in New Jersey and most abundant in the southern end of the state. Ohio estimated a 2-5% loss. Illinois reported a 2% probable loss. In a two-year-old patch examined, 25% of the plants were found with crown gall. It is also one of the most serious nursery problems in the state. Wisconsin reported crown gall as one of the limiting factors in raspberry production. Minnesota and Washington reported the disease.

No reports were made on control measures. It is suggested that collaborators report on what efforts are being made in their respective states to reduce this loss by nursery inspection. It was found in Illinois that the nurseries were very careless about sending out diseased plants.

Yellows (cause unknown)

Wherever this disease occurs it is regarded as very important. It is quite desirable that more information be obtained concerning the geographic distribution of yellows. The accompanying map indicates the distribution of the disease based on information in the files of the Plant Disease Survey office.

Massachusetts reported yellows as "very important". In New York yellows was also regarded as "very important, especially in susceptible plantings". A 5-10% loss was recorded. "The wild raspberries are fast being killed by yellows." Ohio reported the normal amount of yellows and mentioned the Cumberland variety as being especially susceptible. Illinois reported "this disease seems to be increasing in importance and an unusual number of specimens have been received this year". It has been observed on red raspberry varieties only in this state. Wisconsin reported the disease as "important on red raspberries, scattering on black raspberries". Michigan and Minnesota reported it as common. Oregon (Barss) reported what seems to be yellows for the first time.

Orange rust due to *Gymnoconia interstitialis* (Schlecht.) Lagerh. and *Kunkelia nitens* (Schw.) Arth.

Orange rusts of raspberry seem to be generally considered of minor importance. It was reported in 1920 from Connecticut, New York (important in some plantings; Monroe County - "on red raspberries near Hilton"; Jefferson County - "black caps damaged severely"; Orange County - "one bad case, whole crop ruined"), Ohio, Illinois, Minnesota and Wisconsin.

Leaf spot caused by *Septoria rubi* Westd.

Leaf spot was reported from New Jersey, Pennsylvania, Arkansas, Ohio, Illinois, Iowa and Wisconsin. There are no reports of this disease on raspberry from western states in the files of the Plant Disease Survey office. Further information concerning this point is desired. Elliott in Arkansas reported the disease as "severe for the first time in my observations".

Cane blight caused by *Leptosphaeria coniothyrium* (Fckl.) Sacc.

Cane blight was more generally reported than usual but was not regarded as important in most states. It was reported from Massachusetts (worse than last year and rather important), New York (serious in some plantings), New Jersey (common), Pennsylvania, Tennessee (reported to have killed thirty acres for a grower in middle Tennessee a few years ago), Arkansas (5% of crop injured), Ohio, Illinois (of questionable importance; can always be found on old canes in black cap patches and on wild black raspberries), Michigan, Minnesota, Idaho (fairly common), and Wisconsin (as usual).

Spur blight caused by *Mycosphaerella rubina* (Pk.) Jacz.

Reported from Connecticut, Arkansas (first outbreak noted, quite severe, 10% of crop injured), Illinois (while the fungus is everywhere found on the canes of red raspberry no evidence of spur blight was ever noted), Wisconsin, Minnesota and Washington.

Other diseases.

Rust caused by *Phragmidium imitans* was reported from Washington (Frank) as quite prevalent on Cuthbert and Antwerp.

Powdery mildew caused by *Sphaerotheca humuli* (DC.) Burr. was reported as causing 2-3% loss locally in Ohio, and from Minnesota where it was regarded as unimportant.

Blue stem, cause unknown, was reported from Ohio.

Dodder caused by *Cuscuta* sp. was reported from Danbury, Connecticut by Clinton.

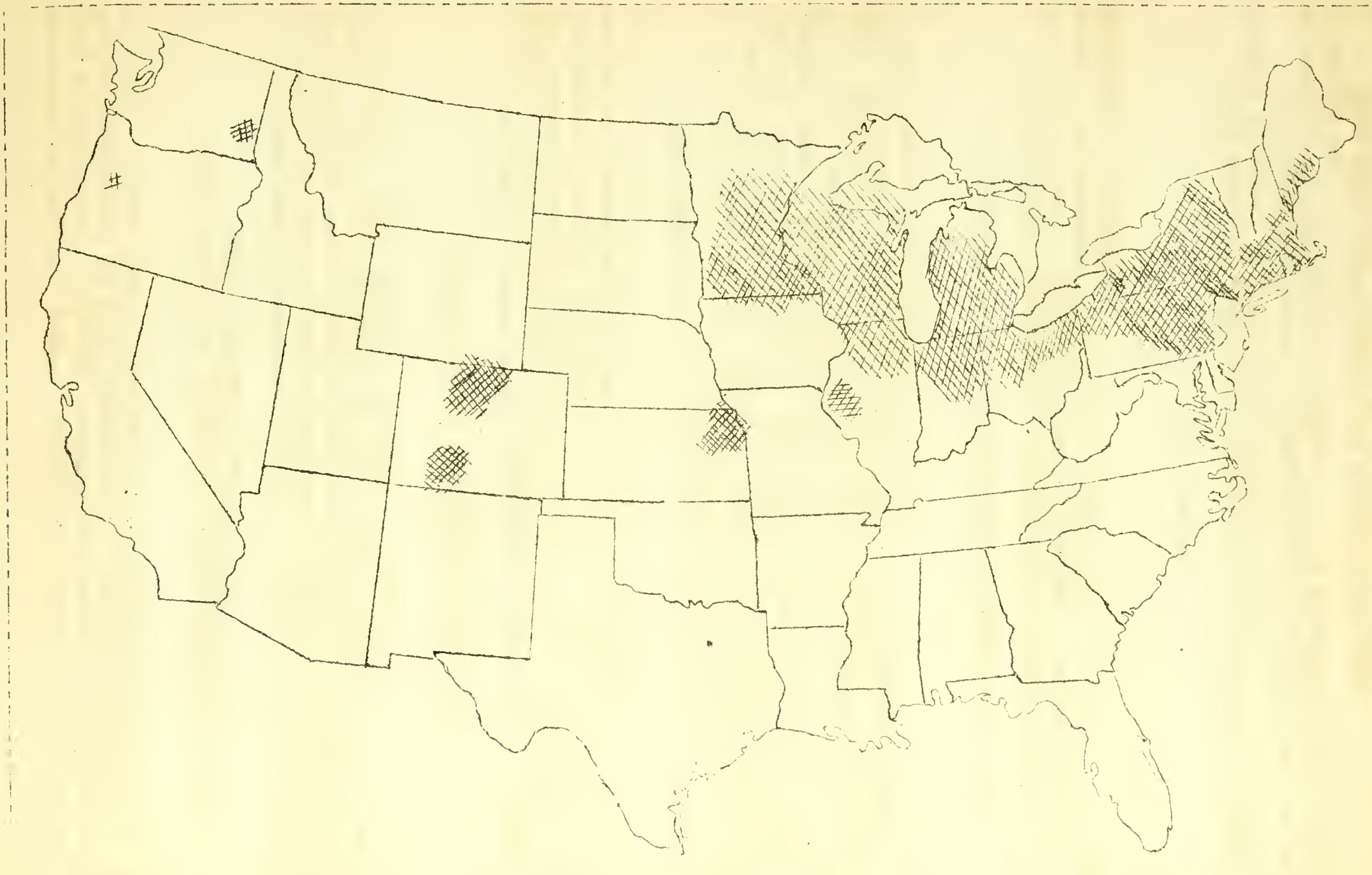

Fig. 15. Distribution of raspberry yellows as shown by records of the Plant Disease Survey.

Winter injury. Illinois (Anderson) reported the dying back of the canes of red raspberries throughout the central and northern portions of the state. While there is always some tip injury, the canes were often killed back half their length. The cause of the injury was difficult to explain since the winter of 1919-20 was not unusually severe. Winter injury was also reported from Connecticut and Washington. In Washington a frost killed the young shoots and spurs and these were later invaded by bacteria, according to Heald and Dana.

Gray mold rot caused by Botrytis sp. was found by inspectors of the Bureau of Markets, on raspberries in seven cars from Michigan, the decay ranging from 4 to 15% with an average of 9%.

Rhizopus rot caused by Rhizopus sp. was noted on raspberries in three cars from Michigan averaging 9%. This decay affected about 30% of the raspberries in one car from Michigan.

BLACKBERRY, DEWBERRY and LOGANBERRY

Orange rust caused by Gymnosconia interstitialis (Schlecht.) Lagerh. and Kunkelia nitens (Schw.) Arth.

About the usual amount of orange rust was reported during 1920 on the above hosts. As a rule most of the damage was reported on wild blackberries and dewberries. The following states reported the disease in 1920: Connecticut, New York (not important, earliest appearance May 24), New Jersey (sometimes destructive), Pennsylvania (reported as destructive in Jefferson County. First observed June 1), West Virginia (abundant and destructive to the wild high blackberries. The short cycle rust is the common one in this locality. Also reported as common on wild dewberries - Sheldon). District of Columbia (observed on young dewberry plants as early as May 12; season late - Haskell), Georgia (common, all blackberries attacked but dewberries resistant - McClintock), Arkansas (general, 2% injury), Tennessee (widespread; 3 samples gave both Kunkelia and Gymnoconia, one sample gave the latter only - Hesler), Ohio (more than usual), Indiana (less than last year), Illinois (common only on wild blackberries and dewberries. Snyder quite resistant, LaGrange very susceptible), Iowa (5% loss), Wisconsin and Minnesota.

Anthracnose caused by Plectodiscella veneta Burkholder.

This disease is considered of little importance on the blackberry and dewberry although very serious on raspberry. It was reported in 1920 from New Jersey, Ohio, Indiana (worse), Illinois, Iowa, Minnesota and Washington (especially on Snyder). It was not reported on dewberry. It was found on loganberry in Washington and Oregon.

Leaf spot caused by Septoria rubi Westd.

It is probable that this disease is more common on blackberry than on raspberry but is of so little importance that it is not thought worth while to report it. For this reason, no doubt, only five states, New Jersey, Texas, Ohio, Minnesota and Iowa sent in reports. Washington reported the disease on loganberry. It was reported on wild dewberry from West Virginia.

Other diseases.

Crown gall caused by Bacterium tumefaciens Sm. & Towns. is considered the limiting factor in the growing of blackberries in Wisconsin. In one planting 10% of the plants were killed. Also reported from Ohio, Illinois (important), Texas, Michigan, Minnesota, Washington and Oregon. This disease is also reported on loganberry from Washington.

Mushroom root rot caused by Armillaria mellea Vahl. was reported from Washington.

Cane blight caused by Leptosphaeria coniothyrium (Fckl.) Sacc. was reported on blackberry from Ohio and Washington.

Spur blight caused by Mycosphaerella rubina (Pk.) Jacz. was reported from Washington on loganberry and from Minnesota on blackberry.

Double blossom caused by Fusarium rubi Wint. was reported on dewberry from New Jersey.

A crown rot, cause unknown, was reported by Barss from Oregon on loganberries. Severe in scattered plantings causing death of one-third of plants in a few instances.

Winter injury was reported as quite serious to blackberry and loganberry in Washington. In some cases there was a total loss of the blackberries and in the Puyallup district 5-25% injury was recorded by Heald and Dana. Evergreen was very severely affected. Injury to the loganberry was also very serious.

Gray mold rot caused by Botrytis sp. was found by inspectors of the Bureau of Markets on dewberries in 16 cars from North Carolina, the decay in 5 cars ranging from 25-45% and in 11 cars from 4-20%, with an average for all cars of 19%.

Rhizopus rot caused by Rhizopus sp. was present in 6 cars of dewberries shipped from North Carolina, the decay averaging 23%.

DISEASES OF SUB-TROPICAL FRUITS

CITRUS

Canker caused by Bacterium citri (Hasse) Jehle

The following summary of present and past conditions of the citrus canker in Florida shows that this disease is at present under complete control. An outbreak was discovered in July of the past year near Boynton (539 trees) but has been completely eradicated.

Citrus canker eradication work. Florida State Plant Board cooperating with the Bureau of Plant Industry for quarter ending December 30, 1920 (The Quarterly Bulletin Fla. St. Pl. Bd. 5: 127-128 1921.)

Citrus grove trees inspected	1,223,388
Citrus nursery trees inspected	15,641,064
Inspectors employed	89
Total properties showing active infection	0

Total properties showing infection................	0
Grove trees found infected........................	0
Nursery trees found infected......................	0
Counties in which active infections were found......	0

General summary of citrus canker eradication work in Florida since beginning of eradication campaign.

Florida counties in which canker has been found.....	22
Grove trees found infected since May, 1914..........	14,267
Nursery trees found infected since May, 1914.......	342,254
Number of properties infected to December 30, 1920..	486
Properties declared no longer "danger centers"......	479
Properties still classed as "infected" December 31, 1920.	7

Table 40. Number of grove trees found infected with canker, per month, since the work began in May of 1914.

1914		1915		1916		1917		1918		1919		1920	
May	108	Jan.	306	Jan.	86	Jan.	14	Jan.	0	Jan.	0	Jan.	0
June	160	Feb.	165	Feb.	21	Feb.	4	Feb.	1	Feb.	0	Feb.	0
July	275	Mar.	444	Mar.	49	Mar.	9	Mar.	1	Mar.	1	Mar.	0
Aug.	1313	Apr.	408	Apr.	49	Apr.	169	Apr.	2	Apr.	1	Apr.	0
Sept.	767	May	1042	May	338	May	52	May	1	May	1	May	0
Oct.	565	June	772	June	450	June	45	June	10	June	0	June	0
Nov.	773	July	651	July	349	July	39	July	0	July	0	July	539
Dec.	366	Aug.	1345	Aug.	219	Aug.	30	Aug.	0	Aug.	1	Aug.	1
		Sept.	618	Sept.	124	Sept.	6	Sept.	0	Sept.	0	Sept.	0
		Oct.	214	Oct.	451	Oct.	2	Oct.	0	Oct.	0	Oct.	0
		Nov.	494	Nov.	131	Nov.	1	Nov.	0	Nov.	0	Nov.	0
		Dec.	256	Dec.	27	Dec.	1	Dec.	0	Dec.	0	Dec.	0
	4327		6715		2294		372		15		4		540

Citrus canker also occurred in Texas in 1920, but at present this disease is under complete control throughout the entire South and only occasional local outbreaks may be expected in the future.

The following report on canker in the Philippines and elsewhere in the Orient was kindly furnished by H. Atherton Lee:

> "This disease is universally distributed throughout Japan, China, Formosa, the Philippines, and had been reported to me by Dr. Yates from Borneo and Dr. Hartley from Java. The literature, of course, reports the disease from Australia. It is not serious in Japan, China, Formosa, or in the Philippines inasmuch as the varieties grown are largely resistant species. Occasionally, in a dooryard tree, a susceptible variety will be partially defoliated and the fruit badly blemished."

Melanose caused by Phomopsis citri Fawcett.

This disease was reported by J. R. Winston, United States Department of Agriculture, on grapefruit and oranges in Florida as moderate on the former fruit and moderate to abundant on the latter. It was estimated that 10% of the grapefruit and 20% of the orange crop was injured. This, according to Winston, would amount to a loss of about $250,000 and $1,000,000 to grapefruit and oranges. The accompanying map shows the places where the disease was worst in 1920.

H. Atherton Lee reported as follows on Melanose:

> "I observed this disease caused by Phomopsis citri only in Japan upon the Unshiu varieties and Pummelo varieties. It is very serious in Japan, often causing defoliation. Japanese growers report that it is easily prevented by spraying. It was not observed by me in China, Formosa, or in the Philippines."

Fig. 16. Areas where melanose of orange was serious in Florida in 1920 according to J. R. Winston. The disease was also bad on grapefruit in these same areas.

Wither tip or anthracnose attributed to Colletotrichum gloeosporioides Penz.

Wither tip and anthracnose were reported from the east coast of Florida by J. R. Winston who estimated about $25,000 loss to grapefruit. According to him, copper sprays applied in the fall usually give negative results.

H. Atherton Lee reports having observed this disease on grapefruit and sweet orange trees in the Philippines, but never causing serious injury.

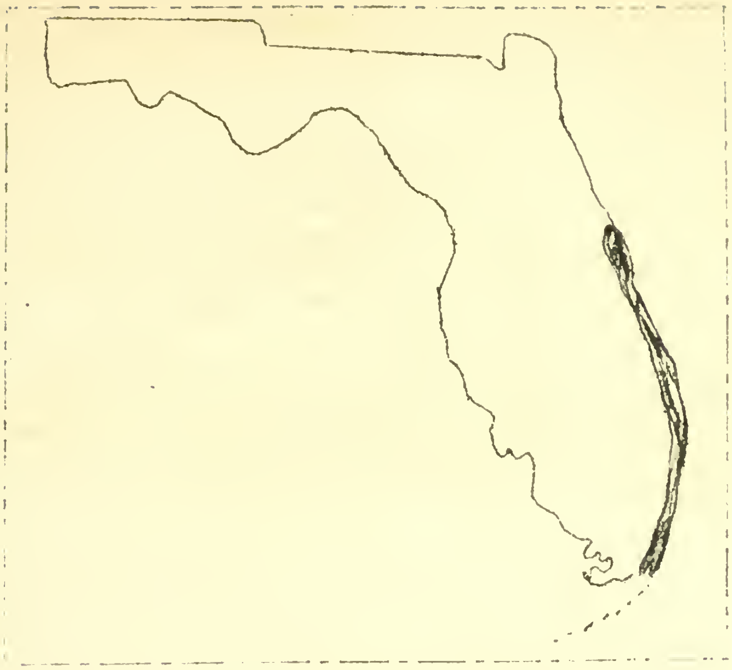

Fig. 17. Anthracnose of grapefruit, occurrence 1920 according to J. R. Winston.

Withertip of limes caused by Gloeosporium limetticolum Clausen

About the average amount of lime withertip occurred in Florida in 1920, according to J. R. Winston, who estimated about 30% of the trees injured. The disease occurs for the most part on the Key or Mexican varieties. This disease has been observed in the Philippines, Japan and China, by H. Atherton Lee, but as limes are not commercially important in those countries the disease is not serious.

Fig. 18. Withertip of limes in Florida. Shades areas indicate regions where the disease was most severe in 1920 according to J. R. Winston

Citrus scab caused by <u>Cladosporium citri</u> Massee.

The information on scab in Alabama and Florida was supplied by H. R. Fulton and J. R. Winston.

In Florida scab was of moderate prevalence but it is annually becoming more widespread. In 1920 it probably injured nearly 20% of the crop of Florida grapefruit, resulting in a loss that may be placed at $500,000. When copper sprays were applied in the spring, thoroughly and at the right time, the results were excellent. Winston mentions the grapefruit variety Hall as very susceptible, the Royal and Triumph apparently immune, while other varieties are moderately susceptible.

In Alabama Fulton reported scab as more prevalent than during previous years on grapefruit and Satsuma oranges in Mobile and Baldwin Counties. Ten percent of the grapefruit, which are not very important commercially, were affected, and $50,000 loss to Satsumas was estimated. Copper sprays in the spring gave favorable results.

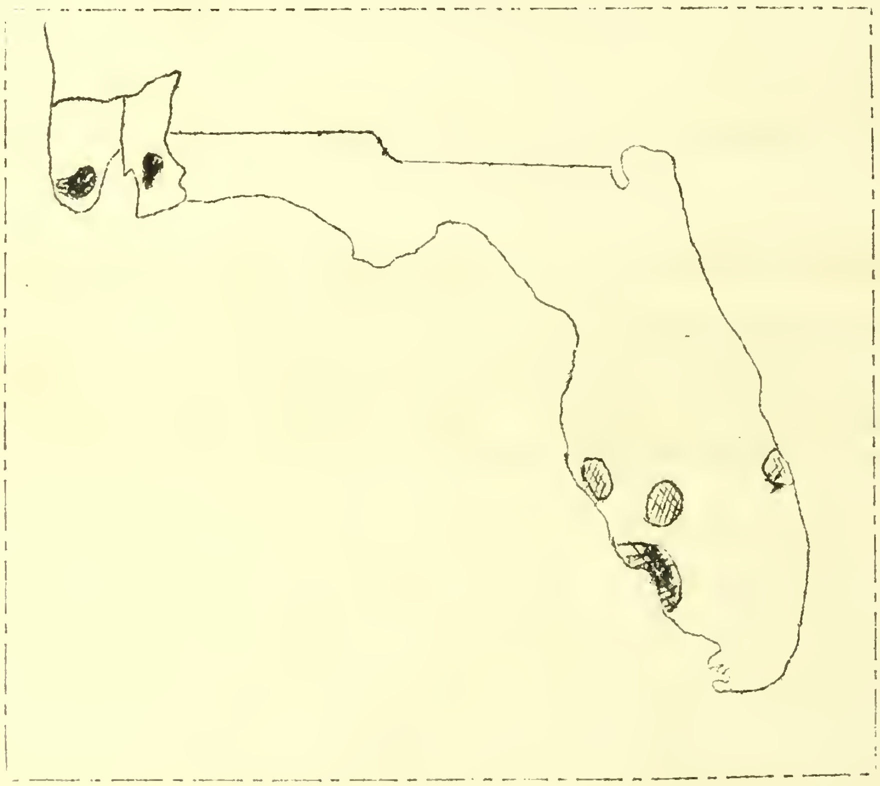

Fig. 19. Areas in Florida, and in Mobile and Baldwin Counties, Alabama, where citrus scab on grapefruit and Satsuma is usually very serious. The disease occurs, however, throughout the entire citrus belt of Florida.

Stem end rot caused by Phomopsis citri Fawcett and Diplodia natalensis Ev.

Stem end rot occurred throughout the entire citrus belt of Florida causing heavy losses to both oranges ($2,000,000) and grapefruit ($250,000). It was considerably above the average in prevalence according to Winston. No varieties seem to be resistant.

It was noted by inspectors of the Bureau of Markets on citrus in two cars from California, the decay ranging from 10-40%, and fruit in 51 cars from Florida showed decay ranging from 1-3%.

Blue mold rot caused by Penicillium sp.

Table 41. Losses from blue mold rot of citrus fruits caused by Penicillium sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Oranges		Tangerines		Grapefruit		Lemons	
	No. cars with decay	Percent rot	No. cars with decay	Percent rot	No. cars with decay	Percent rot	No. cars with decay	Percent rot
Florida	2	50-55	44	1-19	1	54		
	27	25-40			9	25-36		
	457	1-24			341	1-24		
	486	Av. 9			351	Av. 13		
California	2	55-65			5	2-32	1	65
	23	25-45					8	25-45
	467	1-24					189	1-23
	494	Av. 7					198	Av. 13
							2	50-65
							16	2-15
							18	Av. 14
Unknown							1	10
Total & av.	980	Av. 8	44	10	356	Av. 10	211	Av. 13

Other diseases.

Foot rot of orange (cause undetermined) was reported by Winston from Florida as very prevalent in old seedling groves. The removal of affected parts seems to give results but it is usually not worth the cost of the operation. According to Winston sweet oranges are very susceptible, rough lemon and grapefruit are susceptible, and sour oranges are apparently immune. A foot rot was reported by H. Atherton Lee as follows:

> "This disease has been observed in the Philippines, in China and in Japan. Next to psorosis, it is probably the worst disease of citrus trees in oriental countries. I observed it most seriously on seedling trees of the sweet orange and trees budded upon sweet orange stock."

Ammoniated fruit-dieback (cause undetermined) occurred throughout the entire citrus belt of Florida in average amounts. Winston reports good results with application of copper sulphate to the soil.

Gummosis was reported by J. G. Brown, causing 1/4 to 1% loss in Arizona.

H. Atherton Lee, Mycologist of the Bureau of Science, Philippine Islands, has furnished the following data concerning a number of diseases of citrus fruits in the Orient and especially the Philippines:

Pink disease caused by Corticium salmonicolor:

"This disease has been observed by me in the Philippines and Formosa. I did not see it in China nor in Japan. It is very serious in the highly cultivated groves but is not found so commonly in the groves which are uncared for. In orchards where preventive measures are not practiced, this disease can be much more serious than psorosis. The control of the disease is very simple, however, and therefore need not be regarded as seriously as psorosis, foot rot, or bark rot. Pink disease is also serious on cacao, coffee, rubber, acacias and many other economic host plants."

Psorosis or California scaly bark:

"This disease has been observed in Ikiriki, Japan, upon what is known in that country as the 'dai dai', a form of Citrus aurantium. It was also observed in Guam upon a tree of the sweet orange, Citrus sinensis. There occurs on Luzon and throughout South China, a disease which resembles very much psorosis and I am of the opinion that it is the same. Psorosis therefore is universally distributed throughout the Orient and oriental tropical countries. The disease is very serious and is the principal limiting factor to citrus production in South China and the Philippines." (First report)

Florida scaly bark or nail head rust:

"This disease has been found in the Philippines upon trees of the sweet orange, Citrus sinensis, but does very little injury. I did not see it in China or Japan."

Dry rot:

"This disease has been found in the Philippines, China, Formosa, and Japan. We have shown by isolation and inoculation experiments that it is due to a fungus and a later report will appear. It causes the fruit to become dry on the inside similar to the drying of fruits described by Shamel in the Journal of Heredity. We examined some of Shamel's fruits, however, and did not find the organism and we regard his trouble as entirely different from ours although the results are the same in both cases. The dry rot is not visible externally but makes the fruit entirely worthless for eating. The disease in nature affects a large percentage of fruits and consequently is very serious especially in the Philippines." (First report)

Bark rot:

"This disease has been observed upon trees of the mandarin orange, Citrus nobilis. It is very serious in the Philippines, ranking next to psorosis and foot rot in importance. It is also found in China. This disease was also found in the southern part of Japan on trees of the Unshiu varieties, Citrus nobilis var. unshiu (Satsuma). It is quite serious in southern Japan affecting for the most part the older trees and frequently causing the death of the old trees. There is some possibility that this is the same disease described from South Africa as due to Diplodia natalensis, but I have not had opportunity to corroborate my opinion."

Mottled leaf:

"I have never observed this disease upon seedling trees in the Philippines, nor upon plants on Citrus nobilis stock in China, nor upon plants on Citrus trifoliata stock in Japan. Such stocks are the ones generally used for propagating in these countries. In the Philippines, however, it is very serious upon trees budded upon pummelo stock. It causes no extensive injury inasmuch as seedling trees are grown for the most part."

Greasy spot:

"This disease I observed very commonly in Japan, the Philippines and China. In Japan it was occasionally very serious, causing partial defoliation of the tree."

Brown rot of lemons caused by Pythiacystis citrophthora Sm. & Sm. was found by inspectors of the Bureau of Markets in lemons in two cars shipped from California, the decay ranging from 5-19%. Ten cars of Italian lemons showed decay from 2-12%.

Center rot of lemons caused by Alternaria sp. was present in 91 cars from California, the average decay about 10%. The lemons in six cars from Italy showed decay from 4-55% with a probable average of 18%.

BANANA

Wilt caused by Fusarium cubense EFS. The following report on this disease in the Philippines was furnished us by H. Atherton Lee:

"This disease was found in Laguna and Batangas provinces in June of this year. It had not been previously reported in any place in the Philippines. It is sporadic in occurrence and will affect one plantation and escape many nearby plantations of the same susceptible variety. Affected plantations are not numerous but are very seriously hit when once affected. The disease attacks, in our experience, only the Latundan variety which is the most popular variety in central Luzon. This is the only variety we have found susceptible."

Heart rot, cause unknown. H. Atherton Lee has furnished the following report on this disease as it occurs in the Philippines:

> "This disease is a rotting of the terminal bud which extends down through the central cylinder causing it to become black and having a disagreeable saline odor. This disease I have not seen described as yet from other countries. It is quite common but does not cause extensive injury. The pseudostem may be cut off below the limits of infection and new suckers arising are usually free from the disease. We have found it in practically all provinces of Luzon where bananas are grown."

Rhizopus rot caused by Rhizopus sp. was present on bananas in 40 cars of the 133 cars examined by the inspectors of the Bureau of Markets. From 2-5% decay was noted on bananas in four cars from Central America, about 2% in Mexican bananas in two cars, and about 1-37% in bananas in thirty-four cars of unknown origin.

PINEAPPLE

Rot caused by Thielaviopsis sp.:

"This disease is very generally distributed where pineapples are grown in the Philippines. We have found Thielaviopsis on the fruits, leaves, and suckers. In the total, it produces an immense amount of loss which it is impossible to present in any definite estimate."
--H. Atherton Lee.

Wilt, cause undetermined:

"This disease we have found only in the province of Bataan, P. I., on a single plantation. The disease is found only on Hawaiian varieties, and native plantings are either resistant or have not been infected. We have made a very extensive field survey for this disease and find it in only this one locality. The evidence would indicate that the disease was of recent introduction and has not yet been distributed throughout the provinces. Upon the one plantation where the disease was found, the loss was fairly severe."
--H. Atherton Lee.

FIG

Rust caused by Physopella fici (Cast.) Arth. (Uredo fici Cast.) was reported from Texas by Taubenhaus but was considered unimportant.

Anthracnose caused by Glomerella cingulata (Stoneman) Sp. & von S. was reported from Texas as an unimportant disease this season.

Canker caused by Macrophoma fici was reported from Texas.

DISEASES OF NUTS

PECAN

Scab caused by Fusicladium effusum Wint.

This disease was extremely serious in the Mississippi pecan groves according to Neal. It was more prevalent than last year and worse than usual. It is especially severe on the coast but is increasing in other parts of the state. The disease was first observed at Ocean Springs on May 20, and at that time was very abundant. Delmos, Schley, Van Deman and Pabst varieties were severely infected. The last named variety was supposed to be immune. A loss of 25% of the crop is estimated by Neal. The disease caused scabby nuts with premature falling.

Powdery mildew caused by Microsphaera alni (Wal.) Salm.

This disease was common in Mississippi in various parts of the state but the losses were negligible.

Other diseases.

Crown gall caused by Bacterium tumefaciens Sm. & Towns. was reported from Mississippi (Centerville). The growers state that the disease originated in the nursery.

Blight caused by Phyllosticta caryae Pk. was reported from one county in Mississippi.

Die-back caused by various fungi, including Colletotrichum and Alternaria, was reported from Arizona.

Rosette, cause unknown, was observed in Mississippi but was not considered serious.

Black pit, cause unknown, was reported from Mississippi.

WALNUT and BUTTERNUT

Leaf spot caused by Marssonia juglandis (Lib.) P. Magnus was reported as causing a 5% loss in Iowa. It was also unusually serious on black walnut and butternut in Illinois and central Indiana. This is probably the most serious disease of these nuts, since it often causes an early defoliation.

Crown gall caused by Bacterium tumefaciens Sm. & Towns. was reported as heavily infecting walnuts in parts of California.

Bacterial blight of English walnut caused by Bacterium juglandis was reported by Barss as "common and troublesome throughout western Oregon. In some cases as high as 50-75% of crop rendered worthless, but the general damage may not have exceeded 25%. No immune sorts yet discovered and no control known."

Winter injury caused serious losses in Washington and Oregon to English walnuts. Most of the trees were killed back to a few branches, according to

Heald and Dana. In Oregon it was very serious to walnuts planted on low lands. See also special report of D. F. Fisher under apple winter injury, pages 54-56.

COCOANUT

Bud rot was reported from the Philippines by H. Atherton Lee as follows:

> "This disease is very widespread and there are numerous complaints of injury. Bud rot is reported from all the largest islands of the Philippines."

Red ring, a serious disease of cocoanut palms in the West Indies, has been recently discovered in the Canal Zone and is causing some concern on account of its known destructive character.

THE PLANT DISEASE BULLETIN

Issued By

THE PLANT DISEASE SURVEY

SUPPLEMENT 15

Diseases of Cereal and Forage Crops

in the United States in 1920

May 1, 1921

BUREAU OF PLANT INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE

PLANT DISEASE SURVEY

1920

G. R. Lyman, Pathologist in Charge.

R. J. Haskell, Asst. Pathologist. G. H. Martin, Jr., Asst. Pathologist.

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	Prof. H. R. Rosen
Colorado......	Prof. C. D. Learn
Connecticut...	Dr. G. P. Clinton
Delaware......	Dr. T. F. Manns
Georgia.......	Prof. J. A. McClintock
Idaho.........	Prof. C. W. Hungerford
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Indiana.......	Dr. M. W. Gardner
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South Dakota...	Dr. Arthur T. Evans
Tennessee......	Prof. S. H. Essary
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	Prof. C. D. Sherbakoff
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Utah...........	Dr. B. L. Richards
Vermont........	Dr. B. F. Lutman
	Prof. A. H. Gilbert
Virginia.......	Dr. F. D. Fromme
Washington.....	Dr. F. D. Heald
	Mr. B. F. Dana
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DISEASES OF CEREAL AND FORAGE CROPS

IN THE UNITED STATES IN 1920

Prepared by

F. D. Fromme,
Collaborator with the Plant Disease Survey and
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CONTENTS

Introductory Statement

As usual the collaborators of the Plant Disease Survey have furnished the greater part of the information upon which this summary is based. The names of those who furnished most of the state reports and who thus helped to make this summary a success are listed on the opposite page. It should be remembered, however, that their reports were made possible through the cooperation of other collaborators, pathologists, volunteer reporters, and others whose names may not be mentioned here, but to whom credit is due.

There was no cereal disease survey in 1920 and so no data from that source were available as was the case last year. However, the results of the 1919 cereal survey have been studied further with reference to loose smut of wheat and some interesting data on varietal susceptibility are given in connection with the summary of that disease.

Another very important source of information has been data furnished by members of the U. S. Department of Agriculture Office of Cereal Investigations. Many of these data have appeared in the Cereal Courier, the news letter of the Cereal Office.

In preparing this summary it has been kept in mind that many of the facts regarding cereal diseases are too well known to need repetition. Thus the geographic range of the commoner troubles has already been fairly well outlined and so it is only when new or significant occurrences are reported that particular mention is made of them.

DISEASES OF CEREAL CROPS

During the year 1920 cereal crops in general probably suffered much less from disease than the previous year, which as far as cereal diseases were concerned, was an exceptional one. It is true that some of the spring wheat states experienced a very severe epiphytotic of stem rust and although the disease caused heavier losses in these particular states than in 1919, the total loss for the country was somewhat smaller. Scab of small grains, a disease which for the past few years has been taking enormous tolls from the nations crop, and has ranked along with stem rust in destructiveness, was noted for its absence in 1920 causing about 1% loss as compared with 5 1/4% in 1919. All of the other diseases of the small cereals, with the exception of spot blotch of barley, and crown rust of oats, seemed to be either subnormal or normal in severity.

WHEAT

Bunt caused by Tilletia laevis Kühn and T. tritici (Bjerk.) Wint.

The occurrence and losses due to bunt of wheat were as a rule about the same in 1920 as in 1919. It was in general more prevalent and severe in states west of than in those east of the Mississippi River. Bunt was epidemic in Kansas, more than last year in Arkansas, and prevalent throughout the whole wheat growing district of Washington and Oregon. Wisconsin reports much less than in 1919, it was also unusually slight in Virginia, and less than last year in North Dakota. It was said in Indiana to be worse in the northern third of the state and to occur with threshing rings, in Utah to be severe only in certain localities, in Idaho to be more severe in the northern section (4% average) than in the southern (1% average), and in Oregon it was somewhat worse than last year owing to heavy soil infection in the Willamette Valley. The following statements with refer- to severity of bunt are of interest:

Michigan: "Stinking smut (T. laevis) was less than any time in my ten years in the state. I attribute this to the exceptionally fine growth of winter wheat in the fall of 1919. I would place the loss in general at about 3% of the crop. Any fairly clean grain came through with but slight smut." (G. H. Coons)

Kansas: "By far the greatest epidemic of bunt in many years struck Kansas the past season. No records available show that it has ever been as prevalent. Many fields showed as high as 40 or 50% of smut. Two of the worst counties in the state were Rice and Barton. Many others throughout the hard winter wheat district showed all the way from a trace to 20% infection." (L. E. Melchers in Cereal Courier 12: 329. Sept. 30, 1920.)

Bisby reports only a little bunt found in Manitoba and all of it was T.

tritici. He states that treatm nt of seed with formaldehyde is general.

The occurrence and estimated percentages of loss are shown in the accompanying map and also in the following tabulation. The losses in bushels will be given in Plant Disease Bulletin, Supplement 18, 1921.

Table 42. Percentage loss from bunt of wheat - 1920.

Per cent loss	States
5	Kansas.
3	Arkansas, Michigan.
2	West Virginia, North Carolina, Idaho, Washington, Oregon, California, Arizona.
1	New Jersey, Delaware, Maryland, South Carolina, Georgia, Alabama, Tennessee, Missouri, Nebraska, Oklahoma, Colorado, Utah, Nevada.
.5	Virginia, Ohio, Kentucky, North Dakota, Iowa, South Dakota, Texas.
.3	Indiana.
t	New York, Pennsylvania, Illinois, Wisconsin, Minnesota.

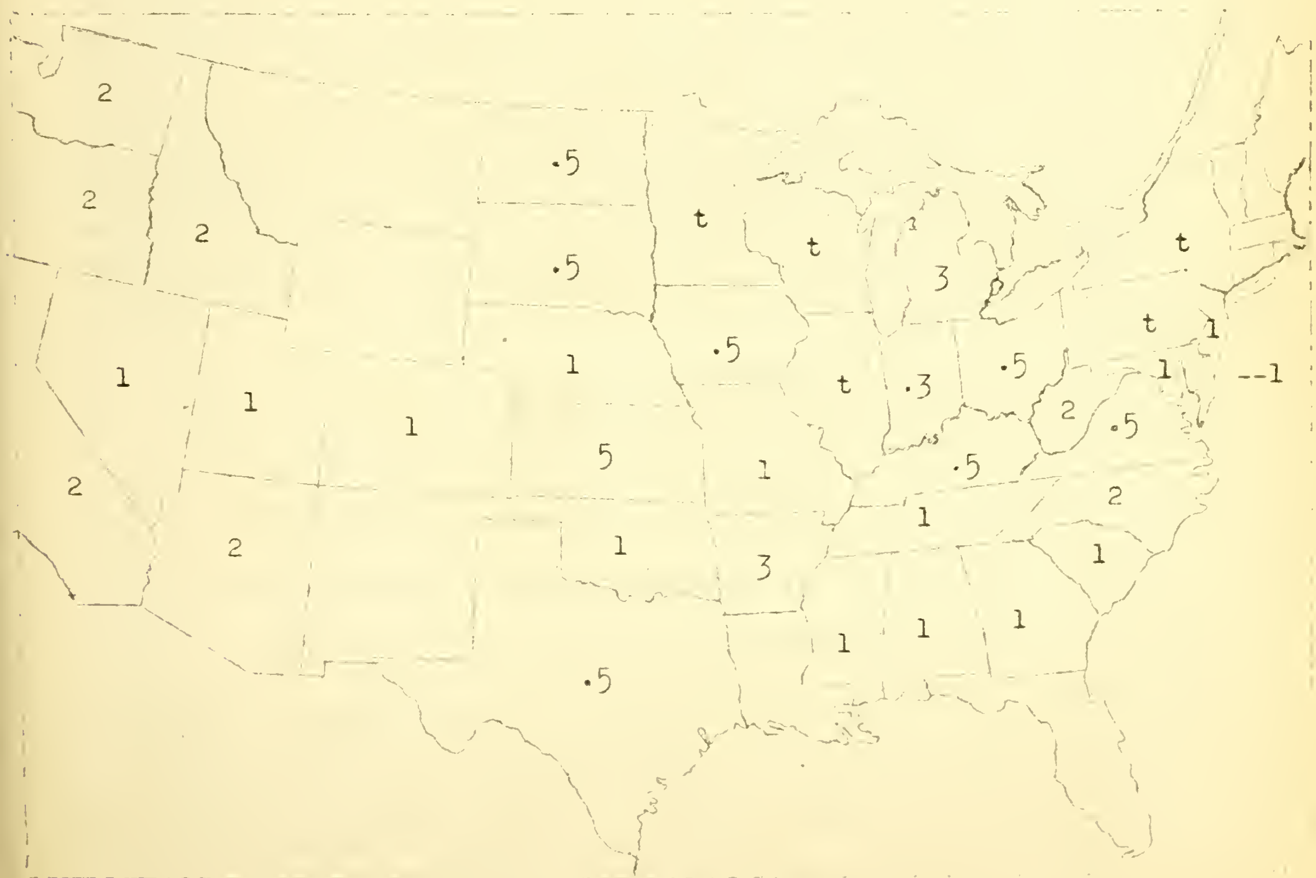


Fig. 19. Occurrence and estimated percentages of loss due to bunt of wheat in 1920.

Considerable progress has been made in the experimental testing of varieties as to relative susceptibility in California and Oregon as reported in the Cereal Courier.

California: "Smut counts have been completed at Davis on 1919 sowings. The counts consisted of both smutted plants and smutted heads. In many rows all the plants were smutted but some smut-free heads always appeared. No significant differences were noted between the early November and the mid-December dates of sowing smutted varieties. There were many varieties only slightly smutted but the following were found immune from bunt (Tilletia tritici):

Martin Amber,	C.I. 4463	Turkey Red,	C.I. 1558
Red Hussar,	C.I. 4843	Crimean,	C.I. 3055
Wash. hybrid,	C.I. 330	Khapli emmer,	C.I. 4573
Wash. hybrid,	C.I. 332	Khapli emmer,	C.I. 4013

Smut counts on 576 surviving plant experiments with 40 varieties gave some very resistant survivals and one immune selection." (W. W. Mackie in Cereal Courier 12: 262-263, August 10, 1920.)

Oregon: "Mr. Woolman has completed making smut counts in the cereal disease nursery. Two years' data are now available on the smut resistance of the commercial wheat varieties of the United States under conditions prevailing at Moro. Comparatively few of the commercial varieties show any resistance to stinking smut. A few varieties, however, have been discovered which are not only highly resistant to that disease but are apparently immune under our conditions. One of these varieties, Red Hussar, C.I. 4843, also came through smut-free at Davis, California, and Pullman, Washington, as well as at several points in Oregon. This year most of the commercial wheat varieties of the United States had more than 75% smut, based on head counts. The following tabulation shows some of the results:

Red Hussar,	C.I. 4843	0	Kofod,	C.I. 2997	7.7
Martin Amber,	C.I. 4463	0	Turkey,	C.I. 1558	8.5
White Odessa,	C.I. 4651	0	Miracle,	C.I. 5665	11.5
White Odessa,	C.I. 4655	.7	Kanred,	C.I. 5146	11.5
Kharkov,	C.I. 1442	6	Marquis,	C.I. 5294	34.0

(D. E. Stephens in Cereal Courier 12: 280, August 20, 1920.)

Kanred was found to be susceptible to bunt in Kansas in 1920.

Kansas: "More than 400 fields of Kanred wheat were inspected this year in all parts of the state, representing a total area of between 15,000 and 20,000 acres. In many counties of the state, from a trace to rather high percentages of stinking smut were found. Growers are being urged to treat all Kanred seed wheat to be sown this fall and some of the larger growers in each county will probably treat all of their seed which is to be sold." (John H. Parker in Cereal Courier 12: 204, July 10, 1920.)

Temple states that Leaps Prolific appears to be resistant to bunt (*T. laevis*) in Maryland, while Fultz is very susceptible.

The general practice of seed treatment is considered to be the important factor in the reduction in severity of bunt losses by several collaborators. A new and promising method of seed treatment for the prevention of bunt has been reported by Mackie and Briggs from California (Chemical dusts for the control of bunt. Phytopath. 11: 38. January, 1921). They report good results from the use of a mixture of copper sulphate and calcium carbonate (1-1), and of copper carbonate. These dusts were used at the rate of 2 ounces per bushel.

Temple states that the dry formaldehyde treatment has caused seed injury in Maryland and that it is not so effective as either the formaldehyde dip or sprinkle.

Loose smut caused by *Ustilago tritici* (Pers.) Jens.

Loose smut occurred to some extent in practically all wheat fields throughout the country, but varied greatly in severity in different sections. It was again more severe in the South Atlantic division (Delaware, Maryland, West Virginia, Virginia, North Carolina, South Carolina, Georgia) as a group than any other, and was a factor of importance in all states east of the Mississippi River with but few exceptions. West of the River the losses did not exceed 1% on the average except in the states of Arkansas, Texas, and Idaho. The average losses for the separate divisions are estimated as follows:

North Atlantic........	2.1%	North Central, East..	1.7%
South Atlantic........	3.2%	North Central, West..	.7%
South Central.........	1.7%	Far Western..........	.7%

Losses were somewhat greater as a rule than in 1919. They are reported as more severe in New York, Pennsylvania, New Jersey, Tennessee, Arkansas, Illinois, Texas, and Idaho, and less severe in Virginia, Georgia, Oklahoma, and Kansas. The percentage losses by states are shown in the following tabulation:

Table 43. Percentage loss from loose smut of wheat by states - 1920.

Per cent loss	States
5	West Virginia.
4	North Carolina.
3.5	Maryland.
3	New York, New Jersey, South Carolina, Tennessee, Illinois, Arkansas.
2.8	Virginia.
2.5	Pennsylvania.
2	Vermont, New Hampshire, Georgia, Massachusetts, Delaware, Alabama, Ohio, Indiana, Texas, Idaho.
1.5	Mississippi.
1	Maine, Connecticut, Michigan, Kentucky, Missouri, South Dakota, Nebraska, Oklahoma, Colorado, Utah, Arizona.
.5	Wisconsin, Minnesota, Kansas, Washington, Iowa.
.1	North Dakota.
t	Oregon, California, Nevada, New Mexico, Louisiana.

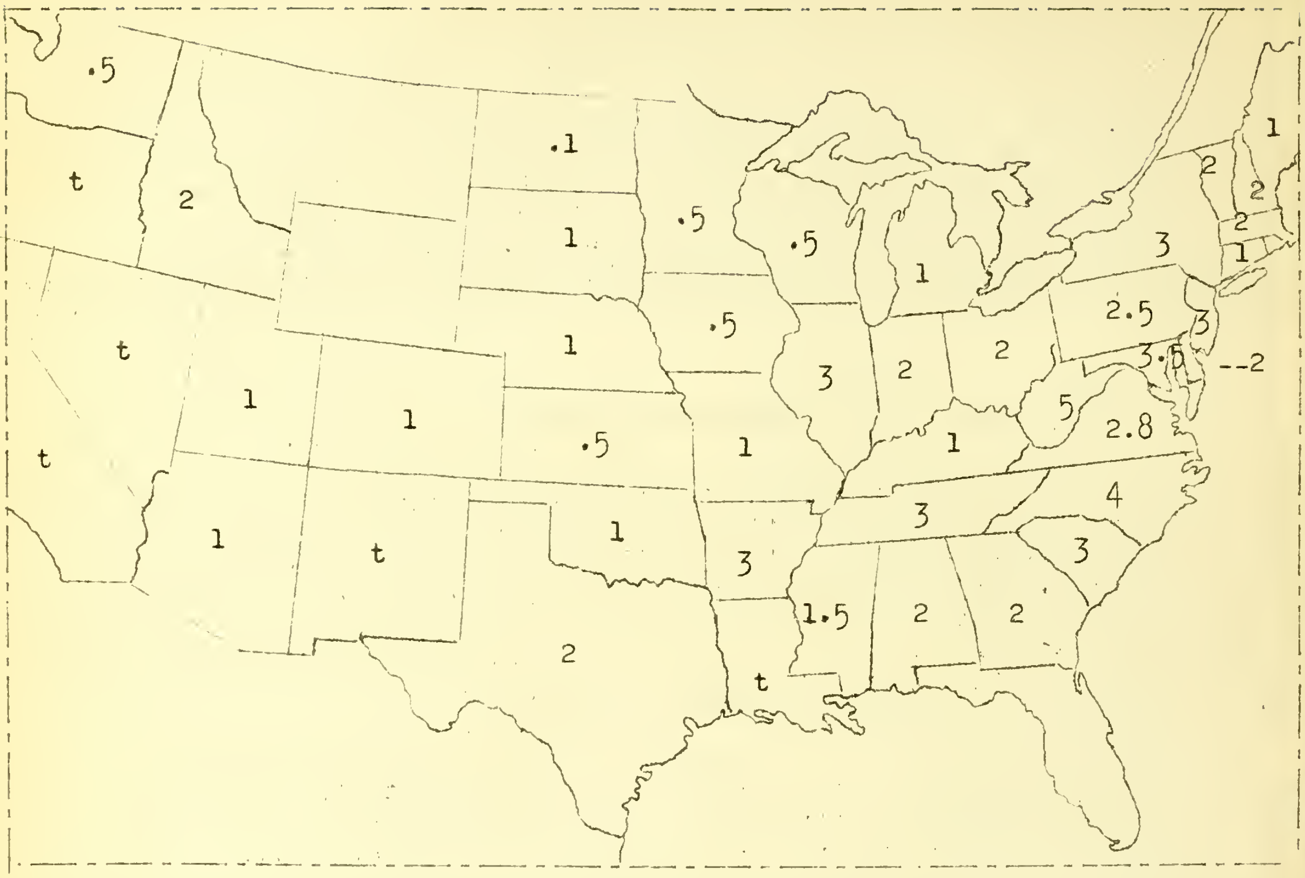


Fig. 20. Percentage loss from loose smut of wheat, 1920.

A special question on the extent of winter killing in wheat was asked of collaborators with the view of correlating, if possible, variations in the occurence of wheat diseases with winter killing. The following note on the variation, ascribed to winter killing, in the percentage of loose smut of wheat was supplied by Fromme:

<u>Virginia</u>: "Winter killing of wheat was general throughout the state but especially severe in the higher altitudes of southwestern Virginia. At Blacksburg on soil of good fertility the percentage of winter killing was 27%, while on very poor soil it was very near 100%. I believe that winter killing tends to lower the percentage of loose smut, probably the affected plants succumb more readily to winter injury. The general lowering of the percentage of loose smut in the state would confirm this as does the following data. In connection with hot water seed treatments in the Shenandoah Valley, which were made in cooperation with the Cereal Office, samples of treated and untreated grain from each lot were planted at Blacksburg as a check on the field results. These were in rod rows, six rows to each lot. There was little winter killing in the fields in the Shenandoah Valley except in one (No. 2), and about 30% on the average at Blacksburg. The percentage of loose smut in the untreated wheat from the two stations was as follows:

Lot number	1	2	3	4	5	6
Shenandoah Valley	5	.2	3	3	4	3
Blacksburg	2	.3	.9	.5	.9	.6"

Coons has previously stated that wheat affected with loose smut seems more likely to succumb to winter killing than healthy wheat (Phytopath. 8: 70, 1918). He makes the following comment in 1920:

"Winter injury commonly culls out affected wheat, reducing loose smut to a trace (as average). This year, with better snow covering, the loss in some fields reached 5%."

Winter injury (1919-20) was reported by collaborators as follows: Slight - Delaware, Georgia, Michigan, Wisconsin, and Washington. Severe - Virginia (30%). Ohio (20%), North Dakota, and Tennessee. Minnesota 25-30%, but not as serious as usual.

Table 44. Summary of cereal disease survey data in 1919 with respect to occurrence of loose smut in certain varieties of wheat, as shown in Table 45.

Variety	Total No. fields inspected	Total No. fields smutted	Per cent fields smutted	Highest % smut found	Average % smut in smutted fields
Stoner	68	58	88	15	3.6
Michigan Amber	45	38	84	15	2.8
Red Wave	193	169	88	20	2.7
Poole	186	157	84	15	2.4
Rudy	44	34	77	12	2.3
Dicklow	55	50	91	10	2.2
Turkey Red	257	217	82	15	2.1
Red Cross	58	41	71	20	1.3
Fultz	211	155	73	15	1.3
Fulcaster	147	129	88	10	1.1
Red Chaff	16	11	68	6	1.1
Red Rock	29	22	76	6	.9
Red May	39	25	64	8	.9
Marquis	91	39	43	2	.3
Leap's Prolific	24	20	83	2	.1

It is probable that winter injury, choice of varieties, and soil fertility are all factors of importance in determining the relative prevalence of loose smut in different sections.

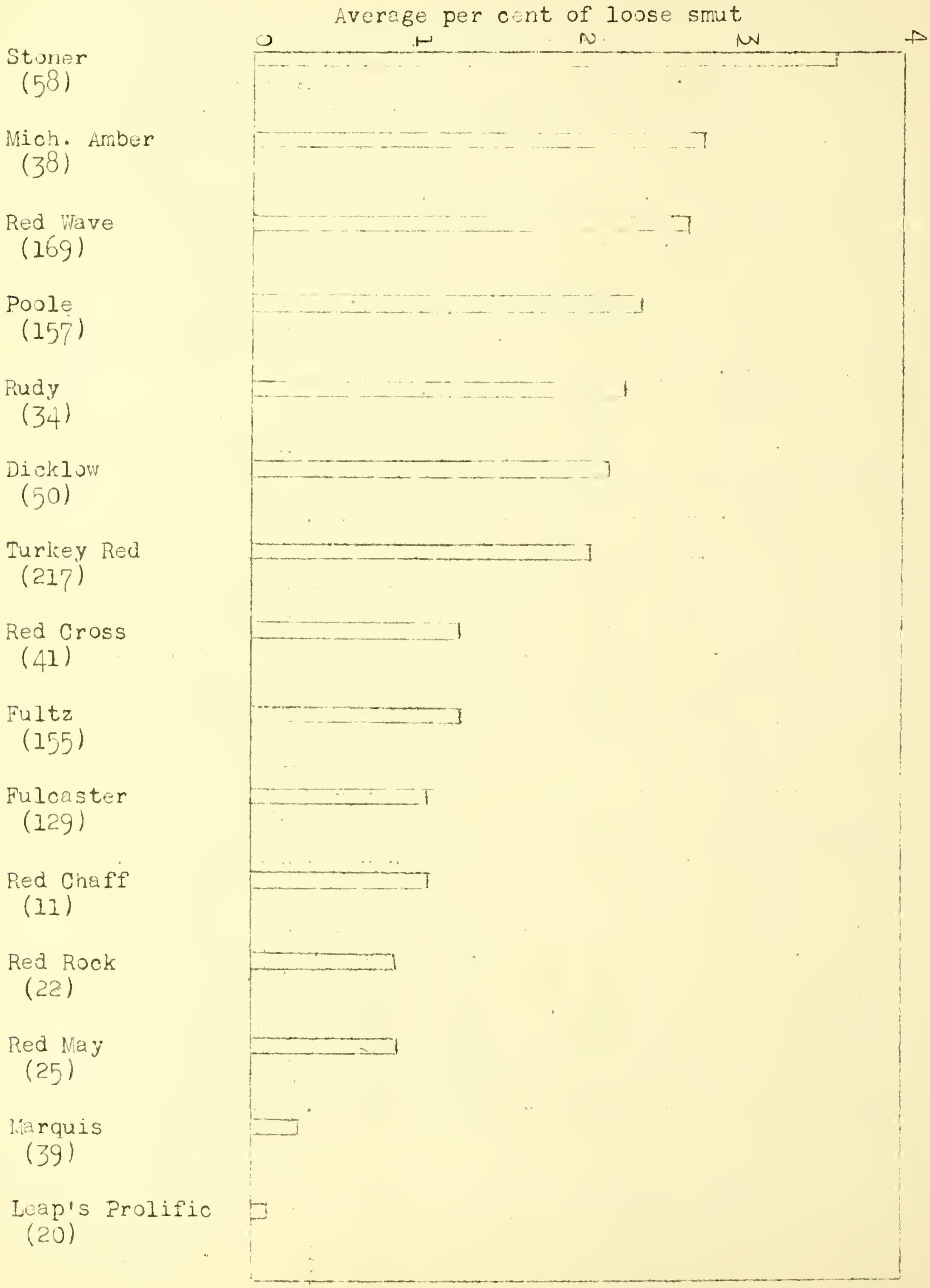
Notes on varietal susceptibility were received from two collaborators. Hungerford states: "In south Idaho the Dicklow wheat, which is the most popular and highest yielding wheat for the irrigated regions, has proven very susceptible to loose smut." Fromme notes that Leap's Prolific appears to be resistant or disease escaping in Virginia, while Stoner and Fulcaster are especially susceptible. Coons has previously shown apparent marked differences in the susceptibility of Shepherd's Perfection and Goings, the latter being much more susceptible than the former. A summary of the cereal disease survey data for 1919 from the standpoint of range and severity of infection in some of the varieties commonly grown in the states where loose smut is common is shown in the following table:

Table 45. Susceptibility of wheat varieties to loose smut as shown by summary of 1919 cereal disease survey records for Pennsylvania, Maryland, Virginia, Kentucky, Tennessee, Georgia, Alabama, Texas, Oklahoma, Ohio, Indiana, Illinois, Iowa, Missouri, Kansas, and Idaho. Upper figure in each percentage column represents the number of fields, lower figure the percentage of fields affected.

Variety	States	Percentage of loose smut															
		0	t	.5	1	2	3	4	5	6	7	8	9	10	12	15	20
Fulcaster	Ala., Ky.,	18	49	13	37	15	5	5	1	3				1			
	Md., Mo.,		38	10	29	11	4	4	1	2				1			
	Ohio, Okla.																
	Pa., Tenn.,																
	Texas.																
Fultz	Ky., Md.,	56	47	10	53	24	10	5	3	1		1				1	
	Mo., Ind.,		30	6	34	16	6	3	2	1		1				1	
	Ohio, Pa.,																
	Tenn.																
Poole	Ind., Ky.,	29	27	8	39	33	17	11	7	4		5		3	1	2	
(Gill)	Tenn., Ohio,		17	5	25	21	11	7	4	3-		3		2	1-	1	
(Harvest King)	Md.																
Stoner	Ky., Md.,	10	14	1	6	6	9	2	4	3	5	5		1		2	
(Miracle)	Ohio, Okla.		24	2	10	10	16	3	7	5	9	9		2		3	
(Marvelous)	Tenn., Va.																
(Three Peck)																	
Michigan Amber	Ind.	7	9	4	6	6	2		5	3				1	1	1	
			23	10	16	15	5		13	8				3	3	3	
Red Chaff	Ky., Ind.	5	4	2	3	1				1							
			37	18	27	9				9							
Red Rock	Ind., Ohio,	7	10	1	7	2	1			1							
	Mo.		45	5	31	9	5			5							

Variety	States	Percentage of loose smut															
		0	t	.5	1	2	3	4	5	6	7	8	9	10	12	15	20
Red Wave	Ind., Ill.,	24	35	14	37	26	12	11	14	5	1	3	1	5	1	1	3
	Ky., Md.,		20	8	22	15	7	6	8	3	1	2	1	3	1	1	2
	Mo., Ohio,																
	Pa.																
Rudy	Ind., Va.	10	7	2	8	6	4	3	2					1	1		
			20	6	23	18	12	9	6					3	3		
Turkey Red	Ind., Ill.,	40	65	8	57	32	10	9	5	14	1	7		5	2	2	
	Ia., Kans.,		30	4	26	15	5	4	2	6	1-	3		2	1	1	
	Ky., Mo.,																
	Idaho, Ohio																
	Okla., Tex.																
Red May	Tenn., Ky.,	14	11	5	5	2		1				1					
	Ga., Mo.		44	20	20	8		4				4					
Leap's Prolific	Pa., Md.,	4	18		1	1											
	Va., Tenn.		90		5	5											
Marquis	Ida., Ill.,	52	27	6	5	1											
	Ind., Ia.,		69	15	13	3											
	Ohio.																
Dicklow	Idaho.	5	14		15	5	2	5	3	3	1	1		1			
			28		30	10	4	10	6	6	2	2		2			
Red Cross	Ill., Ind.,	17	24	3	6	3	1		2	1							1
	Mo.		58	7	15	7	2		5	2							2

Fig. 21. Summary of cereal disease survey data in 1919 with respect to the occurrence of loose smut in certain varieties of wheat. (Figures in parentheses show number of fields.)



The status of the hot water treatment for loose smut.

Information received in response to a special question addressed to collaborators indicates that the economic importance of loose smut is becoming more generally recognized and that demonstrations for its control are being conducted in several states. The practice is becoming well established in Indiana where eight counties have central treating plants according to Gardner and Jackson. The plan of the central treating plant is also being pushed in Virginia and Idaho and demonstrations with this end in view are evidently being conducted in several other states. All reports indicate that the treatments have been efficient and generally satisfactory.

Pennsylvania: "Nine demonstrations of hot water treatment for loose smut of wheat and barley were given last year. The results were 100% control vs. 10-20% infection in the checks. We have given seven demonstrations this fall. To our knowledge the sixteen demonstrations treated all the wheat that was ever treated in the state." (Nixon.)

Maryland: "The modified hot water treatment gives us almost perfect control. We recommend the use of a seed plot, planted with treated seed." (Temple)

Virginia: "Six demonstrations of the hot water treatment were made in the fall of 1919. The percentages of control obtained in the different fields were as follows: 96.3, 99.1, 90.1, 91.2, 95.0, 86.6. Smut percentages in the checks were as follows: One field .2, three fields 3, one 4, and one 5%. Yield data were obtained in one test, the treated seed yielding at the rate of 27 bushels per acre and the untreated 16. Three central treating stations have been established as a result of these demonstrations." (Fromme)

West Virginia: "Hot water treatment tested in five fields, absolute control in treated plots. Untreated - two fields 1-3%, two fields 5-6%, one field trace." (Giddings)

Arkansas: "Results of hot water treatment good, but not in general use." (Elliott)

Ohio: "The hot water treatment has been very satisfactory as practiced here during the last two seasons. In the season of 1919 I think there was much more application of the treatment than in 1920." (Selby)

Illinois: "There is practically no hot water treatment for loose smut of wheat made in this state. I have treated one batch of seed for a farmer in Warren County, but other than this we have not used this method of smut prevention." (George H. Dungan)

Idaho: "This year demonstrations were put on in several counties by the Extension Division. Small amounts of wheat were brought in by farmers to one central place and there treated under supervision. The results have been very satisfactory. Very little injury resulted and satisfactory control of the smut was secured. It is planned to extend this work very materially next year." (Hungerford)

Manitoba: Loose smut occurred commonly in wheat from a trace to about 1% or occasionally more. In certain cases it may become necessary to make arrangements for treating by the hot water method, or for the discarding of seed lots more seriously affected." (Bisby)

On the basis of the results of the work in Indiana it would seem probable that the hot water treatment would be commercially profitable in those states in which the average percentage of loose smut equals or exceeds that of Indiana.

Flag smut caused by Urocystis tritici Koern.

Flag smut which was reported for the first time in the United States in 1919 occurred again and over a slightly wider area in 1920. It is still restricted, so far as is known, to the district around Granite City, Illinois, where it was first reported. It was found in 1919 in 33 fields comprising about 825 acres, but a survey made in 1920 by the Cereal Office in cooperation with the University of Illinois showed the disease to be present in 111 fields comprising about 2,500 acres and confined to an area of about 47 square miles. These data together with those which follow are taken from a report by George M. Reed in the Cereal Courier 12: 242, July 31, 1920. Infection was not severe in most fields, only a trace being found, but in a few places as many as 20-25% of the stalks were found infected. Practically no grain was produced on affected stalks and less than 1% of the affected stalks produced heads. Evidence of soil infestation was obtained by sowing clean seed on land that has borne an infected crop in 1919, which resulted in a small percentage of infected plants. It was also found that the date of seeding was of importance in determining the amount of infection, the worst infection being found in the earliest sowings, October 7 and 8. Seed sown November 17 and 18 did not germinate until spring but came up well and was free from infection. Marked differences in susceptibility were found in both field and greenhouse sowings which are tabulated as follows:

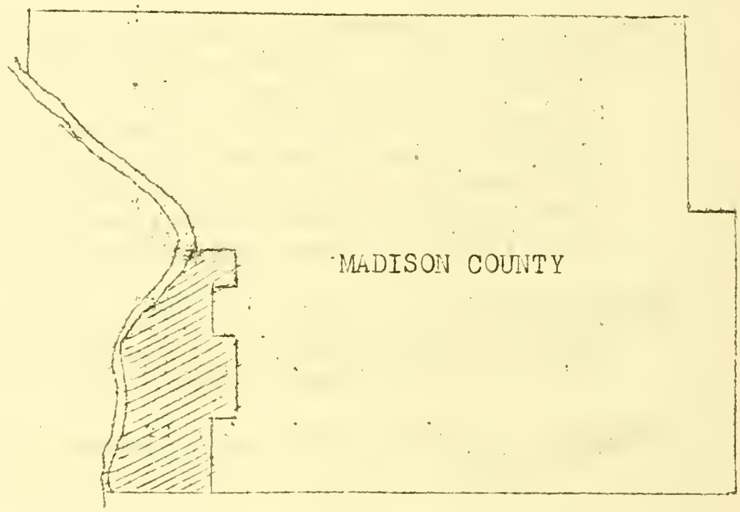


Fig. 22. Madison County, Illinois showing area quarantined for flag smut of wheat.

Field experiments

Most susceptible

Dawson	Leap
Dawson Golden Chaff	Mealy
Fultz	Purple Straw
Jones Winter Fife	Red Cross (Salzer's Prizetaker)
K. B. No. 2	Rocky Mountain

Slight infection, very slight in most.

Acme	Lancaster
Bearded Purple Straw	Missing Link
China	Nebraska Hybrid No. 28.
Currell Prolific	Poole
Dietz	Red Rock
Gypsy	Red Wave
Illini Chief	Treadwell
Kanred	

No infection

American Bronze	Mammoth Amber
Fulcaster	Martin Amber
Imperial Amber	Red May
Indiana Swamp	Theiss

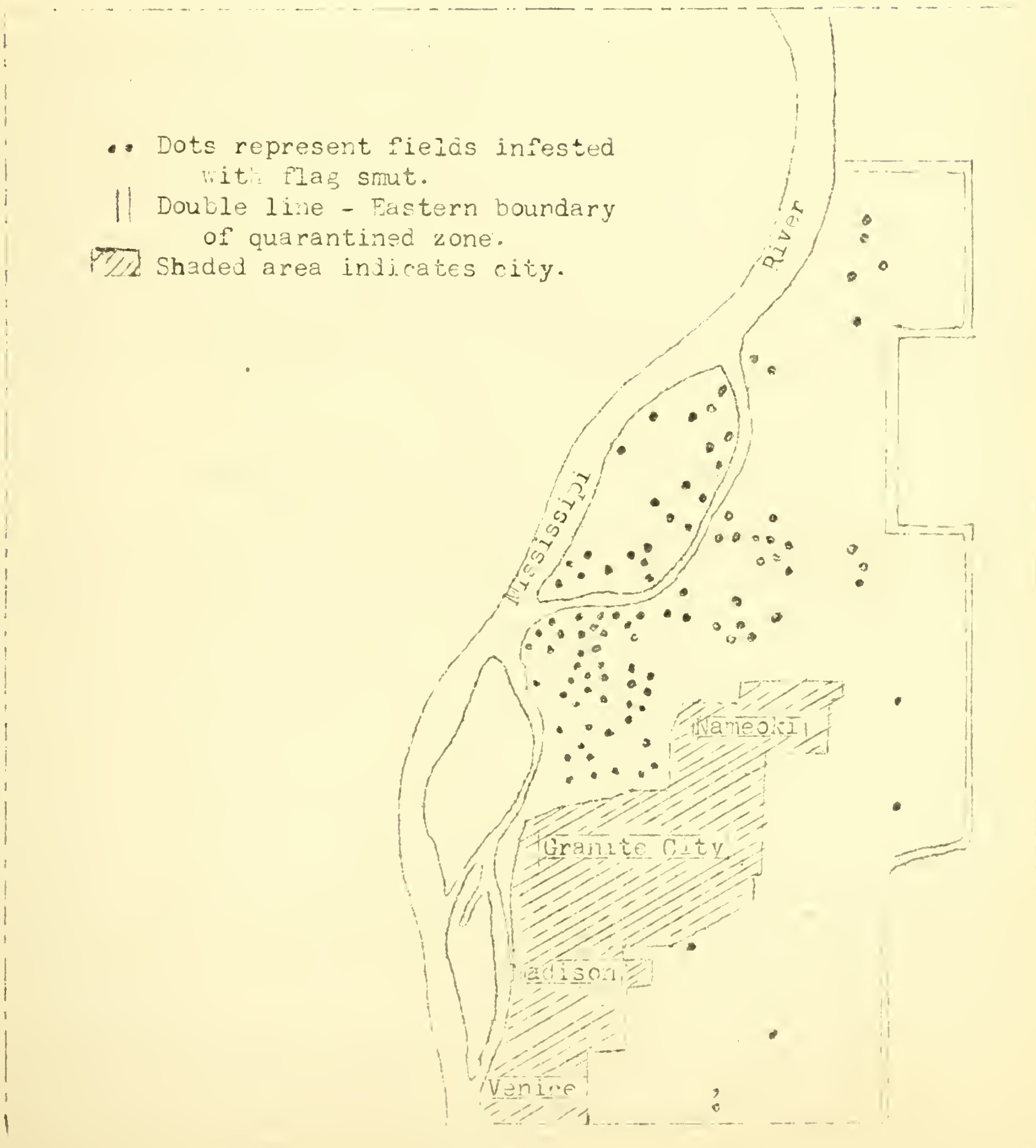


Fig. 23. Quarantined area in Madison County, Illinois - 1920.

Greenhouse experiments
(Figures are percentages of plants infected)

Bobs	95.3	Mealy	2.2
Cowra	92.6	Bunyip	2.
White Federation	90.9	Little Club	2.
Defiance	88.3	Cedar Comeback	0
Red Cross	85.4	Early Defiance	0
Salzer's Prizetaker	75.7	Florence	0
Hard Federation	72.5	Fulcaster	0
Fultz	47.5	Galgalos	0
Early Baart	35.5	Poole	0
Marquis	7.8	Red Rock	0
Kanred	5.4	Red May	0
White Australian	4.1		

Measures which are in operation are planned to accomplish both control and eradication. These consist of (1) quarantine of the infested area; (2) treatment of grain with formaldehyde (1 lb. to 25 bushels) as it comes from the separator; (3) burning of all straw in the quarantined area; (4) avoidance of infested fields for wheat growing; (5) use of seed wheat from non-infested localities; (6) treatment of all seed wheat with the copper sulphate and lime dip; and (7) use of resistant varieties.

The treatment of seed wheat in this area has been placed on a practicable basis by the establishment of a central treating plant in Madison County, in which approximately 15,000 bushels were treated by the copper sulphate and milk of lime method in the fall of 1920. The plant in question has a maximum capacity of approximately 1,000 bushels a day.

Stem rust caused by Puccinia graminis Pers.

Stem rust was very prevalent and destructive in the spring wheat sections of the upper Mississippi Valley. The epidemic exceeded in severity that of 1919 in the states of North Dakota, South Dakota, Minnesota, Nebraska, and Wisconsin, while it was markedly less severe in Kansas, Missouri, and other winter wheat states which border on the spring wheat belt. Infection was slight as a rule with average losses not exceeding a trace in the Atlantic States with the exception of West Virginia and Georgia. In all of the winter wheat states of the Mississippi Valley, rust was of slight importance,as a rule, but Tennessee reports severe local attacks with an estimated reduction in yield for the state as a whole of about 2%. The disease was recorded as occurring in all of the far western states where losses were slight except in Utah and Arizona. B. L. Richards reports stem rust as general in the irrigated districts of Utah, attacking 50% of plants and causing approximately 5% loss for the crop as a whole. The accompanying map shows the occurrence of stem rust and the estimated percentages of reduction in yield in 1920 by states. The complete data on losses will be found in Plant Disease Bulletin, Supplement 18, 1921.

The fact that losses were restricted almost entirely to spring wheat is shown in the reports of the Bureau of Crop Estimates which show a shrinkage of 81,990,000 bushels in spring wheat from the July 1 estimate to the final production as recorded in December, whereas the yield of winter wheat exceeded the July estimate. About two-thirds (63%) of the total shrinkage of spring wheat occurred in the states of Minnesota, North Dakota, and South Dakota. In the first two states stem rust was undoubtedly the most important contributing factor, while a combination of stem rust and scab were chiefly responsible in South Dakota. The percentages of shrinkage in spring wheat for the principal spring wheat states in the Mississippi Valley section are as follows:

Minnesota	46	Wisconsin	36
North Dakota	17	Michigan	25
South Dakota	36	Iowa	28
Nebraska	43	Illinois	28

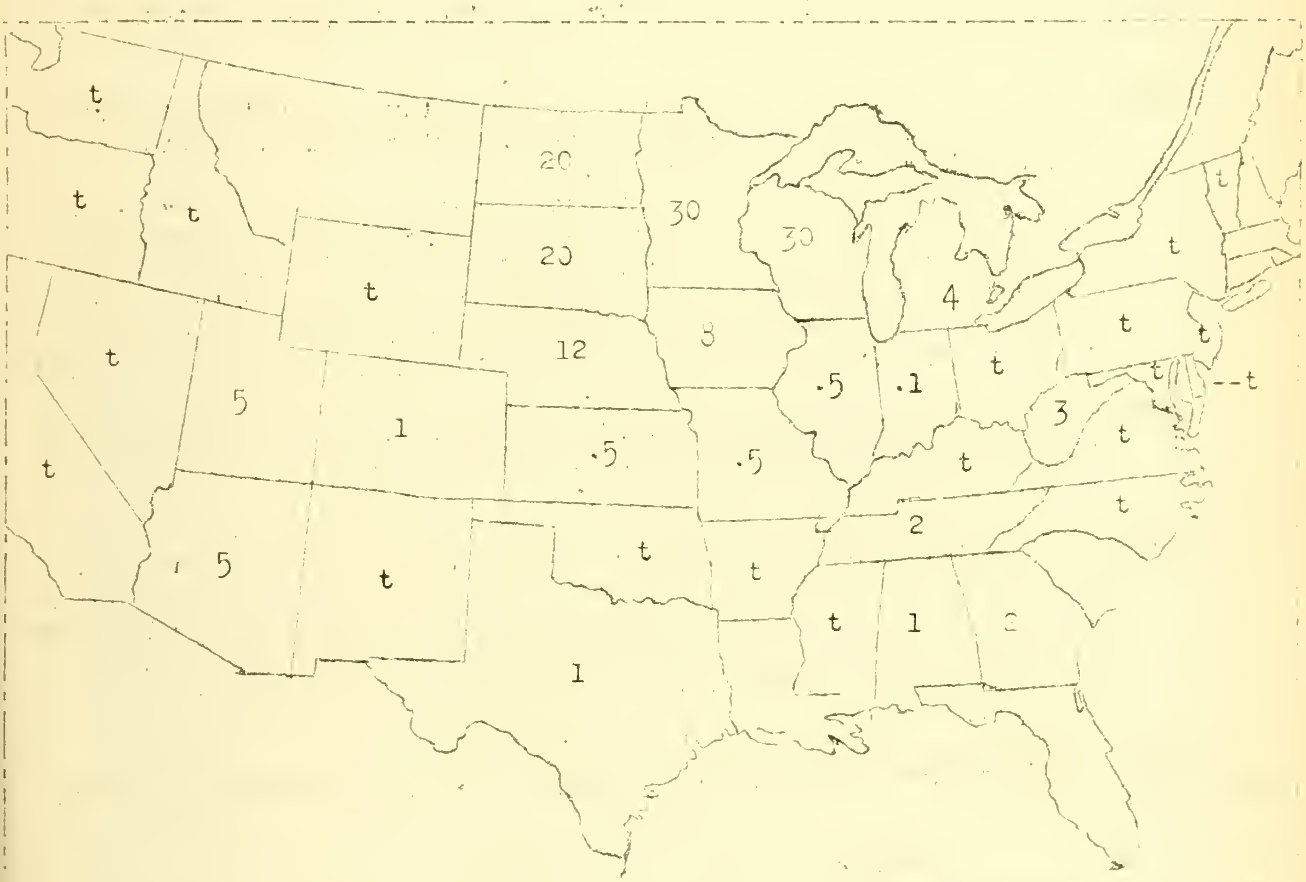


Fig. 24. Estimated percentage reduction in yield from stem rust of wheat, 1920.

Comments of especial interest on occurrence and severity of infection are as follows:

Michigan: "Stem rust probably reduced winter wheat by the average amount which, with leaf rust, has generally been believed to be under 5%. Frequent cases were found in the lower tier of counties where severe loss was associated with barberry plants in close proximity to fields. In the spring wheat area, which is largely in the Upper Peninsula, loss from black stem rust was worst in years, wheat in general being shriveled and of poor quality. At the Chatham station spring wheat was not harvested. A trip through that section showed any number of fields that looked pronouncedly sooty from a distance. I would place the loss at easily 25% in spring wheat.

The average weight of wheat in that county was 52 pounds to the bushel, against an average 60-62".(Coons)

Wisconsin: "Very heavy infection. The earliest planted fields are ripening ahead of great damage. The later plantings will hardly yield 25 to 50% of a crop. Fields on the east side of the state under influence of Lake Michigan show less rust than the interior and western sections. The small acreage of winter wheat had very little rust". (Vaughan)

Minnesota: "More prevalent and destructive than in 1919."(Section of Plant Pathology.)

North Dakota: "Stem rust has been very destructive in southeast North Dakota and in widely scattered areas, particularly in parts of Walsh and Grand Forks Counties". (Bolley)

"Rust, excepting in southeastern counties,was not severe in most parts of the state except in fields sown late. Marquis and Velvet Chaff were found practically free from rust in many fields I visited. In Stutsman County, which is almost entirely a durum wheat county and particularly a D-1 or Monad county, rust was not to be found except in an occasional late field of Marquis".(Weniger)

South Dakota: "Very general, from 10 to 100% of injury. Farmers taking to rust resistant durums. Favorable weather until a week later would have cut loss by 75%". (Arthur T. Evans)

Kansas: "Generally wheat stem rust was not serious in Kansas the past season. If it had appeared in the same amount a few weeks earlier no doubt serious injury would have resulted. The rainy spells stopped in sufficient time and very good weather for maturing the crop continued until harvest". (Melchers in Cereal Courier 12: 328. Sept. 30, 1920)

Dates of first appearance of uredinia,which are of particular interest, are as follows:

May 28..	Alabama
June 8................	Tennessee (uredinia abundant)
June 22...............	Minnesota
June 22...............	North Dakota.

Bisby found the first trace of rust (a single uredinium) on wheat at Winnipeg on June 30. He found infection on barberry June 3 and aecia open and shedding spores on June 11. Some sporulating aecia were found throughout June, July, August, and until September 16.

The occurrence of aecia of stem rust on species of Berberis and Mahonia in the United States as given by Arthur and Fromme (North American Flora 7: 295. 1920) is shown on the accompanying map. This is of especial interest in connection with the question of the sources of initial infection of wheat and other cereals and grasses for which two apparent possibilities exist: (1) overwintering of teliospores with subsequent infection of the aecial host followed by aeciospore infection of the telial host; (2) overwintering of urediniospores, or of dormant mycelium in the telial host, followed by reinfection of the telial host by urediniospores. Stakman, Kirby, and Thiel (The regional occurrence of Puccinia graminis on barberry. Phytopath. 11: 39-40, 1921.) have determined that teliospores in the south lose their viability during the winter and are hence incapable of germination in the spring. This offers an explanation for their observations that aecia on barberry are not commonly found south of 40° N. latitude, except at higher elevations where heavy infection was found as far south as 37°, and is in substantial agreement with the occurrence as shown on the map.

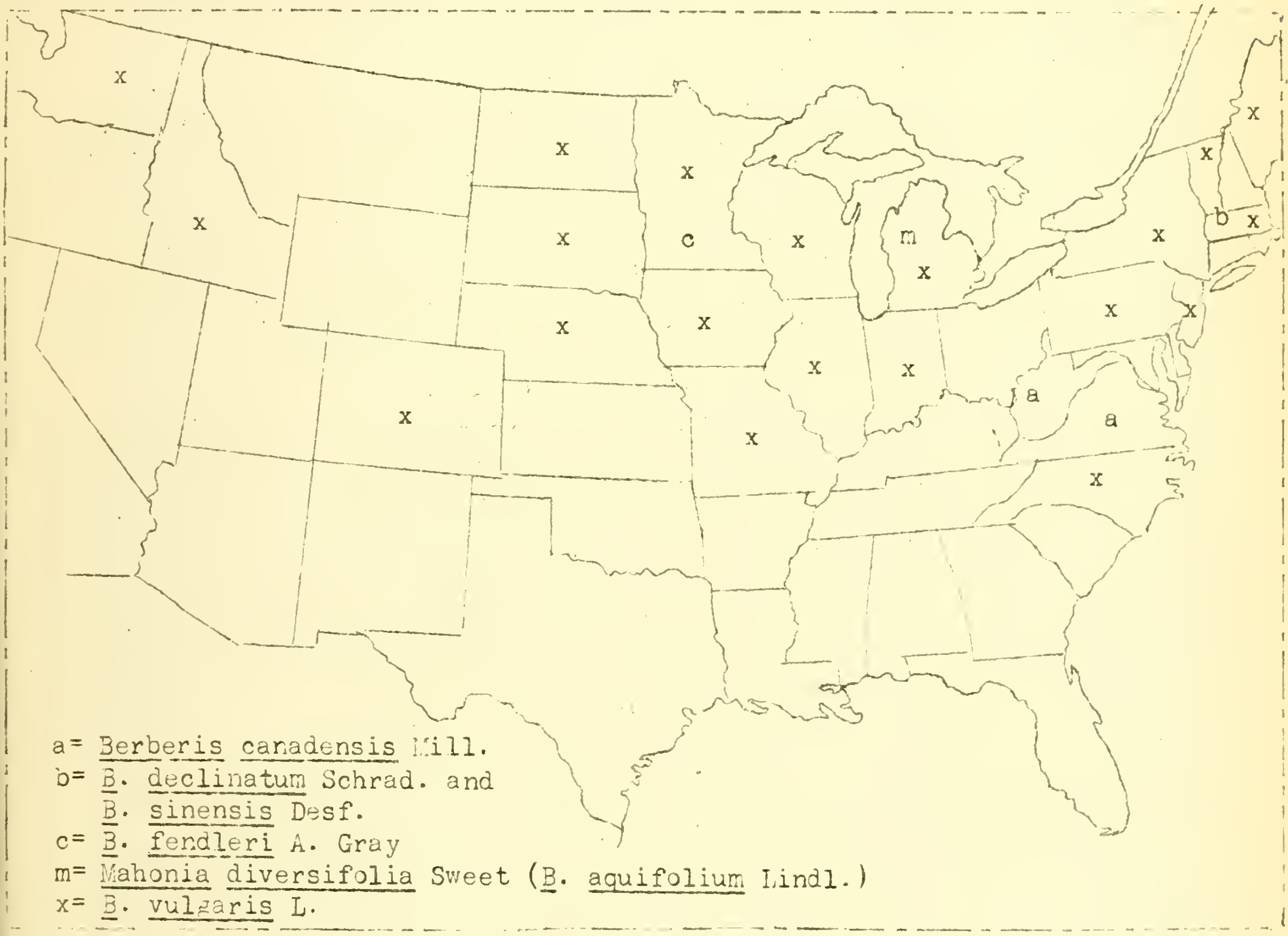


Fig. 25. Occurrence on various hosts of aecia of stem rust (Puccinia graminis) as recorded in the North American Flora. The different hosts are designated by symbols.

Stakman comments in part on the question of overwintering as follows (Cereal Courier 12: 241. July 31, 1920):

"Stem rust did not overwinter in the uredinial stage on winter wheat at St. Paul, Minnesota. There is some evidence that it may have overwintered on a plot of winter wheat at Madison, Wisconsin. The presumptive evidence is strong that rust may have developed from barberry in eastern Nebraska, Iowa, southern Minnesota, and eastern South Dakota. On the other hand, it is quite possible that it may have spread gradually northward from farther south........ The only rust found on Agrostis alba so far has been traced to rusted barberry. Barberries began to rust early in May and rust began to develop in wheat fields about June 20. So far the circimstantial evidence is strong that much rust undoubtedly came from barberry. On the other hand there also is evidence that some infection may have come from overwintered urediniospores and there also is some slight evidence that a certain amount of it may have spread from the South to the North".

Bolley makes the following comment with respect to North Dakota:

"Observations in this state, and I think in others, are very convincing that much of the destruction is brought about by local attacks of rust arising from barberry bushes in the immediate neighborhood of the green fields."

The following notes and data on the susceptibility of varieties were obtained. Kanred was reported as showing resistance to stem rust in Illinois, Wisconsin, Nebraska, and Kansas. A. G. Johnson made observations on the experimental plots at Brookings, South Dakota, and noted that of the durum wheats, Kubanka showed considerable rust, while Acme, D-5 (North Dakota), Mindum, and Monad were slightly rusted, the latter two showing more than the others in the order given. All of the common wheats were heavily rusted, Kota less so than Marquis and Prelude. J. C. Brinsmade, Jr. comments on varieties at the Northern Great Plains Field Station, Mandan, North Dakota, as follows:

"There is a high percentage of stem rust on most of the common wheats and some of the durums in the wheat nursery, which were sown late and in a low, damp spot. Kota is conspicuous for its practical freedom from stem rust while Marquis, Preston, Power Fife, Haynes Bluestem, Prelude, Ruby, and the hybrids between Kubanka and Preston and Kubanka and Haynes are severely rusted. Of the durums, D-5, Acme, and Monad are almost free from rust, while some of the Kubankas and Arnautkas, especially Kubanka C. I. 4063, and Arnautka C. I. 4064 are badly rusted." (Cereal Courier 12: 260. August 10, 1920.)

Progress of Barberry Eradication Campaign
by
F. E. Kempton, Pathologist in Charge, Office of Cereal Investigations.

"The barberry eradication campaign has been pressed vigorously in the eradication area. It has proved to be a more extensive piece of work than was anticipated. Results obtained in the early part of the campaign seemed to indicate that the greater portion of common barberries were in towns and cities. The evidence obtained in the second year of the campaign disproved this conclusion. Accordingly plans were formulated with a view to inaugurating a systematic farm-to-farm survey. Through the execution of this plan it has become obvious that it is necessary to continue the farm-to-farm survey until all important grain-growing areas in which barberries are found to become infected with black stem rust are freed of this pest.

"From the beginning of the campaign to December 31, 1919, the original survey of nearly all cities and towns, except Chicago, Cincinnati, Milwaukee, and villages of less than 300 population, either not accessible by railroads or in less densely populated parts of the States, was completed. In this survey, 1,299,461 bushes were located on 35,878 city properties. Nearby farms and those accessible from main highways traversed were surveyed also. The survey of all main ranches and all farms of the irrigated districts of Montana was completed. A preliminary farm-to-farm survey of a few counties or parts of counties in each

Table 46. Progress of barberry eradication campaign - Summary of state totals from the beginning of campaign to December 31, 1920, inclusive.

A. Number of properties with barberry bushes.

State	In Towns	In country Total	In country Wild	Town and country Found	Town and country Removed
Colorado	1,469	44	10	1,513	1,508
Illinois	6,440	316	193	6,756	6,278
Indiana	3,081	353	19	3,434	3,409
Iowa	6,466	816	172	7,282	5,797
Michigan	3,586	3,369	843	6,955	4,912
Minnesota	2,722	790	182	3,512	3,487
Montana	152	43	1	195	194
Nebraska	2,935	103	3	3,038	1,451
North Dakota	423	90	0	513	513
Ohio	3,686	326	41	4,012	2,622
South Dakota	372	144	31	516	464
Wisconsin	5,730	1,047	309	6,777	6,275
Wyoming	70	7	1	77	24
Totals	37,132	7,448	1,805	44,580	36,934

B. Number of bushes located and removed.

State	Towns	In country Total	In country Wild	Sprouting	Totals Found	Totals Removed
Colorado	19,882	1,760	1,397	1,195	21,642	21,245
Illinois	74,665	9,086	2,201	661	83,751	78,867
Indiana	75,025	10,134	2,441	1,852	85,159	83,918
Iowa	142,491	82,045	29,273	2,883	224,536	174,476
Michigan	35,951	103,696	58,743	187	139,647	92,276
Minnesota	588,104	145,431	50,868	7,241	733,535	733,065
Montana	6,577	2,105	1	4,515	8,682	8,671
Nebraska	71,000	6,057	801	1,325	77,057	61,240
North Dakota	3,782	1,110	0	215	4,892	4,892
Ohio	193,760	20,102	15,209	0	213,862	173,892
South Dakota	21,924	14,262	8,344	913	36,186	30,519
Wisconsin	75,472	3,030,711	3,024,352	8,284	3,106,183	2,013,955
Wyoming	3,932	168	1	190	4,100	492
Totals	1,312,565	3,426,667	3,193,631	29,461	4,739,232	3,478,508

state was made. The entire rural area covered was equivalent to 95 counties. A total of 1,933,841 barberry bushes were found on 5,776 farms showing that more barberries were to be found on farms than on city properties. Of this number, 1,758,244 bushes were escaped from cultivation on 1,425 farms, and the remaining 175,597 bushes were under cultivation on 4,351 farmsteads. The above figures total 3,233,302 bushes on 41,654 properties in this period. Of this total number 2,968,910 bushes have been removed from 31,455 properties. A resurvey of all properties found to have barberry bushes proved to be necessary as bushes were not always readily removed or were improperly dug by the property owners.

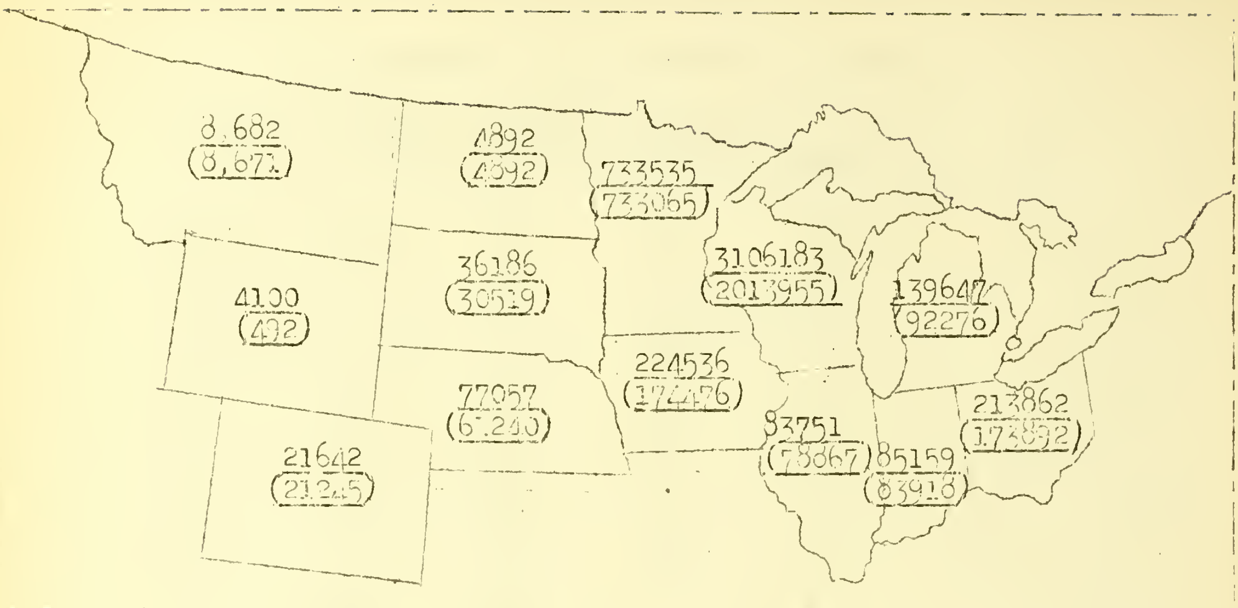


Fig. 26. Progress of barberry eradication. Barberry bushes found and (destroyed) April 1, 1918 to December 31, 1920.

Sprouts and seedlings often appeared. During this period 144,178 bushes and 5,836 sprouts were removed from 1,780 properties in resurvey work.

"In the period January 1 to December 31, 1920, efforts were concentrated upon the farm-to-farm survey. Every rural property and all properties not already surveyed in cities and villages included in the counties covered were surveyed in an area equivalent to 88 counties. The result of this farm-to-farm survey was that during the year 1,492,826 barberry bushes were found on 1,672 farm, 57,439 bushes being located on 1,292 farmsteads while 1,435,387 bushes were escaped from cultivation on 380 farms. These escapes had grown from seeds which had been scattered by birds and by farm animals that feed on the berries. They were found along fence rows, stream banks, in woodlands, orchards, windbreaks, old stone quarries, and on rocky cliffs. These areas of escaped bushes varied from one small seedling in the state of Wyoming to 1,335,000 bushes in one county in Wisconsin. In cities and villages, 13,104 bushes were found on 1,254 properties. In the original survey, 1,505,930 bushes have been located on 2,926 properties. 453,387 bushes were removed from 2,990 properties. In resurvey 72,684 bushes which had not been removed by the property owners were found remaining on 2,602 properties, but 56,303 bushes and 14,148 sprouts were removed from 2,478 properties. During the year a total of 1,505,930 bushes were found on 2,926 properties and 509,690 bushes were removed from 5,477 properties.

"During the entire campaign, April 1, 1918 to December 31, 1920, 1,312,565 bushes have been found on 37,132 city properties; 3,426,667 bushes on 7,443 farms; 233,036 bushes were on 5,643 farmsteads; 3,193,631 bushes were escaped from cultivation on 1,805 farms. In the farm-to-farm survey an area equivalent to 183 counties has been completed. This includes all the rural territory necessary to survey in Montana and in the western part of Colorado. A total of 4,739,232 bushes have been located on 44,580 properties; 3,478,508 bushes have been removed from 36,934 properties. Of the 1,360,724 bushes remaining on 7,666 properties, 1,000,000 are bushes under 18 inches in height on one farm in southern Wisconsin. Many of the others remaining are in areas of escaped bushes or in large hedges too extensive to be eradicated immediately. While state lawa in all states except Wyoming require the property owners to remove them, time must be given to allow the task to be accomplished.

Table 47. Progress of barberry eradication campaign - Number of bushes escaped from cultivation on farms during entire campaign and during 1920 calendar year, also number of bushes found and destroyed from January 1, 1920 to December 31, 1920.

State	Number bushes escaped from cultivation		January 1, 1920 to December 31, 1920.	
	Entire campaign	Calendar year 1920	Number bushes found	Number bushes destroyed
Colorado	1,397	1,347	1,976	4,336
Illinois	2,201	1,205	2,042	2,663
Indiana	2,441	218	1,558	10,048
Iowa	29,273	2,219	13,710	10,860
Michigan	58,743	8,123	20,419	22,782
Minnesota	50,868	6,499	9,222	17,938
Montana	1	0	76	147
Nebraska	801	801	2,574	15,013
North Dakota	0	0	1,805	1,805
Ohio	15,209	12,543	18,798	66,733
South Dakota	8,344	5,473	8,789	10,631
Wisconsin	3,024,352	1,396,958	1,424,708	346,618
Wyoming	1	1	253	166
Totals	3,193,631	1,435,387	1,505,930	509,740

Lear rust caused by Puccinia triticina Eriks. and Henn.

The leaf rust of wheat was in general very much less severe throughout the country in 1920 than in 1919, in which year it was more prevalent and destructive than had ever been recorded previously. It was said to be present to some extent in every state from which reports were received and in general throughout the wheat-growing sections of the states in question. The states reporting the disease as less severe than in 1919 form a well-marked belt, constituting the middle tier of Eastern and Central states, with Pennsylvania and Iowa on the north, South Dakota, Nebraska, and Kansas on the west, and Arkansas and Tennessee on the south. North of this belt the disease was reported as about the same as in 1919 or more severe (same - New York and Wisconsin; more severe - North Dakota, Minnesota, and in the Upper Peninsula of Michigan). It was as usual prevalent and rather destructive in Georgia and other states south of this belt. The estimated percentage of reduction in yield for the different states is shown in the following tabulation:

Table 48. Estimates of percentage loss from leaf rust of wheat by states, 1920.

Percentage loss	States
4	Mississippi.
3	North Carolina.
2	Virginia, Georgia, Alabama, Arkansas, Oklahoma.
1.5	North Dakota, Maryland.
1	Kentucky, Missouri, Iowa, South Dakota, Nebraska, Texas.
.5	Illinois.
.1	Indiana.
t	Vermont, New York, Pennsylvania, New Jersey, Delaware, Ohio, West Virginia, Tennessee, Michigan, Wisconsin, Minnesota, Louisiana, Kansas, Colorado, New Mexico, Arizona, Utah, Idaho, Washington, California.

With respect to relative prevalence the following statement of Melchers is interesting:

"Leaf rust was exceedingly rare in Kansas the past season (1920). There was no injury whatsoever caused. This is interesting in view of the fact that the year before one of the worst epidemics of leaf rust hit Kansas that has occurred for many years." (Cereal Courier 12: 328. Sept. 30.)

A careful comparison of climatic conditions in 1919 and 1920 would no doubt throw considerable light on the causes of the marked variation in severity of leaf rust. Such notes on the influence of climate as were received from collaborators indicate considerable difference of opinion as to effect of precipitation and temperature.

Two important new extensions in our knowledge of the leaf rust fungus have been reported from the Indiana Station, where H. S. Jackson, in collaboration with the Cereal Office, is in charge of the project on leaf rust investigation. These are: (1) the discovery of the existence of two strains of P. triticina; and (2) the successful culture of the rust from wheat on its previously unknown aecial hosts. In a preliminary note (Two strains of Puccinia triticina on wheat in the United States. Phytopath. 11: 40. January 1921.) Mains and Jackson report the separation of a number of uredinial cultures into two groups based on their ability or inability to infect certain selections of Malakoff and Turkey x Bearded Minnesota. They also comment on this as follows in the Cereal Courier for August 31, 1920:

"As a result of greenhouse and field observations it has become evident that at least two fairly distinct strains of the orange leaf rust are to be found in this country. From the data now at hand it appears that these are to be distinguished fairly easily by the character of infection produced upon different wheat varieties."

They have also noted that certain varieties show differences in susceptibility according to the age of the plants, certain varieties which are highly resistant as they near maturity being moderately susceptible in the seedling stage.

With respect to the determination of the aecial hosts of P. triticina, Jackson and Mains (The aecidium of the orange leaf rust of wheat, Puccinia tritiitina. Phytopath. 11: 40. January 1921.) record infection resulting in the development of pycnia or aecia on 12 species of Thalictrum from sowings of wintered teliospores. The most vigorous development of aecia was obtained on four exotic species, and only occasional infection with weak development of aecia was obtained on the native species used. Aeciospores from Thalictrum were sown back on wheat with the production of typical uredinia of Puccinia triticina.

No very definite dates of first appearance were reported. Bolley states that leaf rust was noted on wheat in North Dakota when the plants were a few inches high. It is evident, for the South at least, that the rust winters over on fall sown grain. Fromme notes that the rust was present throughout the winter on wheat at Blacksburg, Virginia, while Temple makes the same comment with reference to Maryland. Johnson supplies the following note concerning hibernating mycelium:

> "On March 28, Mr. McKinney dug up some wheat plants at Granite City, Illinois, and shipped them to us here at Madison. We placed them in the greenhouse and on April 12 it was with especial interest that I noted the development of a number of new uredinia of leaf rust on one of the old, green leaves. They were apparently developing around an old lesion, hence there was rather definite evidence of hibernating mycelium."

E. B. Mains has kindly supplied the following note regarding varietal susceptibility in tests at Lafayette, Indiana:

> "There was not enough P. triticina on winter wheat at Lafayette in the spring of 1920 to give field data on varietal susceptibility. Spring wheat, however, was fairly heavily rusted. The club wheats were all very heavily rusted the latter part of July showing 65-100%. The emmers were in general very resistant, the most susceptible variety, Red Emmer from Canada, showing 25% accompanied, however, with hypersensitiveness. The durums were all very resistant, 0-10%, except Arnautka C. I. 1493, which showed 25-30% with hypersensitiveness. The einkorns were immune. Polish C. I. 5524 showed only a trace, while C. I. 3007 showed 15-25%. White Spring Spelt was only slightly rusted while Bearded Spring C. I. 4776 showed 5-20%. Of the bread wheats none were immune, Marquis showing the lowest percentage of rust, 30-40%, just before harvest."

Bolley notes leaf rust to have been confined rather especially to certain varieties in North Dakota, being much more severe on some than on others, with the durum wheats especially free. Valleau reports the variety Ashland very free from leaf rust at the Experiment Station at Lexington, Kentucky.

Stripe rust caused by Puccinia glumarum (Schm.) Eriks. & Henn.

The only definite reports of stripe rust received in 1920 were from Oregon and California. In the latter state it was reported by Mackie as occurring in the cereal plots at Eureka, affecting Early Baart more than other varieties. The accompanying map shows the occurrence of stripe rust on wheat, rye, barley, and its various grass hosts by states as recorded in the North American Flora 7[5]: 338. 1920.

Fig. 27. Occurrence of stripe rust, Puccinia glumarum, on cereals and grasses in the United States, as recorded in North American Flora 7[5]: 338. 1920. Also recorded from the provinces of British Columbia and Alberta, and from Mexico.

Scab (blight) caused by Gibberella saubinetii (Mont.) Sacc.

Wheat scab, although it occurred over practically the same range as in 1919, was very markedly less severe in intensity throughout its range with a few local exceptions. In most of the states infection occurred on the heads rather generally but the percentage of affected heads was slight. Seedling blights, ascribed to this fungus or to Fusarium spp., were reported from Virginia, Delaware, Wisconsin, North Dakota, and Idaho. They were of minor importance as a rule. The occurrence of the head blight, as well as the estimated percentage reduction in yield for the different states is shown in the accompanying table and map. Losses for 1919 are also shown for comparison with those of 1920. It will be noted in the states in which the disease was epiphytotic in 1919 that the decrease in severity in 1920 was very striking. This is true of all states with the exception of South Dakota where Evans estimates the loss in 1920 as 15% as compared with 10% in 1919, and for localities in Kansas and Nebraska.

Table 49. Comparison of losses from wheat scab (blight) in 1919 and 1920.

Division	State	Estimated percentage loss 1919	1920
North Atlantic	New York	t	t
	Pennsylvania	3	1
	New Jersey	4	1
South Atlantic	Delaware	4	.5
	Maryland	5	1
	West Virginia	15	1
	Virginia	2	t
	North Carolina	5	t
North Central (East)	Michigan	-	t
	Ohio	8	.5
	Indiana	12	.5
	Illinois	18	2
	Wisconsin	9	1.5
North Central (West)	Minnesota	7	2
	North Dakota	5	1
	South Dakota	10	15
	Nebraska	1	1
	Kansas	t	t
	Iowa	20	.5
	Missouri	6	2
South Central	Kentucky	8	2
	Tennessee	8	t
	Alabama	t	t
	Arkansas	t	t
	Texas	t	1

Extracts from reports dealing with the few localities where head blight was severe follow:

Kansas: "Reported in Labette County. Practically every field showed enough injury to reduce the yield from one to six bushels. Soft wheats are grown in this county." (Melchers, July 15)

"This year for the first time distinct injury occurred in Labette County as well as some injury in adjoining counties (Cherokee). In Labette County in particular, very many fields were reduced at least 25% in yield due to wheat scab. Climatic conditions were very favorable for this disease the past year. It is of interest to note that in August specimens of corn root rot had been sent from this same county. According to county agent reports the injury from scab in many fields is serious." (Melchers in Cereal Courier 12: 328. Sept. 30, 1920.)

Nebraska: "Severe infection around Dakota County, 25-50% of the wheat in this section is infected with scab." (R. W. Goss)

"Severe damage from black rust and scab reported." (Weekly Crop Notes of the Bureau of Crop Extimates, Aug. 12)

"Crop very light due to rust and scab." (Weekly Crop Notes, Aug. 19)

"Crop was seriously damaged by black stem rust and scab and much will not be threshed. Yields cut 50% or more." (Weekly Crop Notes, Sept. 16)

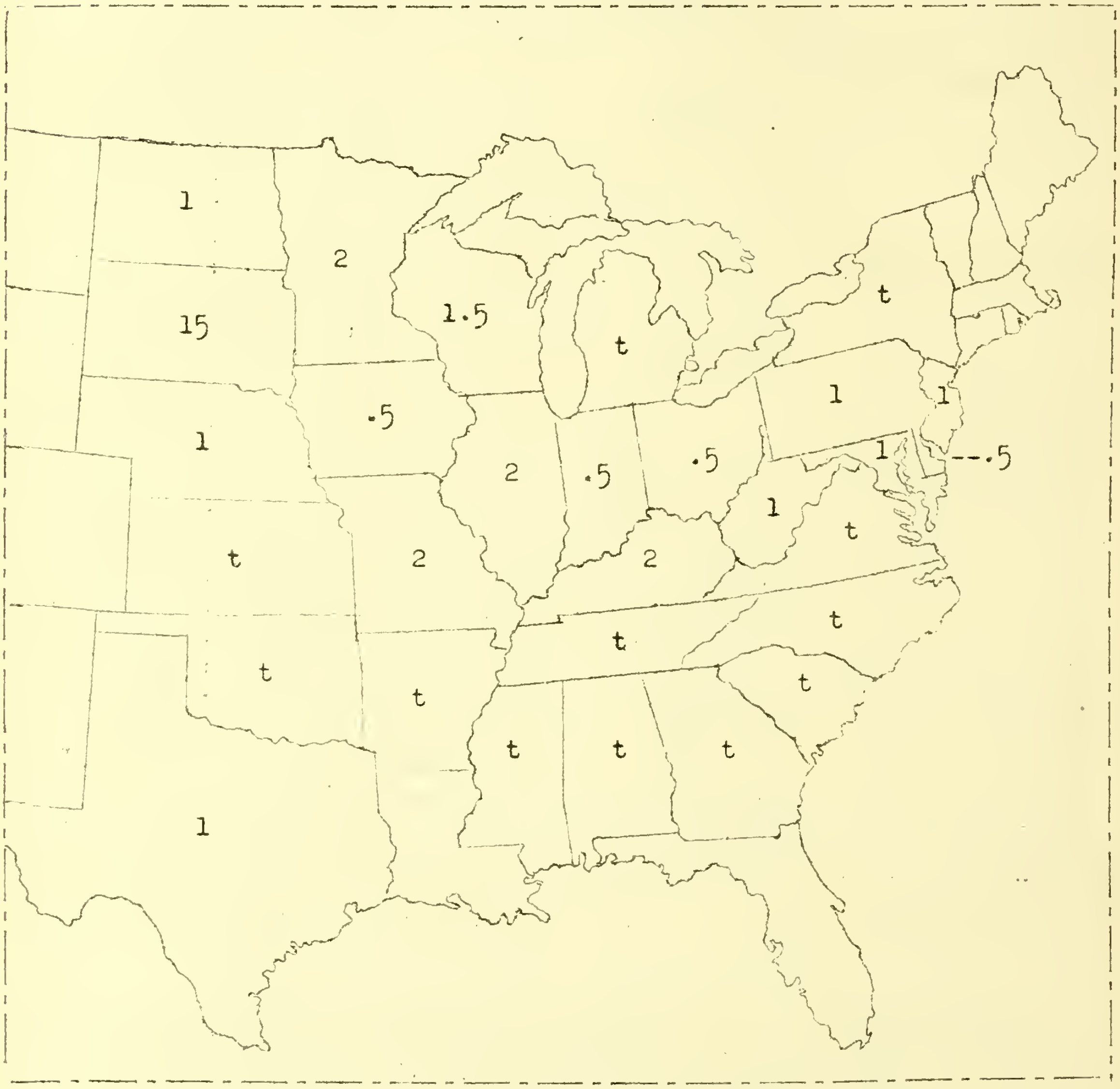


Fig. 28. Percentage losses from wheat scab, 1920.

South Dakota: "Scab is very bad in wheat (Marquis) in every part of the state. Rust developed fast under most favorable conditions (foggy weather) during the middle and latter part of July. These two diseases alone have ruined a most promising crop, the best prospect South Dakota has had in years. Many fields will not make more than one or two bushels per acre and that of inferior grade." (Arthur T. Evans.)

No doubt climatic conditions were chiefly responsible for the slight head blight in 1920. Dickson, Johann, and Wineland (Second progress report on the Fusarium blight (scab) of wheat. Phytopath. 11: 35. 1921) have found great differences in perithecial development for the seasons of 1919 and 1920 - 51% of the specimens in 1919 and 15% in 1920 - and suggest that this is closely associated with moisture. They also find that the highest percentage of infection occurs during the period of flowering. Comments from the states on climatic conditions are as follows:

West Virginia: "I believe the decrease in scab is largely due to different weather conditions when the grain was in bloom." (Giddings)

Virginia: "There were practically no rains during the heading period in 1920 while rains were very frequent during the same period in 1918 and 1919." (Fromme)

North Dakota: "Dry weather preceding harvest prevented general distribution from field to field." (Bolley)

Ohio: "While we have had prolonged rainy periods with much cloudy weather during the harvest season in Ohio, the scab infection upon wheat appears much less prevalent than in 1919. It is felt that the greater care in the preparation of seed wheat and attention to screening and seed treatment have been important in this respect." (Selby)

Wisconsin: "Wet early, followed by dry weather commencing in late June." (Vaughan)

The dates of first appearance of the head blight as given by collaborators are as follows:

June	Arkansas	July 5	South Dakota
Last of June	Indiana	July 7	Ohio
Last of June	Illinois	July 9	Minnesota
July	Wisconsin	July 19	Pennsylvania

Comments and data on the relation of head blight to preceding crops of corn are in agreement with notes which have appeared in previous Supplements of the Plant Disease Bulletin. The following is of especial interest:

"Fusarium blight or scab was found in 46 fields ranging from only a trace in most of the northern portion of Wisconsin and northeastern Minnesota where the only fields showing a moderate scab infection were on corn land, to 40% in one of the southern Wisconsin fields. The highest percentages of scab were in southern Wisconsin, one field on corn land showing 40% by count. In general scab was only present in large quantities where wheat followed corn." (J. G. Dickson)

The following data obtained in the section between Minneapolis and Elk River, Minnesota were submitted by A. G. Johnson:

Wheat after corn	36% affected heads
Wheat after corn	33% affected heads
Wheat after corn	34% affected heads
Wheat after corn	30% (est.) affected heads
Wheat not after corn	trace affected heads
Wheat not after corn	trace affected heads

Various seedling blights, foot-rots and root-rots of wheat.

In the present imperfect state of our knowledge of the seedling-blights, foot-rots and root-rots of wheat that occur in different parts of the United States it seems best to treat them, as in the following, under three groups. It is not assumed that this will be the correct grouping when more definite knowledge of the causative agents is obtained. The seedling blight caused by Gibberella saubinetii and Fusarium spp., which is quite readily distinguished from the other seedling blights, is treated separately under wheat scab (blight).

Foot rot or "so-called take-all" possibly caused by Helminthosporium sp. Apparently there is still some question as to the cause of this disease which is known definitely only from certain localities in Illinois and Indiana. Although both Stevens and McKinney (F. L. Stevens, Foot-rot of wheat. Science n. s. 51: 517. May 21, 1920. H. H. McKinney, The so-called take-all disease of wheat in Illinois and Indiana. Phytopath. 11: 37. 1921) have obtained a Helminthosporium from diseased plants, neither has as yet produced the typical stunting and proliferation, which is so characteristic of this disease, from inoculations with this fungus. Both have obtained local lesions, but McKinney states that he finds these lesions common to all varieties of wheat and on plants which do not show stunting and excessive tillering. There is a suggestion, however, according to McKinney, that the so-called take-all is an unusual manifestation of the Helminthosporium disease of wheat which is present in many sections. The disease was severe in Madison County, Illinois, in 1920 but was less extensive than in 1919. It also recurred in an experimental field in Porter County, Indiana. Field tests of wheat varieties at Granite City, Illinois, which were cooperative between the Cereal Office and the University of Illinois, have shown very marked differences in varietal susceptibility, and resistant varieties, therefore, seem to offer the most promising and feasible means of control. These tests show that Red Wave, May and a strain of Turkey wheat are not susceptible to the disease, while the white-chaffed, red kernel type of Red Cross (Salzer's Prizetaker) and Illini Chief are very susceptible. A number of other varieties are only slightly susceptible.

Helminthosporium blight caused by species of Helminthosporium. A seedling blight of wheat which is ascribed to species of Helminthosporium was reported by collaborators from Wisconsin, North Dakota, Minnesota, Kansas, and Kentucky. This trouble, which has been reported from North Dakota and Minnesota in Plant Disease Bulletin Supplement 8: 36. May 1, 1920 has recently been described as it occurs in Minnesota by Louise C. Stakman (A Helminthosporium disease of wheat and rye. Minn. Agr. Exp. Sta. Bul. 191. July 1920). The disease as it occurs in Minnesota is primarily a foot and root rot of seedlings but also occurs in all parts of the plant. A similar trouble is found in rye and in various grasses. While the exact status of the species of Helminthosporium associated with this type of disease is as yet undetermined and the identity of the trouble in the various states is uncertain it seems best for the present to treat them under the same group, but separately from the foot-rot or so-called take-all which occurs in Illinois and Indiana. The following comments are quoted from reports of collaborators and others:

Wisconsin and Minnesota: "The occurrence of a seedling blight of wheat probably due chiefly to Helminthosporium sp. in the northern portion of the two states is worthy of special comment. Fourteen fields of wheat showed a blight quite different from the so-called take-all, ranging from a trace in most cases to 17% in one field. The latter field showed considerable spotting which could not be accredited to soil conditions. All isolations made from the field gave the typical

Helminthosporium which seems to be causing the blight through these regions. The seedling blight was generally present on the peat soils in Minnesota north of Duluth, varying with different varieties and methods of tillage. Mr. Barker of Minnesota reported similar observations in connection with his survey work in that state. This seedling blight seems in general quite different from that caused by Gibberella and Fusarium species and can generally be distinguished by the difference in color and presence of lesions on the leaves of the Helminthosporium blight. While the Helminthosporium seedling blight was found through the northern regions surveyed there are no indications that this is connected with the so-called take-all." (James G. Dickson)

Minnesota: "Minnesota Bulletin 191 summarizes our information about these diseases. This year the disease either did not reappear or was much less serious on many of the farms on which it almost destroyed the crop last year. While the foot rot as occurring in Minnesota undoubtedly is due to Helminthosporium and various other fungi, the condition of the grain plant has a great deal to do with the seriousness of the diseases." (E. C. Stakman)

North Dakota: "Spring wheat diseases showing their usual characteristic stages. In the old constantly cropped fields good examples of Helminthosporium and also fusarial root rot. In some cases the Helminthosporium acts quite characteristically like take-all of winter wheat. No doubt it would take on these characteristics much more definitely if it were not for the fact that under our spring conditions spring varieties run up with very much greater rapidity, and the atmosphere here is less moist than in the winter wheat regions." (H. L. Bolley)

"Helminthosporium on wheat was found on durum varieties especially D 5, D 1, and Kubanka, as a blade blight and also as lesions on the bases of the culms and on the glumes and grains. From one to five per cent of the heads were attacked in fields examined. As a blade blight, infection was found to run as high as eighty per cent." (Wanda Weniger)

Kansas: "Some young plants had root infection." (Melchers)

Kentucky: "Wheat came through the winter in the usual condition but when the roots were dug and washed in spring as growing just commenced, they were found to have no live roots but were producing a new root system from the crown. A study made on seed borne organisms shows that a very high percentage of what appears to be perfectly normal seed wheat is infected with an organism, probably Helminthosporium, capable of causing a root rot and seedling blight. This may account for the death of the roots during the winter." (Valleau)

Take-all probably caused by Ophiobolus graminis Sacc. The name "take-all" which has been used previously with reference to the foot-rots occurring in Illinois and Indiana should probably be restricted to those types of foot-rots with which species of Ophiobolus are associated. Apparently the first published report of the occurrence of Ophiobolus in connection with a foot-rot of wheat in this country is that of H. H. Whetzel in Plant Disease Bulletin 4: 103, October 15, 1920, and of R. S. Kirby and H. E. Thomas in Science n. s. 52: 368, October

15, 1920, both of which deal with the occurrence of a root and stalk disease in a field of wheat at East Rochester, New York, in 1920, with which a species of Ophiobolus has been found associated. Kirby and Thomas state that both the fungus and the disease symptoms with which it was found associated agree in essential details with the take-all of wheat and Ophiobolus graminis as described in Australia, France, and elsewhere.

F. D. Heald has kindly furnished a summary (prepared by F. D. Heald, B. F. Dana, and G. L. Zundel) of the information on the foot-rot of wheat which occurs in Washington based on studies made in 1918 and 1919. They state that perithecia of an Ophiobolus, which agrees most nearly with O. graminis Sacc., were found on specimens from one field at Shelton, Mason County, Washington. Various other ascomycetes were encountered in the material examined and the pathogenicity of none of these has as yet been determined. In all, foot-rots of wheat have been found in ten counties in the state as follows: Clarke, Cowlitz, Klickitat, Lewis, Mason, Pierce, Snohomish, Spokane, Thurston, and Whatcom, while similar troubles have been reported from Clarke County on oats and from Pierce County on barley. With respect to severity the following statement is quoted from the report:

> "Estimates of losses were made in fields visited by the writers in 1919. In Thurston, Vancouver, and Mason Counties of western Washington losses of 95%, 50%, and 25% respectively, were found. More extensive acreages were involved in eastern Washington. Losses ranged from 30-90% of the crop in certain fields in Klickitat County and one locality of Spokane County. In other places in Spokane County small loss was incurred."

And with respect to climatic conditions:

> "Climatic conditions are probably an important factor in the development of foot-rot. Spring temperatures have been subnormal during the two years that the disease has been under observation."

Other foot-rots and root-rots, causes unknown. Other root and foot troubles, the causes of which have not been determined, were reported from Kansas, Missouri, Oklahoma, and Maryland. There was no recurrence of the trouble reported from Roanoke, Virginia, last year. The foot rot in Kansas was found at Abilene and is considered by Melchers as possibly similar to the Illinois trouble. Learn reports a foot-rot and white heads as occurring in different localities in Oklahoma especially at Enid. Some plants were dwarfed and died when a few inches high, and 25% of white heads was found in one field. Black pycnidia, containing hyaline, oblong spores, were found at the lower nodes. Temple reports a root-rot of wheat in Maryland different from the one in Illinois, in which the diseased plants head but produce little or no grain.

Nematode disease caused by Tylenchus tritici (Stein.) Bast.

The nematode disease of wheat and rye did not occur, so far as is known, in 1920 in any states other than those from which it was recorded in 1919; namely, West Virginia, Virginia, and Georgia.

R. W. Leukel, who made a special survey in the states of North Carolina, Tennessee, and Ohio in August and September, 1920, reports finding no infection in these states. The search was made in counties which border closely on areas of known infestation - Sullivan County in Tennessee, the northern tier of counties in North Carolina, and Lawrence and Gallia Counties in Ohio. The galls which were found at a mill at Gallipolis, Ohio, in 1919 were found by Leukel to have come from a farm near Beech Hill, Mason County, West Virginia. This is the first definite record of occurrence in the Ohio River Valley, all previous records from West Virginia having been in counties on or near the Virginia border. Later in the autumn Mr. E. C. Sherwood, West Virginia Extension Pathologist, visited the farm at Beech Hill and found nematode galls in the wheat. The farmer did not plant any wheat in the fall of 1920 and agreed not to raise any for two or three years, and also to dispose of his wheat in such a way as to prevent the further spread of the nematode. From other evidence furnished by millers at Gallipolis, Ohio, it is not unlikely that wheat nematode may exist on more than the one farm in that general locality.

Giddings states that the disease was about the same in relative prevalence in West Virginia as in 1919 with losses slight for the state as a whole. In Virginia the disease is said by Fromme to be less prevalent than in 1919 and less destructive in individual fields as a rule. This is thought to be due, partly to winter killing of infected plants, and also in some measure at least, to the educational campaign for clean seed and crop rotation. In Georgia, where the disease is known only in Jackson County, it is reported by McClintock to be spreading and to be more serious than in 1919. The loss in Virginia was estimated at .1% for the state. A. G. Johnson and R. W. Leukel report, as the result of their experiments at Arlington, Virginia, (The nematode disease of cereals. Phytopath. 11: 41. 1921) severe infection of wheat, rye, emmer, and spelt. Oats and barley were practically immune although in a few cases rudimentary galls were obtained. Dissemination by the movement of larvae took place horizontally only about four inches, but the larvae moved upward from a depth of twelve inches. They find that the larvae die in less than a year in moist soil, and, in a field test, that one year of grass between wheat crops resulted in a disease-free crop of wheat on land that had been badly infested. Kanred was the only variety of wheat tested which showed consistent resistance.

Black chaff caused by Bacterium translucens undulosum Smith, Jones, & Reddy.

In 1920 black chaff was a disease of minor importance, in the states in which it occurs, the only report of serious injury coming from Oklahoma. No new states were added to the list of those given in previous Supplements of the Plant Disease Bulletin. The disease was reported from Arkansas (some fields generally infested, others almost or quite free; no damage), Wisconsin (found only in Plant Pathology cereal plots where Kansas seed was used), Iowa (present on leaves, only a trace on heads; much less than 1919), North Dakota (found only in the vicinity of Fargo; a disease of minor importance and apparently confined to the bread wheats), South Dakota (very general, some in every field, but no apparent damage), Kansas (present in very slight amounts in only a few fields, no damage whatever), Idaho (common at Idaho Falls, but not found elsewhere), and Oklahoma (not as prevalent as last year, but in new localities; reported by farmers as killing the plants in one locality).

Anthracnose caused by Colletotrichum cereale Manns.

No report of serious injury to wheat from anthracnose was received. Apparently it was much less severe than in 1919 in the few states in which it has been of importance. Reports of definite occurrence in slight amounts with little damage were received from New York, New Jersey, Virginia, Kentucky, Tennessee, Ohio, Alabama, Mississippi, Arkansas, Texas, Wisconsin, and Iowa, while it was said to be general in Delaware and responsible for a loss of 1% for the state.

Glume blotch and leaf spot caused by Septoria spp.

It has been difficult to distinguish between these diseases, which are apparently caused by two distinct species of Septoria, owing to the fact that they have been commonly reported under the same head. Future reports should distinguish between the glume blotch and leaf spot as far as possible.

Glume blotch and leaf spot occurred in practically all of the states east of the line marked by Minnesota on the north and Arkansas on the south, but were in general very much less prevalent and unimportant in these states than in 1919 when they attracted unusual attention. West of this line they were reported as occurring to a slight extent in North Dakota, Texas, Idaho, and California. They were said to be quite serious locally in Pennsylvania with as much as 50-90% infection on experimental wheat plots at State College. In no state were the losses estimated to exceed a trace except in Delaware where Manns states that infection was general with an estimated reduction in yield of .25% and in Maryland where Temple reports it as present in all fields, causing leaf blight, and estimates the loss at .5%. Infection was noted to be much less prevalent than in 1919 in Virginia, Indiana, Iowa, and Arkansas, while in Minnesota it was somewhat more prevalent than in 1919. Leaf spot was noted in Idaho as occurring only on seedlings, none seen on heads. Several collaborators note infection to be more severe on plants injured by other causes. It was associated with Hessian fly injury in Ohio; it followed rust and was worst on badly rusted plants in Minnesota, and was correlated with poor soil fertility in Pennsylvania. The earliest record of occurrence was in Wisconsin where it was found by Johnson on April 16 on wintered-over green leaves of fall sown wheat.

Ergot caused by Claviceps purpurea (Fr.) Tul.

Ergot was reported as occurring in wheat in 1920 from the states of North Dakota, Minnesota, Wisconsin, Nebraska, Illinois, Kentucky, Arizona, and Utah. One case was reported from Blair County, Pennsylvania, but was unconfirmed. It was of slight importance in most states except in Minnesota where the decrease in yield for the state was estimated as -1%. Extracts from reports are as follows:

Minnesota: "Worse than ever before. One variety of Triticum durum on the University Farm heavily affected." (Division of Plant Pathology)

North Dakota: "The one disease which seems to be making progress from one year to another, particularly in the durum wheats, is ergot. It may be that we shall have to make a rather definite fight against this fungous infection. I am inclined to think, however, that it will gradually lessen with more intensive agriculture rather than increase. This will probably come about from a more careful mowing and pasturing of native grasses on the drier lands." (Bolley)

In addition to wheat, ergot was said to occur on the following grasses in Wisconsin: Agropyron caninum, A. repens, A. smithii, A. tenerum, Agrostis palustris (A. alba), Arrhenatherum elatius, Bromus inermis, Calamagrostis canadensis, Dactylis glomerata, Elymus canadensis, E. virginicus, Festuca elatior, Glyceria fluitans, Hordeum jubatum, H. vulgare, Phleum pratense, Poa compressa,

P. pratensis, Secale cereale. Hungerford states that ergot is common on Lolium sp. and Bromus spp., especially B. condensatus, in Idaho.

It is unknown as yet whether or not distinct strains of the fungus occur on different grass hosts. McFarland has recently reported, as the result of cross inoculation work, (Phytopath. 11: 41. 1921) the infection of wheat in a few cases with conidia from rye, Arrhenatherum elatius, poa pratensis, and Agropyron repens. He found it more difficult to secure infection of wheat than of rye. Rye was infected with conidia from these three grasses and from Bromus inermis.

Powdery mildew caused by Erysiphe graminis D.C.

Although occurring rather generally throughout the country, powdery mildew of wheat was of slight importance and the estimated average loss did not exceed a trace in any state. It was especially prevalent and caused some injury locally, but was of minor importance for the crop as a whole in New York, West Virginia, Ohio, and Utah. As much as 80% infection was recorded in New York.

Other diseases.

Node disease, associated with Alternaria sp. was reported by Melchers from Kansas as follows:

> "Several instances have been reported and specimens examined of a culm infection which seems to be due to an Alternaria species. The culms become brittle at the nodes and break. Considerable loss due to the breaking over of heads has resulted in some fields." (Cereal Courier 12: 329. September 30, 1920)

Sooty mold caused by Hormodendrum cladosporioides Sacc. was reported by Mackie from six counties in California, severe in Humboldt and Contra Costa Counties. At Salinas this fungus was said to have ruined what would otherwise have been excellent yields. The only report from any other state to the Plant Disease Survey is that of Oregon in 1918.

RYE

Stem rust caused by Puccinia graminis Pers.

Stem rust of rye occurred to some extent in most of the states where rye is grown but usually in negligible amounts. It was of slight importance in three of the four leading rye states; Michigan (only a little present), North Dakota (not observed), Minnesota (not important) but caused an estimated reduction in yield of 5% in Wisconsin. The most severe losses occurred in South Dakota, where infection was general with an estimated reduction in yield for the state of 10%. Of the southern states, the only one reporting injury was Georgia with 2% estimated loss. In the other states reporting definite occurrences - New York, New Jersey, Maryland, Virginia, Indiana, Illinois, Iowa, Nebraska, Missouri, Oklahoma, Arkansas, Texas, Utah, Idaho, and California -

losses did not exceed a trace. In New York, Kirby reports having found it first on Agropyron repens near a barberry, June 9, and later on rye. It was more severe on late than on early rye in South Dakota.

Leaf rust caused by Puccinia dispersa Eriks.

Leaf rust occurred in practically all states east of Montana and Texas, but was generally much less prevalent and severe than in 1919. Although it was generally more prevalent than stem rust, the losses occasioned by leaf rust were reported as none or a trace except in Tennessee (2%), Georgia (2%), Maryland (1%), Iowa (.5%), and North Dakota (.5%). In Tennessee the disease occurred throughout the winter, according to Essary, Kurtzweil, and Hesler, and was general over the state, causing practically 100% injury. The rye crop in that state, however, is not usually cut for seed.

The first report for the northern states was from Wisconsin on May 3.

Scab (blight) caused by Gibberella saubinetii (Mont.) Sacc.

Scab on rye was reported as occurring in 1920 in New Jersey, Delaware, Virginia, Ohio, Kentucky, Tennessee, Arkansas, Illinois, Wisconsin, Minnesota, and North Dakota. Losses exceeding a trace were reported only from Wisconsin (.1%) and from North Dakota (.5%). This was in marked contrast with the season of 1919 when the disease was epidemic in most of the corn belt states with losses ranging from 2-3% in Indiana, Illinois, Wisconsin, Minnesota, South Dakota, Iowa, and Missouri. The only report of severe infection in individual fields received in 1920 was from Tennessee where 50% head infection was observed.

Anthracnose caused by Colletotrichum cereale Manns.

Anthracnose of rye was of very slight importance in the country in 1920. It was reported as occurring to a slight extent in New York, New Jersey, Delaware, Virginia, Kentucky, Texas, Arkansas, Ohio, Wisconsin, Minnesota, and North Dakota. In Illinois it was said to be general and caused a loss of possibly 1%. In Pennsylvania (Lycoming County) it was reported from one locality where it caused heavy loss

Powdery mildew caused by Erysiphe graminis DC.

Powdery mildew of rye was reported from Massachusetts, New York, New Jersey, Virginia, Texas, Ohio, and Wisconsin. It was of little or no importance in most cases.

Stem smut caused by Urocystis occulata (Wallr.) Rab.

Reports of the occurrence of the stem smut of rye in 1920 were received from Massachusetts, New York, Pennsylvania, New Jersey, Maryland, Virginia, Georgia, Texas, Indiana, Illinois, Wisconsin, Minnesota, and Iowa. The reduction in yield is estimated at 1% for Minnesota and Georgia, .1% for Indiana and Massachusetts and a trace for the other states reporting. Kirby reports that 10% infection occurred in one field in Dutchess County, New York, and that the disease was very prevalent in Columbia County on Rosen rye. Stem smut has been reported in previous years from practically every state east of the Rocky Mountain States and also from Arizona. There are no records in our files of its occurrence in the Pacific Coast States.

Head smut of rye caused by Ustilago sp.

This smut, which appears to be very rare in the United States, was reported in 1920 from Virginia and Indiana. A few heads were found at Arlington Farm, Virginia by members of the Cereal Office, Reed, Leighty, Tapke, and J. W. Taylor, and one head was found at the experimental farm at Staunton, Virginia by Reed and Fromme. H. S. Jackson and A. G. Johnson found six affected heads in a plot of Rosen rye in an experimental field at Wanatah, Indiana. The head smut of rye has been noted in previous years from Tennessee, Indiana, Virginia, Minnesota, Missouri (reported two or three times), and North Dakota (first record by Humphrey, who found one head in spring rye at Dickinson in 1913). It has not been referred definitely to any species of Ustilago and possibly is either an undescribed species or a biologic form of U. tritici.

Ergot caused by Claviceps purpurea (Fr.) Tul.

The occurrence and estimated percentages of reduction in yield for rye ergot in the various states in 1920 is shown in the following tabulation:

Table 50. Estimated percentages loss from ergot of rye in 1920.

Percentage loss	States
1	Minnnesota, South Dakota.
.5	Wisconsin, Ohio, Pennsylvania.
.2	North Dakota, Kentucky.
t	New York, Virginia, West Virginia, Michigan, Indiana, Illinois, Iowa, Missouri, Arkansas, Nebraska, Utah.

Ergot was reported as occurring chiefly on volunteer rye in Virginia, Indiana, Wisconsin, and Nebraska; as less prevalent than normally or than in 1919 from Michigan, Illinois, Indiana, Iowa, and North Dakota; and as more prevalent than 1919 from Minnesota and Ohio. Bisby states that ergot occurs commonly on rye in Manitoba. Farmers will not bother with the salt brine treatment in Wisconsin, according to Vaughan, owing to the slight losses. In South Dakota ergot appears to have been rather severe as Evans reports a 15% loss in one field of 160 acres at Aberdeen.

In view of Seymour and McFarland's recent studies (Losses from rye ergot. Phytopath. 11: 41. 1921) it seems probable that losses from ergot of rye have generally been underestimated. They find, in addition to the loss represented by the actual number of sclerotia, that a larger percentage of blasted kernels and empty florets occur on ergotized than on normal spikes.

Stripe rust caused by <u>Puccinia glumarum</u> (Schm.) Eriks. & Henn.

This rust was reported on rye only from Oregon where it was said to be of only slight importance and less abundant than last year. It was thought to be rather generally distributed in the state, but as no special search was made its prevalence could not be determined.

BARLEY

Covered smut caused by <u>Ustilago hordei</u> (Pers.) K. & S.

Covered smut occurred to some extent in all sections where barley is grown. No comments as to marked differences in occurrence or severity as compared with 1919 were received but it is probably generally true that there was a slight reduction in severity in 1920. It was not unusually severe in any state, the highest estimated percentage reduction in yield for a state being 2% (Idaho, Kansas, and Tennessee). The estimated percentages of reduction in yield from covered smut are shown on the accompanying map together with those for loose smut. These losses are shown in bushels in Plant Disease Bulletin, Supplement 18, 1921.

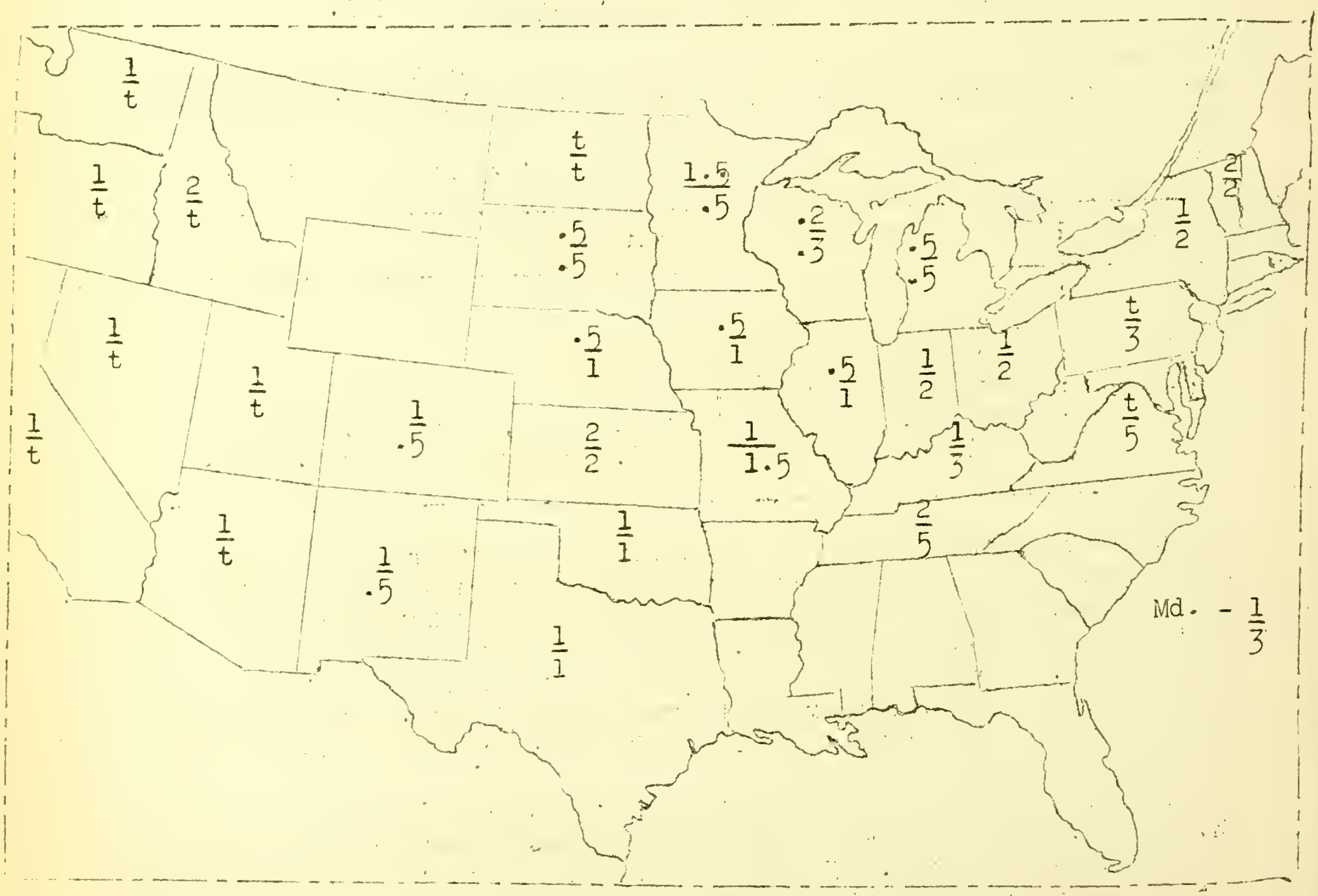


Table 29. Occurrence and estimated percentages of reduction in yield for covered and loose smuts of barley in 1920. The numerator shows percentage reduction in yield for covered smut, the denominator that for loose smut.

It will be noted in referring to the map (Fig. 29) that covered smut is shown to be more severe than loose smut in the Pacific and Rocky Mountain States, while this condition is reversed in a group of Eastern and Central States comprised of New York, Pennsylvania, Maryland, Virginia, Ohio, Indiana, Illinois, Iowa, Missouri, Kentucky, and Tennessee. In other states the two diseases appear to be of about equal importance. No data are available to show whether these differences, if they are real, are due to climatic differences or to other factors. It may be true that variations in the varieties of barley grown in these various sections are the important factors in determining relative prevalence and severity of the two smuts. Very little data on varietal susceptibility have been received.

Seed treatment of barley is said to be rather general in North Dakota, Wisconsin, and California. Lantz states that formaldehyde is used in Nevada with good results. Both the formaldehyde and copper sulphate-milk of lime treatments are used in California. Vaughan states that considerable barley seed is treated with the Cleland smut machine (formaldehyde) in Wisconsin. In North Dakota, according to Bolley, seed treatment appears gradually to eliminate both covered and loose smut.

Loose smut caused by Ustilago nuda (Jens.) K. & S.

Loose smut of barley was general throughout the country in 1920. It occurred in lesser amounts in the west, where state averages did not exceed a trace, than in the east where infection was more general and severe. The greatest losses were reported from the states east of the Mississippi River - Virginia and Tennessee 5%, Maryland, Pennsylvania, and Kentucky 3%, Vermont, New York, New Jersey, Ohio, and Indiana 2%. It is interesting to note that this is also the section where loose smut of wheat is most prevalent and severe. The relative severity of loose and covered smut in the country is shown in the following table as well as on the map included in the summary on covered smut. The range of severity of loose smut exceeded that of covered smut, the average percentage reduction in yield for all states from the former disease being 1.33% and that due to covered smut .88%. Very little information was obtained on severity in individual fields, varietal susceptibility, or weather relations. Gardner states that a few successful hot water treatments demonstrations were held in Indiana.

Table 51. Range of estimated average percentages of loss from loose and covered smuts of barley, 1920.

Disease	Number of states with									Average
	t	.2%	.3%	.5%	1%	1.5%	2%	3%	5%	percent
Covered smut	5	1	-	5	15	1	4			.88
Loose smut	8		1	5	5	1	6	3	2	1.33

Stripe caused by Helminthosporium gramineum Rab.

Barley stripe occurred to some extent in all sections of the country, except in the southern Atlantic States and the Gulf States from which no record of its presence was received. It was less severe in the upper Mississippi Valley

States, where it is usually an important factor in barley production, than in 1919 and average years. In Iowa, for example, where the percentage reduction in yield in 1919 was estimated at 5%, the 1920 estimate was 2%. In Wisconsin, Vaughan states that hundreds of acres were examined where no trace of stripe could be found. The loss here was estimated as a trace, compared with 1% in 1919 when it was reported as much less severe than for several years. The highest percentage of infection found in Wisconsin was 15% on low ground in Racine County. It was reported as very common in Tennessee, common and found in nearly all fields in Michigan, not common in North Dakota, severe where present in Utah but reported from only a few areas. It was observed in five counties in New York with the percentage of infected plants in individual fields ranging from a trace to 20%.

Table 52. Estimated percentages reduction in yield from barley stripe, 1920.

Average percentage loss	State
2	Iowa.
1	Minnesota, Michigan, Illinois, Indiana, Ohio.
.5	South Dakota.
t	Vermont, New York, Virginia, Tennessee, Wisconsin, Missouri, North Dakota, Nebraska, Oklahoma, Washington, Oregon, Idaho, Utah, Arizona, California.

It was first observed in May in Tennessee and California, May 31 in New York, and July 1 in Wisconsin.

Stem rust caused by Puccinia graminis Pers.

Definite occurrences of stem rust of barley in 1920 were reported from New York, Virginia, Indiana, Illinois, Wisconsin, Minnesota, Iowa, North Dakota, Nebraska, Kansas, Oklahoma, Texas, Colorado, Arizona, Utah, Idaho, and California. It was of slight importance in most of these states, occurring as mere traces with slight or no loss, except in Wisconsin, Minnesota, Iowa, and Arizona. It was about the same in severity in Wisconsin (3%) and Minnesota (5%) as in 1919, but was much more severe in Iowa where Melhus estimated a reduction in yield for the state of 17%. In Arizona as high as 4% actual loss was estimated. This disease along with leaf rust cut the barley yield by about one-third according to pathologists and agronomists in the Arizona Station. The rust on barley was reported as more severe in the vicinity of wheat in Wisconsin.

Leaf rust caused by Puccinia simplex (Koern.) Eriks. & Henn.

Leaf rust of barley was reported as occurring in a number of states in 1920 especially in the north-central, eastern, and southwestern parts of the country. It was said to be common in Vermont; general and very serious in Arizona; common, affecting 100% of the crop in Kentucky; and more prevalent than usual in Ohio. Apparently little or no injury resulted in most states and infection was chiefly slight and only occasional. In Arizona, however, this disease was apparently responsible for much damage according to J. G. Brown.

Reports of occurrence were received from the following states: Vermont, New York, Maryland, Virginia, Michigan, Ohio, Indiana, Kentucky, Tennessee, Illinois, Wisconsin, Minnesota, Iowa, North Dakota, Texas, Arizona, and California.

Scab (blight) caused by Gibberella saubinetii (Mont.) Sacc.

Scab was reported to occur on barley only from 11 states in 1920. It was of slight or no importance in all, no estimate of losses in excess of trace being received. This was in marked contrast to the season of 1919 when losses estimated at 3% in Iowa and South Dakota and 1% in Kentucky, Tennessee, and Missouri occurred. It was reported in 1920 as common or general in Kentucky, Tennessee, and Illinois, more than 1919 in Ohio and less than 1919 in Wisconsin. It was also reported to occur in New York, New Jersey, Virginia, Minnesota, Iowa, and Texas.

Net blotch caused by Helminthosporium teres Sacc.

In 1920 net blotch was reported from practically the same range as in 1919. It was reported as severe only in Wisconsin and Iowa. In Wisconsin, Vaughan states that it was more severe than in 1919 causing premature killing of the leaves with 75% injury and an estimated loss of 5%. In Iowa Melhus estimates 60% of the crop injured with a loss of 6%. Definite loss probably occurred in Ohio also where Selby placed the crop injury at 20%. The disease was also reported to occur, with slight or no loss, in Vermont, New York, Indiana, Minnesota, Idaho, and California.

Spot blotch caused by Helminthosporium sativum (P.) K. & B.

Spot blotch of barley was reported in 1920 from Vermont (occasional), Indiana, New York (two counties), Illinois (trace), Texas, California, and Idaho (very rare). It was more prevalent and severe in Wisconsin, where 25% of the crop was reported injured with an estimated loss of 2%, and in Minnesota which also reported 25% of the crop injured with loss amounting to about 1%. Seedling losses were said to be severe in a few cases in Wisconsin, and in North Dakota it was said to be the cause of a root blight of seedlings similar to the seedling blight of wheat. According to Vaughan no treatment tried had any effect on the disease.

Scald caused by Rhynchosporium secalis (Heins.) Davis.

Scald (Rhynchosporium blight) of barley was noted as occurring in Indiana (Lafayette), Kansas (trace), and Idaho (rare). It was less severe than usual in California, where it sometimes causes severe local losses. In Wisconsin this fungus was observed on Dactylis glomerata and Bromus inermis in addition to barley and rye (Charles Drechsler Occurrence of Rhynchosporium on Dactylis glomerata and Bromus inermis. Phytopath. 11: 42. 1921). It was present on Bromus in about the same abundance as on near-by plants of barley and rye, but was less plentiful on Dactylis.

Other diseases.

Anthracrose of barley (Colletotrichum cereale Manns) was reported as of minor importance from five states - New Jersey, Ohio, Wisconsin, Kentucky, and Texas.

Ergot of barley (Claviceps purpurea (Fr.) Tul.) occurred as a trace in Wisconsin, Minnesota, North Dakota, and Iowa.

Powdery mildew (Erysiphe graminis DC.) of barley occurred in rather severe form in New York and Ohio. As much as 80% infection was noted in Tompkins County, New York. It was said by Thomas to have occasioned more loss than rust in Ohio.

Stripe rust (Puccinia glumarum (Schm.) Eriks. & Henn.) was not reported on barley from any state in 1920.

Blight (Septoria sp.). Weniger reports one field of barley near Jamestown, North Dakota, severely attacked by a species of Septoria.

OATS

Smut caused by Ustilago avenae (Pers.) Jens. and U. levis (K. & S.) Mag.

The smuts of oats occurred as usual throughout the country, and were practically coextensive with the cultivation of oats with little apparent variation in severity in the different section. They were also found by E. C. Stakman at Anchorage and Skagway, Alaska. By comparison with the estimates for 1919 and from comments of collaborators it seems evident that as a rule there was slightly less smut in 1920 than in 1919 and considerably less than in years prior to 1919; and, further, that the rather general practice of seed treatment has been the principal factor in this general reduction in severity.

No unusually high percentages of infection were reported, the highest in individual fields being 25% in New York and Maryland, 15-20% in Vermont, 10% in West Virginia and Tennessee, and 6% in Wisconsin. In Virginia there was little smut in winter oats which was generally a very poor crop owing to winter killing, but in spring oats the disease was general. The accompanying map shows the occurrence and estimated percentages of reduction in yield for the oat smuts in 1920. The estimated losses summarized in bushels are given in Plant Disease Bulletin, Supplement 18, 1921. The range of the reported percentages reduction in yield are shown below. The figures under the percentage columns indicate the number of states with that average per cent.

Table 53. Range of estimated percentages reduction in yield of oats from smut, 1920.

Number of states with						Average per cent in all states.
1%	1.5%	2%	3%	4%	5%	
5	4	15	10	2	8	2.7

A special question was addressed to collaborators asking for reports on recent experiences in treating seed oats by the wet and dry methods or modifications. It is understood in these reports that reference to the wet or sprinkle method indicates the 1-320 concentration (1 pint to 40 gallons); the dry method equal parts, 1-1. Excerpts from these reports are given below.

New York: "The amount of oat smut in the state has been reduced very much since the Haskell dry method of treatment has been recommended. At least 75% of the growers practice seed treatment either every year or as often as smut begins to show. At least two seed firms treat most of the oats seed which they sell. There are still a few individual fields with large amounts of smut...... but a large percentage of the fields show none or merely a slight trace." (Chupp)

"Counts in 10 fields in Oneida County showed 1% smut in treated fields, and 12% in untreated fields. In Wyoming County, 8 treated fields had .8% of smut and 19 untreated fields 11.1%." (Data supplied by Chupp)

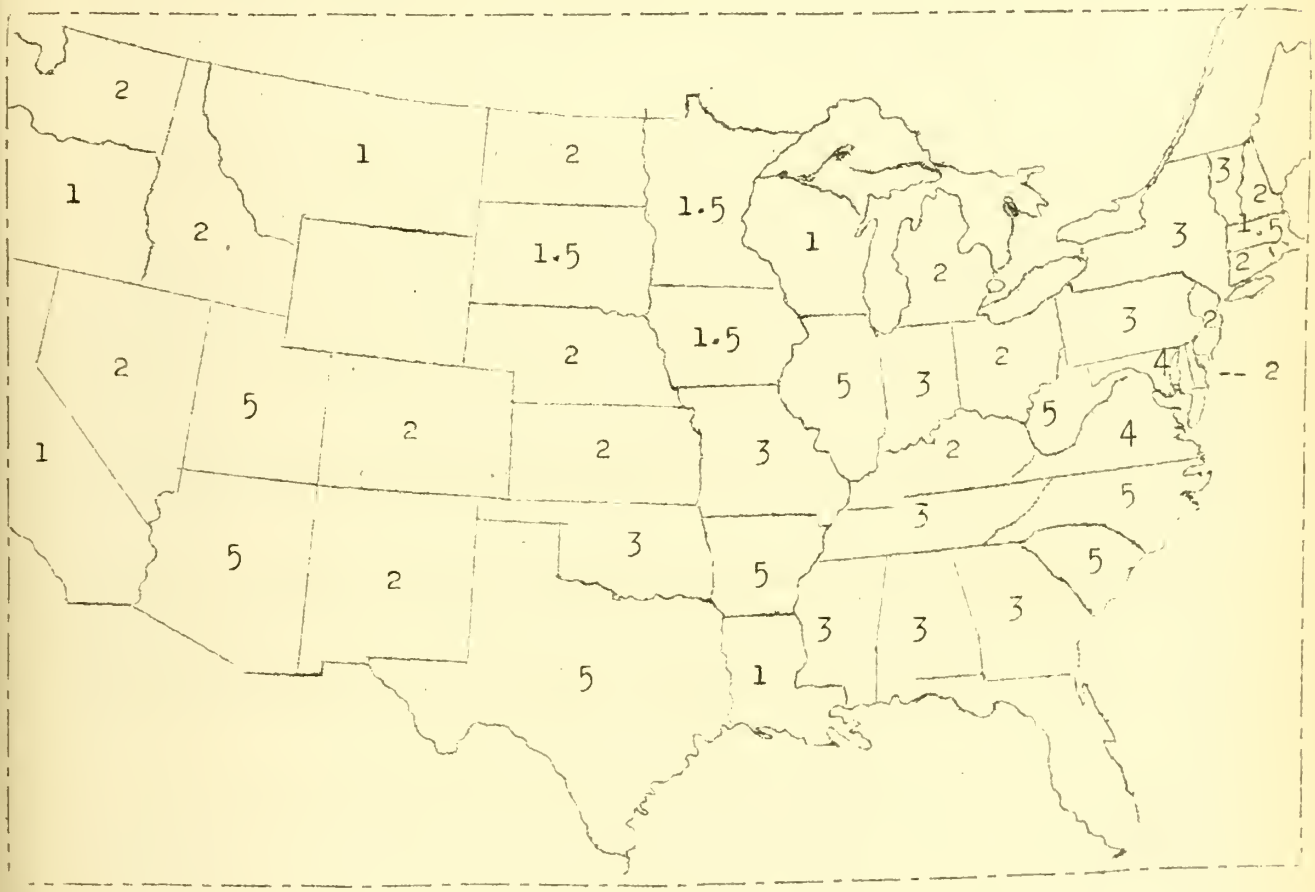


Fig. 30. Estimated percentages of reduction in yield from smuts of oats, 1920.

Pennsylvania: "Seed treatment for oat smut is quite universally practiced, particularly in the counties where county agents have held forth for a number of years. In many of the counties 75% of the seed oats is treated. This work is put over largely by propaganda through newspapers, schools, banks, druggists, etc. Material and directions are put in all trading centers through the counties early enough in the spring to give every farmer an opportunity to get the work done. Several reports have come in indicating injury from the dry method. On investigation it is usually proved that directions were not followed closely." (Nixon)

Tennessee: "Formaldehyde wet method used. Only a small percentage of our farmers treat oats for smuts." (Essary, Kurtzweil, and Hesler)

Mississippi: "The wet method is practiced by a few farmers." (Neal)

Arkansas: "Very little seed is treated." (Elliott)

Michigan: "The dry method is still successful." (Coons)

Ohio: "the seed treatment for oat smut as generally has been the formaldehyde sprinkling treatment, or the wet method. The dry method has resulted in injury to germination, though the amount of injury is very much less than has been noticed where the method has been applied to wheat." (Selby)

Illinois: "The number of farmers who treat their oats for smut is increasing every year. The dry method has not caused satisfactory results in every case. Some difficulty is experienced in making a satisfactory distribution of the formaldehyde without a consequent lower germination in some cases and failure to prevent smut in others. We like the 1-80 mixture using one pint of the solution to each bushel of oats. This permits more uniform distribution and does not wet the oats enough to make it necessary that they be dried before seeding." (George H. Dungan)

Wisconsin. "No reports of the dry method. County agents and farmers are well satisfied with the results from the Cleland smut machine." (Dickson)

Minnesota: "Both the wet and dry methods have proved effective and, so far as we have been able to determine, both have been safe." (Stakman)

North Dakota: "Have not advocated the dry method for this state. It is not satisfactory under our dry seed and atmospheric conditions." (Bolley)

South Dakota: "Seed treatment of oats is fairly general." (Evans)

Indiana: "Use of dry formaldehyde on the increase. Good results." (Gardner)

Nevada: "About fifty per cent of the farmers treat with formaldehyde." (Lantz)

After calling attention to a misquotation in the 1919 report (Plant Disease Bulletin, Supplement 8, May 1, 1920, page 53, line 5 under Idaho, - 1 pt. to 10 gal. should read 1 pt. to 10 pts.), Hungerford makes the following statement with reference to Idaho;

"This modified dry method (1 pint formaldehyde to 10 pints of water) has been used now for three years and has been satisfactory every year. By using ten parts of water to one of formaldehyde it is much easier to cover all the grain uniformly and still there is not enough of the solution to wet the oats to any appreciable extent. The use of this weaker solution is also much better in that the fumes of the formaldehyde are not so strong and unpleasant for the operator. In the tests this year three plots of one-fortieth acre were planted with Swedish Select oats which was very badly smutted. No. 1, untreated smutted seed gave 30% smut; No. 2, treated with the dry method, one pint formaldehyde to one pint of water, gave complete control; No. 3, treated with the modified dry method, one pint formaldehyde to ten pints of water, gave perfect control also."

G. M. Reed in extensive tests with loose smut on a large number of varieties of species of Avena (Missouri Agr. Exp. Sta. Res. Bul. 37. July, 1920) has obtained no infection with _Avena brevis_ (3 varieties), _A. strigosa_ (3 varieties), _A. sativa_ var. Black Mesdag and var. _nigra_. Most of the varieties of _A. sterilis_, especially Burt, Early Ripe, Fulghum, and Selection gave very low percentages of infection. The _A. nuda_ group proved highly susceptible. In general the different species and varieties reacted in the same way to the covered smut as they did to loose smut.

Stem rust caused by _Puccinia graminis_ Pers.

Stem rust of oats was quite localized in 1920. In the Atlantic States it was reported from Vermont, Massachusetts, New York, and West Virginia, but occurred only as traces. In the South it occurred in Georgia and Alabama, being rather severe in the former state (2% estimated reduction in yield) and of slight importance in the latter. It was reported from the following North Central States: Michigan, Indiana, Illinois, Wisconsin, Iowa, Minnesota, North Dakota, and South Dakota. It was of about average severity in these states except in South Dakota where Evans reports it very general and severe with an estimated loss for the state of 10%. The other states in this section reported losses as follows: 1%,North Dakota, Minnesota, Michigan; .5% - Iowa and Wisconsin. It occurred in Idaho, Nevada, Utah, and Colorado, but in slight amounts, and caused severe injury in California, Arizona, and Texas. Complete data on losses are given in Plant Disease Bulletin, Supplement 18, 1921.

The following statement is quoted from Bolley with reference to conditions in North Dakota;

> "Seldom seen this year. We do not know whether the apparent disappearance of stem rust of oats is being brought about by the destruction of the barberry or not, but for the past three years, even when the stem rust is abundant on wheat, oats have seldom suffered severely. Again this may all be due to drought periods coming on at the proper time."

Crown rust caused by _Puccinia coronata_ Cda.

The observed geographic range and estimated percentages of loss of crown rust of oats in 1920 are shown on the accompanying map. The disease, as usual, was especially prevalent and destructive in the southern states. It was about the same in prevalence and severity in most of these states as in previous years, but was unusually severe in Louisiana, Arkansas, and Tennessee. Edgerton states that nearly 100% of the crop was affected and that even the resistant varieties showed considerable rust in Louisiana. It was less severe as a rule in the northern Mississippi Valley than in previous years. Definite occurrence in the West was reported only from California where the rust was not important. It seems quite evident that crown rust overwinters on fall sown oats in the South. Edgerton reports the presence of rust on oats in Louisiana in January. Bisby states that while crown rust was fairly common in Manitoba it caused little loss to the oats crop. He noted the first aecia on Rhamnus on June 19, and the first uredinia on oats in July.

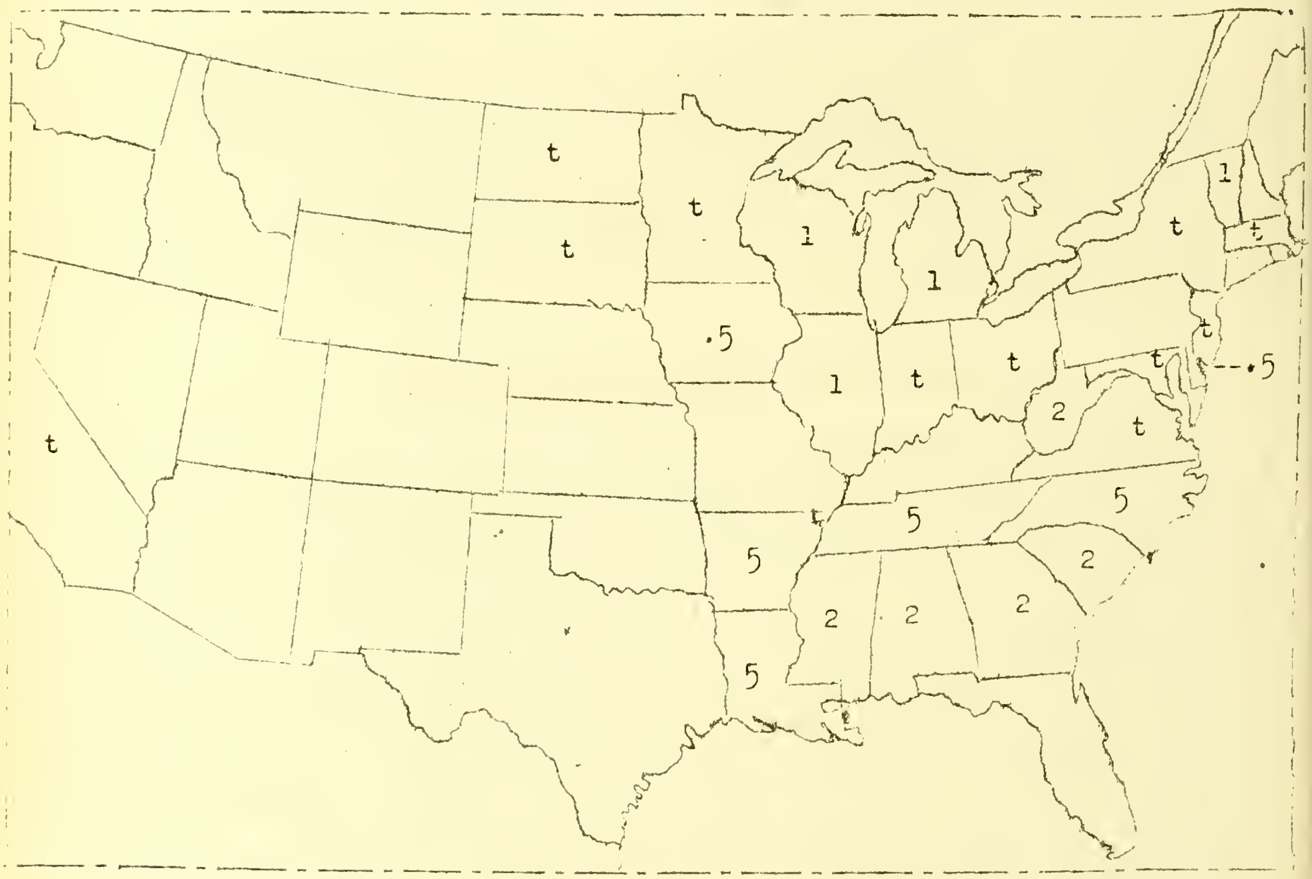


Fig. 31. Occurrence and estimated percentages reduction in yield of oats from crown rust, 1920.

Halo-blight caused by Bacterium coronafaciens Elliott = Pseudomonas avenae Manns.

Halo-blight of oats was reported from more states in 1920 than in any previous year. The indications are that it occurs to some extent throughout the country but that it is quite dependent on favorable climatic conditions for vigorous development. The fact that the organism is seed borne would provide for its introduction generally. It was reported as fairly common or general in Delaware, Indiana, and Arkansas. It also occurred in slight amounts in New York, Ohio, Illinois, Michigan, Wisconsin, North Dakota, South Dakota, Kansas, Idaho, and California. It was said to have caused some loss in Delaware but, according to reports, was of slight or no importance in the other states. In Wisconsin Vaughan states that mild infection occurred when the plants were in the boot but that they appeared to outgrow it later. Elliott states (Jour. Agr. Res. 19: 139-172. May 15, 1920) that the 1-320 formaldehyde treatment as used for oat smut checks halo-blight but does not entirely control it, while the dry heat treatment, 100° C. for 30 hours, is fully effective. She finds differences in varietal susceptibility but states that these are not marked when the disease is severe.

Anthracnose caused by Colletotrichum cereale Manns.

Reports of the occurrence of anthracnose on oats in 1920 were received from only six states. In none was it of more than very minor importance. It was common in New Jersey, Delaware, and Michigan, slight in Ohio except on plots in continuous oat culture where 100% infection was noted, and it was reported occurring only in traces in Wisconsin and Minnesota.

Scab (blight) caused by Gibberella saubinetii (Mont.) Sacc.

The Fusarium blight or scab of oats was reported in 1920 from Delaware, Ohio, Illinois, North Dakota, and Texas. It was of slight importance, being much less severe than in 1919. A loss of .5% was estimated in Texas.

Blast (sterility) causes not determined.

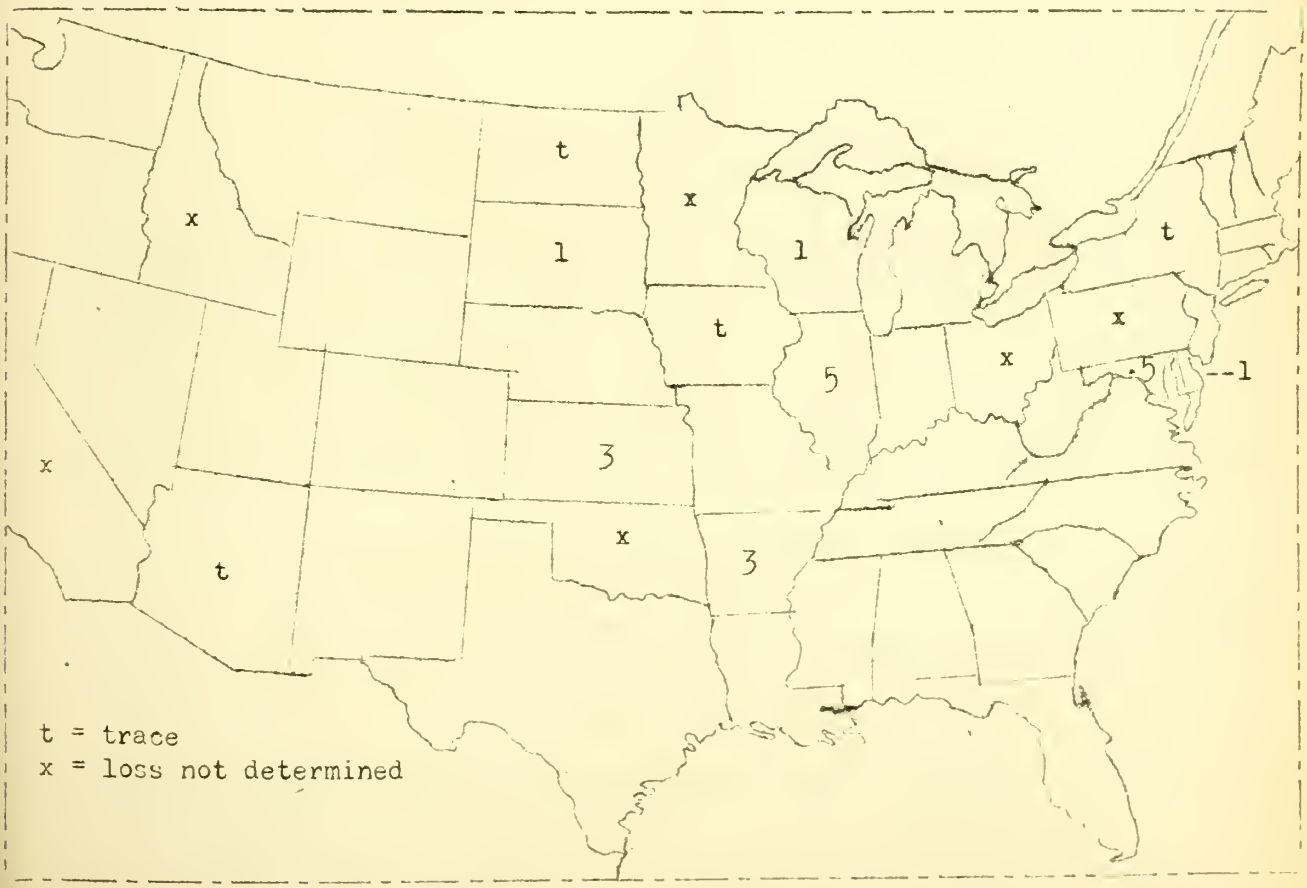


Fig. 32. Geographic distribution and estimated losses to oats from blast, 1920.

The occurrence of blast in oats and the estimated percentages of loss in 1920 are shown on the accompanying map. It occurred rather generally over the country, being especially severe in Illinois, Kansas, Arkansas, Wisconsin, South Dakota, and California. It was also reported from Pennsylvania (very common in Sullivan County), Delaware (general), Oklahoma (present in many fields), Idaho (common), Arizona (chiefly in the Salt River Valley), and as slight in Iowa, Ohio, and North Dakota. Vaughan gives the following for Wisconsin:

"More than in 1919, 25% of the crop injured. Highest loss estimated was 15% in Brown County, six cases 5%, one case 4%, one case 2%, fourteen cases trace. Thought to be associated with heavy rains when plants were entering the flowering stage."

Other diseases.

Red leaf of oats, cause not definitely determined, was reported from Michigan, Idaho, and California. The injury in Idaho is thought by Hungerford to be due to frost.

Seedling blight. Specimens of oat seedlings were received on May 10, from R. C. Rose, who collected the material south of Fort Smith, Arkansas. The lower part of the seedlings were covered with mycelium and sclerotia of *Sclerotium rolfsii*.

Burning of young oats, due to hot weather, occurred in occasional fields in Michigan according to Coons.

CORN

Smut caused by *Ustilago zeae* (Beck.) Ung.

Corn smut occurred in every state from which reports were received in 1920. It is no doubt coextensive with the culture of corn in the United States, but varies considerably in prevalence and severity in the different sections. Corn smut was of slight importance in the extreme northern states, with the exception of Vermont, and in the Northwest. It was general in the Eastern, Southern, and Central States, probably causing 1-2% crop loss, and was most prevalent and severe in states west of the Mississippi River and in the Southwest. The estimated percentages of loss are shown on the accompanying map and also in the following tabulation.

Table 54. Estimated losses from smut of corn, 1920.

Percentage loss	States
8	Kansas.
5	Nebraska, Colorado, Arizona.
3	Vermont.
2	North Carolina, South Carolina, Georgia, Kentucky, Indiana, Illinois, Missouri, Arkansas, Texas, Oklahoma, New Mexico, California.
1	New York, Pennsylvania, New Jersey, Maryland, Delaware, Virginia, West Virginia, Ohio, Tennessee, Alabama, Mississippi, Minnesota, Iowa, South Dakota, Utah.
.5	Massachusetts, Connecticut, Michigan, Louisiana, North Dakota.

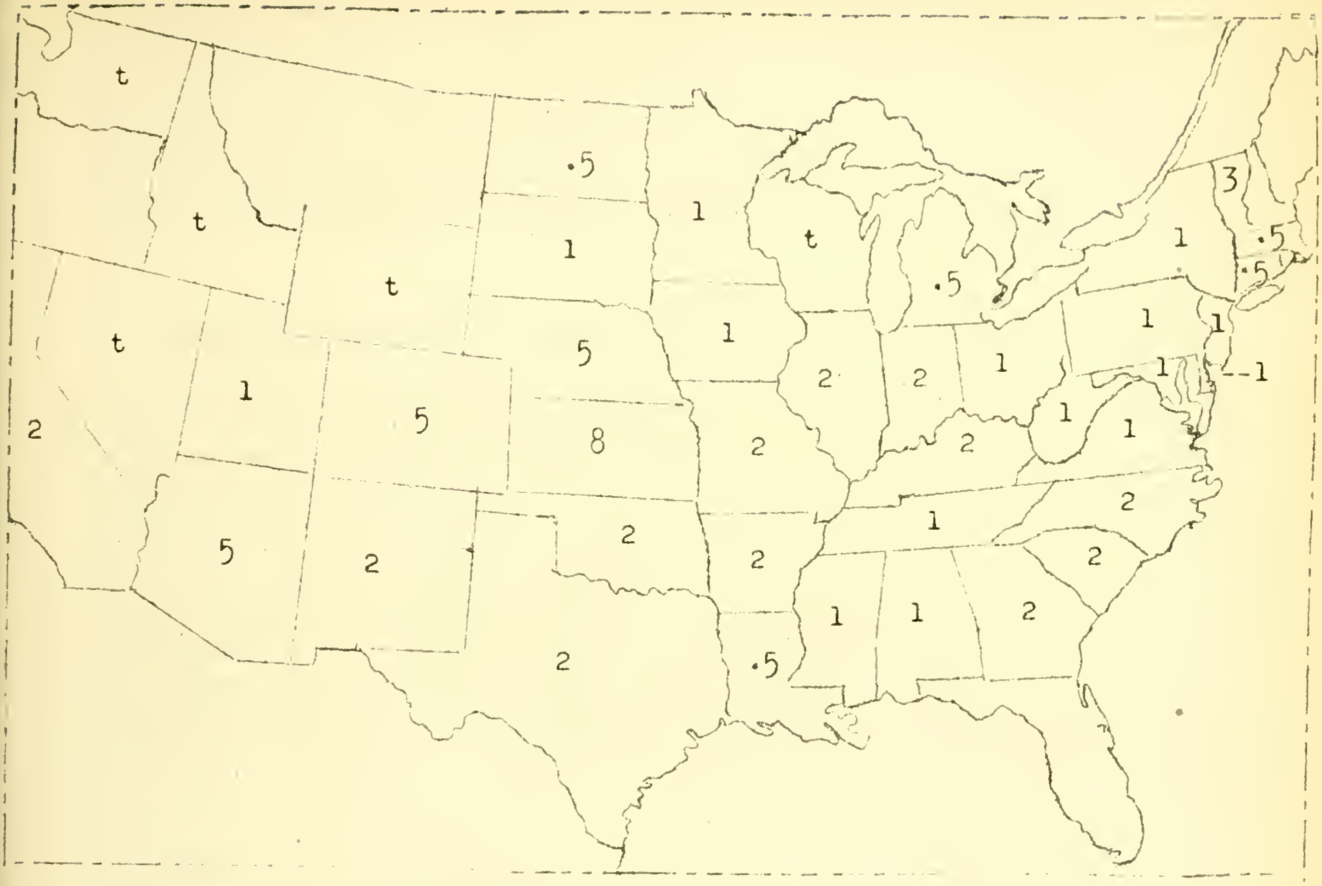


Fig. 33. Occurrence and estimated percentages of loss from corn smut in 1920.

Corn smut was reported as more severe than previously in Vermont, Indiana, Kansas, Arkansas, and Colorado, and as less severe in Wisconsin, North Dakota, Iowa, and Louisiana. More infection on the tassels than usual was reported from Ohio. Comments received on severity are as follows:

<u>Vermont</u>: "More than I have ever seen here." (Lutman)

<u>New York</u>: "Present in small amounts throughout the state. An epidemic, however, occurred in Suffolk County, Long Island. Counts of 5,000 plants were as follows:
12.95% of plants had smut infection
3.13% of ears had smut infection
1.5% of ears were destroyed by smut." (Kirby)

<u>Kansas</u>: "Very common. Many fields showed 50-80% affected plants." (Melchers)

<u>Colorado</u>: "Reported by the Agricultural Agent of the Denver and Rio Grande R. R. as causing the greatest loss along his line in ten years." (Learn)

<u>Utah</u>: "Appears to be rapidly increasing in severity." (Richards)

Sweet corn is said to be more susceptible in Maryland and Indiana, while Wisconsin also notes that more smut is found in sweet corn where no attention is given to rotation, and that heavy growing varieties like Evergreen show more smut than the smaller early varieties. McClintock states that in Georgia ear infection is most important in sweet and pop corn. It was noted in Tennessee that smut is generally less damaging to late corn, while it was observed in Wisconsin to be more prevalent in late planted fields. McClintock observed an old field, in corn for the first time in years, that had about 35% of smut on various parts of the plants.

Root, stalk, and ear rots caused by <u>Gibberella</u> spp. and <u>Fusarium</u> spp.

These troubles, in all or some of their various forms, were present, as in 1919, in practically all of the states east of the 100th meridian. Reports of one case in Washington, and very slight infection in California, were the only reports received from the West. The injury was in most states practically the same as in 1919, being evidently more severe in Kansas, Nebraska, and South Dakota, and it was somewhat less so in Wisconsin, New Jersey, and Virginia. In Kansas, the disease was especially severe in Labette County, where some fields showed as much as 75-80% down stalks, according to Melchers. Thomas states that some fields in Ohio showed losses as high as 90%, Bolley noted two severe cases in North Dakota, and Evans in South Dakota reported two badly infested fields, where few ears were expected to mature. Stakman states that this disease is unimportant in Minnesota as a rule. The ear rots seem to be especially prevalent

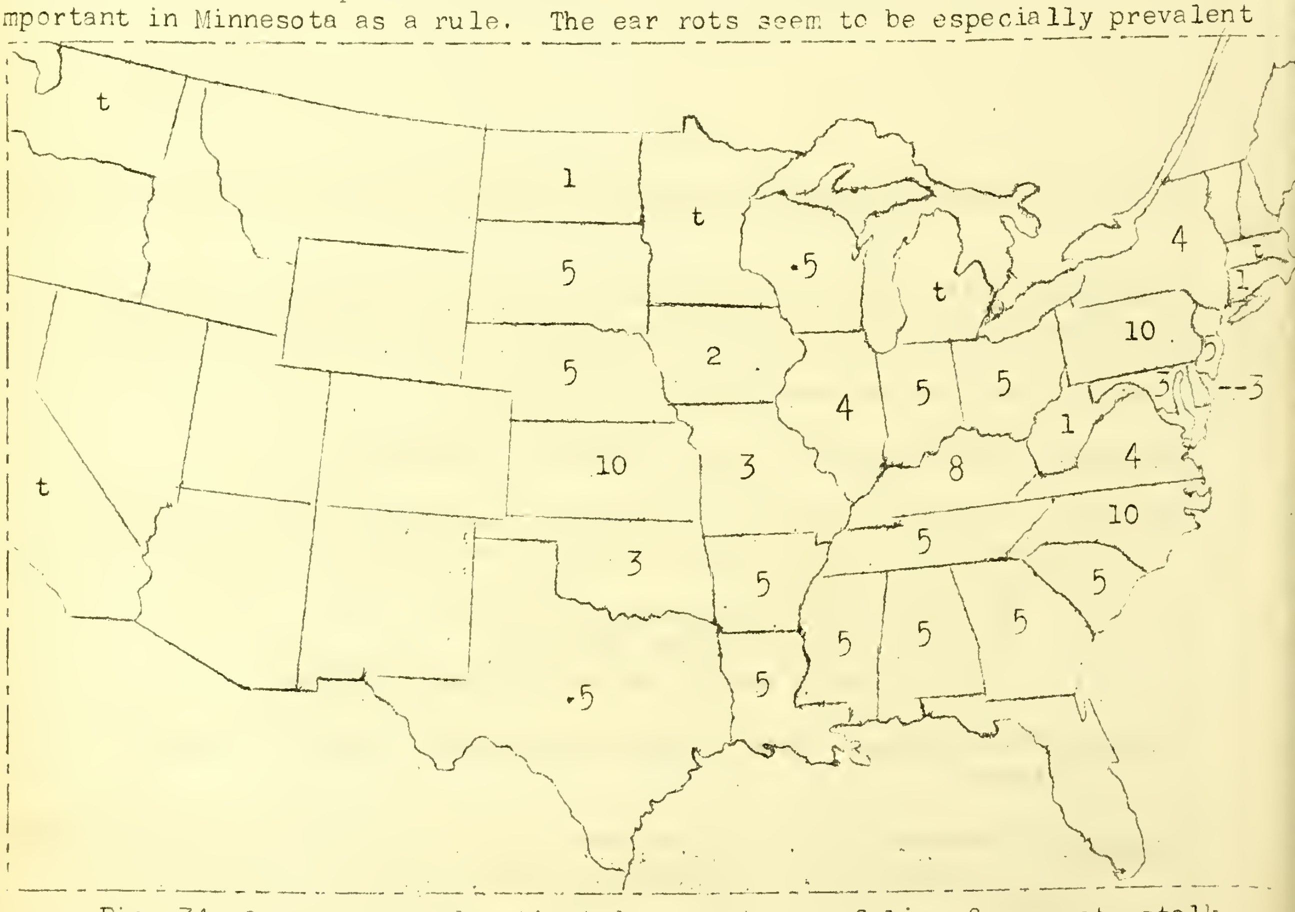


Fig. 34. Occurrence and estimated percentages of loss from root, stalk, and ear rots of corn in 1920.

in the South. Valleau finds in Kentucky that approximately 8% by weight of the ears harvested are made up of rotten ears. That ear rots may also be severe in the North is shown in the following data supplied by Kirby from Suffolk County, New York. He found in field counts of Luce's Favorite corn that 16% of the ears had Fusarium rot throughout the ear, 48% had rot only on the tip, and 36% were free from rot. Neal states that in Mississippi missing stalks, down stalks and rootrot symptoms are found throughout the state, but that the ear rots are met with most frequently. Elliott notes that ear rot is found on most worm-eaten ears. The occurrence and estimated percentages of loss for 1920 are shown on the accompanying map, while losses, summarized in bushels will be given in Plant Disease Bulletin, Supplement 18, 1921.

With reference to varietal susceptibility Hoffer notes that sweet corn is more susceptible than dent corn, while Trost and Hoffer (Phytopath. 11: 32-34. 1921) have found that ears with starchy kernels produce plants that are more susceptible than those from horny kernels. In experimental plantings they obtained a decrease of 4% in initial stand and of 16.4% in yield in rows planted from ears with starchy kernels, as compared with those planted from ears with horny kernels. Valleau notes that individuals within a variety exhibit striking resistance to root rot.

Very satisfactory results are being obtained in Indiana in the separation of diseased and disease-free ears by means of the improved rag-doll germinator and this method is being put into commercial practice in Indiana and Illinois in particular. In experimental plantings of Fusarium-infested ears which germinated 100%, Duddleston and Hoffer (Phytopath. 11: 33. 1921) found an average decrease of 11.1%, or 8 bushels per acre, as compared with the general fields planted with apparently disease-free ears. In work with sweet corn Smith and Hoffer (Phytopath. 11: 34. 1921) find three profitable lines of control: (1) the selection of seed corn in the field from apparently healthy stalks; (2) artificial drying by heat immediately after harvesting; and (3) selection of ears on the germinator.

The following account of the Utility Corn Show held at Galesburg, Illinois, is by J. R. Holbert and is quoted from the Cereal Courier 13: 3. January 15, 1921.

> "There were 119 entries from more than 20 counties. These included more than 2,000 ears of corn. Many of the fine looking entries were very badly infected with both Diplodia and Fusaria. Many of the entries contained from two to four dead ears. Others that contained no dead kernels were frequently badly diseased. No sample was entirely disease-free, even the ten ears that won sweepstakes contained one diseased ear. The other nine were outstanding in general appearance, vigor and vitality, and freedom from diseases and were of the type that we have been finding to be characteristic of our high-yielding, disease-free corn."

Bacterial wilt caused by Aplanobacter stewartii (Sm.) McC.

This disease was reported in 1920 from New York (trace in field corn on Long Island), Maryland (rather common), Virginia (common in home gardens), Ohio (reported in two or more localities without serious losses), Indiana (rare), Kentucky (in small-growing varieties of sweet corn, following root rots caused by Fusarium moniliforme), Arkansas (only one report, from Sebastian County), and Texas (present in slight amounts in west Texas, but not seen in east), F. V. Rand states that wilt is usually of slight importance in commercial fields of corn growm for canning owing to the rather general use of two varieties, Stowell's

Evergreen and Country Gentleman, both of which show considerable resistance to the disease. Temple notes that Country Gentleman is resistant and Golden Bantam susceptible in Maryland, and Fromme states that wilt is found commonly on Golden Bantam in Virginia.

Brown spot caused by Physoderma zeae-maydis Shaw.

Physoderma occurred practically throughout the range that had been determined by survey work in previous years. A noteworthy feature of the season was the unusual severity of the disease in eastern Nebraska. Goss reported it especially prevalent near Lincoln with considerable damage resulting from the breaking over of stalks. The severe occurrence of the disease was associated with heavy rainfall. The relation of the disease to moisture and temperature was shown, as formerly, by especial prevalence in river bottoms. Losses of about 1% were experienced in North Carolina, South Carolina, Georgia, Alabama, and Louisiana, and smaller losses in Mississippi, Arkansas, Missouri, Nebraska, Tennessee, and Kentucky.

Rust caused by Puccinia sorghi Schw.

Corn rust was reported in 1920 from practically every state east of the 100th meridian and from no state west of this line. It was in general very common in the section in which it occurred but was generally considered to be of slight importance with very slight or no loss except in Mississippi and Louisiana where losses were estimated at 1%. As a rule all varieties were said to be affected although Indiana reports more on sweet corn. A varietal test of susceptibility by Fromme and Wingard in Virginia was reported as follows:

> "A number of varieties of corn, both sweet and field, were inoculated in the field and compared for varietal susceptibility. All became heavily infected and no marked variations existed."

Weber in studies with corn rust at Wisconsin (G. F. Weber. Phytopath. 11: 31. 1921) finds that urediniospores kept on corn leaves out of doors failed to germinate after December. He found some variation in susceptibility with greenhouse inoculations on seven species of corn.

Head smut caused by Sorosporium reilianum (Kühn) McAlp.

Head smut was reported from Washington as less prevalent than in 1919 and known only from the vicinity of Pullman, and also from California. In the latter state W. W. Mackie reported that the disease has spread since last year in the delta region near Stockton and that in Napa Valley it has become severe with reports of 40% damage.

Mosaic, cause unknown.

Corn mosaic was reported in 1920 from Louisiana and Georgia where it had previously been reported in 1918 as "frenching". It was said to be more prevalent than previously in both of these states, but in general injury was slight. Edgerton states that the disease was present throughout the season, which was especially wet, and that 100% affected plants were observed in some fields. When severe, the disease prevents ear development. Brandes (Jour. Agr. Res. 19: 517-521. Aug. 16, 1920) has found corn mosaic to be identical with that of sugar cane and sorghum as shown by inoculation experiments. He has also observed the same disease in Porto Rico and states that it is similar to mosaic of corn as reported in Hawaii and Guam.

Other diseases.

Bacterial root and stalk rot caused by Bacterium sp. This disease which, as described by Rosen (H. R. Rosen. A bacterial root and stalk rot of field corn. Abstract Phytopath. 11: 32. 1921) affects the roots, stalks, and leaves of both field and sweet corn was reported as severe locally in Arkansas. Death of 20 to 30% of the stalks is reported in some cases.

Leaf blight of sweet corn, cause probably bacterial, is reported by Hungerford as present in gardens in northern Idaho and found only on Golden Bantam.

A bacterial leaf spot, cause unknown, reported from Iowa as less prevalent than in 1919.

Leaf sheath spot caused by various species of fungi-reported from Iowa as present on nearly all plants with a trace of loss.

Leaf blight caused by Helminthosporium sp., reported from New Jersey (common but not important) and Tennessee (more than in 1919, 90% of the crop injured, slight loss).

Downy mildew caused by Sclerospora philippinensis. Very complete accounts of the occurrence, severity, host ranges, and life history of this important disease, as it occurs in the Philippines, have been given by W. H. Weston in several papers.

Ear rot caused by Diplodia sp., reported from New York (about .01% found in Suffolk County, none observed at any other place), Tennessee (causing some damage, especially after heavy rainfall of more than 11 inches in August), and Ohio (more than usual, 1% estimated loss in the state).

RICE

Blast caused by Piricularia oryzae Br. & Cav.

Blast (rotten-neck) of rice was reported by collaborators from Mississippi and Louisiana. It was found in Mississippi in three counties, Pearl River, Lauderdale, and Oktibbeha. Neal reports one field of 30 acres in which the infection was 40% and estimates the loss in the state at 4-5%. In Louisiana the disease is said to be common but losses are estimated to be less than 1%. This disease has also been reported previously from Arkansas, Texas, Alabama, Florida, and South Carolina.

Straighthead (non-parasitic)

Straighthead was reported from Arkansas and Louisiana and occasioned considerable loss in both states. It was said to be especially prevalent and severe in Louisiana in 1920, especially in the river district where a large amount of new land had been put into rice. The loss in the state was estimated at 2-4%, while that in Arkansas was placed at 1-2%. Tisdale has recently reported (Rice straighthead and its control. Abs. in Phytopath. 11: 42-43. 1921) that the disease is caused by the exclusion of air in applying water which prevents the formation of secondary roots and root hairs. It is especially prevalent on virgin soil and soil that has been in dry land crops previously. The development of this condition may be prevented by draining the soil at certain times during the irrigation period to permit soil aeration.

Smut caused by Tilletia horrida Tak.

No reports of the occurrence of this smut of rice were received from collaborators in 1920. It was reported in 1919 by W. H. Tisdale as having occurred to a slight extent in Louisiana.

Other diseases.

Leaf spot caused by Cercospora sp., reported by Edgerton as common in Louisiana but causing slight loss.

Seedling blight caused by Sclerotium rolfsii Sacc. was observed by W. H. Tisdale at Crowley, Louisiana in 1919 as destructive to germinating seed and young seedlings. He reports that irrigation checks the disease and that cultivation reduces the amount of the fungus in the soil (Two Sclerotium diseases of rice. Phytopath. 11: 42. 1921).

Stem rot caused by Sclerotium oryzae Catt.? was found in 1920 by W. H. Tisdale (l.c.) as a serious disease in Louisiana on Early Prolific and other varieties. The stems are attacked at the water line causing lodging and failure of grain to fill normally.

FLAX

Wilt caused by Fusarium lini Bolley.

Flax wilt was reported in 1920 from Michigan (first record for the state according to Coons), Wisconsin, Minnesota, North Dakota, South Dakota, and Montana. C. S. Reddy reported finding the disease in three counties in Michigan - St. Clair (Yale), Sanilac (Applegate, Crosswell, and Peck), and Ingham (East Lansing). It usually occurred in slight amounts but was sometimes severe in spots in the fields. It was found in Wisconsin only on the plots at Madison and was general in Minnesota, about as in average years, with an estimated loss in the state of 7.5%. Bolley states that in North Dakota the disease was somewhat less prevalent than formerly but was destructive as usual on old flax-cropped areas where non-resistant varieties are used. He estimates the loss in the state at about 5%. Evans states that the disease was present at Brookings, South Dakota on experimental plots but none was found in numerous fields examined in the north-central part of the state. W. E. Brentzel reports, as the result of a survey in Minnesota, North Dakota, and Montana, (Cereal Courier 12: 273. Aug. 20, 1920) the finding of flax wilt as far west as Plentywood, Montana, and Dickinson and Williston, North Dakota. Further west at Moccasin and Havre, Montana, no wilt was found in any of the fields, even on land that had been in flax continuously for five years. Bolley's resistant selections are reported as satisfactory on wilt infested soil, especially N. D. R. No. 114. The accompanying map shows the occurrence of flax wilt as reported to the Plant Disease Survey.

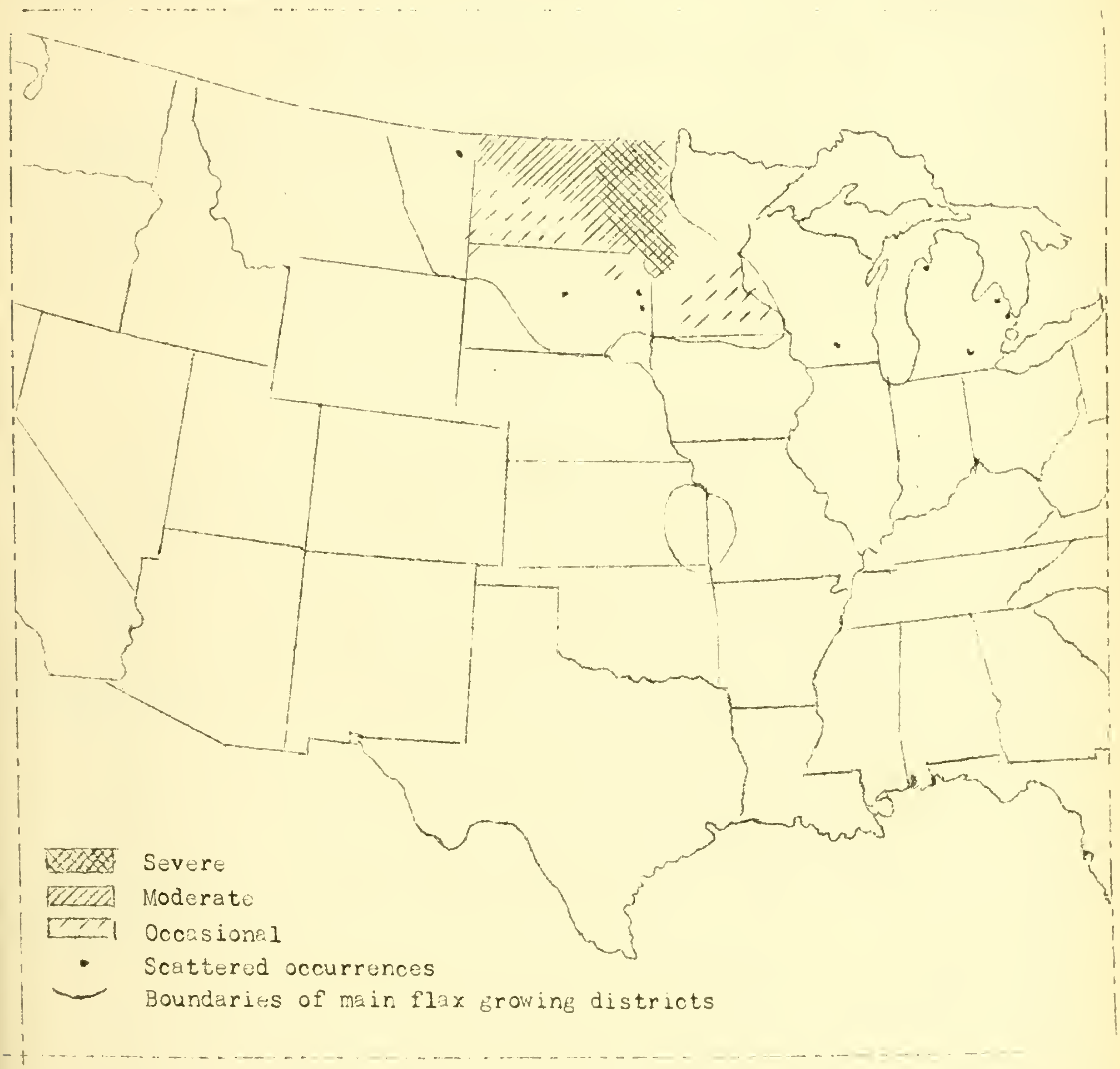


Fig. 35, Occurrence of flax wilt (Fusarium lini) as shown by records in the Plant Disease Survey.

Canker (non-parasitic)

Canker, which has been shown to be due to high temperatures at the surface of the soil, was reported as present to a slight extent in Wisconsin and South Dakota and as much less than in 1919 in North Dakota. W. E. Brentzel first noted canker at Fargo on June 16, following high temperatures on June 13 when a soil thermograph registered a temperature of 120° F. during a period of about two hours (Cereal Courier 12: 207. July 10, 1920). It was found in the flax survey as reported by Brentzel (Cereal Courier 12: 275. Aug. 20, 1920) at places in Minnesota, North Dakota, and Montana. It was found to be more severe in Montana and western North Dakota than in other places, as much as 50% damage being found in a large commercial field at Havre, Montana.

Rust caused by Melampsora lini (Pers.) Desm.

Flax rust was reported from Michigan (at East Lansing on breeding plots, first report for the state according to Coons), Minnesota, and North Dakota. It was not very prevalent in Minnesota and caused only very slight loss. In North Dakota it was reported by Bolley as general, and as usual, with an estimated loss of about 1%. In the flax survey, previously referred to, it was reported by Brentzel as severe in eastern North Dakota with as much as 100% in some fields, and as present in all fields in the Red River Valley to a greater or less extent, depending considerably upon the variety of flax grown. No rust

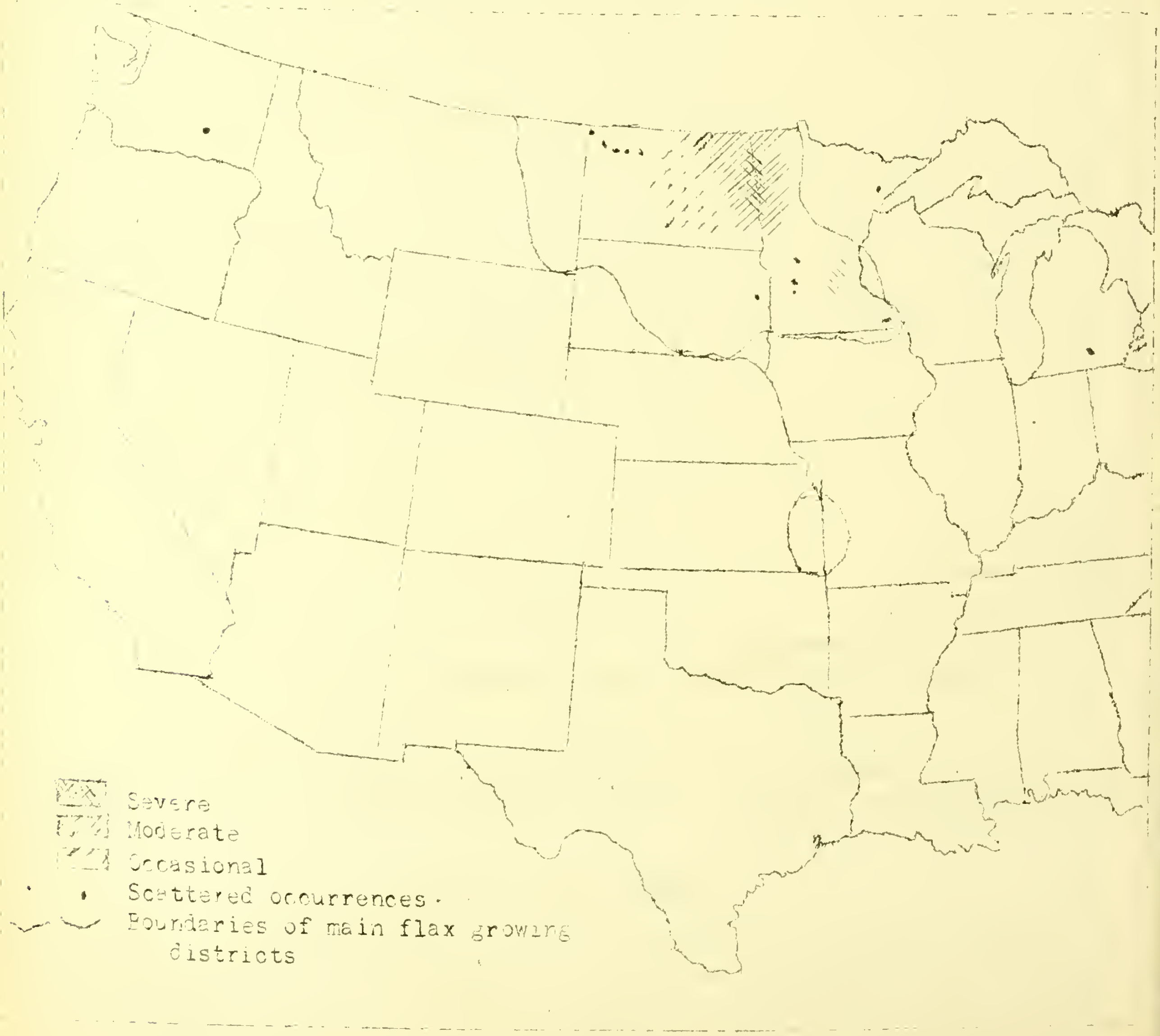


Fig. 36. Occurrence of flax rust (Melampsora lini) as shown by records in the Plant Disease Survey.

was found in North Dakota west of Dickinson and none was found in Montana. The occurrence of flax rust in 1920 and previous years, as reported to the Plant Disease Survey is shown on the accompanying map.

Anthracnose caused by Colletotrichum lini Bolley.

C. S. Reddy reports the occurrence of anthracnose on flax at three points in Michigan.- East Lansing, Yale, and Peck. In the plots at East Lansing the percentage of affected plants ranged from less than 1% in some to more than 60% in others, while in the commercial fields the percentage ranged from less than one to five. A type of canker was produced in many cases.

SORGHUM

Covered kernel smut caused by Sphacelotheca sorghi (Link) Clinton.

The covered kernel smut of sorghum was reported in 1920 from Ohio (one collection), Missouri (one report), Texas (prevalent, 1% loss), New Mexico (slight), and California (prevalent).

Loose kernel smut caused by Sphacelotheca cruenta (Kühn) Potter.

This smut was reported from Alabama, Texas, and New Mexico. It was found in Alabama on the University farm, not serious. In Texas it was said to be prevalent, causing .5% loss, and in New Mexico was slight.

Head smut caused by Sorosporium reilianum(Kühn) McAlp.

Head smut of sorghum was reported as fairly prevalent in Texas (2% loss), and slight in New Mexico and California. The following statement by Melchers, with reference to the disease in Kansas, is quoted from the Cereal Courier 12: 329. Sept. 30, 1920.

> "Many inquiries are coming into the Station for treatment to prevent sorghum smut. Fields examined show more kernel smut than usual. The head smut has been showing in unusual and most alarming quantities at Hays, Kansas, in some experimental plots."

Other diseases.

Bacterial blight caused by Bacillus sorghi Burr. The bacterial blight was reported only from Iowa on sorghum and occurred there only as a trace.

Leaf spot caused by Colletotrichum lineola was reported by Edgerton as of considerable importance in Louisiana as a leaf spot and head blight. The percentage of affected plants in different fields ranged from 1-100 and the loss for the state was estimated as 1-5%.

FORAGE CROPS

A. LEGUMES

ALFALFA

Leaf spot caused by Pseudopeziza medicaginis (Lib.) Sacc. This disease was reported as very general in Vermont (5-7% loss), New York, New Jersey, Virginia, Maryland (2.5% loss), West Virginia, Tennessee (2% loss), Georgia (2% loss), Ohio, Indiana, Iowa (2% loss), and Idaho. It was also present in Pennsylvania, Colorado, Washington, Oregon, and Arizona (common in southern part of the state and causing considerable loss which is difficult to estimate because of the presence of bacterial disease).

Yellow leaf blotch caused by Pyrenopeziza medicaginis Fckl. - reported as general and destructive on experimental farm at State College, Pennsylvania, as common but not serious in Idaho, and one record in 1920 in Washington.

Leaf blight caused by Ascochyta imperfecta Pk. This disease together with bacterial blight was said to be doing much damage in New Mexico.

Leaf spot caused by Pleosphaerulina briosiana Pol. - was reported from one locality in Minnesota. This is the first report of the occurrence of this disease in Minnesota. It was first reported from Kansas in 1914 and records are on hand also from Wisconsin (1915) and Georgia (1915 and 1916).

Leaf spot caused by Cercospora medicaginis E. & E. - reported from Texas (unimportant).

Downy mildew caused by Peronospora trifoliorum de Bary - reported from Arizona, Idaho, Washington, and Oregon. Injury was slight.

Rust caused by Uromyces medicaginis Pass. - reported from Texas as important only under dry conditions.

Bacterial blight caused by Bacterium medicaginis Sackett was reported from New Mexico, Arizona, Idaho, and Washington. It was most severe in the Southwest. L. H. Leonian (New Mexico) comments as follows: "The alfalfa stem spot is doing much damage here this year. It occurs with Ascochyta imperfecta and between the two alfalfa does not have much chance." J. G. Brown examined one field near Tucson, Arizona, in which 40-50% of the plants were affected.

Yellows (non-parasitic) - reported from Tennessee as less prevalent than in 1919.

White top, cause undetermined, "may be a mosaic", was reported from Maryland.

Root rot caused by Phythium debaryanum Hesse - was reported from Missouri (one county).

Root rot caused by Ozonium omnivorum Shear - Texas (very important especially under irrigation. Loss .5%).

Violet root rot caused by Rhizoctonia crocorum DC. - reported by Hopkins from Andrew County, Missouri as root rot caused by R. medicaginis, but from the description "roots covered with dull reddish mycelium", it seems evident that violet root rot was present.

Root rot caused by Sclerotinia trifoliorum Eriks. - reported from Washington and Oregon (apparently more than last year, 10% found in one field. First noticed March 24, at Grant's Pass. Prevalent in western Oregon.)

Root knot caused by Heterodera radicicola (Greef) Müll. - reported from Texas. The disease was said to be unimportant owing to the fact that all varieties except the Hairy Peruvian (which is apparently resistant) have been discarded.

Dodder (Cuscuta spp.) - reported from Tennessee, Texas, and Washington.

CLOVER

(White clover, *Trifolium repens*; red clover, *T. pratense*; alsike clover, *T. hybridum*; crimson clover, *T. incarnatum*)

Anthracnose caused by *Colletotrichum trifolii* Bain was reported from Kentucky, Tennessee, Ohio, and Indiana. In Kentucky it was severe on crimson clover causing a loss of 80% in one field. In Tennessee the loss was said to be less than some years ago owing to the general use of Bain and Essary's variety, Tennessee Resistant Red. The earliest recorded appearance was May 24 in Kentucky and May 28 in Indiana.

Anthracnose said to be caused by *Gleosporium caulivorum* Kirch. was reported from West Virginia, Ohio, Wisconsin, Minnesota, and Iowa. It caused appreciable damage on red clover in the vicinity of Madison, Wisconsin.

Bacterial leaf spot caused by *Bacterium* sp. This disease has recently been described by L. R. Jones and Maude M. Williamson as occurring in Wisconsin, and apparently widely elsewhere, on red clovers, both *Trifolium pratense* and *T. medium*. The organism overwinters in the crown or bud and dissemination is chiefly by spattering water. Progress of infection is most rapid in moist weather in spring, summer, and fall, and is checked by dry heat. (Bacterial leaf spot of red clover. Abstract Phytopath. 11: 50. 1920).

Leaf spot caused by *Pseudopeziza trifolii* (Bernh.) Fckl. Reported from New York, Pennsylvania, West Virginia, Ohio, and Minnesota.

Leaf spot caused by *Macrosporium sarciniforme* Cav. was general in fields in Pennsylvania and Arkansas. It was also reported from Minnesota and Missouri. In the latter state it was associated with rust in causing severe injury to red clover on continuous clover plots.

Sooty spot caused by *Phyllachora trifolii* (Pers.) Fckl. - reported on red clover from West Virginia, on clover from Tennessee and Vermont, and on red, white, and alsike clover from Minnesota.

Powdery mildew caused by *Erysiphe polygoni* DC. was reported from West Virginia and Washington.

Rust caused by *Uromyces fallens* (Desm.) Kern. was reported on red clover from Pennsylvania, West Virginia, Minnesota, and Washington. It probably occurred very generally as usual. In Pennsylvania it was said to apparently cause considerable damage at times. F. L. Duley reported this rust as severe, causing death of the plants, on continuous clover plots in Missouri.

Rust caused by *Uromyces trifolii* (Hed.) Lev. was reported generally on white clover with slight or no injury, also on alsike clover from Pennsylvania and Minnesota.

Mosaic (cause unknown) was reported from Arkansas as general, injuring 25% of the crop. C. R. Orton has supplied the following note with reference to observations on this disease in Pennsylvania:

> "For several years the writer has observed a pronounced mosaic disease upon the common species of cultivated clovers, *Trifolium pratense*, *T. repens*, *T. hybridum*, and *T. incarnatum*. Upon all these plants the disease has the typical mosaic symptoms with the chlorotic streaks pronounced. Usually it appears to be systemic and atrophy is commonly an accompanying symptom. No severe cases of the disease have come to my attention upon the red, white, and alsike clover, but in May, 1919, my attention was called, by the Extension Pathologist, E. L. Nixon, to a serious trouble of crimson clover on a farm near Chambersburg, Pennsylvania. Specimens brought in were found to show very pronounced mosaic symptoms. Most of the plants were in the dwarfed stage and not more than a 50% crop was harvested from a 7-acre field."

Gray mold caused by Botrytis sp. - reported as slight in one locality in Pennsylvania.

Stem rot, cause unknown, apparently associated with nematode injury, was reported by Hungerford as common and destructive in the Twin Falls section of Idaho.

Wilt caused by Fusarium sp. - This disease, which appears to be new, was reported by Selby as known from three counties in Ohio in 1920.

Root rot caused by Sclerotinia trifoliorum Eriks. - observed locally on clover in Kentucky (near Louisville), Tennessee (east), Ohio (Montgomery County), Washington (Snokomish County), and Oregon (worse, damage general, 50% in one field. Observed first February 10, Douglas County).

Nematode disease caused by Tylenchus dipsaci (Kühn) Bastian. This disease was again very severe in the Twin Falls section of Idaho. In a number of fields infection was so severe that it was necessary to plow them up. G. H. Godfrey also reports finding this disease in western Oregon, in non-irrigated sections, on strawberry and clover, and in Washington and Utah. It was rather severe in parts of the latter state.

A. J. Pieters, of the U. S. Department of Agriculture, visited the clover seed district in the Yakima Valley of Washington in the summer of 1919. In this section, where about 2,000 acres of red clover are grown for seed, he found evidence of nematode in every field examined. Specimens were sent to Dr. Ralph Smith of the Idaho Experiment Station who positively identified the nematode as T. dipsaci.

Dodder (Cuscuta spp.) on clover was reported from New Hampshire, Tennessee, and Arkansas.

VETCH

Root rot caused by Sclerotinia trifoliorum Eriks. was reported from Tennessee as the first record for that state on vetch. Only one previous record, from North Carolina in 1916, of occurrence on this host has been received by the Plant Disease Survey.

Blight caused by Ascochyta pisi Lib. - reported from Michigan as severe in Charlevoix County.

SWEET CLOVER

Ascochyta caulicola Lau. - reported on sweet clover from Michigan.

Root rot caused by Sclerotinia trifoliorum Eriks. was reported from Washington, Pierce County.

Root rot caused by Fusarium sp. occurred in experimental plots at Knoxville, Tennessee.

COWPEA

Leaf spot caused by Cercospora cruenta Sacc. was general in New Jersey, Arkansas, and Texas, also one report from Missouri. The disease was said to be very important in Texas causing early shedding of the leaves.

Leaf spot caused by Phyllosticta phaseolina Sacc. was noted in one field in Indiana causing distortion of the pods. Fifty percent of the plants were affected.

Rust caused by *Uromyces appendiculatus* (Pers.) Lev. was generally distributed on cowpea in Texas, as in 1919, but was said to occur late in the season and hence caused little loss.

Mosaic (cause unknown) was noted as quite widely scattered in Arkansas and as extremely severe in large fields.

Wilt caused by *Fusarium* sp. - reported from one locality in Arkansas.

Root rot caused by *Ozonium omnivorum* Shear was a very important disease in Texas and caused a loss estimated at 5%.

Root knot caused by *Heterodera radicicola* (Greef.) Müll. - generally present in Arkansas.

SOYBEAN

Bacterial blight caused by *Bacterium glycineum* Coerper and *B. sojae* Wolf - According to I. V. Shunk and F. A. Wolf (Soybean bacterial blight. (Abstract) Phytopath. 11: 52. 1921) these two organisms are distinct and both are pathogenic to soybeans causing a similar type of injury. The latter organism only has been found associated with blight in North Carolina. Soybean blight was also noted in 1920 to occur in Louisiana, Indiana, and Michigan. The disease was of moderate importance in Louisiana and Indiana.

Mosaic (cause unknown) was reported by C. R. Orton from Pennsylvania on soybean as follows:

> "On July 30, 1920, a field of Ito San soybeans was inspected at Girard, Erie County, and in this field the writer first observed mosaic upon soybeans. About 2% of the plants were affected, and most of them only on the top, showing the condition often found in tomatoes and tobacco when the plants become infected late in the season. The symptoms were pronounced - even more so than is usually seen in red and alsike clover. In fact this mosaic is as pronounced as one often sees mosaic upon tobacco."

VELVET BEAN

Leaf spot caused by *Bacterium* sp. (probably *Aplanobacter stizolobii* Wolf) was reported as of moderate importance in Louisiana.

HORSE BEAN

Sun scald (non parasitic) practically destroyed the crop of horse beans on the college farm in Idaho according to Hungerford.

B. GRASSES

SUDAN GRASS

Bacterial blight (Red spot) caused by Bacillus sorghi Burr. was reported by Goss as prevalent on experimental plots in Nebraska.

Kernel smut of sudan grass was reported from Nebraska by Goss: "Experimental plots on the college farm show considerable infection of kernel smut."

MISCELLANEOUS GRASSES

Since most of the data on diseases of grasses consist only of records of occurrence it seems best to list them in tabular form under the causative fungi as follows:

RUSTS

Puccinia coronata
- Avena fatua - Minnesota

Puccinia epiphylla
- Poa canadensis - Minnesota
- Poa pratensis - Minnesota

Puccinia glumarum
- Hordeum jubatum - Idaho

Puccinia graminis
- Agropyron caninum - Minnesota
- Agropyron repens - Minnesota, New York, Vermont

Puccinia graminis (cont.)
- Agropyron tenerum - Minnesota
- Agrostis palustris - Minnesota
- Avena fatua - Minnesota
- Elymus canadensis - Minnesota
- Elymus robustus - Minneosta
- Hordeum jabatum - Minnesota
- Phleum pratense - Maine, Tennessee, Ohio, Michigan, Minnesota, Iowa, Idaho

SMUTS

Urocystis agropyri
- Elymus sp. - Minnesota

Ustilago bromivora
- Bromus sp. - Idaho

Ustilago crameri
- Chaetochloa lutescens - Minnesota

Ustilago lorentiziana
- Hordeum jabatum - Minnesota

Ustilago neglecta
- Chaetochloa lutescens - Minnesota

Ustilago rabenhorstiana
- Syntherisma sanguinalis - Minnesota

Ustilago striaeformis
- Poa pratensis - Minnesota
- Phleum pratense - Pennsylvania, Iowa, Minnesota, Idaho.

MISCELLANEOUS

Claviceps paspali
- Paspalum sp. - Arkansas

Claviceps purpurea
- Agropyron caninum - Wisconsin, Minnesota
- Agropyron repens - Wisconsin, Minnesota

Claviceps purpurea (cont.)
- Agropyron smithii - Wisconsin, Minnesota
- Agropyron tenerum - Wisconsin, Minnesota
- Agrostis palustris - Wisconsin
- Arrhenatherum elatius - Wisconsin

Claviceps purpurea (cont.)
- Bromus condensatus - Idaho
- Bromus inermis - Wisconsin, Minnesota
- Calamagrostis canadensis - Wisconsin, Minnesota
- Calamagrostis sp.-Minnesota
- Dactylis glomerata - Wisconsin, Minnesota
- Elymus canadensis - Wisconsin, Minnesota
- Elymus virginicus - Wisconsin, Minnesota
- Festuca elatior - Wisconsin
- Festuca sp. - Minnesota
- Hordeum jubatum - Wisconsin
- Hordeum nodosum - Minnesota
- Lolium sp. - Idaho
- Panicularia fluitans - Wisconsin
- Phelum pratense - Wisconsin, Minnesota
- Poa compressa - Wisconsin
- Poa pratensis - Wisconsin, Minnesota
- Stipa viridula - Minnesota

Colletotrichum cereale
- Beckmannia erucaeformis - Minnesota

Epichloe typhina
- Calamagrostis canadensis - Minnesota
- Elymus robustus - Minnesota

Erysiphe graminis
- Agropyron repens - Minnesota
- Hordeum jubatum - Minnesota
- Poa pratensis - Minnesota

Phyllachora graminis
- Agropyron repens - Minnesota
- Calamagrostis canadensis-Minnesota
- Elymus canadensis - Minnesota
- Elymus striatus - Minnesota
- Elymus virginicus - Minnesota
- Hystrix patula - Minnesota
- Oryzopsis asperifolia - Minnesota

Piricularia grisea
- Chaetochloa italica - Ohio

Rhynchosporium secalis
- Bromus inermis - Wisconsin
- Dactylis glomerata - Wisconsin

Sclerospora graminicola
- Chaetochloa italica - Minnesota
- Chaetochloa lutescens - Iowa
- Chaetochloa viridis - Iowa

Scolecotrichum graminis
- Hordeum jubatum - Idaho
- Phleum pratense - Idaho,Minnesota
- Poa compressa - Minnesota
- Poa triflora - Minnesota

Sporotrichum sp.
- Poa pratensis - Iowa

C. MISCELLANEOUS

SUN FLOWER (Helianthus)

The cultivation of sunflower as an ensilage crop has become quite important recently in certain sections; especial interest is, therefore, attached to the diseases of this crop.

Wilt caused by Sclerotinia sp.

Sunflower wilt was reported in 1920 from Montana, Washington, and Oregon, also from Manitoba by Bisby. According to Morris and Swingle (H. E. Morris and D. B. Swingle. An important new disease of the cultivated sunflower. (Abstract) Phytopath. 11: 50. 1921) the disease appeared at several points in Montana and attacked plants at all stages of growth. In one field 24% of the plants were killed by this disease, and within a month there was an increase of 22%. The disease was reported from Oregon in 1920 by H. P. Barss as follows:

"Worse than last year and worse than average year. Threatens to become serious in the moist coast section as sunflower silage industry grows. Twenty percent of affected plants were found in one field. The disease causes death of plants at any stage from attack near the ground."

Heald and Dana report it from four counties in Washington - Whatcom, Snohomish, (two localities), Kitsap, and Whitman. It was reported from Minnesota, Ramsey County (first record). G. R. Bisby reports this disease as well distributed over Manitoba and states that in addition to sunflower, certain composite weeds, such as Iva, Canada thistle sowthistle, and wild sunflowers are found killed in the field by this disease (Sclerotinia disease of sunflower in Manitoba. Phytopath. 11: 49 1921). Previous records of this disease in the files of the Plant Disease Survey show it to have occurred at Puyallup, Washington in 1912 and 1919, also in Yamhill County, Oregon, in 1916. The identity of the disease in the different sections is as yet uncertain. The disease as it occurs in Washington has been described by Lawrence (W. H. Lawrence. Plant Diseases induced by Sclerotinia perplexa nov. sp. Washington Agri. Exp. Sta. Bul. 107: 1-22. 1912) and the organism ascribed to a new species (Sclerotinia perplexa Lawrence. Lawrence states that the disease was quite severe on sunflowers in western Washington in 1909 and 1910 and that the same fungus also occurred on quite a number of other plants including thousand-headed kale, Jerusalem artichoke, marrow cabbage, onion, and others.

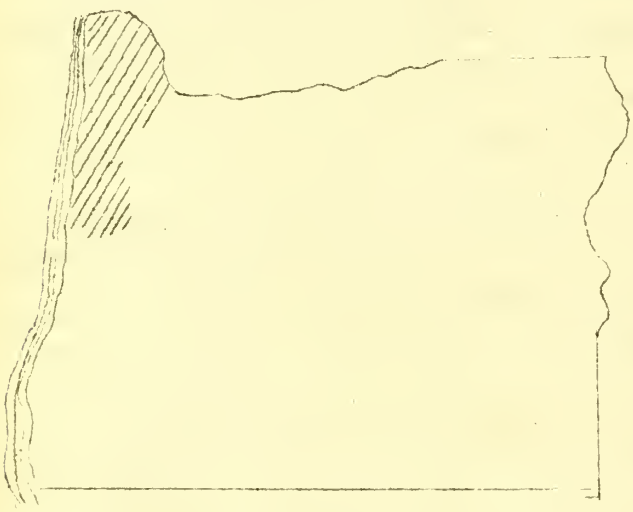


Fig. 37. Occurrence of Sclerotinia disease of sunflower in Oregon in 1920, according to H. P. Barss.

Other diseases.

Rust caused by Puccinia helianthi Schw.,although reported only from New Jersey, Michigan, and Minnesota was no doubt general over the country.

Soft rot of head (cause probably bacterial) - reported from Georgia as causing considerable loss in silage plants. It caused a rotting of the heads and shattering of the seeds.

Powdery mildew caused by Erysiphe cichoracearum DC. was reported from Iowa, Minnesota, and Washington.

Botrytis blight caused by Botrytis sp. was reported as rather prevalent in the coast sections of Oregon according to H. P. Barss. The fungus attacked the leaves, growing tips, and heads.

THE PLANT DISEASE BULLETIN

Issued By

THE PLANT DISEASE SURVEY

SUPPLEMENT 16

Diseases of Field and Vegetable Crops

in the United States in 1920

June 1, 1921

BUREAU OF PLANT INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE

PLANT DISEASE SURVEY

1920

G. R. Lyman, Pathologist in Charge.

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DISEASES OF FIELD AND VEGETABLE CROPS IN THE UNITED STATES IN 1920.

Prepared by

R. J. Haskell and J. I. Wood.

CONTENTS

INTRODUCTORY STATEMENT.

The customary sources of information have been drawn upon in the preparation of this summary. Collaborators of the Plant Disease Survey have furnished the major part of the data, as usual, and the names of those who did most of the reporting to the Survey are listed on the opposite page.

Many of these persons were assisted by other collaborators and volunteer reporters whose names cannot be listed here for lack of space, but the Survey wishes to thank them and all others who took part in the reporting service of the year.

The Office of Cotton, Truck, and Forage Crop Disease Investigations has furnished valuable information both directly to the office and indirectly through its "News Notes". The data collected by Inspectors of the Bureau of Markets has also been used freely and F. C. Meier, Pathologist with that Bureau, has contributed interesting material. Notes of the field men of the Bureau of Crop Estimates and reports from the U. S. Weather Bureau, as well as current bulletins and periodicals, have been scanned for matter relating to the plant disease situation of the year.

THE WEATHER OF 1920

The weather conditions over the entire United States for a complete growing season cannot be adequately summarized in the few words that space in the Bulletin will permit. The reader is therefore referred to the various publications of the Weather Bureau for data on this subject. However, for convenience a table (Table 55) and brief statement showing the ways in which the season differed from the normal have been extracted from Climatological Data published by the Weather Bureau. In using these data, however, it should be remembered that monthly averages are necessarily rough and that wide variations occur within a single state.

The season for the country as a whole was cold and late. The month of April was so prevailingly cold that only one state, Florida, had a temperature of normal or above. The rainfall during that month also averaged more than usual in all states except in a few in the Southwest and in Minnesota and North Dakota.

May averaged cooler than normal also in practically all states except a few in the lower Mississippi Valley, a group in the Southwest and in North Dakota and Minnesota. The total rainfall was less than normal in most states although seldom seriously scanty.

June continued cool and in most parts of the country the season remained late. A deficiency of precipitation occurred in a belt extending in a northwest and southeast direction from Washington to Florida, but in the northeastern and western portions of the country an excess of rainfall was reported.

July temperatures were above normal west of the Great Plains except in California, but east of this area the monthly means were below normal as a rule, the deficiency being most marked in the Lake region and upper Ohio Valley. East of the Plains States the rainfall was mainly close to, if not equal to or greater than, the monthly normal.

August averaged cooler than normal in most districts except in the Northeast and in a few Gulf Coast districts. The month's rainfall was usually large, and in the main much above normal, in the Gulf States, Tennessee, Kentucky, and the Atlantic States up to the northern border of New Jersey and Pennsylvania.

September averaged warmer than usual in the Rocky Mountain States and eastward. The month had a large total rainfall in New England and New York, and in the coast districts from North Carolina to central Louisiana. A group of states in the central part of the country also had an excess of rain as did Washington and Oregon. The others experienced a deficiency.

Table 55. Departures from the normal temperature and rainfall by states - April to September, 1920.
(Figures taken from United States Department of Agriculture Weather Bureau Climatological Data 7, 1920.)

State	Departure from normal											
	Temperature (°F.)						Precipitation (inches)					
	April	May	June	July	August	September	April	May	June	July	August	September
New Eng.	-1.8	-3.0	-1.2	-1.6	+2.8	+1.7	+3.00	-2.04	+1.35	-0.05	-0.24	+2.00
N. Y.	-2.4	-2.0	-0.6	-2.5	+1.7	+1.7	+0.97	-2.04	+0.06	+1.02	-0.21	+1.31
N. J.	-1.0	-3.0	-0.8	-1.9	+0.3	+1.0	+0.93	-0.83	+2.80	+0.96	+1.31	-0.18
Pa.	-2.8	-3.2	-0.4	-2.7	-0.2	+0.9	+0.96	-1.81	+0.83	+0.34	+0.64	+0.94
Del.& Md.	-1.3	-4.4	-0.5	-2.1	-0.1	+0.4	+1.23	-1.57	+1.34	-0.23	+2.58	-0.16
Va.	-1.1	-5.1	-1.8	-3.1	-1.4	+	+0.60	-1.97	+1.08	+0.25	+2.35	-0.16
W. Va.	-2.0	-3.3	-0.9	-3.0	-0.6	+1.0	+1.42	-1.33	+0.52	+0.53	-0.37	+0.41
Ky.	-5.1	-1.4	-1.8	-1.5	-2.3	+0.8	+2.22	+0.13	-1.06	-0.45	+2.24	+0.54
Tenn.	-1.5	-0.4	-1.6	-1.0	-1.9	+1.3	+3.59	-0.20	+0.41	-0.68	+3.10	+0.86
N. C.	-0.6	-4.3	-0.4	-1.2	-1.0	+1.9	+2.06	-2.41	-0.32	-0.01	+2.30	+0.95
S. C.	-0.9	-3.7	-0.1	-0.9	-1.1	+1.5	+2.21	-1.69	-1.54	-0.30	+1.95	+1.48
Ga.	-0.4	-2.2	-0.1	-0.4	-1.3	+1.5	+3.73	+1.29	-1.10	+0.14	+2.31	+0.05
Fla.	+0.9	-1.6	-1.0	-0.5	-0.6	+0.6	+4.04	+1.09	-0.35	+0.22	-0.50	+1.32
Ala.	-0.8	-1.0	-1.1	-0.6	-2.0	+1.7	+5.00	+0.88	-0.19	-0.16	+2.48	-0.71
Miss.	-0.8	+1.5	-1.4	-0.5	-1.7	+2.6	+4.39	+1.14	+0.10	+0.82	+0.58	-0.19
La.	-0.3	+2.6	-1.5	-0.4	-1.2	+2.5	+0.26	+0.34	+0.42	+2.10	+1.70	-0.02
Texas	-1.1	-1.3	-2.1	0.0	-2.9	+1.8	-2.17	-1.43	+0.39	-0.14	+3.05	-0.65
Okla.	-2.7	-1.2	-0.8	-0.1	-4.7	+0.4	-0.83	-0.05	-1.17	+0.26	+1.96	+0.71
Ark.	-1.4	+1.8	-1.7	-0.3	-2.6	+1.2	+0.89	+2.86	-0.93	+0.43	+0.27	+0.06
Ohio	-4.1	-2.6	-0.1	-3.4	-1.4	+0.8	+2.58	-1.36	+1.01	+0.44	+0.94	-0.16
Ind.	-5.1	-2.1	-1.6	-2.5	-1.8	+1.6	+2.52	-0.47	-0.72	+0.24	-0.19	-0.18
Ill.	-4.7	-1.4	+0.8	-1.4	-1.4	+2.6	+1.16	+0.92	-1.65	-1.14	-0.44	-0.87
Mich.	-4.9	-1.1	+1.4	-3.1	-0.4	+2.4	+0.65	-1.91	+0.90	-0.01	+0.09	-0.57
Wis.	-5.7	-0.6	+1.5	-2.4	-1.0	+3.1	0.00	-	+2.50	-1.50	-0.65	-

State	Departure from normal											
	Temperature (°F.)						Precipitation					
	April	May	June	July	August	September	April	May	June	July	August	September
Minn.	-7.3	+1.2	+1.0	-1.1	+0.4	+4.4	-0.33	-0.35	+1.91	-0.96	-1.58	-0.06
Iowa	-6.3	-1.1	+1.6	-1.8	-2.5	+3.1	+1.73	-1.31	-0.82	+0.26	-0.33	-0.06
Mo.	-4.7	-0.8	-0.5	-0.9	-3.0	+1.4	+0.15	+0.04	-2.16	-0.84	+0.89	+0.92
N. D.	-9.6	+1.3	-0.6	+0.8	+3.4	+2.6	-0.55	-0.81	+0.12	-0.46	-0.72	+0.62
S. D.	-8.8	-0.2	-0.3	-0.1	-1.2	+2.2	+1.36	-1.69	+1.66	-0.57	-0.59	-0.44
Nebr.	-8.4	-1.1	-0.2	-0.3	-3.0	+1.4	+2.55	-0.06	-0.87	-0.67	+0.97	-0.93
Kans.	-4.8	0.0	0.0	-0.4	-4.3	+0.6	+0.33	-0.86	-1.15	-0.26	+1.35	+0.22
Mont.	-6.2	-1.2	-1.9	+3.1	+1.7	+0.9	+0.94	-0.37	-0.58	-0.26	+0.07	-0.55
Wyo.	-8.5	-0.3	-0.9	+0.7	-0.9	-0.4	+1.26	-0.29	-0.43	-0.47	+0.23	-0.33
Colo.	-7.4	+0.9	-0.6	0.0	-2.6	-0.9	+1.13	-0.11	+0.19	-0.58	+0.38	-0.27
N. Mex.	-4.3	+0.5	-1.7	-0.2	-2.1	-0.4	-0.66	+0.47	+0.81	-0.83	+0.32	-0.42
Ariz.	-3.8	+1.4	+0.9	+1.4	-1.2	-1.4	-0.22	+0.02	+0.30	-1.29	-0.17	-0.19
Utah	-5.6	-1.1	-0.5	+1.5	-0.4	-0.4	+0.83	+0.03	-0.21	-0.36	+0.40	-0.26
Nev.	-3.3	+1.4	-1.0	+0.3	-0.2	-0.1	+0.26	-0.44	-0.03	-0.24	+0.51	-0.18
Ida.	-4.6	-1.7	-0.7	+2.4	+0.5	0.0	+0.52	-0.73	-0.26	-0.39	+0.74	+0.52
Wash.	-3.8	-2.9	-1.4	+2.1	+1.2	0.0	+1.01	-0.95	-0.02	+0.08	+0.67	+1.69
Ore.	-3.4	-1.9	-0.6	+0.5	+1.6	-0.3	+1.29	-1.34	+0.21	-0.01	+0.64	+1.80
Calif.	-2.2	-0.4	-1.7	-2.3	+0.6	-2.1	+0.77	-1.02	+0.11	+0.02	+0.17	-0.20

DISEASES OF POTATO

Late blight caused by *Phytophthora infestans* (Mont.) De Bary.

The year 1920 may be considered as the worst blight year for the late potato states, and in fact for the country as a whole, that has been experienced since 1915 when an epiphytotic swept over the Great Lakes Region and northern Iowa as well as over the northeastern area where the disease is commonly prevalent. The 1920 outbreak was less serious than that of 1915 in that it did not involve Minnesota or Iowa and the losses in Wisconsin and Michigan were slight in comparison.

When compared with the reports for 1919, those for 1920 showed the disease as more severe in Northern New England, less in southern New England; more in New York, Pennsylvania, Ohio, and Michigan; less in Wisconsin and Minnesota; more in Oregon; and less in the early crop of Florida. One of the especially noteworthy differences from 1919 was the outbreak in Ohio, where the disease has not been destructive since 1915 but where, nevertheless, a small amount has occurred annually, and also the extension of the range into Michigan, which has been practically free from late blight rot for the past five years. The state as a whole did not experience heavy loss (not over 1%) but the occurrences were numerous and widely scattered. Michigan is now provided with an abundance of infected tubers, many of which will be used for seed in 1921 and if blight weather prevails in that state this year much damage may be expected. In Maine, New Hampshire, and Vermont the disease was worse than it has been for years. According to County Agent Scribner of Aroostook County, Maine the vines in the northern portion of the county were mostly killed by August 25, thus cutting off practically one month's growth of late varieties. The situation seemed to be worse than in 1918 when 15% loss was reported in Maine. Growers were not so much concerned this year, however, owing to the extremely low prices that they were receiving for the crop. F. C. Meier visited Aroostook, October 19-21 and reported in the Bureau of Markets, Fruit and Vegetable Division Letter, November 18, 1920: 12 as follows:

> "The northern part of the State was most severely affected. This territory includes Washburn, Ft. Fairfield, Limestone, Presque Isle, Easton, Caribou, and Van Buren, all of which are heavy shipping points. In the region south of Houlton, blight is reported as being less severe.
>
> "During the course of this trip many barrels of potatoes were examined, and in every instance some late blight dry rot was found. The Cobblers, since they mature early, were of course least affected. Much dry rot was found at all points on the Mountain varieties, on Spaulding Rose, and on Aroostook Prize. Van Buren storage houses seemed to contain potatoes showing the most injury. This is of interest on account of the fact that the Aroostook Prize is grown extensively in that section. This potato, when sent to New Jersey, becomes the 'Giant'. Several seedsmen are having difficulty in procuring stock sufficiently free from blight for their purpose, and there is little doubt that inspections of seed stock will be requested on account of late blight."

B. F. Lutman in Vermont reported on October 15:

> "Tuber rot is bad especially on heavy clays and will cause a loss through the state of 25-50% of the entire crop. One of the worst blight years we have ever had here."

In Massachusetts, Connecticut, and Rhode Island the disease was worse than in average years but less disastrous than last year when losses of 20, 30, and 25% respectively were reported.

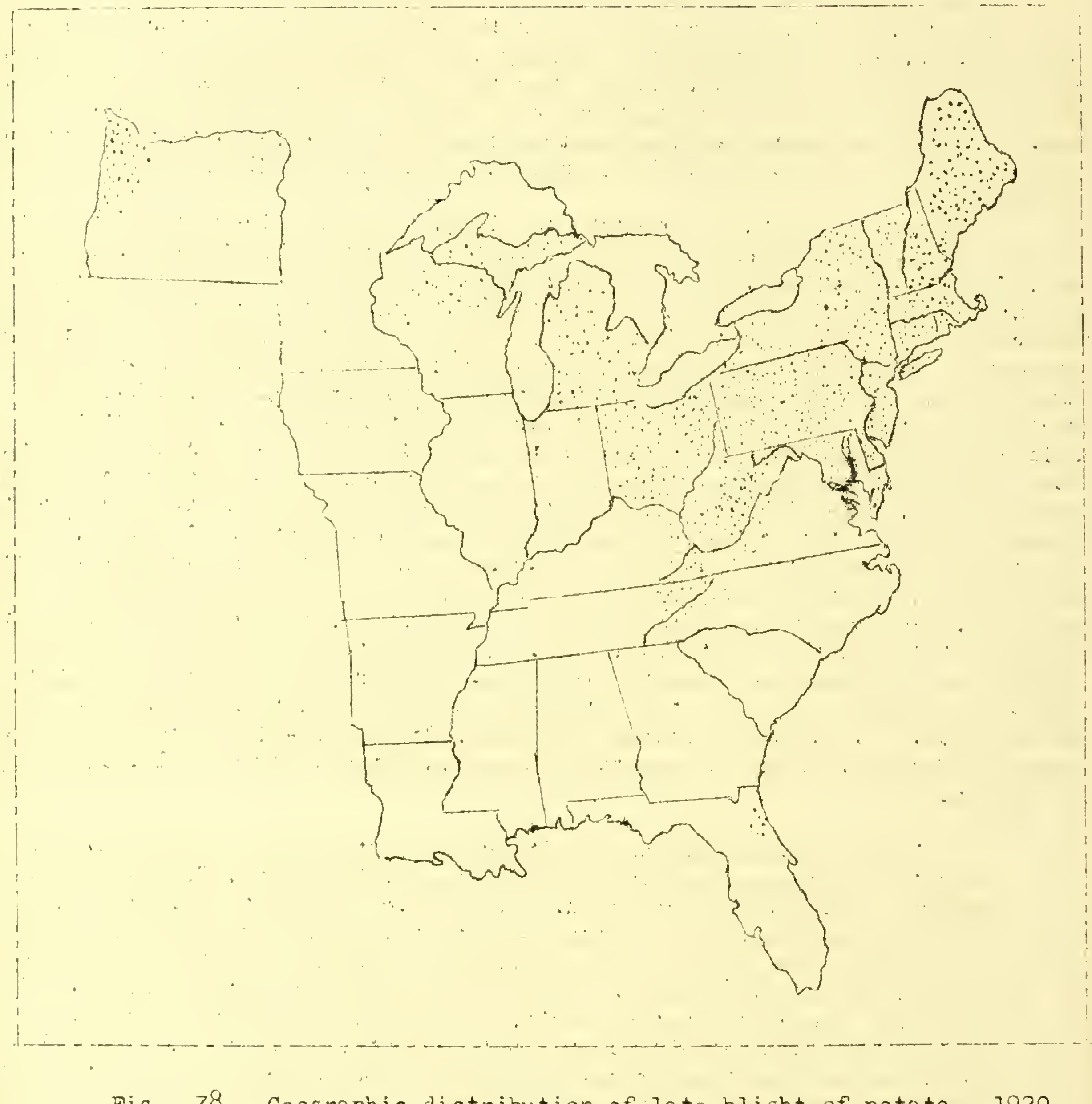

Fig. 38. Geographic distribution of late blight of potato - 1920.

In New York the disease took a heavy toll both by premature killing of the vines, as early as August 1 in many cases, and by rotting of the tubers in field and storage. In connection with the seed potato certification work, percentages of late blight rot were determined on the harvested potatoes in the bin and the average percentage of rot on 436 farms was 4.1%. This figure is lower than on the average farm because many of these farmers sprayed and consequently had less rot. In addition to this loss in the bin there must have been much more in the field from rot of the tubers and blight of the vines.

The following table shows the results of this inspection by counties.

Table 56. Percentages of late blight rot in harvested potatoes as shown by bin inspection, New York, 1920.

County	Number lots inspected	Average percentage late blight rot	County	Number lots inspected	Average percentage late blight rot
Allegany	26	2.96	Monroe	18	0.23
Cayuga	13	0.62	Orleans	23	0.62
Chenango	9	4.00	Oneida	15	0.54
Clinton	34	15.10	Onondaga	36	0.37
Cortland	58	9.04	Ontario	19	2.44
Erie	12	0.51	Oswego	25	4.16
Essex	5	5.10	Rensselaer	2	trace
Franklin	27	4.25	Seneca	14	2.02
Genesee	11	0.02	Steuben	13	1.20
Jefferson	2	0.00	Washington	47	10.47
Livingston	9	0.00	Wyoming	18	2.87
			Total and average	436	4.10

In the potato disease survey conducted by the Pennsylvania Department of Agriculture last year, 521 fields yielding 478,449 bushels were examined for late blight rot. In Cambria County, where 21,3% rot was found, the counts were made in the fields but in the other two counties, Lehigh and Potter, where 6.8% and 8.9% were found, the determinations were made in storage after harvest. It will be seen, therefore, that the percentage of rot in the field was probably more than that in storage, and the Pennsylvania inspectors have estimated the total loss from rot in all three counties as over 20%.

Table 57. Amounts of late blight rot in three Pennsylvania counties, according to survey by Pennsylvania State Department of Agriculture, 1920.

County	Number fields surveyed	Total yield	Percentage of late blight rot
Cambria	175	90,156	*21.3
Lehigh	207	330,868	6.8
Potter	139	57,425	8.9
Total	521	478,449	Av. 12.3

*Counts made in field. In the other two counties counts were in storage.

The loss from blight and rot for the entire state of Pennsylvania was placed by the pathologists there at 25%, which was thought to be a conservative estimate.

In New Jersey there was a large amount of rot on American Giants in the central part of the state, especially the east central part.

In Florida the disease was apparently of less importance on the early crop than is often the case.

In Wisconsin the disease became established in the northeastern part of the state in July but the dry weather of August and September held it in check so that the ultimate loss was small.

In November 1920 the Bureau of Crop Estimates sent out for the Plant Disease Survey a questionnaire addressed to volunteer crop reporters in states where late blight was known to have occurred. The following questions were asked:

1. Were potato vines in your locality attacked by late blight?

2. If so, please answer the following:

    a. When was the trouble first noticeable on the vines?
    b. Were the vines eventually killed by it?
    c. What percent reduction from a normal yield would you estimate took place because of blight of the vines?
    d. What percent of farmers sprayed with Bordeaux?

3. Was tuber rot prevalent in your locality?

4. If it was, please answer questions below:

    a. What percent of reduction in yield from tuber rot would you estimate?
    b. What was the worst case of rot that came to your attention?
    c. Remarks.

5. How have stored potatoes been keeping thus far this fall?

Replies were received from reporters, distributed by states as shown in Table 58.

A summary of the replies to questions 2-c, 4-a, and 4-b, asking for the estimated reduction in yield from vine blight and tuber rot is given in Table 58.

It is surprising to observe the high percentages of loss from both blight and rot as reported by these correspondents. A loss of more than half the crop, which seems very high, is revealed in some states. It is possible that mistaken identity of the disease is a source of error, but it would seem that there should be little chance of confusing the late blight rot with other rots as the others are unimportant in these states, especially at this time of year. The vine blight might be confused with tip burn or early blight but neither of these diseases were destructive in these states last year. On the other hand both the distribution of the losses among the states and the relative amounts of the two forms of the disease agree with other data on hand in the Survey Office. The figures are, therefore, given in Table 58 without comment and each reader can make his own interpretation of them.

A set of estimates based chiefly on those of collaborators is given in Table 59. For further details, including losses in bushels, see Supplement 18 of this Bulletin.

An idea of the amount of late blight rot found in shipments of potatoes may be gained from Table 60. It will be noted that there was more rot in the 1920 than in the 1919 crop shipped during the year.

Table 58. Reduction in yield of potatoes from late blight as reported by voluntary crop reporters of the Bureau of Crop Estimates, 1920.

State	Total number reports received	Percentages reduction in yield from late blight			Maximum percentage rot in any one field
		Vine blight	Tuber rot	Total	
Maine	196	22.6	24.5	47.1	100
Vermont	133	19.0	28.1	47.1	100
New Hampshire	110	20.8	28.4	49.2	100
Massachusetts	112	16.6	14.6	31.2	100
Connecticut	64	17.4	12.6	30.0	90
Rhode Island	29	17.2	9.8	27.0	90
New York	707	19.2	22.9	42.1	100
New Jersey	87	13.7	9.3	23.0	100
Pennsylvania	597	24.4	16.8	41.2	100
Delaware	24	9.3	7.1	16.4	80
Maryland	132	10.9	5.3	16.2	66
Virginia	91	5.7	4.0	9.7	40
West Virginia	312	14.7	6.1	20.8	75
Kentucky	104	3.5	1.0	4.5	10
Tennessee	102	3.9	5.7	9.6	40
North Carolina	100	6.3	5.1	11.4	50
Ohio	645	16.5	6.6	23.1	100
Michigan	659	10.4	1.8	12.2	100
Wisconsin	531	9.4	1.9	11.3	75
Oregon	104	6.2	5.4	11.6	100
All states reporting	4839	15.2	10.8	26.0	

Table 59. Estimated percentage reduction in yield from late blight and rot, 1920.

Percentage reduction in yield	State
30	Vermont.
25	Pennsylvania.
20	Maine, New Hampshire.
15	Massachusetts, Rhode Island, New York.
10	Connecticut, Maryland, West Virginia, Ohio.
5	New Jersey.
3	Delaware.
1	Virginia, North Carolina, Florida, Michigan, Wisconsin.
trace	Minnesota, Kentucky, Tennessee, Washington, California.

Table 60. Losses from late blight tuber rot caused by Phytophthora infestans, as shown by inspection of cars at destination by inspectors of the Bureau of Markets, calendar year 1920.

January 2 - June 19, 1920			August 5, 1920 - January 15, 1921		
Origin of shipment	No. cars with decay	Average percentage decay	Origin of shipment	No. cars with decay	Average percentage decay
Colorado	1	2	Colorado	1	3
Florida	2	12	Maine	132	6
Maine	106	5	Maryland	2	2
Maryland	5	8	Michigan	45	6
Massachusetts	4	4	Minnesota	3	11
Michigan	1	8	New Jersey	22	5
Minnesota	5	7	New York	81	6
New York	53	3	Ohio	3	8
North Carolina	1	1	Oregon	3	20
Virginia	2	3	Pennsylvania	13	5
Wisconsin	11	4	Wisconsin	2	4
Canada	65	6	Canada	63	8
Unknown origin	15	4	Unknown origin	10	6
Total & average	271	4.9	Total & average	380	6.4

Total number of cars inspected (approximate)...... 5,140
Total number of cars shipped 166,233

Dates of first observation of late blight, 1920:

March 22	Sanford, Fla.	August 2	Monroe Co., N. Y.
June 22	Raymond City, West. Va.	August 4	Rochester, Vt.
July	Connecticut.	August 9	Hampshire Co., Mass.
July (early) .	New Jersey.	August 13 ...	Blacksburg, Va.
July 11	Suffolk Co., L. I., N. Y.	August 23 ...	Wooster, O.
July 21	Frostburg, Md.	August 28* ..	Corinna, Me.
July 25	Oneida Co., Wis.	August 30 ...	Center Harbor, N. H.
July 29	Somerset Co., Pa.		

*Was noted earlier in northern Maine (early in August)

Some of the more significant reports of collaborators and others concerning weather conditions are given below:

New York - Long Island (F. C. Meier): "Although blight was present in many fields on Long Island, there were but few heavy rains following the period when the disease was at its worst; consequently tuber infection by means of spores washed into the soil seems to be rather rare."

Michigan (Waid): "Occurred in scattered places quite well distributed over state. However, weather conditions were such following the outbreak that comparatively little damage was done considering the number of places which were hit."

Wisconsin (Vaughan): "General drought over most of state held blight in check."

Minnesota (Stakman): "It was so dry during July that the conditions were extremely unfavorable for the development of the disease."

Oregon (Barss): "Early and continued fall rains induced severe late attack in some sections."

Collaborators in New York, Pennsylvania, and West Virginia all said that where spraying with Bordeaux was carefully practiced good results were obtained.

Early blight caused by Macrosporium solani E. & M.

Early blight occurred during the course of the season in practically all of the country. However, it was mentioned as not having been seen in Washington or Nevada. Most of the reports indicate that the disease was generally distributed but in some of the more northern states, like Minnesota and Indiana, it was mentioned as being much more abundant in the southern sections, and in Oregon and Michigan it seemed to be more or less localized, depending on climate, soil or varietal differences.

Although this was probably one of the four or five most universal potato diseases in the United States, in importance it ranked among the minor diseases of the crop. Most of the states experienced losses of less than one per cent. Preliminary estimates indicate that the following losses of more than 1% occurred. For corrected percentage estimates see Plant Disease Survey Bulletin, Supplement 18, 1921.

Table 61. Losses of 1% or more from early blight of potato, 1920.

State	Percent loss	State	Percent loss	State	Percent loss
Pennsylvania	2	South Carolina	1	Ohio	2
New Jersey	2.5	Georgia	1	Indiana	1
Delaware	3	Florida	5	Illinois	1.5
Maryland	1	Alabama	3	Iowa	1
Kentucky	2	Mississippi	3	New Mexico	3
Tennessee	4	Texas	1		

Many states indicate that the disease was much below the normal but some states report it as prevalent in about the usual amounts. However, no records have been received to show that early blight was more important than ordinarily in any one state.

Dates of earliest recorded appearance of early blight, 1920:

May 15 .... Crystal Springs, Miss.
June 3 .... Ohio
June 24 ...... Marion Co., Ind.
June 24 ...... Corinna, Me.
July .... Bedford Co., Pa.
July 13 ...... Bath, N. H.
July 28 ...... Oneida Co., N. Y.
August 1 ..... Madison, Wis.

The disease was usually reported more commonly on early maturing varieties and the Triumph was mentioned as being badly injured in Georgia. It is not suggested that any great differences in susceptibility of varieties exist, however, provided plants of similar age are subjected to similar conditions of environment.

Spraying for this disease with Bordeaux does not seem to be practiced to any particular extent although there are probably many localities where it would pay in certain years.

Fusarium blight caused by Fusarium oxysporum Schlect.

As usual Fusarium blight, or Fusarium wilt as it is often called, was widespread but owing to the lateness of the season and sub-normal temperatures during the summer, the disease was not so destructive as normally. It was most serious in the western potato sections and in states along the southern border of the late potato belt. In Pennsylvania it was mentioned as most abundant in the southeastern part of the state, while in Indiana and Idaho it was reported as especially bad in the northern and southern sections respectively.

In a number of western states this disease often occurs in the same fields and on the same plants with blackleg thus complicating the symptoms and making loss estimates difficult. Mr. Shapovalov found this condition to exist in parts of the Red River Valley of Minnesota and North Dakota and in southern Idaho this past season.

Regarding the seriousness of this disease in the West the Office of Cotton, Truck, and Forage Crop Disease Investigations of the Department of Agriculture has issued the following statement under date of December 11, 1920.

> "The disease affecting the potato plants in the field, variously known as Fusarium blight, wilt, etc., is considered to be by all means the most serious risk to the western potato industry, although scarcely yet recognized as such by the growers. It is the common, perhaps almost universal, experience that yields fall off rather rapidly as potato culture is continued in any western district. This is frequently attributed to exhaustion of fertility and to other diseases, when as a matter of fact, in our opinion, the Fusarium blight is really the responsible cause. This situation is particularly marked in the San Joaquin Delta of California, although severe cases of the disease have been noted in Idaho, Utah, Colorado, and Washington, and it occurs to a greater or less extent throughout the Eastern States also, particularly in the warmer districts. In some localities in southern Idaho and on the western slope in Colorado the percentage of distinctly diseased plants ran as high as 90%. The average per cent of infected hills in the fields surveyed in 1920 is estimated at 20%. The premature death of the plants is hastened by high temperatures such as prevailed in August, 1920, when many Idaho and Colorado fields were completely killed in a few days."

The loss estimate of .5% from Fusarium blight in New York was based largely on the results of inspections that were made in connection with the seed certification work of that state. A total of 440 fields comprising 1392 acres in 22 counties were examined. The percentages of affected plants by counties are given in Table 62.

Table 62. Percentages of Fusarium blight in New York counties where potato inspection work was conducted in 1920.

County	Percentage blight	County	Percentage blight	County	Percentage blight
Alleghany	0.35	Genesee	0.18	Oswego	4.87
Cayuga	4.05	Jefferson	Trace	Rensselaer	8.85
Chenango	Trace	Livingston	1.28	Seneca	0.24
Clinton	0.05	Monroe	1.46	Steuben	2.41
Cortland	Trace	Oneida	0.01	Washington	3.58
Erie	0.69	Onondaga	2.06	Wyoming	0.42
Essex	0.05	Ontario	1.14		
Franklin	0.25	Orleans	2.43		

Average per cent affected plants in state 1.28%
Estimated loss 0.5%

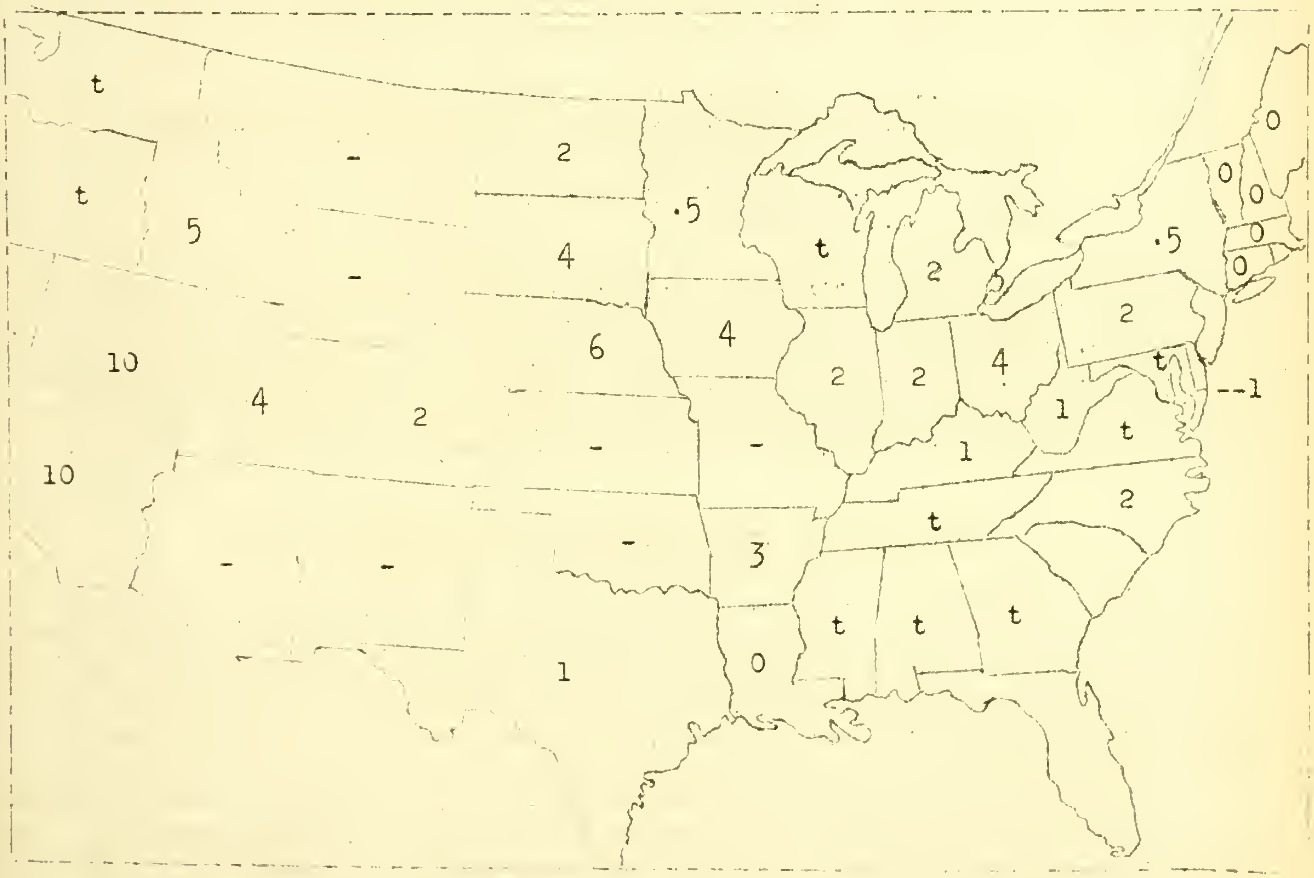

Fig. 39. Preliminary estimate of percentage of loss from Fusarium blight, 1920. For corrected estimate and loss in bushels see Plant Disease Bulletin, Supplement 18, 1921.

In Indiana and Illinois, as in the majority of western states, Fusarium blight was the most important parasitic disease of potato. In the potato sections of the southern states this does not seem to be a disease of any special importance, perhaps because the early crop matures before the advent of sufficiently high temperatures, while the late crop is planted late and reaches a susceptible stage late in the fall when the weather is again comparatively cool. There is no doubt that the range and severity of this disease is greatly influenced by temperature conditions.

The following statement of conditions in North Dakota is given by H. L. Bolley:

> "The disease seems to have been greatly developed this year in the dry land regions wherever seed was originally slightly infected. Drought seems to check the growth of the tuber and thus allows invasion. Perhaps this is not the full explanation but the semi-dry land regions have, as a fact, produced more stem-end rot and wilt than the wetter, heavier lands of the valley."

Inoculation from seed tubers showing vascular discoloration due to Fusarium has not been considered during recent years as a very important mode of infection, especially when the crop is grown in a region where soil infestation exists. However, more observations and experiments are needed on this subject.

Comparatively few collaborators submitted dates when the disease was first observed this year. Those that did reported as follows:

May 25	Starkville, Mississippi.
June 14	Suffolk County (Long Island), New York.
July	Arkansas.
July 7	Clay County, Minnesota.
July 15	Utah.

No states report any concerted effort or any success in the control of the disease. In an experimental way the planting of whole seed has been shown to help in Colorado (McMillan, H. G. Fusarium blight of potatoes under investigation, Journ. Agr. Research 16: 270-303, 1919) and varying the planting date has proved helpful in parts of New York. (Haskell, R. J. Fusarium wilt of potato in the Hudson River Valley, New York. Phytopath. 9: 223-260. 1919).

Wart caused by Chrysophlyctis endobiotica Schilb.

The intensive survey of suspicious areas in Pennsylvania, West Virginia, and Maryland initiated in 1919 was continued in 1920 by the Plant Disease Survey acting for the Federal Horticultural Board and with the Experiment Station authorities of the states concerned. The main results of the work which have been reported also elsewhere in this publication (Pl. Dis. Bul. 4: 109-110. 1920) are as follows:

In Pennsylvania wart was discovered in five new villages, making a total of eleven infested villages discovered to date in the soft coal district. The area known to be infested was extended both eastward and westward, but the general situation is not changed. In West Virginia the survey of the northern coal fields was completed without finding wart in any new localities. In Maryland wart was found in three villages near Frostburg, and there is every indication that the disease is more or less abundant in that region. The extensive and growing seed-potato industry in the Frostburg section renders the discovery of wart there of exceptional importance. Further field work is needed in these three states, as undoubtedly other infested villages remain undiscovered. The present known distribution of wart outside the Hazleton district is as follows:

Table 63. Present known distribution of potato wart outside the Hazleton district.

Town	County	State	No. of infested gardens known	Date of discovery	Discovered by
Nanty Glo	Cambria	Pa.	*2	8-27-19	Plant Disease Survey men
Lilly	"	"	*1	9-13-19	" " " "
Llanfair	"	"	*12	9-23-19	" " " "
Vintondale	"	"	*2	9-27-19	" " " "
Osceola Mills	Clearfield	"	*5	10-8-19	" " " "
Clarence (Snow Shoe	Center	"	*2	10-14-19	" " " "
Woodvale	Huntingdon	"	2	7-29-20	" " " "
Robertsdale	"	"	7	8-3-20	" " " "
Janesville (Smithmill)	Clearfield	"	2	9-1-20	" " " "
Beaverdale	Cambria	"	1	8-18-20	Pennsylvania State men
Yatesboro	Armstrong	"	3	-20	" " "
Whitmer	Randolph	W.Va.	2	9-19-19	Plant Disease Survey men
Thomas	Tucker	"	21	9-12-19	" " " "
Coketon	"	"	2	-20	West Virginia State men
Pierce	"	"	2	-20	" " " "
Lord	Allegany	Md.	1	9-15-20	Plant Disease Survey men
Mt. Savage	"	"	1	9-19-20	" " " "
Eckhart Mines	"	"	1	9-21-20	" " " "

*Number of gardens found in 1919. The 1920 findings by the Pennsylvania State authorities in the quarantined villages have not been reported to the Plant Disease Survey.

The nation-wide publicity campaign of 1919 was continued during 1920 in a minor way by correspondence. It is believed that the general interest in watching for wart was sustained in large measure.

Carefully selected areas in Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Ohio, Michigan, Wisconsin, Indiana, and Illinois, were visited and extensive garden inspection undertaken. Many of these areas appeared to be favorable for the introduction and establishment of wart, but the disease was not found.

It is hard to believe that wart in the United States is confined to the coal fields of Pennsylvania, Maryland, and West Virginia, yet all our evidence thus far points in this direction. Many millions of bushels of European potatoes were distributed in other regions, where conditions appear to be as favorable for the development of the disease as those in the three states named. It hardly seems possible that wart was absent in all the shipments going to

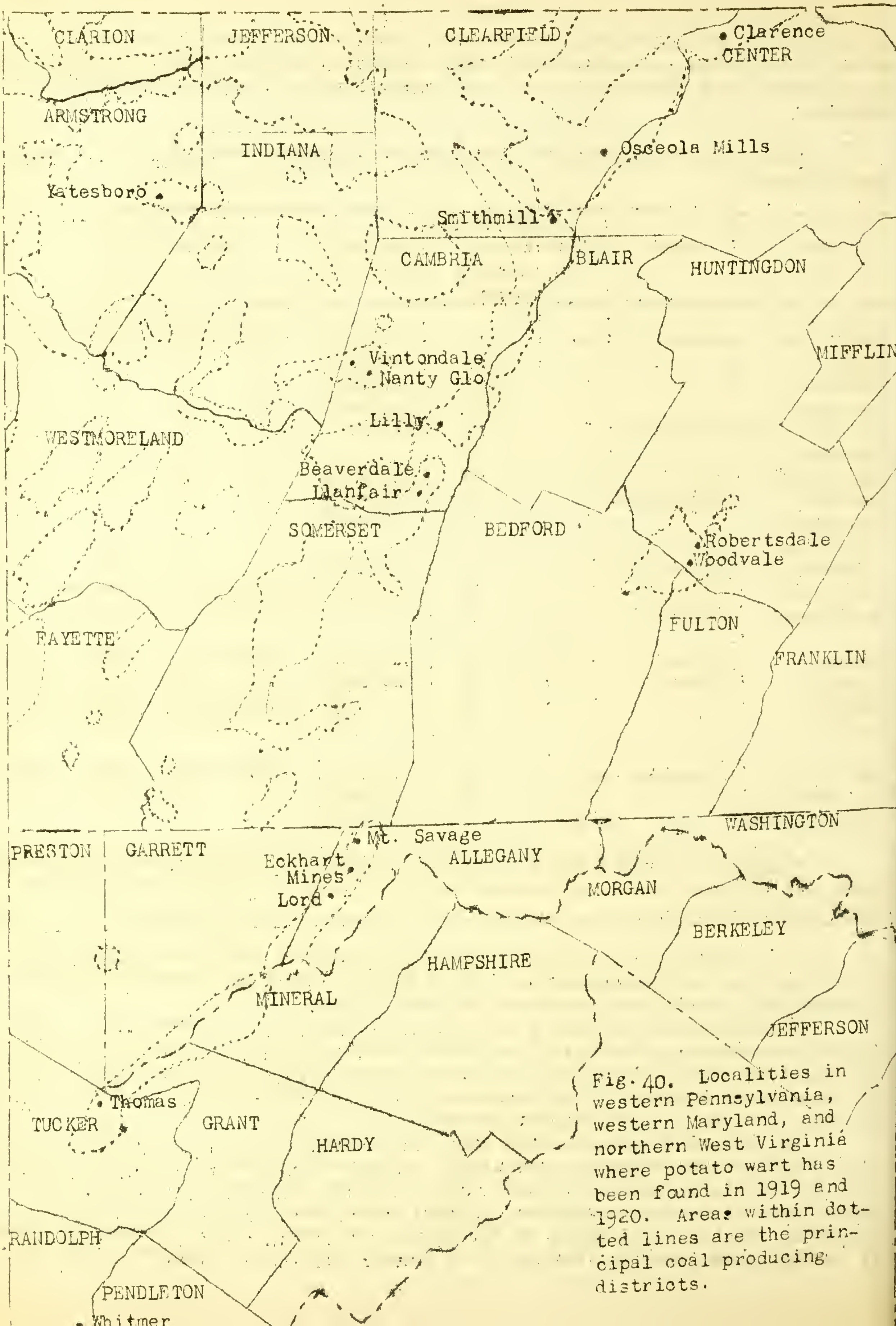

Fig. 40. Localities in western Pennsylvania, western Maryland, and northern West Virginia where potato wart has been found in 1919 and 1920. Areas within dotted lines are the principal coal producing districts.

other states, or that it failed to establish itself in all cases when present. However, we believe it can be stated with reasonable assurance, that there is no other large area of severe infestation comparable to the Hazleton district. We believe that such areas would have been located by the surveys of the past two years. Smaller areas, or those with slight infestation, might easily have been overlooked.

It appears from the work of the past year that we are not likely to find wart in large cities like New York and Chicago, even though vast quantities of foreign potatoes which may have carried wart were consumed there. This statement is based on the following observations: (1) Gardens are not common in foreign quarters of large cities, where the imported potatoes were largely consumed, and, where present, are small and usually contain no potato plants. (2) Garbage is usually collected by the city, domestic animals like chickens and pigs are not generally kept, and as a result garden sanitation is not favorable to the establishment of the disease. (3) In the environs of large cities, where gardens are more common, the people are usually more intelligent and conditions do not usually favor the disease.

The greatest danger points appear to be small, more or less isolated communities of foreigners, where there is room for gardens and where general surroundings are unsanitary. Mining villages present ideal conditions, but saw-mill villages and many of the smaller industrial communities would seem to be equally favorable.

Stem rot and scurf caused by Corticium vagum solani Burt.

This diesease, commonly spoken of as Rhizoctonia, doubtless occurred in all regions where potatoes were grown. Most of the collaborators that reported on the disease in 1920 mentioned that it was generally distributed with the crop. The sclerotia of the fungus are very common and traces of them can be found in almost any lot of seed or table potatoes one wishes to examine. Of course the abundance of the disease varied greatly in different localities, depending on climatic and soil conditions. Thus, in parts of Arkansas it is said not to be important as the soil is too acid, while in Ohio, on the contrary, it is reported as being especially bad on certain acid soils.

The recent work of Richards (Abstract in Phytopath. 11, January, 1921) has shown that soil temperature is a vital factor in determining the degree to which the potato may be damaged by Rhizoctonia. Temperatures of 15-21° C (59-69.8°F) are said to be optimum for the production of lesions on shoots and stems below ground. It is obvious then that variations in locality, date of planting, character of the season or any other circumstance influencing soil temperature, may have much to do with the degree to which the potato plant is damaged. In Wyoming, H. G. McMillan reported severe attacks of Rhizoctonia in places where the irrigation water was applied to early.

Rhizoctonia is classed among the more serious potato troubles, not because of its large and conspicuous local losses but because it causes damage everywhere. It is the aggregate loss for the country as a whole that places it among the major potato diseases. According to estimates of this office Rhizoctonia ranked fourth in importance of the potato diseases, both in 1918 and 1919.

The estimates of percentage loss from this disease for 1920 are given on the accompanying map - Fig. 41 (For loss in bushels and totals for the United States see Plant Disease Bulletin Supplement 18, 1921). The losses of 1920 were apparently somewhat in excess of those of the preceding year. Although the majority of the states indicated that the disease was about the same as last year, collaborators in Iowa and Utah reported less and those in North Carolina, Ohio, and Kentucky reported more.

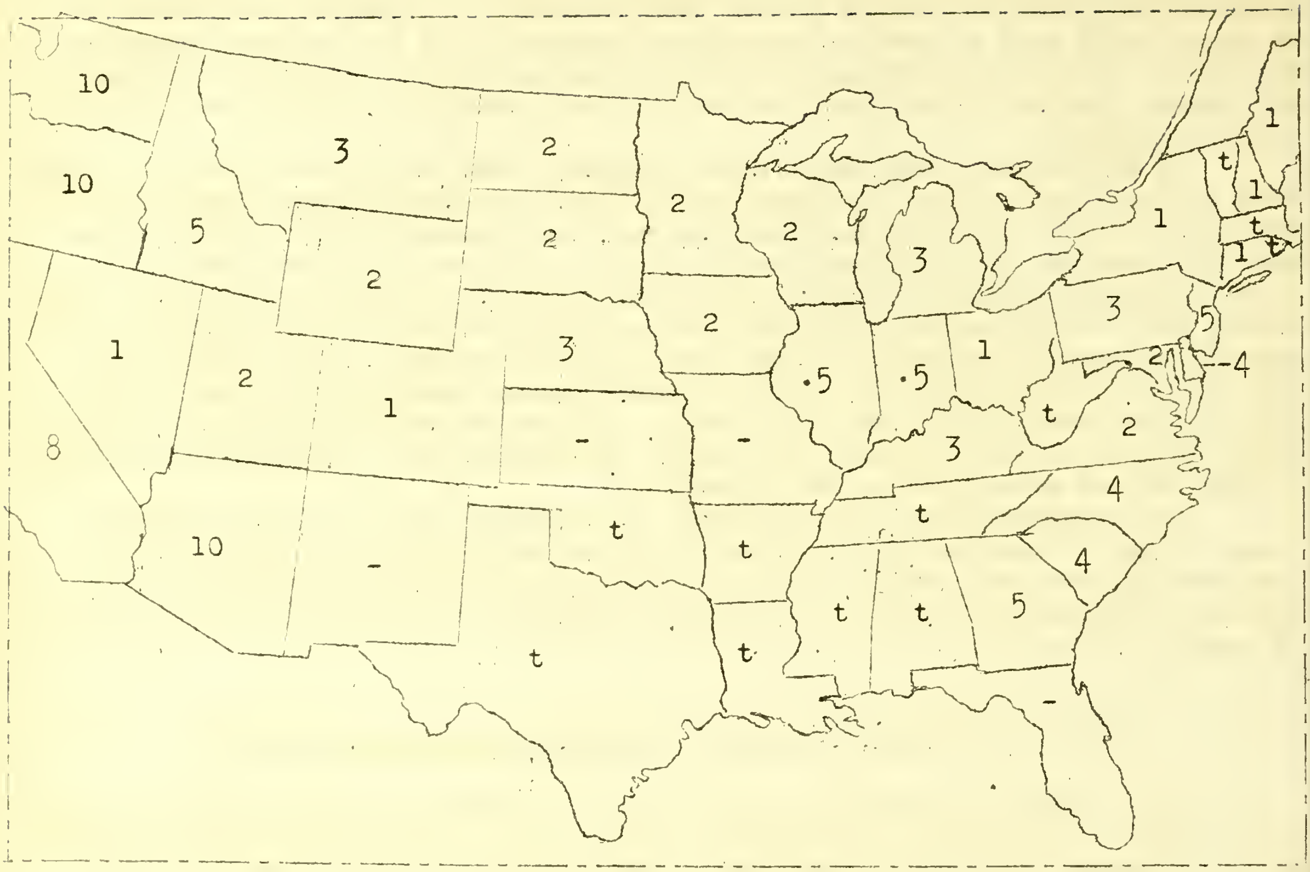

Fig. 41. Estimated percentage reduction in yield of potatoes from Rhizoctonia, 1920.

A better idea of the importance of this disease can be gained from the following quotations from collaborator's reports:

Massachusetts (Osmun) - General and as prevalent as usual. New York (Chupp) - important. Same as last year and average year. Present in 95% of the fields, wherever potatoes are grown. New Jersey (Cook) - Present throughout the state. Losses much greater than supposed. West Virginia (Giddings) - Unimportant. Generally distributed in slight amounts. Kentucky (Valleau) - Very important in early crop killing growing points or girdling young plants. Present in all fields examined, affecting 8% of the plants and causing 5% reduction in yield of spring crop. North Carolina (Jehle) - Very important. All over state but very prevalent in Wayne and Transylvania Counties. Georgia (McClintock) - Slight, causing stem lesions and aerial tubers. Mississippi (Neal) About same. Of no importance. Arkansas (Elliott) - Trace of injury. Soil too acid. Ohio (Selby) - Prevalent and quite widely distributed, especially on late and medium late potatoes. Indiana (Gardner) -Same as last year. Very little in southern Indiana. Wisconsin (Vaughan) - As usual. One of the principal diseases. Is coexistent with the host causing reduced stands with a result that the crop is reduced 2%. Minnesota (Stakman) - Rather prevalent and destructive. In some fields as many as 25% of the plants were severely affected. Iowa (Melhus) - Less than last year, 2% loss. North Dakota (Bolley) - Very common throughout the state. Not always well controlled, even when seed tubers were properly treated. Utah (Richards) - Very important, less than last year. Occurred throughout the state causing stem cankers. Idaho (Hungerford) - About same as last year. Important, present in all fields reducing the yield about 5%. Washington (Heald and Dana) - Reported from all parts of the state. Oregon (McKay) - Widespread in western Oregon causing, in combination with hot dry weather of August, the premature death of 10-30% of the plants. Very bad where rotation is not properly used. California (Smith) - Rhizoctonia, combined with the effect of prolonged cold and dryness, caused a serious set-back in early planted potatoes and other field crops. Many recovered and produced a good crop.

The season of 1920 was unusually backward over the greater part of the country. The months of June and July, when late potatoes were sprouting and coming through the ground in the late potato belt, were wet and abnormally cold. The weather records for July show that the temperatures were below normal in all states except North Dakota, Montana, Wyoming, Utah, Arizona, and all states west except California. In view of the temperature relations that have been demonstrated for Rhizoctonia it is quite probable that the subnormal July temperatures of 1920 favored the disease.

Dates of first appearance of Rhizoctonia on potato plants, 1920:

May	Louisville, Ky.	July	Texas
May 15	Jackson, Miss.	July 3	Nautoma, Wis.
May 24	Suffolk Co., N. Y.	July 28	Ohio
June 1	Corinna, Me.	August 4	Hennepin Co., Minn.
June 15	Utah		

Rural New Yorker was less injured in Wisconsin than early varieties and Green Mountain, and in Wyoming the disease was noticed particularly on Triumph.

Considerable evidence is being accumulated to show that infection from the soil is not so important as infection from the seed piece. This is borne out by the success that has attended seed treatment. The following statement by H. L. Bolley of North Dakota points in the same direction:

> "This disease at digging time is found to be quite general throughout the state but evidently depends upon previous seed infection more than upon soil infection, for there are fields essentially free interspersed."

Good control by seed disinfection with mercuric chloride (1-1000 for 1-1/2 hrs.) is reported from Ohio, Indiana, and Wisconsin. Cooperative seed treatment experiments were conducted in Iowa, Minnesota, and Wisconsin in 1919 using -

(1) - Formaldehyde (1-240) cold for 2 hours.
(2) - Formaldehyde (1-120) 50° C for 2 minutes.
(3) - Copper sulphate (3-4000) for 2 hours.
(4) - Mercuric chloride (1-1000) for 1-1/2 hours.

The results, which were conflicting, may be summarized as follows: (I. E. Melhus. Cooperative potato seed treatment experiments (Committee Report) Phytopath. 11: 59, January, 1921).

Treatments listed in order of efficiency.

Iowa: Copper sulphate, hot formaldehyde, mercuric chloride.

Minnesota: Hot formaldehyde, mercuric chloride, copper sulphate.
Wisconsin: Mercuric chloride and hot formaldehyde about equal in efficiency, and copper sulphate poorest.

The cold formaldehyde (1-240) for 2 hours gave fair control at all stations.

Bacterial wilt caused by Bacillus solancearum EFS

In North Carolina, the only state reporting losses due to bacterial wilt during 1920, the disease was said to be increasing in severity and importance in the Coastal Plains counties. The reduction in yield in the state was estimated at 3%. Bacterial wilt was reported also from Ohio as less prevalent than usual, and from Alabama.

The disease undoubtedly occurred in South Carolina, Georgia, and Florida, although no definite reports were received from those states in 1920.

Verticillium wilt caused by Verticillium albo-atrum Reinke & Barth.

Verticillium wilt was reported during 1920 from Ohio where it was found in Hardin County, August 5, and from western Oregon where it is always one of the serious potato diseases. The Oregon report would indicate that the disease was not so destructive as usual and that the loss in yield would approximate 3%. According to pathologists at the Agricultural Experiment Station the presence of the disease in Massachusetts is suspected.

Scab caused by Actinomyces scabies (Thax.) Güssow.

Common scab occurred generally with the potato crop in regions, localities and fields where soil and climatic conditions were favorable for the disease. It is a common experience to find scab much worse in some parts of a state than in other parts. Thus in 1920 it was reported as worse in the northern than in the southern parts of Indiana, and in the Marinette section of Wisconsin and on Long Island, New York the disease was negligible in quantity compared with many other parts of the same states. Records of other years have indicated this regional distribution within states for in 1918 Georgia reported scab worse in the northern counties and in 1917 and 1919 Idaho and Minnesota reported less in the northern than in the southern portions of those respective states.

Within a given section the amount of scab varies greatly, depending largely on the nature of the soil and the presence of the organism. The same thing applies to individual fields for it is very often found to be much worse in some parts of a field than in others. An examination of past reports to the Plant Disease Survey shows that collaborators have frequently mentioned that the disease was worse on the heavier and more poorly drained soils, as well as on those that have had applications of lime, ashes or stable manure or for some reason are alkaline. In Aroostook County, Maine the Caribou type of soil which is usually on the higher land and on the ridges, normally yields much less scab than the Washburn soil, which for the most part occupies the depressions and lower levels. According to H. A. Edson the hydrogen-ion concentrations of solutions from these two soils are considerably different and correspond with the hydrogen-ion concentrations of solutions that will prohibit or permit the growth of the scab organism as the case may be. In Colorado H. G. McMillan reported very little scab except at the lower end of potato fields where the irrigation water is backed up.

Thus, although scab is a widespread disease and occurs to a greater or less extent in all parts of the country, it still is quite largely a local problem, important in some sections and not in others.

In 1920 scab was about as prevalent as last year and the average year although collaborators in Connecticut, Mississippi, and Iowa reported more than in 1919. The meager estimates of damage as furnished by collaborators for 1920 are given in Table 64.

Table 64. Injury and loss to potatoes from scab, 1920.

State	Percentage of injury	Percentage of loss	State	Percentage of injury	Percentage of loss
New York	3	0.3	Ohio	Small	
New Jersey	Heavy		Indiana	-	5% (in value)
Georgia	1	0.01	Wisconsin	4	.5
Texas	-	0.5	Minnesota	50	1
Mississippi	-	4-6	Iowa	-	6
Arkansas	5	-			

The requirements for U. S. Grade No. 1 potatoes call for tubers which are practically free from scab, meaning so free that, "the appearance shall not be injured to any extent readily apparent from a causal examination <u>of the lot</u> and that the damage can be removed by the ordinary process of paring without appreciable increase in waste over that which would occur if the potato were perfect". This requirement, together with those set up within the states for certified seed potatoes, make scab a more serious economic problem for the farmers who are trying to grow first class table or seed stock than in earlier years. The following instance quoted from a communication from F. C. Meier, August 26, illustrates this point:

> "Common scab is causing much trouble in the above mentioned territory (Redbank, New Jersey and vicinity). Our shipper claims to have had about 19 carloads rejected at destination on account of failure of stock to meet requirements of U. S. Grade No. 1 as regards common scab and second growths. This shipper went so far as to make the statement that, in his opinion, not more than 10% of the crop in some sections could be graded No. 1."

In order that we may have before us the data on losses, importance and relative prevalence by states the accompanying digest of all reports made to the Plant Disease Survey since its beginning has been prepared.

Importance of scab in various states as reported to the Plant Disease Survey:

<u>Maine:</u> 1907 - On the increase, especially in the best potato sections where they have not apparently recognized the importance of clean seed. There is much complaint from it this year and the subject demands serious attention from all growers. 1908 - Many reports, 5-10% injury. 1909 -

Usual amount. 1910 - Usual amount. 1914 - Generally distributed.
New Hampshire: 1906 - 20% crop injury. 1907 - 20% injury. 1909 - Less. 1917 - Less than 5% loss.
Vermont: 1906 - Apparently less than average. 1907 - Same. 1908 - Less than 1907. 1915 - Common, 15-20 injury. 1916 - Very abundant, 10-15% injury. 1917 - 10-15% injury, 5-10% loss. 1918 - 25% injury, 10% loss.
Massachusetts: 1905 - Not serious. 1906 - Quite serious. 1907 - More abundant. 1910 - Always present but never severe when seed is treated and no lime applied to soil. 1915 - Frequent, less. 1916 - Very small loss. 1917 - More common. 1918 - 3% loss. 1919 - 1% loss. 1920 - As usual.
Connecticut: 1915 - Negligible owing to acid soil. 1916 - Probably less. 1917 - As usual. 1918 - Probably 1-2% loss. 1919 - Probably less. 1920 - More.
New York: 1907 - Much worse. 1910 - But little. 1913 - Fairly common, loss small. 1914 - Common, 20-25% affected, 1% unsalable. 1915 - 5% injury, small loss. 1918 - 6% injury, 1% loss. 1920 - .3% loss.
New Jersey: 1905 - Much less than 1904. 1906 - More. 1912 - Very abundant. 1913 - Abundant. 1914 - Abundant. 1915 - As usual, 25% injury. 1917 - Same or less than usual. 1919 - More than usual. 1920 - Same, loss heavy.
Pennsylvania: 1908 - Same, 5-10% injury. 1909 - 5% injury. 1910 - 5% injury. 1911 - 5% loss. 1912 - 5% loss. 1914 - 25% injury, 3-5% loss. 1915 - As usual, 5% injury, less than 1% loss. 1917 - 10% depreciation. 1918 - 20% injury, 5-8% loss. 1919 - About as usual, 10-15% injury, 4-5% depreciation.
Delaware: 1907 - less than 2% injury. Not serious this year. 1912 - 1% injury. 1913 - 1% injury. 1914 - 1% injury. 1915 - Very common, 2-5% injury. 1916 - 1% injury. 1917 - 2% injury. 1918 - Same or less than 1% injury. 1919 - 4-5% loss in east.
Maryland: 1905 - Up to 25% injury.
Virginia: 1910 - 20% injury. 1912 - Usually very slight. 1915 - 5-25% injury.
West Virginia: 1914 - Slight. 1915 - Slight. 1917 - About 1% loss. 1918 - Slight. 1919 - Moderate, 10% injury, 2% loss.
Kentucky: 1915 - 1% local injury. 1917 - Quite prevalent in all fields, 10% injury.
Tennessee: 1919 - 50% injury.
North Carolina: 1905 - Less than 1904, 5% loss. 1912 - Loss very slight. 1913 - Loss moderate. 1915 - Moderate. 1916 - No appreciable damage, rare, loss negligible. 1917 - About 5% crop injury.
South Carolina: 1906 - Less. 1917 - 10-20% injury. 1918 - 30% injury, 2% loss. 1919 - Common, 10% injury, 1% loss.
Georgia: 1915 - Light. 1917 - 2-3% loss. 1919 - 2-10% loss. 1920 - Trace loss.
Florida: 1905 - Complete loss on 50 acres of limed land. 1907 - 5% crop attacked. 1914 - Same. 1917 - 5-10% loss, frequently 95% crop affected locally. 1918 - As usual.
Alabama: 1907 - 80% injury. 1918 - Very little. 1919 - Large loss, more.
Mississippi: 1909 - General. 1914 - Scarce, slight loss. 1919 - Common, probably 5% loss. 1920 - 4-6% loss.
Louisiana: 1910 - Very large loss in places. 1913 - Common, considerable loss. 1914 - Considerable loss. 1915 - Considerable. 1917 - One-third of crop seconds or culls in one parish. 1918 - Very common; about 5% loss. 1919 - Very common, probably 10% loss.
Texas: 1916 - 2% injury in east. 1917 - .5% loss. 1919 - Prevalent, 5% loss. 1920 - .5% loss.
Oklahoma: 1907 - Very prevalent, 5% injury. 1908 - 5% injury. 1916 - Very slight loss. 1917 - 2% loss. 1919 - Less than usual.
Arkansas: 1915 - Less. 1917 - 10% infected tubers. 1919 - 5% injury. 1920 - 5% injury.

Ohio: 1905 - More, 21% injury. 1906 - Less than 1905, 5% injury. 1907 - Less. 1908 - Less, 2% injury. 1914 - More reported. 1915 - Less than 1914. 1917 - About 15% loss. 1919 - More than 1918. 1920 - Loss small.

Indiana: 1905 - 15% injury. 1907 - 10-20% injury. 1908 - 25% injury. 1910 - 15% injury. 1915 - 2-50% injury. 1917 - 3% loss. 1920 - 5% loss in value.

Illinois: 1911 - Injury small. 1912 - Well controlled in commercial sections. 1917 - 10-15% loss.

Michigan: 1912 - Whole state badly infested, 5% crop thrown out. 1913 - 5% loss, 90% in one field. 1914 - Everywhere, 5-10% loss with deep scab. 1915 - As usual.

Wisconsin: 1914 - Small injury, 1-5% loss. 1915 - Little, 3-4% injury. 1916 - More than for several years. 1917 - Less than 1916, small loss. 1918 - Small loss. 1919 - 3% loss. 1920 - As usual, 4% injury.

Minnesota: 1906 - 5% injury. 1908 - Considerable damage. 1915 - Average amount. 1916 - More than 1915, 5% injury. 1917 - Less. 1918 - Less than usual, about 1% loss. 1920 - Same as 1919, 1% loss.

Iowa: 1904 - Great deal. 1905 - Prevalent, 4% injury. 1906 - Same. 1907 - Same. 1910 - 5% injury. 1913 - Abundant. 1914 - Abundant. 1915 - Abundant. 1916 - 1% injury. 1917 - 3% injury. 1919 - More, 12-20% damage. 1920 - More, 6% damage.

Missouri: 1918 - Common, 15% injury. 1919 - Slight to moderate.

North Dakota: 1907 - Less common. 1908 - Less. 1913 - Not common. 1915 - Less than 1914.

South Dakota: 1913 - Common. 1914 - Bad. 1915 - Same, 10% injury. 1917 - More. 1919 - 25% injury; 5% loss.

Nebraska: 1903 - Very common in some parts of state. 1904 - Occurs in all parts of state and in counties on Missouri River (Sarpy and Nemaha) a damage of from 10-15% is reported. 1906 - 15% injury. 1915 - Same as 1914, 5-10% injury. 1919 - 5% loss.

Kansas: 1915 - Very little noted; injury negligible.

Montana: 1903 - Found in many parts of state but not considered dangerous. 1917 - Average prevalence.

Wyoming: 1915 - General, 50% injury.

Colorado: 1915 - All over state, worse in irrigated fields. 1917 - One of the important diseases.

New Mexico: 1915 - 2% loss. 1916 - 1-10% loss. 1917 - 10-20% loss.

Utah: 1912 - Very bad in some cases. 1915 - Not quite as abundant as usual, 20% injury. 1917 - Not common.

Nevada: 1915 - 25% injury. Worst on heavily irrigated areas. 1919 - 2% loss.

Idaho: 1913 - 1-100% injury, very prevalent. 1915 - Generally prevalent, 1-100% injury. 1916 - Bad in places. 1919 - 10% injury, 2% loss. 1920 - About same, important.

Washington: 1903 - General but loss not large. 1907 - Injury up to 100%. 1908 - Common, 5% injury. 1917 - 5-10% loss and 10-20% reduced to second grade.

Oregon: 1909 - Serious locally. 1911 - Common but not serious except locally. 1915 - Common everywhere. 1917 - Not very serious loss.

California: 1910 - Fairly serious. 1917 - Common but not serious.

Among other things an examination of the preceding data shows that not only is the disease generally distributed over the United States, but (1) that it is much more of a problem in some states and in some localities than in others, (2) that the average state losses in general are not especially high although the percentage of injury is in many cases, and (3) that the disease varies considerable from year to year, apparently being influenced by the season.

Potato varieties differ in their susceptibility to scab. Lutman (Resistance of potato tubers to scab. Vermont Agr. Exp. Sta. Bul. 215. 1919) has shown recently that the true russet types of tubers show marked resistance while the semi-russets show some scab resistance, and the white, thin-skinned varieties seem most susceptible. He has demonstrated that resistance is correlated with thickness of skin, tubers that have the thinnest skin being the most susceptible. The following list gives the named varieties that Lutman used in 1917 arranged in order of their resistance to scab, the most resistant given first and the most susceptible last.

Table 65. Potato varieties arranged in order of resistance to scab according to B. F. Lutman's experiments, 1917.

Variety	Percentage clean tubers 1917	Variety	Percentage clean tubers 1917
Cowhorn	60.	Early Rose	17.5
Burbank's Russet	57.5	Bovee	12.1
Scab Proof	55.9	Green Mountain	7.4
Cambridge Russet	36.2	Reading Russet	.8
Dibble's Russet	22.9	Ninety-fold	.7
Sir John Llewellyn	19.6		

In Plant Disease Survey collaborator's reports since 1903 a number of varieties have been mentioned as resistant or susceptible as shown in Table 66.

Table 66. Susceptibility of potato varieties to scab as shown by collaborators' reports, 1903-1920.

Susceptible varieties	Resistant varieties
Early Rose - Pennsylvania, 1913	Netted Gem - Idaho, 1915
Early Ohio - Minnesota, 1919	Rural New Yorker - Wisconsin, 1918-1920
Green Mountain - Wisconsin, 1915	Russet Burbank - Minnesota, 1917
Rehobeth - Maryland, 1915	Irish Cobbler) (Montgomery County,
Early varieties in general - Wisconsin, 1919	Crown Jewel) (Maryland, 1908

The value of seed treatment in the control of scab has been demonstrated in many different places, but there are also many sections, particularly the older ones, where seed treatment appears to be of little value. The discussion on potato diseases at the Chicago meeting of the American Phytopathological Society, December 30, 1920 brought out the fact that seed treatment is not established in many of the great potato growing sections and that the principal reason seems to be that the growers do not find that it pays them. The case was cited of Aroostook County, Maine where farmers have watched the results of seed treatment for years but still have not yet considered the practice commercially profitable. As already stated, these growers have practically no trouble with scab on what is called the Caribou soil, and it is on this that most of the potatoes are grown, but they do suffer heavy losses on so-called Washburn loam and it seems to make little difference whether or not the seed is treated.

Hot formaldehyde (2 pints to 30 gallons - 2 minutes at 118-122° F) has probably been used more in Iowa during the past year than ever before and it is being employed some in other states. In New York, for instance, it has been met with favor by a number of farmers and it is expected by New York collaborators that its use will increase. On the other hand many states still prefer corrosive sublimate as a general disinfectant for seed-borne diseases of the potato.

During the last two years progress on cooperative community seed treatment work has been made in Iowa (Porter, H. R. Cooperative seed treatment using hot formaldehyde. Abstract Phytopath. 11: 59. 1921). Hot formaldehyde was employed with favorable results some of which are given in Table 67.

Table 67. Some results of seed treatment with hot formaldehyde, Iowa, 1919-1920.

Year	Number of fields	Percentage of infected tubers: Seed treated	Percentage of infected tubers: Seed not treated
1919	4	15	76
1920	4	33	68

Results with the use of inoculated sulphur have been reported from New Jersey[1] and Wisconsin[2] during the past year. In New Jersey sulphur flour inoculated with soil well supplied with sulphofying organisms gave better scab control when applied to the land than did the sulphur flour alone. In Wisconsin, where a commercial inoculated sulphur was used, the results were not successful.

Mosaic (cause undetermined)

Mosaic is distributed widely all over the country where susceptible varieties are grown. In 1920 it was reported from practically all states. In most of these it occurred in about the same amounts as usual although collaborators in Massachusetts, Connecticut, and Idaho estimated somewhat more the last year. In Alabama A. F. Thiel reported that some fields in Mobile County, which showed heavy infection in May recovered considerably with the result that the ultimate loss was negligible. Observations along similar lines are reported by R. E. Vaughan from Wisconsin, September 1 as follows:

> "The mosaic which showed up earlier in the season has been largely masked by dry weather and development of the vines. Late planted Triumphs have much more mosaic than early planted, showing the importance of environment in the severity of this trouble."

B. F. Lutman, on October 15, stated that the loss from Mosaic would be smaller than usual on account of the cool, rainy season.

The mosaic situation in the western states is summarized by Mr. M. Shapovalov of the Office of Cotton, Truck, and Forage Crop Disease Investigations, who examined fields extensively in many of the important potato sections of the West during July, August, and September, 1920. He has contributed the following:

> "Mosaic appears to be common in all western states. Its symptoms sometimes are obscure, but on close examination it could be detected on

1. Martin, W. H. Inoculated vs. uninoculated sulphur for the control of common scab of potatoes. (Abstract) Phytopath. 11: 58. 1921.
2. Vaughan, R. E. Inoculated sulphur for potato scab control. (Abstract) Phytopath. 11: 58. 1921.

the foliage in every locality visited. It is fully recognized in Wisconsin and Minnesota as an important problem, but it presents practically an untouched field farther west. An adequate study of it there is very urgent in order to find out (a) the actual reduction of yields, (b) the rapidity of its spread during the season, and (c) the deterioration of the stock in the course of a number of successive seasons. Judging from the basis of our experience in the East, and considering the condition of the potato fields in the West, this year we may expect that a substantial increase in production can be secured through a more vigorous extermination of the mosaic-infected hills."

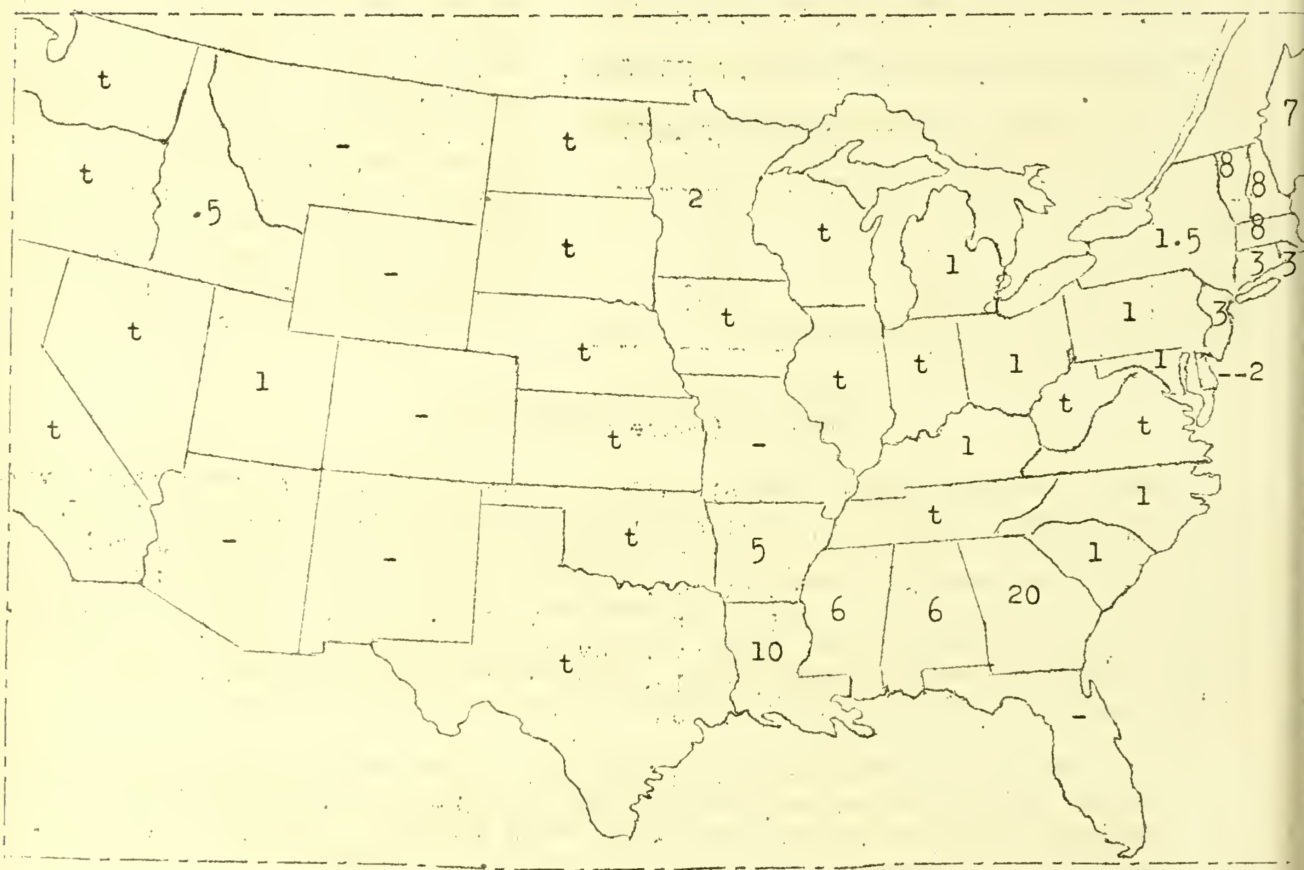

Fig. 42. Percentage reduction in yield of potatoes from mosaic, 1920. (For final estimates and loss in bushels see Supplement 18, 1921.)

Mosaic is the cause of very heavy losses to varieties that are susceptible, especially the Triumph and Green Mountain. In states where these varieties are largely grown, such as New England, New York, and the early trucking sections of Georgia, Alabama, Mississippi, and Louisiana, the disease becomes very important from the economic standpoint. In Michigan, Wisconsin, and Minnesota it is said to be very important on Triumph wherever it is grown.

The above map shows the estimated percentage loss by states and Table 68 gives other data bearing on the percentage of infection.

In New York and Pennsylvania a large number of counts were made of the percentages of mosaic in connection with seed potato inspection and certification work. Some of the results by counties are given in Table 69.

Table 68. Percentages mosaic affected plants and losses as given by a number of states.

State	Per cent affected plants in state	Estimated reduction in yield	Highest percentage found in any one field.
New Hampshire	-	8	100
Vermont	25-50	8	-
New York	4.42	1.5	90
Kentucky	-	1	60
Tennessee	-	t	40
Mississippi	-	6	100
Alabama	25-50	6	100
Arkansas	15	5	-
Wisconsin	2.5	t	90
Minnesota	9.5	2	50

Table 69. Percentages of mosaic in potato fields inspected in New York and Pennsylvania, 1920.

State	County	Number of fields inspected	Acerage	Average percentage mosaic
New York	Allegany	26	55.00	1.75
	Cayuga	18	43.00	6.00
	Chenango	9	27.00	18.07
	Clinton	34	110.25	15.64
	Cortland	58	195.69	1.52
	Erie	12	60.75	1.82
	Essex	5	17.50	5.04
	Franklin	27	121.75	11.67
	Genesee	11	54.20	0.23
	Jefferson	2	3.50	0.00
	Livingston	9	25.00	1.37
	Monroe	18	57.45	0.54
	Orleans	23	88.75	0.47
	Oneida	15	38.20	1.45
	Onondaga	36	105.10	5.22
	Ontario	19	57.65	1.38
	Oswego	25	66.75	15.74
	Rensselaer	2	10.50	0.48
	Seneca	14	26.25	0.11
	Steuben	13	58.50	0.92
	Washington	47	115.86	3.70
	Wyoming	18	63.00	0.89
Total and average		440	1391.65	4.42
Pennsylvania	Cambria	175	617.00	8.20
	Lehigh	207	1524.00	2.10
	Potter	139	454.00	11.00
Total and average		521	2595.00	3.90

Dates of first appearance of mosaic, 1920.

March	Baton Rouge, La.	June 21	Suffolk Co. N. Y.
May	Alabama	June 22	Bremford, Conn.
May	Griffin, Ga.	July 15	Milton, N. H.
May	Arkansas	July 22	Sherbourne Co. Minn.
May 15	Crystal Springs, Miss.	July 25	Rhinelander, Wis.

The data that has been received on varietal resistance can best be summarized by quoting directly from collaborators' reports.

New Hampshire: "Especially prevalent on Green Mountain." (Butler)

New York: "Especially on white sprout varieties." (Chupp)

New Jersey: "Common on Giants, Green Mountains and in some cases on Jersey Red Skins." (Cook)

Pennsylvania: "Green Mountain and Spaulding Rose susceptible." (Thurston and Orton)

Kentucky: "Carmans practically a failure. Green Mountains and Cobblers seem fairly free probably due to tuber unit selection on part of a few growers of seed." (Valleau)

Georgia: "Observed on 90% of the Red Bliss (Triumph) planted as a spring crop and on 2% of the McCormicks planted as a late crop. Also observed on Green Mountain. Cobbler, Early Ohio, and Early Rose were quite free from mosaic in spring crop." (McClintock)

Alabama: "Triumph always heavily diseased." (Thiel)

Mississippi: "Bliss Triumph most susceptible." (Neal)

Louisiana: "Severe on Triumph. Not so important on other varieties." (Edgerton)

Indiana: "Tippecanoe County - on three plants of Rural New Yorkers. DeKalb County - bad on Early Ohio. Floyd County - bad, 100% incidence, on Bliss Triumph." (C. T. Gregory)

Michigan: "Very serious on Bliss (Triumph) in Upper Peninsula - serious on Green Mountain. Of minor importance on Rural types." (Coons)

Wisconsin: "Hardly a field of Triumph but what will show some mosaic. Fields from the stock of J. W. Smith, Kent, Langlade County, Wisconsin are remarkably free. Rural New Yorker free." (Vaughan)

Minnesota: "More common on Triumph, next Green Mountain and rare on other varieties." (Section of Plant Path.)

Leaf roll (cause undetermined)

Leaf roll was reported from most of the states east of the 100th meridian and from Idaho, where it was most common in the north, and from the Palouse country of Washington. In most states the disease seemed to be of comparatively slight importance but Kentucky lists it as the most important potato disease and Pennsylvania regards it as second only to late blight in destructiveness. In New York it is a very important trouble in the "blue sprout" area of the western part of the state and in Vermont it was the third most important potato disease in 1920. In the West leaf roll was not at all abundant, but was noticeable locally in many states. Losses were reported by states as follows:

Table 70. Percentage losses from leaf roll of potato, 1920.

Percent loss	States
10	Pennsylvania.
5	Kentucky and Georgia.
2	Maine, Vermont, New Jersey, Maryland, Virginia, West Virginia, Ohio, and North Carolina.
1.5	New York.
1	New Hampshire, Massachusetts, Rhode Island, Connecticut, and Illinois.
Trace	Other states.

An idea of the situation in Pennsylvania may be gained from reports received from that state August 1 and October 15, 1920.

"E. L. Nixon, who is continually in the field and spending his time largely on work with potato diseases, reports that the average amount of leaf roll for all fields in the State will approximate 20%. This is the most important potato trouble, except late blight in Pennsylvania. Careful rogueing of fields for seed is having pronounced effect in reducing this percentage.

"Professor Nixon reports that seed free from this disease has uniformily resulted in an increase in yield of 25%. He bases his report on the results of his demonstrations in over 15 counties, where clean seed was planted side by side with the farmer's field run seed." (H. W. Thurston)

The situation at Bardstown, Kentucky has already been reported (Pl. Dis. Bul. 4: 51, Aug. 15, 1920). Mr Valleau has also sent in a supplementary report;

"The occurrence of this type of leaf roll was previously reported to the Survey. It is characterized by very vigorous and erect growing plants, upward rolling of leaves, the extent of rolling indicating the extent of the injury to tubers, production of shorts growing up between the rows in place of tubers, or long stolons bearing several tubers of small size. It is carried in the seed potatoes from infested fields. It may cause complete loss when apparently normal northern grown seed are used."

As high as 90% infection was noted in a field in New York during the season; 100% was seen in Pennsylvania; 93% in Kentucky; and 50% in Indiana. The dates on which the disease was first observed are:

May .... Crystal Springs, Mississippi.
June .... Griffin, Georgia.
June 16 .... Bardstown, Kentucky.
June 28 .... Albany, Orleans, and Steuben Counties, New York.
July 14 .... Ohio.
July 15 .... Milton, New Hampshire.
July 28 .... Beltrami County, Minnesota.

Leaf roll was mentioned as being especially bad on potatoes of the Rural group in New York and Pennsylvania. In New Jersey it was most common on Cobbler. There are a few strains of Rural in New York that are almost free from leaf roll.

A noticeable reduction in the amount of leaf roll in New York occurred according to the following statement:

> "Much more certified or disease free seed is used. Therefore, leaf roll has a much lower average. Seneca County is a good example. During 1920 all the inspected fields were planted with Gibbs' stock - one of the best in the State." (Chupp).

Tip burn (non-parasitic) and hopper burn induced by leaf hoppers.

The form of tip burn caused by the direct effect of the sun on the leaves seemed to be much less abundant than usual last year owing to the cool and moist weather that characterized much of the growing season. Regarding this trouble B. F. Lutman in Vermont says:

> "Much less important than usually. Would estimate that in the Champlain Valley that the potatoes had lost 40-50% of their foliage, September 1 by tip burn in average years; this year not more than 15-20%. No tip burn locally of any importance before about August 20, but made rapid progress for a few days then."

The hopper burn which seems to be especially bad in the Great Lakes States was also of less importance generally. Thus, in Michigan the statement is made that hopper burn was less serious than for the past five years and C. W. Waid says that it was widely scattered but did not prove as serious in 1920 as during the two previous seasons.

In Minnesota, on the other hand, hopper burn was very important, as it was last year and worse than the average. It affected about 80% of the plants in the state and caused a loss of about 1% of the crop. Other losses that have been estimated for tip burn are given in Fig. 43.

Dates of first reports, 1920:

June .... Starkville, Mississippi.
June 29 .... Hennepin County, Minnesota.
July 10 .... Randolph County, Vermont.
July 10 .... Michigan.
September .... Ohio.

That Bordeaux mixture has some beneficial effect but does not control is the opinion of collaborators in Indiana and Michigan.

The Late Petoskey which is so generally grown in the Lower Peninsula of Michigan seems to be quite resistant to hopper burn according to C. W. Waid.

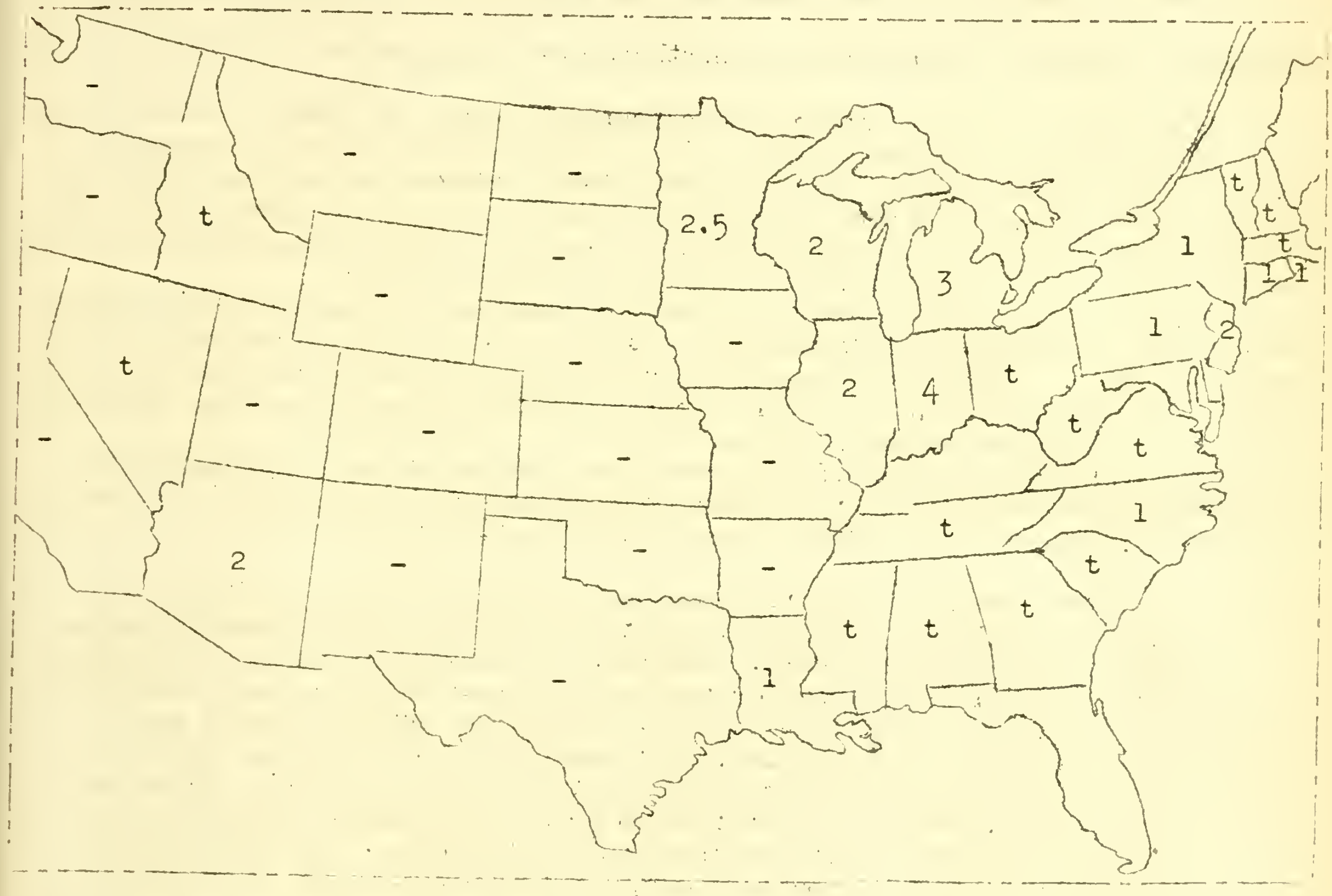

Fig. 43. Percentages loss from tip burn and hopper burn of potato, 1920. (For corrected figures see Pl. Dis. Suppl. 18, 1920.)

Blackleg caused by Bacillus phytophthorus Appel.

During 1920 blackleg was reported from the majority of states in the northern half of the country. Regarding the distribution of the disease within the states the following has been reported by collaborators and others:

New Hampshire: (Butler) "Present in small amounts in the fields of the northern counties; rare in the southern part of the state."

Virginia: (Fromme) "Reported as rather severe from trucking sections around Norfolk and Eastern Shore."

West Virginia: "Very prevalent in some of the higher sections of Tucker County."

Michigan: (Coons) "J. E. Kotila reports disease common and very persistent in the Upper Peninsula. I am figuring the loss as 5% for that district. I figure the loss from the Lower Peninsula as a trace."

(C. W. Waid) "Mr. E. B. Moore reports that he found considerable blackleg in Cass and adjacent counties. This seems to be the chief outbreak of the trouble in the Lower Peninsula. Some seasons we have found quite a good deal in the upper counties but it did not develop much this year. Blackleg is one of the serious troubles of the Upper Peninsula."

Wisconsin: (Vaughan) "Distributed in northern and southeastern sections."

From these and other statements concerning range and losses it would appear that blackleg is essentially a cool climate disease; that it propagates itself most actively in the more northern potato sections and at the higher altitudes. It happens that for the most part these sections are also good seed-producing sections and as a result local outbreaks commonly occur in some of the more southern states where infected northern seed is planted.

During the year 1920 more blackleg was reported than usual by the following states: Massachusetts, Connecticut, North Carolina, Ohio, Wisconsin, Minnesota, and Idaho. The growing season was cooler than normal in many parts of the country and it is possible that this fact had something to do with the increased amount of the disease in these states.

The following account of the occurrence and seriousness of blackleg in the West particularly during the season of 1920 has been furnished by the Office of Cotton, Truck and Forage Crop Disease Investigations:

"The disease of potato stems and tubers has been prevalent in the Red River Valley, in Colorado, and to a greater or less extent throughout the West for many years. Observers have differed in their diagnosis of this trouble as to whether the primary cause was blackleg, Fusarium, or Rhizoctonia. Recent work by Mr. Shapovalov, however, shows that blackleg, due to an organism indistinguishable from that prevalent in the northeastern states, is widely distributed in the West. Climatic conditions, depending on altitude as well as latitude, evidently have a marked influence on its geographical distribution. In 1920 it did not appear to be of importance early in the season either in northern Wisconsin or northern Minnesota, but it was very much so in the Red River Valley and in Montana, Washington, and northeastern and southeastern Idaho, especially at higher altitudes. Up to the middle of September its occurrence had been quite insignificant in central and southern Idaho and none had been seen in Utah although it was said to have been found there. In sections of Colorado it was quite serious, especially in the San Luis Valley. It occurs throughout the Greeley district and in Wyoming and Nebraska, but has not yet appeared there as a serious factor. Only one well known case was found in which the disease had persisted in locally grown seed over a period of years. It may be that the disease is introduced mainly through seed brought from eastern or northern seed-producing centers. It has been reported from western Oregon and probably occurs in California. During the summer blackleg appears mainly as a stem rot, the infection apparently spreading throughout the season in some irrigated sections. The tubers often show browning of the vascular ring, and in localities favorable to the disease it takes the form of tuber rot, which in external appearance sometimes resembles Fusarium stem-end rot or jelly-end rot."

Blackleg was not important in the East except in local fields, but in the West as indicated in the above quotation it was serious in some states. Thus, in Minnesota it was "common and widespread, affecting 15% of the plants in some fields". In the Upper Peninsula of Michigan an estimated loss of 5% took place. In Utah the disease was estimated as present in 75% of the fields of early potatoes, affecting about 5% of the plants in those fields and causing a loss of approximately 3% for the state. The greatest amount of disease found in any one field was reported by states as follows: New Hampshire - 4%, Minnesota - 15%, New York - 5%, West Virginia - 5%, Wisconsin - 25%, Missouri 2%, and Utah - 35%. The accompanying map gives the preliminary estimates of reduction in yield from blackleg. For final estimates see Plant Disease Bulletin Supplement 18, 1921.

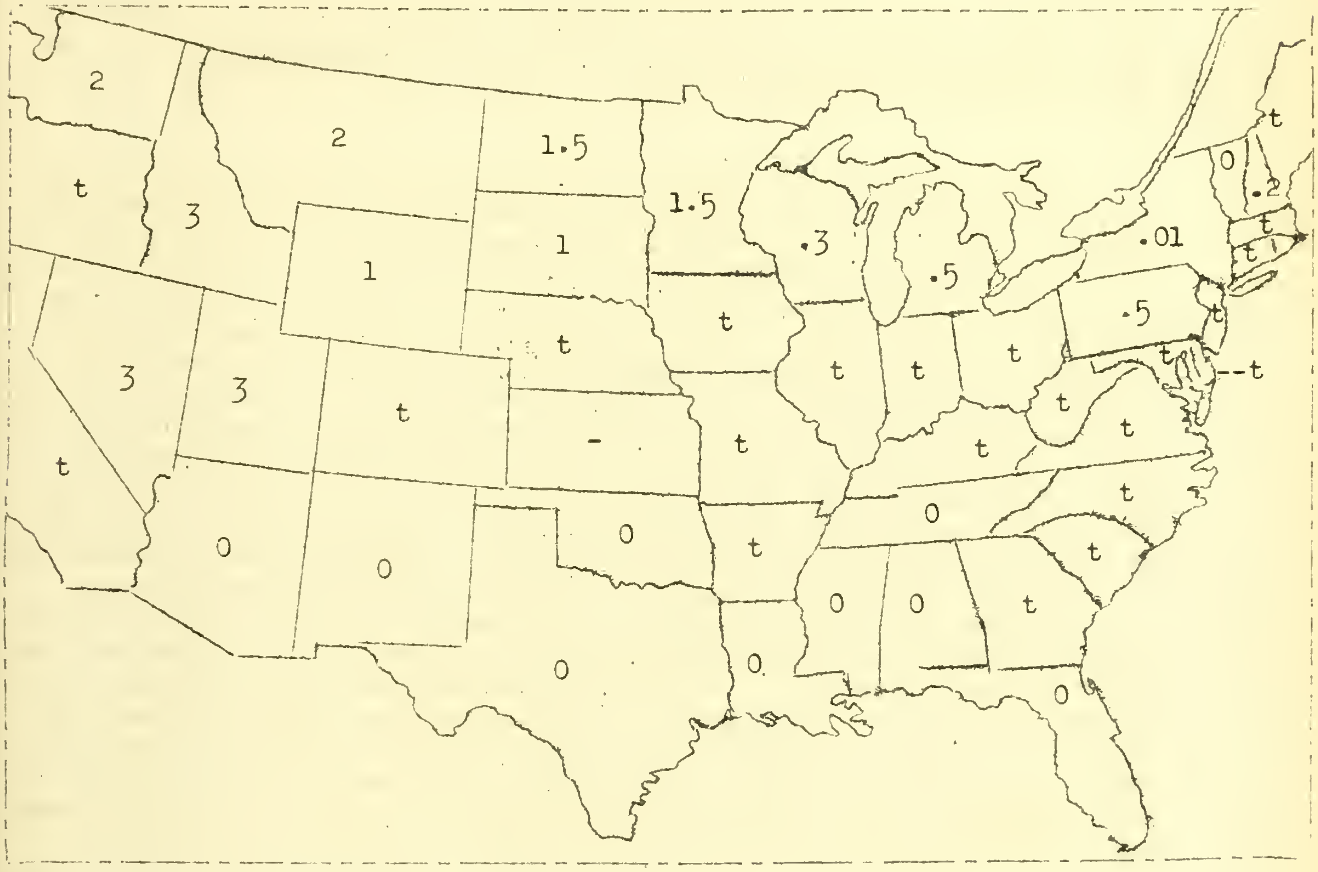

Fig. 44. Preliminary percentage loss estimates from potato blackleg, 1920.

Dates of first appearance of blackleg according to collaborators, 1920:

June 14 .... Corinna, Maine.
June 14 .... Suffolk County, Long Island, New York.
June (late) .... Utah.
June 29 .... Aitken County, Minnesota.
July 10 .... Davis, West Virginia.
August 1 .... Racine, Wisconsin.

According to reports from Wisconsin the most damage was done from August 1 to October 1 or after blossoming, while in some of the other states much of the injury took place early in the season and prior to blossoming.

No reports of varietal susceptibility were received.

Wisconsin reported that "careful selection and culling at seed cutting reduced loss of stand from 25% to 2%". In Minnesota numerous cases of partial failure with seed treatment were reported, but it is probable that in these cases the methods employed were not the best.

Anthracnose caused by Colletotrichum atramentarium (Beck & Br.) Taub.

This disease, which is considered by the botanists of the Ohio Experiment Station as the same as that caused by Vermicularia atramentaria Beck and Br. and Colletotrichum solanicolum O'Gara is reported on by Dr. Freda Detmers as follows:

> "This disease recurs annually in Ohio, fluctuating in prevalence and severity according to the weather conditions prevailing during the growing season, as, for example, the disease was very widespread and severe during 1919. During that year the weather was unusually variable. The first week in April, when the very earliest plantings were made, was warm and fair. This was followed during the latter part of the month by cold, freezing temperatures. In May when the majority of the earlier varieties of potatoes were planted, the weather was very wet, delaying planting and retarding sprouting of those already planted. June was a warm, dry month. A good many potatoes were planted this month, but it was so dry that they did not sprout well. July was hot and wet and August was characterized by a mean temperature slightly below the average and by heavy rainfall. September was warm and dry.
>
> "On the other hand, potato fields during the cool, moist season of 1920 were noticeably free from, or showed but light infection. This fungus escapes observation because the stems and not the leaves are the chief regions of attack. The acervuli and sclerotia do not appear conspicuously until the tops are quite mature and the mycelial growth is not copious. The very poor yield which results is therefore generally ascribed to weather or other conditions. This was the case in 1919, many crops not being considered worth digging. The most striking symptoms of the disease are the early maturity, followed by complete prostration and drying of the tops, the stems frequently becoming white and dry as tinder. No visible infection of the tuber occurs. The injury to the crop is due to the reduction of yield both in size of the individual and in number of tubers. Infection seems severe in the early and medium late maturing varieties."

Jelly end rot probably caused by Fusarium sp.

This rot was reported on Netted Gem potatoes from southern Idaho where it was apparently the cause of less damage than last year. The disease was also found in a few fields in Monmouth County, N. J. by F. C. Meier and a report of occurrence has been received from Ohio.

Bureau of Market inspectors found potatoes with jelly end rot as set forth in Table 71.

Table 71. Percentages of jelly end rot found in individual cars of potatoes inspected during 1920.

State	Date	Number of cars	Percentage jelly end rot	State	Date	Number of cars	Percentage jelly end rot
Calif.	Feb. 5-6	2	1-4, 1-4	Ida.	Feb. 2-4	2	10-15, 5-8
	Feb. 7-16	5	10,4, 4, 3-4,3		Mar. 17	1	30-35
					Nov. 9	1	2-4
	Feb. 10	1	6		Dec. 17	1	2
	Mar. 4	1	10-12	Kans.	Feb. 5	1	3-4
	Oct. 26-30	2	5, 5	Minn.	Jan. 30	1	2-3
	Nov. 12	2	2,2	Wash.	June 1-3	2	15, 20
	Dec. 2-15	2	5, 2		Nov. 1	2	4-6, 5
Colo.	Nov. 12	1	1-2				

Leak caused by Pythium debaryanum Hesse or Rhizopus nigricans Ehr.

The Office of Cotton, Truck and Forage Crop Disease Investigations reports on this disease as follows:

> "Leak, due in large part to Pythium debaryanum, but to some extent also to Rhizopus nigricans, has occurred in western Idaho fields this summer and probably also in eastern Oregon. In these districts not only wounded tubers but sun-scalded potatoes are subject to infection. It is the early shipments of potatoes in which the principal losses from leak occur."

It was also reported as occurring in the field in Washington and was found by market inspectors as shown in Table 72.

Table 72. Percentages of leak in shipments of potatoes as determined by inspectors of the Bureau of Markets, 1920.

State	Number of cars	Average percentage of decay	State	Number of cars	Average percentage of decay
California	4	5	*Minnesota	5	4.3
Colorado	12	3	Wyoming	8	4.6
Idaho	16	3.3			

* The cause of leak occurring in Minnesota potatoes is questionable.

Other diseases.

Powdery scab caused by Spongospora subterranea (Wallr.) Johnson was reported once from each of three states: Hamilton County, New York, September 30; St. Louis County, Minnesota, in December; and Pierce County, Washington.

Southern blight caused by Sclerotium rolfsii Sacc. was reported from Mississippi and Texas. In the latter state it was thought to be more prevalent than last year.

Table 73. Percentages of Sclerotium rot caused by Sclerotium rolfsii as found by inspectors of the Bureau of Markets, 1920.

State	Variety	Date	Number cars	Percentage Sclerotium rot
Alabama	Spaulding Rose	June 19-21	5	14.4
Florida	" "	June 23-25	4	15
Georgia	-	June 21	1	4
Louisiana	-	June 14	2	19
North Carolina	Cobblers	June 21-July 8	4	6
Virginia	-	June 24	2	Occurred

Skin spot, uncertain cause, but said to be associated with Oospora pustulans Owen & Wakef. was found on British Columbia potatoes in the State of Washington, and was also found by market inspectors at Chicago on Canadian potatoes. When reporting this trouble and sending specimens to the Plant Disease Survey, F. D. Heald wrote:

"This trouble is described in Bulletin 8 of the Royal Botanical Garden, Kew, England, which was issued just last year. These specimens are from our identification No. 2210, and originated from a carload of Gold Coin potatoes that was shipped into Spokane from British Columbia. So far as I know it is the first definite record of this disease from America, although Güssow apparently found what was the same trouble in Canada, but did not recognize it as of definite fungus origin. (See note and illustration in Phytopathology 8: 492-493, 1918). We have thus far no record of the occurrence of "skin spot" on potatoes in the United States, but this is not the first time it has come over from Canada. The disease was also abundant on some Scotch potatoes brought in for experimental purposes by the Pennsylvania Department of Agriculture. It is a trouble that should be watched, as, although it is classed as a minor disease, the disfiguration of the tubers is sufficient to materially impair their commercial value."

Silver scurf caused by Spondylocladium atrovirens Harz. - definitely reported only from South Dakota, Idaho, and Washington, but known to be common in many parts of the United States.

Violet root rot caused by Rhizoctonia crocorum (Pers.) DC. was reported from Thurston County, Washington.

Root knot caused by Heterodera radicicola (Greef) Müll. Reported by collaborators from Arkansas (common, 15% injury) and Nevada (4% reduction in yield, some benefit by planting clean seed on new land) and by the Office of Cotton, Truck and Forage Crop Disease Investigations from the West as follows:

"The parasitic nematode, Heterodera radicicola, occurs very extensively in the warmer districts of the Southwest, throughout the valleys of California, in Nevada, and locally elsewhere. The potato is quite susceptible to this nematode and is one of the most dangerous carriers of the parasite. The fact must therefore be considered in all crop rotation plans, and cultivation of potatoes in nematode-infested soils limited or temporarily abandoned until the infestation can be reduced by rotation with nematode-immune crops. The problem is really much more serious than we now realize, since it affects the culture of nearly all vegetables and most of our fruits."

Slimy soft rot (bacterial) was very common as usual in potato shipments, particularly those from the South.

Curly dwarf, cause undetermined, was reported from New Hampshire, Iowa, and Washington. Three per cent reduction in yield is estimated for Iowa from this disease. Whether the disease is distinct from mosaic dwarf in all of these cases remains to be determined.

A dwarfing, probably related to mosaic or leaf roll, was important in a few counties in New York according to Charles Chupp. As high as 60% was found in one field and from 1 to 5% occurred in three counties. It is thought not to be the regular curly dwarf but it is characterized by sessile tubers, persistent seed pieces, and hard, brittle, internally-discolored young tubers.

Streak, cause undetermined, was reported from New York, Georgia, and Washington. In New York it is thought that trace of streak may have existed in nearly every county but it was observed as common in only one field at Granby, August 8. In Georgia what appears to be streak was seen on both Rose and Cobbler varieties. The disease that was reported as streak in Idaho last year is given this year under the heading of russet dwarf.

Russet dwarf, cause undetermined, which was reported from Idaho last year as "streak" occurred again in that state in 1920. The symptoms of this disease do not agree with those given by Orton. It causes a russeting of the leaves, blackening of the vascular system, and a dropping of the lower leaves. According to Hungerford the disease is very serious in southern Idaho.

Dodder (Cuscuta sp.) reported from Washington.

Alkali injury - reported from Washington.

Nut grass injury, caused by a species of sedge, *Cyperus* sp. boring into the tubers, was reported from Milford, Connecticut.

Thumb-nail cracking (non-parasitic) was much more prevalent on harvested tubers than usual in Minnesota. Observed mostly on Early Ohio and less on Irish Cobbler.

Black heart (non-parasitic) was observed in a number of carlots by market inspectors during 1920. Definite reports were received as follows:

January 10 ... Minnesota potatoes at Kansas City, 30-40% in one car 40-50% in another.
March 20 ..... Maine potatoes at New York, 40% in one car.
April 2 ...... Maine Triumphs at Philadelphia, 50-65% black heart in top layer and 10% in 5th layer.
October 4 .... Colorado potatoes at Memphis, 5-10% black heart.

Hollow-heart (non-parasitic) reported by market inspectors in potatoes shipped from the following states:

Table 74. Percentages of hollow-heart found in carlots of potatoes from various states, as reported by inspectors of the Bureau of Markets, 1920.

State	Percentage Hollow-heart	State	Percentage Hollow-heart
Colorado	5-10, 5-10, 5-10	Montana	10-12, 8-10, 10, 8,
Michigan	2-4, 2-3, 5, 8-10, 8,		8-10.
	5, 5-6, 6, 3-4.	Pennsylvania	10-70, 35, 25, 20.
Minnesota	12-18, 10-25.	Wisconsin	5-8.

Internal brown spot, cause undetermined, was reported from Connecticut and Washington.

Malnutrition or potash hunger was reported from Connecticut by G. P. Clinton as follows:

> "One very definite report. Had trouble last year because of no potash in fertilizer. This year fertilizer was obtained with potash and no trouble was experienced except on a piece where last year's fertilizer was used and trouble resulted as last year."

Sunscald, caused by high temperature, was observed on potatoes in light, sandy soil in Idaho by M. Shapovalov. Scalding of potatoes lying on the surface of the ground is not uncommon but scalding while still beneath the surface is less frequently found. In this particular case two fields were seen, each containing several acres, where the potatoes were planted rather shallow and had no large vines to shade the ground. The weather had been extremely hot, being above 100° in the shade for several days (107° at Boise, Aug. 15). The tubers were flabby with dark brown skin and brownish flesh throughout. Sun scald was found on potatoes arriving on the market from North Carolina (June 8-25, 6 cars averaging 33% scald), and Virginia (July 1, 17, 22, and 26, 4 cars, averaging 13%).

Spindling sprout, cause undetermined, was reported from Connecticut, Michigan, and Washington. Regarding the disease in Michigan, C. W. Waid says:

> "Spindling sprout is becoming more prevalent each season. In a few fields it was noted that fully 25% of the hills were affected. The number of fields affected with this trouble, of course, is as yet quite limited but it is one of the diseases that needs to be watched."

Lightning injury was reported from Mason County, Michigan.

Chlorosis (non-parasitic) - This disease which was reported in 1919 from Idaho, occurs especially in the southern part of that state in irrigated potato fields according to C. W. Hungerford. The average per cent infection for that district is estimated at 1%. The disease is relatively unimportant but it reduces the yield somewhat. It was also reported from Washington in 1920.

A spot (non-parasitic) was reported from Minnesota for the first time. The spots occurred chiefly on Irish Cobblers and were small, sunken and purplish, located mostly near the stem end and sometimes extended one centimeter into the flesh of the tuber. The spots did not spread in storage. An examination of these tubers in the Bureau of Plant Industry leads to the temporary opinion at least that the spots might be due to bruises from contact with small pebbles.

DISEASES OF TOMATO

Leaf spot caused by Septoria lycopersici Speg.

Septoria leaf spot was reported in 1920 from practically all of the states east of the 100th meridian, but no reports were received from any of the western states. In general the disease was the cause of less damage than last year as it was said to be less abundant in the important tomato canning states of New York, New Jersey, West Virginia, and Ohio. On the other hand in Indiana, Michigan, and Iowa it was apparently more prevalent than in 1919.

The disease was much worse in some parts of the individual states than in others. Thus, in New Jersey, it was mostly in the southern half; in Pennsylvania it was especially severe in Erie County but also bad in Adams, Lehigh, and Sullivan Counties. In Virginia it was most important in the western canning sections where defoliation was almost complete by September 1. In North Carolina it was said to be prevalent at elevations below 3000 feet and in Wisconsin it was worst in the southeastern section of the state.

The disease was most abundant in the group of states comprised of New Jersey, Delaware, Maryland, Virginia, West Virginia, North Carolina, Kentucky, and Tennessee. It was also important in Pennsylvania, Ohio, Indiana, Illinois, Michigan, Iowa, Missouri, Kansas, Oklahoma, and Arkansas, but in the Gulf states it was not serious, being very rare in Florida. In New England and westward through the northern tier of states, with the exception of Michigan, it was of minor importance.

This was mentioned as the most important tomato disease in Virginia and the same statement holds true for all states in the same group as given above. In Indiana it was the most important parasitic disease but was probably secondary to blossom-end rot. In New York it was estimated that of the total reduction in yield from all leaf diseases, one-fourth was due to Septoria.

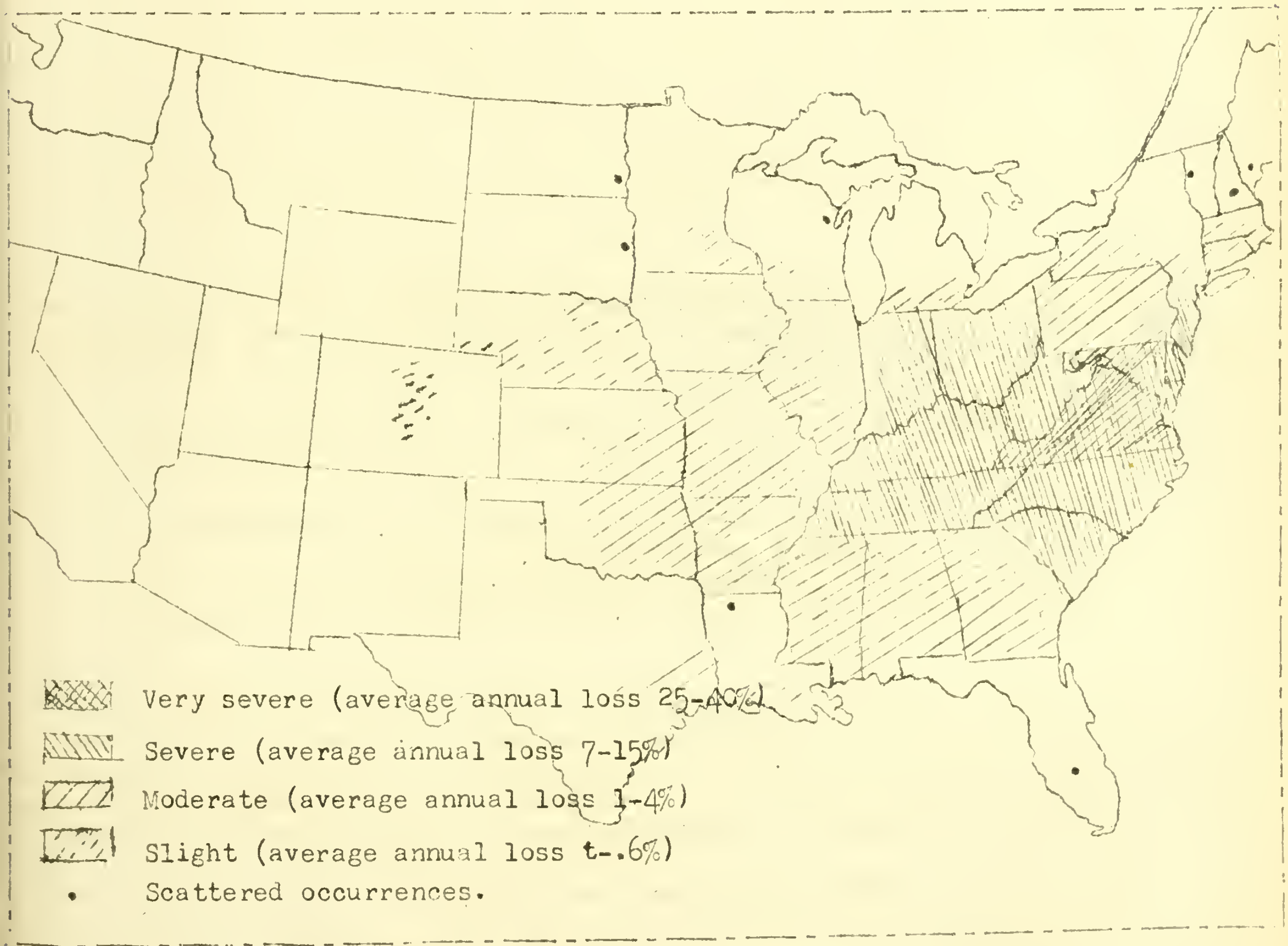

Fig. 45. Distribution and severity of Septoria leaf spot of tomato as shown by records of the Plant Disease Survey, 1920.

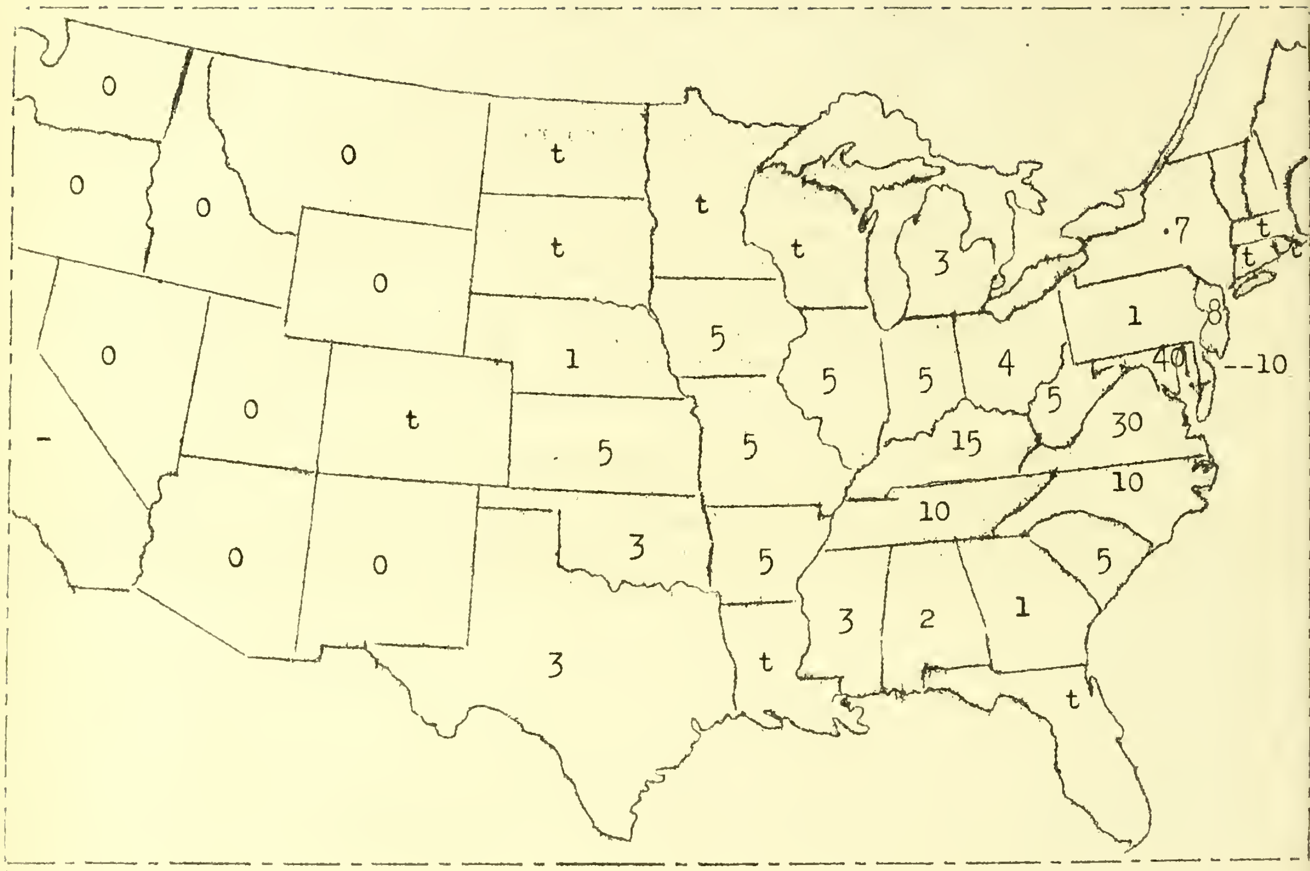

Fig. 46. Estimated percentage reduction in yield of tomatoes from leaf spot. (For final figures and losses in quantity see Pl. Dis. Bul. Suppl. 18, 1921.)

The heavy losses from leaf spot resulted from the following forms of injury:

(a) - Reduced yield because of destruction of leaf area by spotting and defoliation.
(b) - Sunscald resulting from defoliation.
(c) - Premature ripening resulting in small fruit of inferior quality.

All of these forms of injury occurred in the states where losses were heaviest. In those where leaf spot was of lesser importance defoliation and its consequent disastrous effects were not so common. In Michigan it was thought that the disease was beneficial to the early crop in that it induced early ripening, but the late canning crop probably suffered an actual loss of about 10%.

Dates of first appearance of leaf spot, 1920:

May .... Arkansas	June 28 ... Salem, Va.
June 10 ... Crystal Springs, Miss.	July 20 ... Hennepin County, Minn.
June 11 ... Ohio	August 15 . Madison, Wis.
June 24 ... Indianapolis, Ind.	September . Amherst, Mass.

The greatest injury was reported as taking place as follows:

Kentucky ..... August and September while fruit was ripening.
Mississippi .. June 25-July 1 when fruit was 2/3 mature, or less.
Indiana ...... September, when fruit was being picked.
Wisconsin .... August 15-September 15, when plant was fully developed.

Practically nothing was reported to the Survey during 1920 concerning the success of control measures or varietal susceptibility.

Fusarium wilt caused by Fusarium lycopersici Sacc.

Fusarium wilt occurred in about the same regions as usual although reports indicate that it is spreading annually to new fields. Evidence of extensive introduction with southern plants was observed in Indiana last year. The causal Fusarium is already present in practically all parts of the southern states but in east central and more northern states it is still localized. In 1920 reports of occurrences in new localities came from New Jersey, Kentucky, and Indiana, and it was identified for the first time in two southern Michigan counties. A number of reports of geographic range in individual states were received. Thus, in New Jersey the disease was confined mostly to the southern part; in West Virginia it was local; in Kentucky it was serious principally along the Ohio River between Louisville and Paduca; in North Carolina it was all over the state but most prevalent in the Piedmont soils; in Texas it was mostly in the east; in Arkansas in the southwest particularly; and in Indiana it was serious in the central section, but not in the Orange County crop. In California it was said to be present in all parts of the state, but more prevalent in the sandy soil regions. In Georgia, Alabama, Mississippi, Louisiana, and Tennessee, it was said to be generally distributed over each state.

In prevalence, wilt was about as last year although New Jersey, Georgia, Arkansas, and Ohio indicated more. It caused heavy general losses in the southern states, taking practically all of the crop in some fields and gardens that were planted with susceptible varieties. In the Ohio Valley states heavy local losses occurred. In Indiana and Ohio much loss occurred in greenhouses, Indiana estimating a loss of 15% of the greenhouse crop as compared with 2% in the field. The percentage losses, as estimated by the Survey, are presented on the map (Fig. 47) and the losses in quantity by states, and also for the entire country, are to be given in Plant Disease Bulletin Supplement 18, 1921.

The following estimates of the percentage of affected plants in certain states have been given: Kentucky - 10%, Georgia - 90%, Louisiana - 40%, Arkansas - 5%, and Ohio - 2-25%.

The dates when the disease was first noted in 1920 in various states are as follows:

May .... Baton Rouge, La.
May 15 .... Crystal Springs, Miss.
June ...... Griffin, Ga.
June ...... Arkansas.
June 24 ... Indianapolis, Ind.
July 1 .... Perryville, Mo.
July 23 ... Elkhorn, Walworth County, Wis.
July 24 ... Starkey, Va.
July 26 ... Erie County, N. Y.

Several collaborators commented on the use of resistant varieties as a means of evading the disease, and their notes are quoted below.

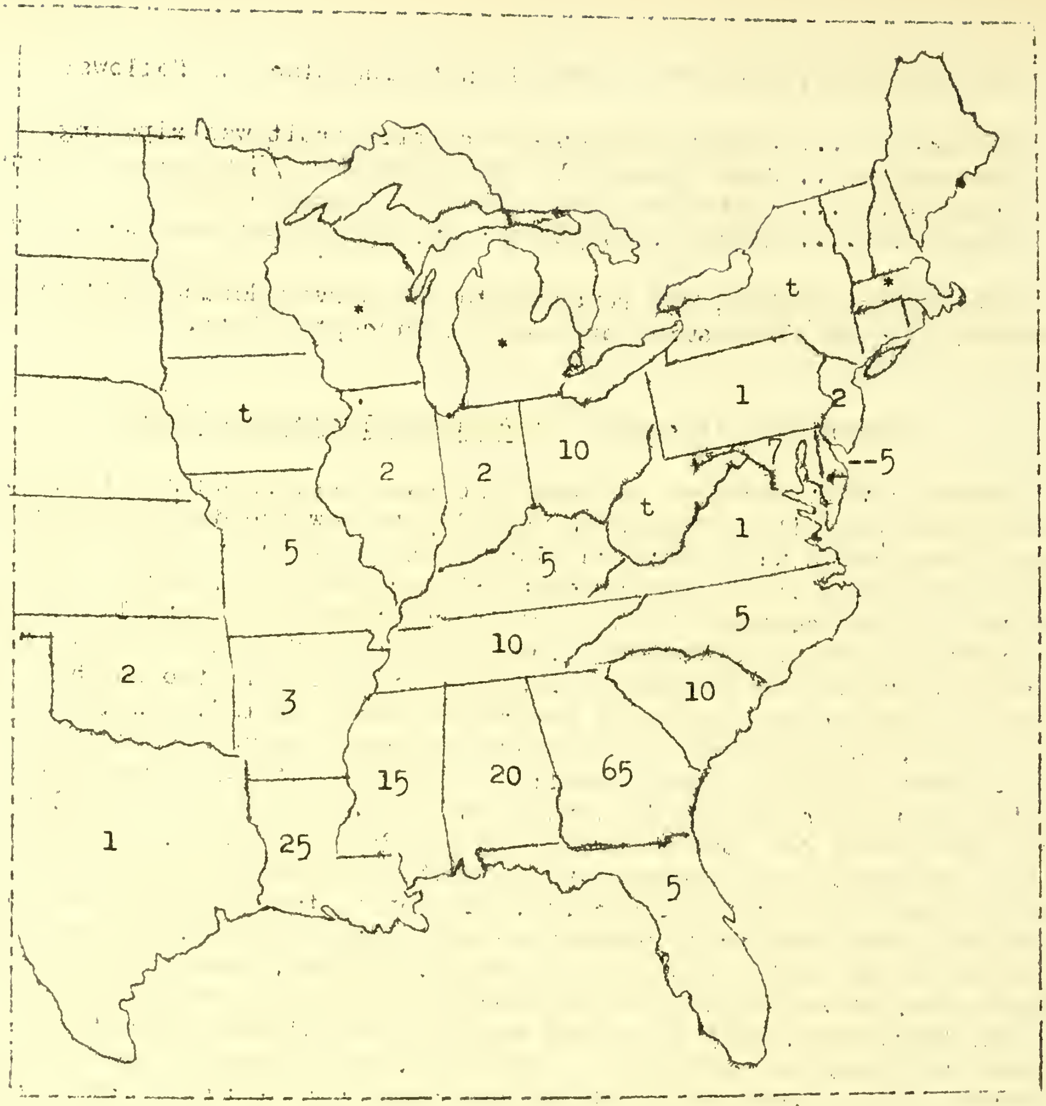

Fig. 47. Estimated percentage loss by states for Fusarium wilt of tomato, 1920.

Virginia: (Fromme) Norton and Marvel fully resistant in one planting where other varieties were almost a complete loss.

Kentucky: (Valleau) Some resistant strains are being tried in the canning sections with very promising results.

Tennessee: (Essary) Resistant varieties are being grown extensively, especially the Globe.

Georgia: (McClintock) Some commercial varieties as Globe, Duke of York, etc. are partially resistant but the only markedly resistant strains are those developed through continued selection on infested soil.

Mississippi: (Neal) Resistant varieties are not used by the large commercial growers; only the small gardeners employ them. The wilt resistant strains sent out by the Office of Cotton, Truck and Forage Crop Disease Investigations have been found effective in many instances.

Ohio: (Selby) Selections from Marvel, Arlington, and Columbia show excellent resistance.

Indiana: (Gardner) Variety Marvel, used as substitute for Bonny Best in greenhouse by one grower, gave good satisfaction.

Yellow blight probably caused by Fusarium spp.

In 1920 yellow blight was reported from Idaho, Nevada, Washington, Oregon, and California and what seems to be this disease was also reported from Arizona and New Mexico. The majority of these states and also New Mexico unite in expressing the opinion that yellow blight was less severe than in 1919. A comparison of the estimated losses for the years 1919 and 1920 also shows this.

Table 75. Losses from yellow blight of tomato in 1919 and 1920.

States	Percentage loss	
	1919	1920
Nevada	10	8
Idaho	50	25
Washington	10	8
Oregon	15	10
California	5	4

In New Mexico the damage was estimated as not exceeding 5%, and in Arizona about 10% of the crop was lost on account of a disease that resembled yellow blight. The blight was present in Idaho wherever tomatoes are grown, affecting about 35% of the plants. In Oregon it is very important in the dry, hot sections of the eastern part of the state and the Columbia River Basin. The disease was reported as first observed June 30 at Lewiston, Oregon, and July 7 at Beatty, Nye County, Nevada.

No cases of resistance in varieties were reported and no control methods were indicated.

Early blight and nail-head spot caused by Macrosporium spp.

Early blight, causing a leaf spotting with defoliation and in some cases a fruit rot, occurred in states east of the 100th meridian but was not reported from any of the states west of that line. For the most part it was about as prevalent as usual but West Virginia, where the disease is sometimes seen, reported less, and Louisiana, Texas, and Ohio reported more than in 1919.

Nail-head spot was only reported to the Survey through the medium of the market inspectors who recorded the disease on tomatoes from Florida, Mississippi, Texas, Arizona, California and Mexico. It is becoming rather apparent that nail-head spot is a disease distinct from the early blight and fruit rot that we have generally attributed to Macrosporium solani.

Most of the collaborators reporting early blight mentioned it as general in their states but in Ohio it was unusually bad throughout the northern section, where it caused the greater part of the defoliation that occurred there. In Indiana it was serious in the southern part of the state and in the gardens and greenhouses about Indianapolis; and in Louisiana it was mentioned as being southern in its range.

Tentative estimates of percentage loss have been made and are given in Table 76. Final estimates in percentages and quantity will appear in Supplement 18, 1921.

Table 76. Percentages loss from early blight of tomato, 1920.

Per cent	States
Trace	New England, Wisconsin, Iowa.
Trace to 1%	New York, Maryland, Indiana, Illinois, Michigan.
1%	Delaware, West Virginia, Virginia, North Carolina.
2%	Tennessee, Texas.
3%	New Jersey, Alabama.
5%	Ohio, Mississippi.
10%	Florida (mostly nail-head spot)

A table showing the percentage of infection of Florida tomatoes as found on the market from February to May, 1920, has already been given (Pl. Dis. Bul. 4: 33-34. 1920). A condensed summary for all states for the year is given below.

Table 77. Losses from nail-head spot as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of shipment	No. cars with infected fruit	Average Percentage of infection	Origin of shipment	No. cars with infected fruit	Average percentage of infection
Arizona	1	6	Mississippi	4	14
California	2	8	Texas	2	6
Florida	108	13	Mexico	5	7

Total number cars with nailhead spot 122
Total number cars inspected 878

Dates of first observation:

May ....Baton Rouge, Louisiana.
May 10 ....Jackson, Mississippi.
August 16 ....Green County, New York.

No varietal resistance or control measures were reported to the Survey in 1920.

Mosaic (cause undetermined).

During 1920 mosaic was reported to the Survey from twelve states: Connecticut (more, of moderate importance), New York (probably more than last year, seems to be increasing in importance), New Jersey (abundant), Pennsylvania (about same as 1919), Louisiana (about same, very important), Arkansas (more), Ohio (only in greenhouses, less than usual), Indiana (less, very destructive locally, in general too late in appearing to do much damage), Wisconsin (one report), Iowa, Oregon (of slight importance), and California (unusual increase over 1919; affected plants did not produce any fruit).

Figures showing the extent of infection and losses were given as follows:

Table 78. Percentages of injury and loss from tomato mosaic, 1920.

State	Percentage injury	Percentage loss	Maximum percentage in any field
Pennsylvania	4	slight	10
Louisiana	-	5-10	100
Arkansas	5	-	-
Indiana	25	2	100
Wisconsin	-	trace	-
Iowa	-	9	-
Oregon	-	slight	90 greenhouse
California	-	7	-

In New York, mosaic was said to be present in nearly every patch in Albany County and from 7-65% was to be found in many fields in Erie County.

Dates of first observation by collaborators:

April .... Baton Rouge, Louisiana.
May .... Arkansas.
May 24 .... Albany County, New York.
June 24 .... Indianapolis, Indiana.
July 20 .... New Haven, Connecticut.

No difference in the susceptibility of varieties to mosaic were reported to the Survey during 1920.

An important contribution to our knowledge of new hosts and overwintering has been made by Crawford during the past year (Crawford, R. F. Overwintering of mosaic on species of Physalis. Phytopath. 11: 47, 1921). He has transferred mosaic from the root stalks of Physalis longifolia, a common perennial solanaceous plant, to both tomato and pepper, and has also transferred infective material from tomato to the following wild plants of this family that occur in Iowa and secured infection: Solanum dulcamara, Solanum nigrum, Physalis longifolia, Nicandra physalodes, and Datura stramonium.

Late blight caused by Phytophthora infestans (Mont.) De Bary.

Phytophthora was reported on tomatoes in 1920 from New York, Pennsylvania, Ohio, West Virginia, Virginia, and North Carolina. The distribution as given by collaborators is presented in Fig. 48. In New York it was stated that it was present only where tomatoes were grown adjacent to blighted potatoes and in

Pennsylvania it was mentioned that the greater prominence of the disease on tomatoes was no doubt correlated with the epiphytotic on potatoes. In this connection it should be recalled that Giddings and Berg (A comparison of the late blights of tomato and potato. Phytopath. 9: 209-210, 1919) have found the strains of Phythphthora on the two hosts to be biologically different and that while the potato strain may attack tomato it is not nearly so virulent, nor does it produce the same symptoms, as the tomato strain. More complete information is needed concerning the geographical range of this tomato strain of the fungus and it is hoped that during 1921 collaborators who have the opportunity will make as many observations on the disease as possible. Tomato late blight is confined to the higher altitudes at least in the southern part of the infection area. Thus, in the southwestern part of Virginia, Fromme says it is restricted to the higher altitudes, and Jehle, in North Carolina, reports it in the mountain counties with elevations of 3000 feet and above.

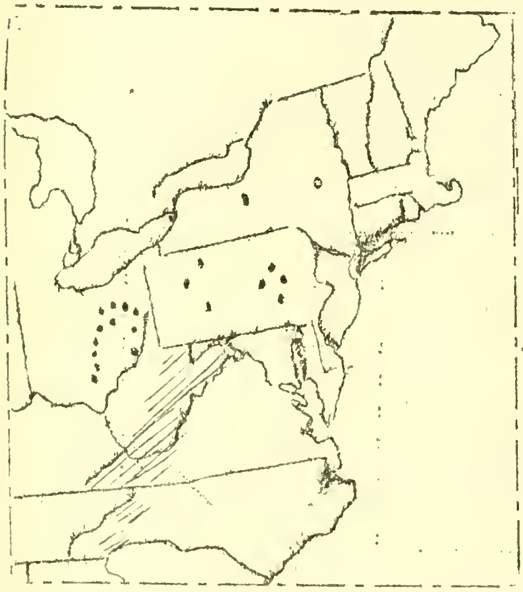

Fig. 48. Geographis distribution of late blight of tomato in 1920.

Fruit rot as well as leaf blight occurred in all states and in New York and Pennsylvania it was said to be the most important form of injury.

Regarding losses, 10 to 20% reduction in yield was reported locally in Pennsylvania. One per cent loss was estimated for the state of Virginia, 5% for West Virginia, and 2% for North Carolina. In all states except New York as high as 100% infection was reported in individual fields, 100% loss took place in some cases, and in West Virginia it is estimated that 50% of the plants in the state were infected.

More loss and wider occurrence were recorded from all states except Virginia and North Carolina. The abundance of the disease in Ohio was unusual.

Dates of first observation:

July 1 .... Wyoming County, West Virginia.
July 12 .... Albany, New York.
August 19 .... Ohio.

Good control with Bordeaux was reported from West Virginia and North Carolina.

Bacterial blight caused by <u>Bacterium solanacearum</u> EFS.

This disease was reported from the Gulf States, North Carolina, and Arizona. Two collections were also made in Virginia (Roanoke and Chesterfield Counties) and one in West Virginia (Monongalia County). In North Carolina, Jehle reported it as very prevalent in Transylvania County and also prevalent in the Coastal Plain counties. In Mississippi and Alabama the majority of reports were received from the coast counties also. Losses for the year are estimated as follows:

Table 79. Estimated losses from bacterial blight or tomato, 1920.

State	Per cent loss	State	Per cent loss
North Carolina	5	Alabama	1
South Carolina	4	Mississippi	1
Georgia	2	Louisiana	2
Florida	5	Arkansas	1

As high as 75% infection was observed in North Carolina and 5% in Mississippi.

In Arizona, where this disease has been confused with various Fusarium troubles, it was clearly distinguished last year according to J. G. Brown. Material from Jerome showed the organism both by culture and microscopic examination. It is thought that the disease is much more prevalent than commonly supposed in that state.

Bacterial wilt was first observed in Mississippi on June 10 at Poplarville and in Virginia on July 28 in Chesterfield County.

Blossom end rot (non-parasitic)

This trouble was reported from 15 scattered states in most parts of the country. It seemed to cause less complaint than last year in the northeastern part of the United States but was a more serious factor than usual in the western Lake States and Iowa. In Indiana, Minnesota, Iowa, and Texas the average loss was estimated at 5% of the crop, and in New York and Wisconsin losses of 1% were estimated. In Indiana and Mississippi this disease was considered responsible for more loss to the grower than any other. One field in the former state yielded 8 tons of good fruit and 3 tons of rotted fruit per acre, a loss of 27%. It was estimated that the disease was present in about 90% of the Indiana fields and that 50% of the plants in those fields bore one or more affected tomatoes.

It is generally recognized that blossom end rot is caused by unfavorable soil water conditions but not all are in agreement as to just what the conditions are that bring about the disease. It is therefore of interest to note the following reports of collaborators:

New York: (R. P. White for Niagara Co.) "Only a few fields that were planted late or did not get a good start were caught by the dry spell of August and show a great deal of blossom end rot."

Georgia: (McClintock) "Very prevalent this season to date (July 15) due to the dry weather of the past month."

Texas: (Taubenhaus) "Very important because of excessive rain."

Indiana: (Gardner) "Worse on soils with gravel sub-soil."

Idaho: (Hungerford) "Common in non-irrigated sections. Also doing considerable damage in irrigated sections where water supply has not been sufficient."

Dates of first recorded appearance of blossom end rot, 1920:

May 10	Crystal Springs, Miss.	July 19	Ohio.
June	Arkansas.	August 1	Ramsey County, Minn.
July 12	Albany County, N. Y.	September 30 ..	Vermont.

It was reported by Gardner from Indiana that the Horticultural Department there finds single plant strains that vary in susceptibility and plans to select for resistance.

Buckeye rot caused by Phytophthora terrestria Sherb.

During 1920 buckeye rot was reported in the field by Jehle from North Carolina where it was said to be quite prevalent in the Coastal Plain Counties causing an estimated loss of one or two per cent by rotting of the fruits. It was also reported from Arlington Farm, Virginia, by F. J. Pritchard as follows:

> "Buckeye rot destroyed a large part of a variety test at Arlington and was present in all tomato fields on the farm. It probably destroyed .5% of the fruit."

In Indiana it occurred in a few greenhouses causing loss of the lower fruits - first observed there June 4.

Phoma rot caused by Phoma destructiva Plowr.

The only states reporting this in the field are Iowa and California. Inspectors of the U. S. Bureau of Markets, however, found this rot in tomatoes from six of our southern states and from Canada, Cuba, and Mexico. A report of the percentages of Phoma rot, found in individual carlots from January to June 1920, has already been given (Pl. Dis. Bul. 4: 35-37, 1920). A condensed summary of the Phoma situation in the market is given in Table 80.

Table 80. Losses from Phoma rot caused by Phoma destructiva, as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Percentage of decay: Number of cars	Percentage of decay: Per cent	Origin of shipment	Percentage of decay: Number of cars	Percentage of decay: Per cent
Arizona	2	2-4	Tennessee	8	2-20
California	4	25-40	Texas	5	11-20
	9	1-18	Canada	1	6
Florida	14	50-85	Cuba	7	4-37
	64	25-47	Mexico	69	1-35
	239	1-23			
Mississippi	2	45			
	38	1-23			

Total number of cars with decay................. 462
Total number of cars inspected (approximate)..... 878

In connection with this table it should be mentioned that associated with the Phoma rot there was usually also considerable decay due to other causes, principally Rhizopus and Fusarium. It was difficult for inspectors to distinguish between these various rots and to make percentage estimates of the losses caused by each.

Soil rot caused by Rhizoctonia sp.

A statement of the occurrence of soil rot in shipments of tomatoes from January to May, 1920 has been given (Pl. Dis. Bul. 4: 37-38, 1920). A note by G. K. K. Link on soil rot in Mexican tomatoes is also recorded there.

The only collaborators reporting the disease in 1920 were those in Ohio and Washington.

Stripe or winter blight (bacterial)

This disease was reported from Massachusetts, New York, New Jersey, and Pennsylvania. How this disease compares with the new bacterial disease recently reported by Gardner and Kendrick (Phytopath. 11: 55. 1921, See also new diseases in this summary) remains to be seen.

From Massachusetts the report comes that it has been serious in the greenhouse since 1912. In New York it was reported very serious in the tomato districts causing a loss of about 2%. In Niagara County, New York, it killed practically all the leaves on many plants and was much more serious than Septoria as a cause of defoliation. It did not attack the fruit in the field as it did in the greenhouse.

In New Jersey, Cook reported the "so-called winter blight" as very severe out of doors in some localities, whereas it has previously been confined mostly to greenhouses. The Department at Washington has also received several field grown specimens of the disease from New Jersey, according to F. J. Pritchard.

Thurston and Orton in Pennsylvania report less winter blight than in 1919 and state that it is chiefly a greenhouse trouble but occurs rather commonly outside though to a less serious extent. For the most part it was not severe in the state except for one greenhouse at Kennett Square that came to their attention. It was first observed outdoors in Pennsylvania, July 29 and in New York August 26 (Albany County).

Rhizopus rot caused by Rhizopus sp.

Table 81. Losses from Rhizopus rot as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of shipment	Number of cars with decay	Average percentage of decay	Origin of shipment	Number of cars with decay	Average percentage of decay
Arizona	1	2	Ohio	2	23
California	24	15	Tennessee	31	17
Florida	173	13	Texas	53	14
Mississippi	35	17	Cuba	7	7
Missouri	5	12	Mexico	55	9
New Jersey	1	30	Unknown	2	14
Total number of cars with decay				389	
Total number of cars inspected (approximate)....				878	

Rhizopus rot, associated with other decays, caused considerable loss to tomatoes in transit as shown by the accompanying table. It was also a disease of some importance in southern California and in the San Joaquin Valley of that state. Three per cent loss is estimated for California.

New diseases.

Bacterial spot caused by an undescribed organism has been reported by Gardner and Kendrick (Phytopath. 11: 55. 1921) from Indiana and nearby states attacking stems, leaves, and fruits. The fruit spots are extremely objectionable to gardeners and canners. No resistant varieties have been found as yet. The organism is carried over winter on the seed and seed disinfection with mercuric chloride (1-3000 for 5 minutes, and washed 10-15 minutes) has been found safe and effective.

Stem girdle caused by a new species of Phytophthora has been reported by Reddick (A fourth Phytophthora disease of tomato. Phytopath. 10: 528-534, 1920) causing damage in the vegetable greenhouses at Cornell University, Ithaca, New York. This is the only present known occurrence of the disease.

The symptoms as described by Reddick, are:

(a) - typical damping-off of seedlings;
(b) - a girdling of stems of all ages and at any point;
(c) - blight of foliage, usually in limited areas but occasionally involving one or more leaflets;
(d) - a rapid rot of the fruit;
(d) - gradual death of foliage from the base and eventual death of the plant as a result of late root infection.

Blossom blight caused by Sclerotinia sp. was reported from Albany County, New York by H. W. Fitch, July 29.

Leaf roll, very similar in appearance to potato leaf roll, was found at the United States Department of Agriculture Experimental Farms at Rosslyn, Virginia, and reported by F. J. Pritchard (See Pl. Dis. Bul. 4: 91-92, 1920 for symptoms).

Other diseases.

Leaf mold caused by Cladosporium fulvum Cke. - reported in the greenhouses in New Jersey, Pennsylvania, Ohio, Indiana, and Iowa. In the field it was thought to be more prevalent than usual in Ohio. Sulphur dust failed to control the disease in one Indiana greenhouse that was under observation.

Summer blight, cause unknown, was said to be more serious than last year in California, causing a thickening and curling of the leaves, blue veins, and final wilting. D. G. Milbrath reported a 2% loss for California and stated that in the early crop many plants were killed in the field before blossoms could set.

Anthracnose caused by Colletotrichum phomoides (Sacc.) Chester, was reported as very abundant in New Jersey and as occurring in Indiana (not a serious factor). A rot of ripe fruit especially in transit.

Damping off caused by various organisms - reported from New York, causing injury to seedlings. In one house in Orleans County 300 boxes or 300,000 plants were thrown away because of damping off.

Sclerotium blight caused by *Sclerotium rolfsii* Sacc. - prevalent in Texas causing .5% loss.

Bacterial soft rot of fruit was reported by Fromme as more prevalent than usual in Virginia, causing severe loss in some sections, particularly Montgomery, Roanoke, and Botetourt Counties. It caused a rot of green and ripening fruit, injuring about 10% of the crop of the state. As high as 50% fruit rot was found in an individual field. First observation - September 1 at Roanoke.

Melanconium spot caused by *Melanconium* sp. reported from Ross County, Ohio by Selby.

Gray mold, *Botrytis* sp. - reported as local in green houses of Summit and Wayne Counties, Ohio by Selby. Sanitation gives good control.

Root knot caused by *Heterodera radicicola* (Greef) Müll. - reported from Georgia (serious on plantings in sandy soils), Texas (fairly important, .5% loss in the sandy soils), Ohio (slight in the greenhouse) and Indiana (found on southern-grown plants and on crop from these plants. The use of southern seedlings results in importation of nematodes).

Black spot, cause undetermined, reported from Washington.

Blossom drop, non-parasitic - reported from Ohio (in greenhouse), Texas (fairly prevalent, unimportant .1% loss), and Arizona (severe locally).

Growth cracks, non-parasitic, occurred commonly but were only reported to the Survey by Hungerford from Idaho and Gardner from Indiana. In the latter state cracking of the fruit was the most important source of loss to the canning crop. It occurred on fruit on all plants and probably caused a loss of 5% to the canners of the state.

Sunscald, - reported from Ohio and Indiana. It also occurred in many other states where defoliation of plants occurred either because of Septoria or some other fungus.

DISEASES OF SWEET POTATO

Stem rot caused by *Fusarium batatatis* Woll. and *F. hyperoxysporum* Woll.

Fusarium stem rot apparently did less damage than usual in most of its range. The disease was said to be increasing in importance in Mississippi, particularly in the northwestern portion. In New Jersey it was very abundant, but control measures were said to be satisfactory.

Dates when the disease was first noticed were reported only from Mississippi (June 10 at New Albany) and Arkansas (May). For reports of losses see Plant Disease Bulletin Supplement 18, 1921.

Black rot caused by *Sphaeronema fimbriatum* (E.& H.) Sacc.

According to reports, received, black rot was generally prevalent, as usual, and was responsible for heavier losses than any other disease of sweet potato, especially in the southern states. Except in Mississippi, it was not reported to have been more important than it ordinarily is.

The disease was destructive on young plants in seed beds, as well as on the plants and tubers in the field, and tubers in storage and transit. Estimates of reduction in yield due to black rot were as follows:

Table 82. Estimated percentages reduction in yield from black rot of sweet potato, 1920.

State	Per cent loss	State	Per cent loss	State	Per cent loss
New Jersey	16	Mississippi	10-15	Indiana	.5
Tennessee	10	Louisiana	5	Iowa	3.
North Carolina	10	Texas	8		
Georgia	5	Arkansas	2		

Black rot also caused losses in transit, as shown in Table 83.

Dates of first appearance of the disease were reported from Mississippi (May 15, Sturgis), Louisiana (October, Bayou Sara), and Arkansas (May).

The variety Nancy Hall was said to be most susceptible in Mississippi. Growers in that state experienced some difficulty in obtaining seed free from disease, particuly black rot.

Rots caused by various organisms.

Various rots caused losses in the field, in storage, and in transit. The most important of the transit rots were black rot (Sphaeronema fimbriatum (E.& H) Sacc.), dry rot (Diaporthe batatatis (E.& H.) H.& F.), Rhizopus soft rot, and Fusarium rot, which were reported by inspectors of the Bureau of Markets as follows:

Table 83. Losses to sweet potatoes in transit from various rots as reported by inspectors of the Bureau of Markets, 1920.

Origin of shipment	No. cars shipped	Approximate No. cars inspected	Amount of decay: Black rot No. cars	Black rot Per cent	Dry rot No. cars	Dry rot Per cent	Rhizopus No. cars	Rhizopus Per cent	Fusarium No. cars	Fusarium Per cent
Alabama	453	15	1	2	-	-	15	10	1	10
Arkansas	287	15	4	7	1	8	20	11	1	4
California	648	1	-	-	-	-	1	18	-	-
Delaware	1431	42	4	7	4	3	35	19	-	-
Florida	61	0	-	-	-	-	-	-	-	-
Georgia	635	45	7	11	6	6	31	8	2	9
Indiana	* --	1	1	3	-	-	1	2	-	-
Kentucky	* --	1	-	-	-	-	1	10	-	-
Louisiana	375	23	3	2	2	9	20	18	-	-
Maryland	1208	15	4	27	-	-	15	19	-	-
Mississippi	55	4	3	18	2	14	5	6	-	-
New Jersey	2573	6	1	4	-	-	6	17	-	-
New Mexico	27	0	-	-	-	-	-	-	-	-
N.Carolina	859	26	11	8	4	3	18	13	1	2
Oklahoma	*--	3	2	6	1	3	1	6	-	-
Porto Rico	*--	3	1	18	-	-	3	49	-	-
S.Carolina	*--	2	2	10	-	-	2	33	-	-
Tennessee	1175	28	11	8	1	13	27	12	1	6
Texas	480	19	9	13	7	13	19	14	-	-
Virginia	5151	57	5	27	2	36	38	13	-	-
Unknown	--	8	2	6	1	5	9	12	1	17
All other	*71	0	-	-	-	-	-	-	-	-
Total	15691	314	71		31		267		7	

Storage rots caused by various organisms - New Jersey (heavy losses), Georgia (chiefly soft rot, but some black rot, etc. general but less than usual due to increase in storage houses; bad in banked potatoes; reduction in yield 25%), Mississippi (general, more than usual, reduction 20%), Kansas (from 15-20% loss in some storage houses).

Soft rot caused by Rhizopus nigricans Ehr. - Virginia (data from market inspection on 21 shipments from eastern section show 12% loss; storage loss will equal or exceed this), Georgia, Arkansas (less than usual, much better storage; 8% loss), Iowa (20% loss), California (about as usual, very serious).

Foot rot caused by Plenodomus destruens Harter - Alabama, Kansas (small amounts in some fields), California (San Fernando Valley, in storage).

Charcoal rot caused by Sclerotium bataticola Taub. - Louisiana (first record of occurrence in the state, of little importance; first observed October 23 at Mansfield; very moist season), Texas (fairly important as storage rot, following soft rot, .5% loss).

Java black rot caused by Diplodia tubericola (E. & E.) Taub. - Louisiana (more than usual, of considerable importance all over state; reduction in yield less than 1%), Texas (traces, unimportant).

Soil rot or pox caused by Cytospora batata Elliott.

Reported from New Jersey (More, southern half of state), Texas (important as field trouble only, 1% reduction in yield), Kansas (common in some fields).

Scurf caused by Monilochaetes infuscans Hals.

Scurf was of considerable importance in some states, due to the disfiguration of the tubers rather than to reduction in yield, which was slight. It was reported from New Jersey, Mississippi, Louisiana, Arkansas, and California and was generally distributed in all states.

Other diseases.

White rust caused by Albugo ipomoeae-panduranae (Schw.) Swingle - Arkansas (more severe than usual locally; 10% injury; first report June).

Mosaic (cause unknown) - Texas (traces), Arkansas (probably general, though not abundant).

Root rot caused by Ozonium omnivorum Shear - Texas (important only in heavy, waxy soils, reduction in yield .5%).

Root knot caused by Heterodera radicicola (Greef.) Müll. - Arkansas (general, 5% injury; first report September).

DISEASES OF BEAN

Bacterial blight caused by Bacterium phaseoli EFS.

Blight was reported in 1920 from practically all states in the eastern half of the country and from Utah and Idaho. New England and New York reported less than usual, as did also Kentucky and Wisconsin. On the other hand Pennsylvania, Indiana, and Michigan reported more than last year.

Table 84. Estimated percentage reduction in yield of beans from bacterial blight, 1920. For final estimates in bushels, see Supplement 18, 1921.

State	Per cent loss	State	Per cent loss	State	Per cent loss
New York	1.5	Ohio	4	Tennessee	2
New Jersey	1	Indiana	3	Mississippi	5
Pennsylvania	7	Illinois	3	Louisiana	8
Maryland	1	Michigan	3	Texas	3
North Carolina	3	Wisconsin	1	Oklahoma	1
South Carolina	2	Minnesota	1.5	Arkansas	1
Georgia	1	Iowa	3	Arizona	8

In 1920 Michigan produced 3,575,000 bushels of dry beans, or more than any other state, and over one-third of all the dry beans raised in the country (9,075,000 bushels). The reduction of 3%, or about 106,000 bushels, because of blight made great inroads into this enormous crop. Federal and state crop reporters frequently called attention to the losses that were occurring because of blight in Michigan, and G. H. Coons of the Experiment Station at East Lansing and O. F. Burger and G. A. Meckstroth, also of the Federal Department, directed attention to the damage being caused. For the most part the injury was due to attack of the leaves and pods, but pathologists in New York and Michigan noted attack of the stems, producing wilt and also breaking over at the nodes.

Dates of first observation of bacterial blight, 1920:

May 5.......... Starkville, Miss.	June (middle) ... Perry, N. Y.
May .... Arkansas	July 1 .... Madison, Wis.
June 11 .... Ohio	July 10 .... Ramsey Co., Minn.
June 24 .... Marion Co., Ind.	July 31 .... Erie Co., Pa.

Gloyer, in New York, who is trying to secure bean varieties resistant to bacterial blight, reported a correlation of the amount of disease with time of planting. Kidney beans planted at various times from the latter part of May to the first of July showed no disease on the late planted, but considerable on the early planted beans. Nixon, in Pennsylvania, experienced the same thing, losing the crop from the first planting in his garden but securing a good yield from the same seed planted later.

Regarding resistant varieties, Gloyer in New York reported the White Kidney resistant, but the Wells Red Kidney, although resistant to anthracnose, is very susceptible to bacterial blight. This observation on the resistance of White Kidney is an important one as bean varieties in general do not exhibit wide differences in susceptibility to this disease. Burkholder reported the Red Kidney to be the most susceptible of the field beans in New York.

Control measures for blight are badly needed. Nothing but general sanitation methods are to be recommended at the present time. Resistant varieties would fill a great want and some practical method of securing blight-free seed is needed.

Anthracnose caused by Colletotrichum lindemuthianum (Sacc. & Magn.) Br. & Cav.

Anthracnose occurred to some extent throughout the entire eastern half of the United States. No reports were received from west of the 100th meridian. It was generally distributed within these states, for the most part, but in Georgia it was said to be more prevalent in the coastal counties and in Mississippi it occurred mostly in the southern half.

The disease varied greatly in abundance in different states. Less than usual was reported from Vermont last year and this in spite of a cool, wet season that would appear favorable for it. Kentucky, Georgia, Mississippi, and the South generally seemed to experience smaller losses than usual. Wisconsin and Minnesota reported less than last year, the latter state escaping loss except to the early crop. Michigan and Indiana reported the absence of anthracnose.

On the other hand the important dry bean state of New York experienced an epiphytotic of anthracnose unequaled since 1915. Parts of Ohio, Pennsylvania, and New England, also apparently shared in this outbreak.

In New York the loss of dry beans from anthracnose in 1920 was greater than in 1919, but for the country as a whole, the losses were not above those of last year.

Table 85. Percentage losses (estimated) from bean anthracnose, 1920.

Percentages	States
1	Vermont, Georgia, Minnesota, Iowa, and Missouri.
2	New Jersey, South Carolina, Alabama, Louisiana, and Kentucky.
3	New Hampshire, Virginia, North Carolina, and Mississippi.
4	Tennessee.
5	Maine, Pennsylvania, West Virginia.
10	New York, Ohio.

The following regarding weather relations was reported by collaborators:

Vermont (Lutman): Unimportant this year, possibly due to the very dry weather in June and August.

New York (Burkholder): Cool, wet weather favorable.

Kentucky (Valleau): Weather favorable only in fall.

Ohio (Selby): More abundant than usual. Abundant rainfall.

Wisconsin (Vaughan): Less. Too cool.

Minnesota (Leach): Rather scarce during later July and August.

Dates of first observation of anthracnose, 1920:

May	Raymond, Miss.	July 1	Madison, Wis.
May	Arkansas.	July 4	Ramsey Co. Minn.
June 26	Durham, N. H.	August 25	State College, Pa.
July	New York.		

Wax varieties were mentioned as most affected in Mississippi and Wells Red Kidney was reported resistant again in New York.

Rust caused by Uromyces appendiculatus (Pers.) Lev.

Rust, causing a spotting of the leaves, and sometimes the pods, was reported from Massachusetts, New York, New Jersey, Pennsylvania, Virginia, West Virginia, Tennessee, Mississippi, Louisiana, Texas, Arkansas, Ohio, Indiana, Wisconsin, Minnesota, Missouri, New Mexico, and California. For the most part it was scattered over these states, occurring on the susceptible varieties. In Indiana it was noted especially in the northern part and in New Mexico it was abundant in the southeastern portion.

It was not a factor of any great importance except in certain local instances. Apparently it did not do quite so much damage as usual. In Virginia, where losses are sometimes heavy, Fromme says that the "rains of August seem to have lessened injury as affected plants are retaining leaves longer than in dry summers."

Dates of first observation of bean rust, 1920:

July 4	Isanti County, Minn.	August 26	Marshall County, Ind.
July 10	Meridan, Miss.	August 31	State College, Pa.
August	Ohio.	August (last of)	Perry, N. Y.

At Perry, New York the rust was found in very slight amounts on pea beans and mediums, according to W. H. Burkholder; and in California, Lady Washington, Blackeye, California Pink, Red Mexican, and French White were attacked according to D. G. Milbrath(s report.

Mosaic (cause undetermined)

Mosaic occurred in the states from which it was reported in 1919 (Pl. Dis. Bul. Suppl. 10: 229. 1920) and in addition in Iowa, Utah, and Washington. It was about as last year in most states, although in New York there was less owing to a great reduction in the acreage of susceptible varieties of the pea and medium types. The only states mentioning mosaic as important are Utah, Idaho, and Washington. The losses that occurred in New York and Pennsylvania (3%) would also indicate that it was important in those states.

Losses of 1% or more occurred as follows according to collaborators' estimates:

Table 86. Losses of 1% or more from mosaic of bean, 1920.

Percentages	States
1	Georgia, Indiana, Illinois, Minnesota, Tennessee, Louisiana.
2	Iowa, Washington.
3	New York, Pennsylvania.
5	Idaho, Oregon.

As high as 25% affected plants were found in Mississippi, 26% in wax beans at Kalamazoo, Michigan, and 33% in Oregon. In this latter state it was estimated that affected plants failed to set more than one-third of a crop. Few Oregon fields were free from the disease.

Dates of first observation of bean mosaic, 1920:

May 15	Griffin, Ga.	July 1	Ramsey County, Minn.
June	Crystal Springs, Miss.	July 16	Freeland, Pa.
June	Arkansas.	July 30	Madison, Wis.
June 15	Humboldt, Tenn.	August 15	Vermont.
June 24	Marion County, Ind.	September 29	Hadden Neck, Conn.
July	New York.		

Mosaic was reported on the following beans in 1920:

Common beans
- Field varieties
  - Pole Horticultural .... Vermont.
  - Pea and medium types ..... New York.
- Snap varieties .... Vermont, Connecticut, Georgia, Virginia.
  - Wax types .... Michigan, Mississippi.

Lima beans...................... Georgia.

Root rot caused by Fusarium martii phaseoli Burkholder.

Root rot was reported by Burkholder as causing less injury in New York than last year. Due to sufficient moisture at podding time the yield was not reduced as much as usual. An estimate of 1 to 2% loss was made for the state. The rot appeared in the middle of June in Wyoming County, and was most destructive during August when plants were forming pods.

A disease closely resembling this was reported by Gardner from Indiana, killing plants in scattered localities. Meckstroth in Michigan also found a root and stem rot in sandy soils near Saginaw that answered the description of the New York disease.

Watery soft rot or drop caused by Sclerotinia libertiana Fckl.

This rot was reported occurring on beans in the field in New Hampshire, New York (more, 75% in one field as a stem and pod rot), Pennsylvania (serious in one to two localities in Center County), and West Virginia (more than usual but of slight importance as damage was local).

It was found in shipments of green beans from the South as follows, in Table 87:

Table 87. Losses from watery soft rot caused by Sclerotinia libertiana, as shown by examination of cars at destination by inspectors of the Bureau of Markets:

Origin of shipment	Number of cars with decay	Average percentage of decay	Origin of shipment	Number of cars with decay	Average percentage of decay
Alabama	1	2	Mississippi	3	4
Florida	3	14	South Carolina	1	8
Louisiana	5	27	Virginia	2	35
Maryland	2	9	Total	17	
			Total number of cars inspected.....	45	

Other diseases.

Powdery mildew (Erysiphe polygoni DC.) - reported from Connecticut (new to state but not a serious trouble), Illinois (in greenhouse at Urbana), and Texas (unimportant).

Leaf spot caused by Cercospora canescens was reported by Taubenhaus as important in Texas, causing a loss of 1% to fall beans. More than 1919.

Angular leaf spot caused by Isariopsis griseola Sacc. was found by J. L. Sheldon on pole bean leaves and pods in small amounts in a garden near Morgantown, West Virginia.

Root rots caused by Fusaria were reported from Massachusetts (worse), Georgia (same), Mississippi, and Missouri.

Root rot caused by Rhizoctonia sp. - reported from New Jersey (very common), Texas (unimportant), Ohio, Idaho (common in Twin Falls County), Washington, Oregon, and California.

Southern blight caused by Sclerotium rolfsii Sacc. - reported from West Virginia, (new), Georgia, Mississippi (trace observed, first noticed June 10 at Agricultural College), and Texas (unimportant).

Texas root rot caused by Ozonium omnivorum Shear was important on late beans in Texas causing about 10% loss.

Root knot caused by Heterodera radicicola (Greef.) Müll. - reported from Arkansas (general, 10% injury).

Chlorosis said to be caused by the soil being too rich in lime was reported from Texas.

DISEASES OF LIMA BEAN

Downy mildew caused by Phytophthora phaseoli Thax.

Downy mildew was more widespread and more destructive than usual in the Northeast. It occurred in Connecticut, New York, New Jersey, Pennsylvania, Virginia, West Virginia, and Ohio. In New Jersey it was said to be very destructive and in Pennsylvania it was serious in the southeastern corner of the state, causing 100% infection in some plots. At Blacksburg, Virginia practically 100% infection on young pods was noted in some gardens.

The disease was noted in New York, on Long Island, in August; in Pennsylvania at about the middle of the same month; and in Virginia at Blacksburg, August 10. Undoubtedly the disease was favored by the cool wet weather that prevailed in most of the northeastern states during August. The average rainfall for August in the states reporting downy mildew was nearly one inch in excess of the normal. Fromme, in Virginia, made observations at Blacksburg indicating restriction to higher altitudes.

Other diseases.

Bacterial spot has recently been studied and described by W. B. Tisdale and Maude M. Williamson (Abstract in Phytopath. 11: 52, 1921). They report it from Madison, Wisconsin where it was quite destructive in 1917.

Bacterial blights were also reported from West Virginia and Missouri in 1920, but the identity of these troubles is somewhat uncertain.

Leaf and pod spot caused by Diaporthe phaseolorum (C. & E.) Sacc. (Phoma subcircinata E. & E. and Phyllosticta phaseolina Sacc.) - reported from New York (one report from Mattituck, L. I., August 10), New Jersey (abundant in southern part of state), Indiana (widespread and very destructive in some gardens), and Michigan.

Leaf spot caused by Cercospora cruenta Sacc. - reported from Long Island, New York and Boone County, Missouri.

Mosaic (cause undetermined) was observed by McClintock in Georgia and Sheldon in West Virginia. The latter reported a garden at Morgantown with scarcely a plant that was free from the disease.

Root-rot (cause undetermined) - reported from Morgantown, West Virginia. Many of the plants failed to come up and others died later in the season. A parallel row of peas also had root rot. Lima beans had been grown on the same soil the year before.

Powdery mildew caused by Erysiphe polygoni DC. caused 2-5% loss to limas along the coast in California according to D. G. Milbrath.

DISEASES OF ONION

Smut caused by Urocystis cepulae Frost.

During 1920 smut was reported from certain onion sections in Massachusetts, New York, Pennsylvania, Kentucky, Ohio, Indiana, Wisconsin, and Oregon. In Massachusetts it was largely in the Connecticut Valley, although some was found in the eastern part of the state. In New York the geographical distribution was outlined by Chupp as follows:

> "Nearly all of the onions of the state are grown in the following sections: Orange County, Wayne County, South Lima in Livingston County, Elba in Genesee County, Fulton in Oswego, and a few about Buffalo. In all of these sections, excepting Elba, where the muck has been recently put under cultivation, the smut is very serious."

In Pennsylvania it was said to be important in the Luzerne and Erie County sections. In Kentucky it was serious about Louisville. In Indiana it was found to occur only in a few fields of onions grown for sets in one section of Lake County. In Wisconsin the disease appears to be localized in the southeastern part of the state, Racine, and Kenosha Counties, and in Oregon it was confined to the northern part of the Willamette Valley.

The losses were very heavy, at least to some growers, in most of the sections mentioned above. An average state loss of 2% is estimated for Massachusetts, 20% for New York, and 5% for Wisconsin. Regarding the New York losses, Chupp writes as follows:

> "It is not uncommon either in Orange or Wayne Counties to find as high as 60% of the plants smutted. We do not grow onions in New York by the planting of sets. The seeds are put directly in the ground, using twice as much seed as is necessary in order to make up for the loss that is sure to result from the attack of Urocystis. The seedlings that do come up are quite often so badly smutted that, even though they grow to be mature onions, they have to be discarded as culls in the fall. Furthermore, in nearly all of the demonstrations that were conducted in 1920, the yield when formaldehyde was used was increased from one-third to one-half. Taking all these things into

consideration, it seems to Dr. H. W. Dye and myself that 20% reduction in yield is very conservative."

In Wisconsin it was estimated that the disease was present in about half of the commercial onion fields of the state, affecting an average of 5% of the plants and causing about that much loss.

Reports from New York and Wisconsin indicate that the disease is slowly spreading to new areas.

First observed in spring - April 19, Albany County, New York; May 5, Racine, Wisconsin.

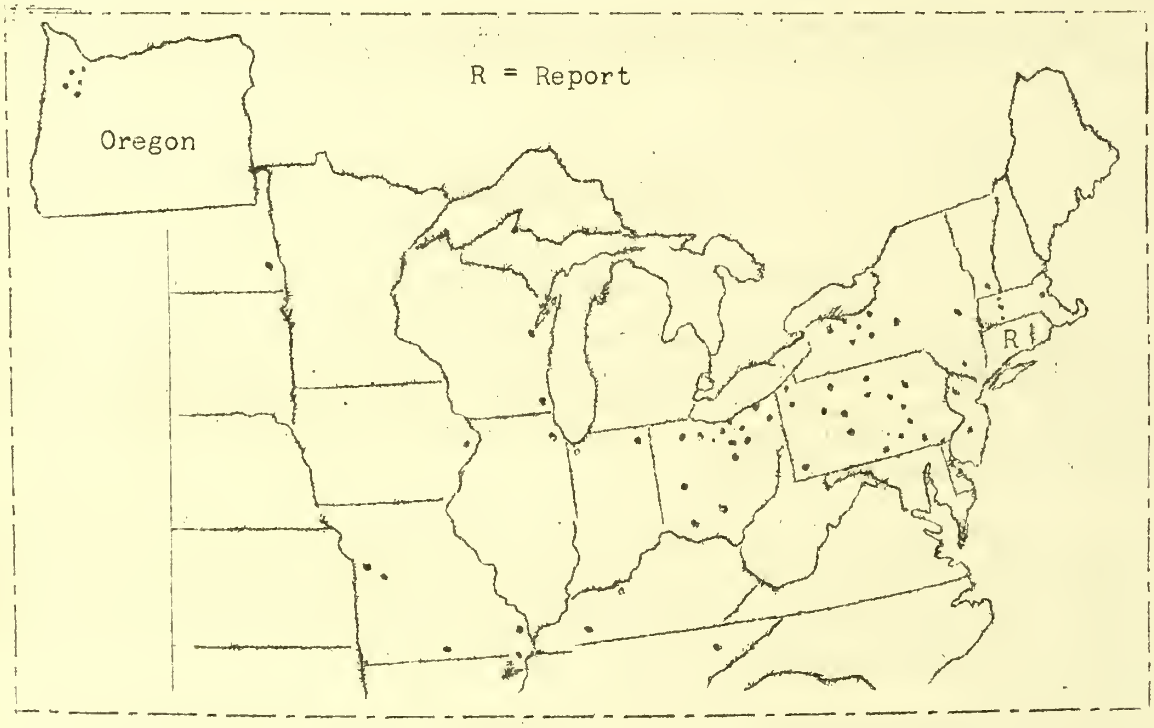

Fig. 49. Geographical distribution of onion smut as reported to the Plant Disease Survey since 1903. Each dot represents a single county. A single report has been received also from Alabama, but there is some doubt as to its authenticity.

An important contribution to our knowledge of relation of environment to onion smut has been made by J. C. Walker and L. R. Jones during the past year (Abstract in Phytopath. 11: 52, 1921). They have found that infection occurs at temperatures from 10°-25° C., marked reduction takes place at 27.5° C. and complete inhibition exists at 29° C. Also they have shown that when successive out-door plantings are made in inoculated soil, so timed as to expose the crops of seedlings to gradually increasing temperatures, the percentage of infection falls as the soil temperatures rise. The significance of this temperature relation to the geographical distribution of the smut is pointed out.

Formaldehyde soil treatment resulted in 240% increase in yield in Luzerne County, Pennsylvania last year and 100% increase in parts of New York. The method gave satisfactory results also in Massachusetts, Indiana, and Wisconsin.

Downy mildew caused by Peronospora schleideni Ung.

States reporting this disease were New York, Pennsylvania, Mississippi, Louisiana, Oregon, and California.

According to H. W. Dye in New York there was much more downy mildew than usual, occurring wherever onions were grown, and causing a loss of 3-5% for the state. It appeared late and so did not do great damage except on some late planted fields.

Very serious losses were reported by R. C. Thomas from Ohio where some fields located on low, muck soil suffered heavily.

In Santa Clara County, California, Milbrath found the yield cut 30% in some fields of onions grown for seed.

Neck rot caused by Botrytis sp.

Neck rot was reported by collaborators from New York, Pennsylvania, West Virginia, Ohio, Illinois, Wisconsin, Idaho, Washington, and California.

J. C. Walker reported very little in Wisconsin or in the Chicago district. One lot from Lansing, Illinois, showed about 5% infection. It was common on white bulbs in the Chicago retail markets in October, according to Walker.

Table 88. Losses from neck rot caused by Botrytis sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Number of cars with decay	Average percentage of decay	Origin of shipment	Number of cars with decay	Average percentage of decay
California	11	8	Ohio	29	7
Colorado	2	17	Oregon	2	7
Indiana	2	9	Texas	13	7
Iowa	4	3	Washington	2	3
Kentucky	4	5	Wisconsin	1	2
Massachusetts	1	9	Spain	20	21
Michigan	2	27	Unknown	2	14
New York	5	5			

Total number of cars with decay 100
Total number of cars inspected 1314

Pink root caused by Fusarium mallii Taub.

According to Taubenhaus this disease was very important as usual along the Rio Grande Valley. It was about as prevalent as usual and caused a loss in the state estimated at 3%. A pink root disease caused by Fusarium was also reported from New York, Indiana, and California.

New York: (H. W. Dye) "Present in 25% of fields and probably reducing the yield in a few. The dry season has apparently favored the disease."

(Chas. Chupp) "First observation July 12 at Williamson. Mr. Newhall found it in 12 out of 15 fields in Wayne County where it was equally bad on red and yellow onions."

Indiana: (M. W. Gardner) "Found in Lake County but not doing any damage."

California: (D. G. Milbrath) Pink root - Fusarium mallii - found on several islands in Delta region. Infested spots reduced 50%."

Other diseases.

Leaf spot caused by Macrosporium sp. was very severe on seed onions in the Bayou La Fourche district of Louisiana, according to Edgerton. A mold (Macrosporium) was reported as unimportant in New York.

Bulb rot caused by Macrosporium sp. was noted by J. C. Walker in the Wisconsin-Illinois section in 1917 and 1918, and recently reported by him (Phytopath. 11: 53, 1921). It did slight damage in 1920 to white sets from Somers, Wisconsin and to large white bulbs in the Chicago market.

Smudge caused by Vermicularia circinans Berk. - prevalent on white onions in Wisconsin and Chicago districts and in the Indianapolis market gardens. Damage only slight.

Fusarium rot - occasional but not serious on sets in Chicago section. In one field at Racine, Wisconsin, it was doing considerable damage to large bulbs. It was also reported from the state of Washington and by market inspectors on onions from Iowa and Texas.

Damping-off of seedlings caused by Pythium and Fusarium was serious in a few fields in Massachusetts.

Root knot caused by Heterodera radicicila (Greef.) Müll. was found near Goshen, Indiana.

Rust (Puccinia asparagi DC.) was found near Madison, Wisconsin by J. C. Walker and reported by him as follows:

"Aecial stage on seed stems and leaves of top onion (Allium cepa bulbellifera) was found in two patches in a market garden near Madison, Wisconsin. Diagnosed by Dr. Arthur as Puccinia asparagi affecting onion. This was supported by the fact that an asparagus patch intervened between two onion patches. No aecia found on asparagus but crop was cut short in early part of season. Uredo and telial stage later developed on asparagus but not on onion. A species of Botrytis attacked the onions through rust lesions so that eventually each rust lesion was invaded many times before they were mature. Botrytis lesions enlarged and eventually girdled the stems. Rust itself not serious but Botrytis caused considerable damage."

Stem and leaf rot caused by Botrytis attacking through rust lesions - See note on rust above.

Scale rot caused by a Botrytis sp. of the small sclerotial type reported by Walker as very prevalent on white bulbs in the Chicago markets during October and also noted at Madison, Wisconsin.

Dodder (Cuscuta spp.) was noted during July, 1919 by J. C. Walker on large bulb tops at Stockton, California; in 1920 by J. Monteith, Jr. on large bulb tops at Racine, Wisconsin; and September, 1920 by Walker on white sets at Lansing, Illinois, where it was doing considerable damage (See Abstract in Phytopath. 11: 53, 1921).

Rhizopus rot caused by Rhizopus sp. was found in California onions, mostly yellow Bermudas arriving in eastern markets during June.

Slimy soft rot caused by bacteria of the Bacillus carotovorus group was One of the most important decays of onions in transit. It was found in onions from many states and affected especially those shipped during the summer.

Black mold rot caused by Aspergillus niger Van Tieghem, sometimes called Sterigmatocystis niger Van Tieghem, caused 15% severe infection of bulbs in the Delta Region of California, and 2% severe infection in the Coachella Valley, according to D. G. Milbrath. In Texas, Taubenhaus reported its occurrence mostly in the Rio Grande Valley in places where onions were dug during rainfall.

In onion shipments it was reported affecting a considerable portion of the onions in 86 cars from California, 28 from Texas, 5 from Kentucky, 2 from Indiana, and 1 from each of Iowa, Michigan, Minnesota, and New York.

Blue mold rot caused by Penicillium sp. was reported by market inspectors as follows: California onions, 24 cars with 29% decay; Indiana onions, one car with 6%; Michigan onions, 4 cars with 3%; Ohio onions, one car with 3%; Texas onions, one car with 4%.

Gray mold rot caused by Botrytis sp. - reported by market inspectors as follows:

Table 89. Losses from gray mold rot of onion caused by Botrytis sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Number of cars with decay	Average percentage of decay	Remarks as to seriousness of decay.
California	32	9	
Illinois	1	100	Followed by slimy soft rot.
Indiana	2	2	
Michigan	2	4	
Minnesota	1	2	Associated with slimy soft rot.
Ohio	5	5	
Texas	48	20	Considerable slimy soft rot.
Washington	5	20	
Wisconsin	3	2	Advanced stage of decay.
Egypt	1	13	
Spain	17	15	Associated with other decays.
Unknown	4	28	

Total 122   Total number of cars inspected 1314

DISEASES OF CRUCIFERS

CABBAGE AND CAULIFLOWER

Club root caused by Plasmodiophora brassicae Wor.

The geographical distribution of club root on cabbage as reported to the Survey for 1920 is shown in Figure 50. On cauliflower it was reported also from

New York and Ohio. It will be noted that the disease occurred chiefly in the more northern and cooler sections of the country. An examination of past data on the range of club root shows the same sort of limitation, although it is true that a few scattering and local reports have come from some of the more southern states. Although club root is sensitive to soil reaction, it is thought that temperature may have much to do with the tendency toward restriction of the disease to northern states. Chupp (Studies on club root of cruciferous plants, N. Y. Sta. Agr. Exp. Sta. (Cornell) Bul. 387: 424-426. 1917) pointed out that infection of seedlings in agar tubes takes place at temperatures of from 16°- 21° C. (61°- 70°F.) which are comparatively cool.

As a rule club root was most serious in gardens, especially in those small long established vegetable growing communities where cabbage or cauliflower are favored. The large commercial cabbage sections do not seem to suffer much loss from club root, and those in the west are less affected than those in the east. In the Cortland Valley district of New York, however, considerable trouble is experienced. The reductions in yield estimated by collaborators in 1920 were: Vermont 2-5%, New York 1-2%, Pennsylvania 2-5%, Wisconsin trace, Minnesota trace. The highest percentage of diseased plants found in any one field was: New York 60%, Pennsylvania 50%, Wisconsin 5%, and Minnesota 50%.

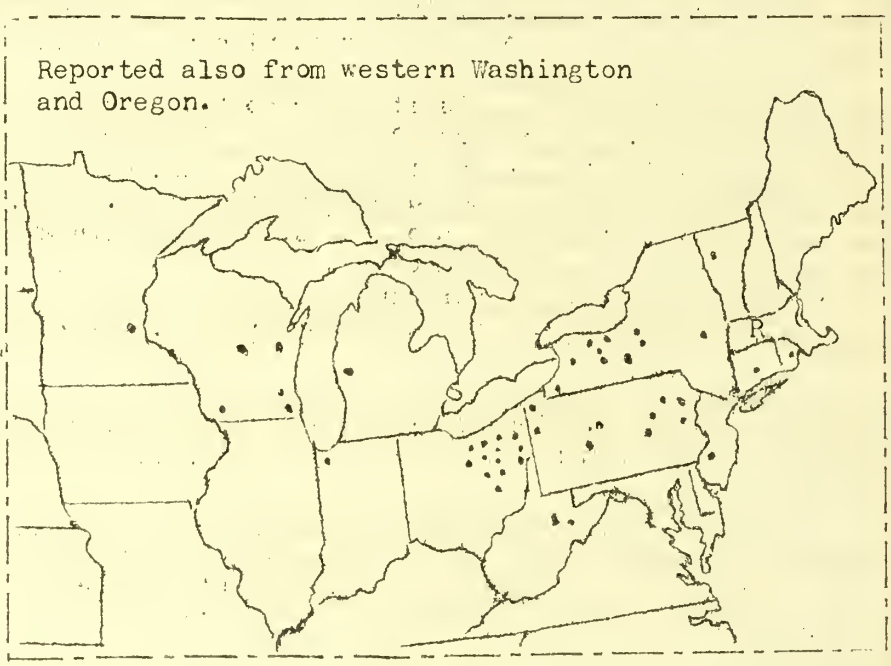

Fig. 50. Range of club root on cabbage as reported by collaborators for 1920. Each dot represents a single county where the disease occurred.

Nothing on the susceptibility of varieties nor on control was reported.

Yellows caused by Fusarium conglutinans Woll.

A good account of the geographical distribution of cabbage yellows in the United States and reasons for limitations in range has been given recently by Jones, Walker, and Tisdale (Wis. Agr. Exp. Sta. Res. Bul. 48. 1920).

In 1920 yellows was reported from the following states in the eastern half of the country: New Jersey, Pennsylvania, Delaware, Maryland, Virginia, Kentucky, Tennessee, Alabama, Mississippi, Louisiana, Texas, Oklahoma, Arkansas, Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, and Kansas. Along the northern border of the area, that is, southern Wisconsin and Michigan and northern Indiana, the disease was less severe than usual owing to the cool summer.

This undoubtedly is the most important cabbage disease, as many states mention it as their worst trouble, and it occurs widely in the commercial cabbage sections of the east. Losses expressed in percent reduction in yield by states were estimated as follows for 1920: Virginia 16%, Louisiana 5%, Texas 4%, Indiana 5%, Wisconsin trace, and Iowa 20%. The loss in Wisconsin is small because of the cool season and because the disease is limited to the southern portion of the state and in that section the resistant Wisconsin Hollander is generally used on infested land. In Iowa, on the other hand, weather conditions were more favorable and resistant varieties are not so widely grown.

The highest percentage of disease in any one field was reported as follows: Pennsylvania 10, Virginia 80%, Tennessee 10%, and Missouri 60-100%.

In the southwest cabbage section of Virginia, Wythe and Smyth Counties, where about 5000 acres of cabbage are grown, yellows was the worst disease according to L. L. Harter and F. D. Fromme. As high as 80% was found in one field and from the district about Louisville, Kentucky, Valleau reported 30-75% loss in some of the early cabbage fields.

Dates of first appearance of yellows, 1920:

March	Lockport, New York.	June 24	Delaware.
June 4	Marion County, Indiana.	July	Arkansas.
June 20	Amboy, Illinois.	July 15	Racine, Wisconsin.
June 23	Marion, Virginia.	July 27	Plain View, Minnesota.

Four collaborators have furnished notes on resistant varieties:

Pennsylvania: (Thurston and Orton) Wisconsin Hollander resistant.

Virginia: (Fromme) Copenhagen Market seems especially susceptible in the southwest cabbage section. All Head Early is more so than Succession.

Michigan: (Coons) This disease is known from Wayne, Kent, Monroe, and Branch Counties. It is becoming a serious problem in Branch. The Wisconsin No. 8 is too late for this county, since they wish to ship before November and have better success with Copenhagen.

Wisconsin: (Vaughan) Use of Wisconsin Hollander general on infested soil. hence loss is small. Good results with a new strain of resistant All-Seasons developed in Wisconsin. In one test field at Union Grove, six or seven strains of Wisconsin All-Seasons were free from Yellows, while the check row gave 67% yellows.

Black rot caused by *Bacterium campestre* (Pam.) EFS.

More black rot than usual was reported from Vermont, Indiana, Wisconsin, and Minnesota. On the other hand, New York, Pennsylvania, and Iowa apparently experienced less than normal.

On the whole, the disease was not a very important one, although Outagamie, Dane, and Brown Counties, Wisconsin, where fields were to be found showing from 95-100% infection, suffered heavily. Imported Hollander seed in Wisconsin seemed to show most of the disease, the domestic grown seed being practically free. An estimated reduction in yield of 10% has been made for that state, while 2-5% loss probably occurred in Minnesota.

According to reports from Alabama and Mississippi, the disease was also rather serious on early cabbage in parts of those states as from 5-25% affected plants were found in several fields in Mobile County, Alabama, and in one field near Crystal Springs, Mississippi, 10% infection was observed. In Pennsylvania about 5% loss from black rot was estimated.

Black rot was found by market inspectors in cars of cabbage from Florida, Alabama, Texas, Wisconsin, Minnesota, and New York. Some cars showed as high as 75% infection. In many cases slimy soft rot was associated with the black rot.

The disease was reported on cauliflower only from Ohio.

Dates of first observation of black rot, 1920.

May	Mississippi.
May 24	Mattituck, New York.
June 19	Ohio.
August 12	Marion, Virginia.
August 15	Appleton, Wisconsin.

Lutman in Vermont attributes the excess of black rot to the wet September.

Seed treatment with mercuric chloride gave good results in Wisconsin last year.

Black leg caused by Phoma lingam (Tode.) Desmaz.

In 1920 black leg was reported from New York, New Jersey, Pennsylvania, Maryland, Virginia, Georgia, Alabama, Mississippi, Louisiana, Arkansas, Ohio, Indiana, Wisconsin, and Missouri. In New York it was important on Long Island but not in the other portions of the state. I. H. Vogel reporting for Long Island made the following statement:

> "In six seed fields there was a loss of 15-25% of seed and the quality was poor. In cabbage fields as many as 75% were affected and at least 80% of the fields showed infection. Loss on the Island, 5-10%."

In New Jersey, Cook reported it most abundant in Camden County where it was very destructive and in Pennsylvania it was reported only from Philadelphia County in the southeastern part of the state.

Table 90. Estimates of losses to cabbage from Phoma as given by collaborators, 1920.

State	Percent reduction in yield	Maximum percent found
Long Island, N. Y.	5-10	80
Pennsylvania	-	30
Virginia	1.5	10
Louisiana	slight	
Wisconsin	10	50
Missouri	-	24

L. L. Harter, who visited the cabbage district of southwestern Virginia near Marion and Rural Retreat on July 26 and 27, found black leg common and second to yellows in importance, but in no field did it exceed 10% infection.

In Georgia it was noted by McClintock as serious on collards grown for seed. Seventy-five percent of the plants were killed during the season due to Phoma attacks on the stem.

It will be noted that in Wisconsin this disease was far more serious than yellows as it caused 10% loss as compared with a trace from yellows.

It was stated that in Wisconsin wet weather early gave a favorable opportunity for repeated infection.

Dates of first observation of black leg, 1920:

March ....Baton Rouge, La.	June 23 ....Marion, Va.
May 15..........Racine, Wis.	July ....Arkansas.
June 15 ....Manchester Road, Mo.	July 12 ....Mattituck, L. I., N. Y.

Late varieties were more affected than early ones in Maryland. No resistance was reported from any state.

Seed treatment with mercuric bichloride gave good results on Long Island and was fairly successful in Wisconsin. The seed source is mentioned as being very important and in the southwestern Virginia section where the seed is sown directly in the field, it is thought that the elimination of the seed bed by this manner of planting is helpful.

Black leaf spot caused by Alternaria brassicae (Berk.) Sacc.

Black mold or black leaf spot caused considerable damage in San Francisco and San Mateo Counties in California, according to D. G. Milbrath. In other states it was said to be of little importance in the field. It was rather common on cabbage in transit, however. The following table shows the infections reported by inspectors of the Bureau of Markets in shipments from various states.

Table 91. Losses from black leaf spot of cabbage caused by *Alternaria brassicae* as shown by examination of cars at destination by food-products inspectors of the Bureau of Markets, 1920.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay		Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	
			No. cars	Percent				No. cars	Percent
Ala.	5	48	2	100	La.	3	75	3	45-100
			3	4-22	N. Y.	14	28	3	50-90
Calif.	4	26	4	15-42				11	6-30
Fla.	42	41	8	75-100	Tex.	106	31	25	50-100
			9	35-65				81	2-45
			25	2-30	Unknown	3	22	3	7-42
Ind.	1	17	1	17	Va.	1	40	1	40

Total number of cars with Alternaria 179
Total number of cars of cabbage inspected 1252

Gray mold rot caused by Botrytis sp.

Gray mold rot was reported from California as a serious field disease in all trucking sections except the Coachella and Imperial Valleys. The cool weather and heavy fogs prevailing during the winter and spring months are especially favorable to the development of the Botrytis, according to G. K. K. Link. Gray mold rot was not reported from other states as occurring in the field, but it was observed by markets inspectors in shipments from several, as shown in the following table:

Table 92. Losses from gray mold rot of cabbage caused by Botrytis sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	Number of cars with decay	Average percentage of decay	Remarks as to seriousness of decay.
California	2	8	In 3-6 outer leaves.
Colorado	1	62	Associated with slimy soft rot.
Florida	3	33	" " " " "
Illinois	2	33	
Indiana	1	6	In 4-8 outer leaves.
Kentucky	2	60	Generally early stage in 2-4 leaves.
Louisiana	1	100	Associated with slimy soft rot.
Michigan	6	20	In 4-6 outer leaves.
New York	19	36	Considerable slimy soft rot.
Texas	7	31	
Wisconsin	6	44	In 3-5 outer leaves.
Unknown origin	4	68	Considerable slimy soft rot.
Total	54		Total number of cars inspected 1252

Other diseases.

Downy mildew caused by Peronospora parasitica (Pers.) De Bary was unimportant in New York, Louisiana, and Texas.

Ring-spot caused by Mycosphaerella brassicicola (Duby) Lindau was reported from California, where it is of considerable economic importance throughout the year in the San Francisco Bay region on both cabbage and cauliflower, according to D. G. Milbrath.

Black leaf speck, cause unknown, was said by G. K. K. Link to be prevalent in all sections of California where the variety Winningstadt was grown.

Slimy soft rot caused by Bacillus carotovorus Jones was again reported as rather important in the field in Vermont, Pennsylvania, and Louisiana. The losses caused were estimated at 1-3% in Vermont, 2% in Pennsylvania, and 5% in Louisiana. In other states it was apparently insignificant as a field disease. It occurred very generally in shipments of cabbage, however.

Drop caused by Sclerotinia libertiana Fckl. was reported from New York, Tennessee, Louisiana, Texas, Missouri, and California. It was apparently of no particular consequence except in New York, where it was especially bad in late harvested fields, and in California. Watery soft rot caused by this fungus was prevalent on cabbage in transit, particularly in shipments from New York and Florida.

Southern wilt caused by Sclerotium rolfsii Sacc. was reported from Texas, where it was unimportant.

Stem rot caused by Corticium vagum solani Burt was reported from Washington.

Damping-off of cabbage, thought to be due to Pythium sp., and of cauliflower, caused by various fungi, was reported from New York.

Root knot caused by Heterodera radicicola (Greef.) Müll. occurred in light soils in Texas.

Malnutrition was of considerable importance in California, according to G. K. K. Link, especially where the variety Winningstadt was grown.

BRUSSELS SPROUTS

Ring spot caused by *Mycosphaerella brassicicola* (Duby) Lindau - California (present in 75% of the fields in San Mateo and San Francisco Counties).

Black leaf spot caused by *Alternaria brassicae* (Berk.) Sacc. - California.

COLLARDS

Black leg caused by *Phoma lingam* (Tode.) Desmaz. - Georgia (more than usual, serious on seed plants, 85% affected plants and large loss in state. All varieties attacked). - See cabbage.

HORSE RADISH

Root rot caused by *Thielavia basicola* (B. & Br.) Zopf. - New Jersey (common but not serious in one locality, Passaic County).

Bacterial root rot (bacteria) - Passaic County, New Jersey.

KALE

Yellows caused by *Fusarium conglutinans* Woll. - Indiana (severe in market gardens near Indianapolis, stunting and killing plants, first noticed June 24.)

KOHL RABI

Club root caused by *Plasmodiophora brassicae* Wor. - Ohio.

RADISH

White rust caused by *Albugo candida* (Pers.) Ktz. - Olmsted County, Minnesota.

Downy mildew caused by *Peronospora parasitica* (Pers.) De Bary - Indiana

(foliage spotting and distortion of floral parts in Indianapolis market gardens.)

Black root caused by Rheosporangium aphanidermatus Edson - Indiana (important in certain market sections).

Rhizoctonia sp. - Ohio (in greenhouse) and Washington.

RUTABAGA

Black leg caused by Phoma lingam (Tode.) Desmaz. - Georgia (rutabagas planted on land where collards were seriously affected last spring showed some infection in the fall).

Club root caused by Plasmodiophora brassicae Wor. - North Dakota (in new land, evidence of introduction with seed).

TURNIP

Club root caused by Plasmodiophora brassicae Wor. - Connecticut.

Black rot caused by Bacterium campestre (Pam.) EFS - Connecticut (August 31, Middlebury).

Downy mildew caused by Peronospora parasitica (Pers.) De Bary - Texas.

White rust caused by Albugo candida (Pers.) Ktz. - Texas.

Rhizoctonia sp. - Ohio (new collection).

DISEASES OF CUCURBITS

CANTALOUPE

Leaf blight caused by Alternaria brassicae nigrescens Pegl.

Leaf blight was reported only from New York, Texas, and Indiana in 1920. In Texas it occurred too late in the season to do any particular damage, but in the other states it caused considerable injury. In Indiana, where the reduction in yield due to leaf blight was estimated at 1%, it was said to be next to bacterial wilt in importance, though it was severe only in the southern part of the state. It was not destructive in clean soil, but where rotation was not practiced, as was the case in most fields, it was serious.

Bacterial wilt caused by Bacillus tracheiphilus EFS.

Bacterial wilt was generally reported as more prevalent and more severe during 1920 than usual. In Virginia and Indiana it was said to be the most serious disease of cantaloupe (Pl. Dis. Bul. 4: 96). In the latter state, where favorable weather conditions prolonged the attack of the fungus, the reduction in yield was estimated at 3%. The disease was also reported from New Jersey, Pennsylvania, Ohio, and Mississippi. In the last named state it caused slight damage.

Dates when bacterial wilt was first observed were as follows:

July 2 .... Vincennes, Indiana.
July 3 .... Ohio.
July 23 ...... Chesterfield County, Virginia.

Anthracnose caused by Colletotrichum lagenarium (Pass.) Ell. & Hals.

Except in southern Georgia, where it was said to have caused a loss of 15%, anthracnose apparently was only locally important during 1920. In West Virginia it was reported to have been locally destructive in the Ohio Valley. Other states in which it was said to occur are New Jersey, Tennessee, Georgia, Alabama, Mississippi, Texas, Ohio, and Arizona.

Mosaic (cause undetermined)

Mosaic was reported as an important disease only from the vicinity of Louisville, Kentucky and from the Vincennes region in Indiana. In Kentucky it was said that 20% of the plants of the variety Rocky Ford were badly stunted on May 29, when the disease was first reported.

Other states reporting mosaic were Pennsylvania, Georgia, Texas, Indiana, and Wisconsin.

Fruit rot caused by various organisms.

Table 93. Losses from Fusarium rot of cantaloupe caused by Fusarium sp. as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of shipment	No. of cars with decay	Range of percentage of decay: No. cars	Range of percentage of decay: Percent	Origin of shipment	No. of cars with decay	Range of percentage of decay: No. cars	Range of percentage of decay: Percent
Arkansas	5	5	3-17	Indiana	4	4	1-35
California	71	62	1-25	Maryland	1	1	2
		6	25-50	New Mexico	2	2	18-21
		3	65-100	North Carolina	1	1	12
Colorado	12	12	1-25	South Carolina	5	5	1-25
Georgia	1	1	33	Washington	1	1	35-95

Total number of cars of cantaloupes with Fusarium rot .. 103
Total number of cars of cantaloupes inspected 577

Table 94. Losses from Rhizopus rot of cantaloupe caused by Rhizopus sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay: No. cars	Range of percentage of decay: Percent	Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay: No. cars	Range of percentage of decay: Percent
Ark.	5	6	5	1-15	Ind.	3	30	1	85
Ariz.	2	2	2	1-3				2	2
Calif.	99	11	3	50-75	Md.	1	2	1	2
			9	25-45	N. M.	1	3	1	3
			87	1-25	N. C.	1	2	1	2
Colo.	3	16	3	4-30	S. C.	3	40	1	100
Del.	1	30	1	30				2	4-15
					Unknown	1	30	1	30

Total number of cars of cantaloupes with Rhizopus rot 120
Total number of cars of cantaloupes inspected 577

Table 95. Losses from green mold rot of cantaloupe caused by Cladosporium sp., as shown by examination of cars at destination by inspectors of the Bureau of Markets, 1920.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay: No. cars	Range of percentage of decay: Percent	Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay: No. cars	Range of percentage of decay: Percent
Ark.	6	7	6	5-8	Colo.	1	2	1	2
Ariz.	1	10	1	10	Ind.	1	1	1	1
Calif.	39	17	3	50-75	Md.	1	2	1	2
			6	25-50	S. C.	2	15	2	12-18
			30	1-25					

Total number of cars of cantaloupes with green mold rot 51
Total number of cars of cantaloupes inspected 577

Black mold rot caused by Alternaria sp. was reported by inspectors of the Bureau of Markets as follows: Arkansas, 1 car with 15-20%; California, 13 cars with 1-15%, 6 cars with 15-40%, 2 cars with 80-87%, total 21 cars with an average of 19%; Colorado, 7 cars with 3-35%, average 11%; Delaware, 1 car with 13%; Indiana, 1 car with 35%. The total number of cars with black mold rot was 31.

Blue mold rot caused by Penicillium sp. was found by inspectors of the Bureau of Markets in a total of 21 cars, as follows: California, 17 cars with 1-25%, 2 with 20-45%, average in 19 cars 14%; Indiana, 1 car with 2%; unknown origin, 1 car with 30%.

Bacterial soft rot was found by inspectors in 25 cars: Arkansas, 4 cars with an average of 44%; California, 6 cars with 2-10%, 5 cars with 10-25%, 4 with 30-65%, average in 15 cars 21%; Colorado, 2 cars with an average amount of 11%; Georgia, 1 car with 3-5%; Indiana, 1 car with 25%; Missouri, 2 cars with 2-7%.

Other diseases.

Downy mildew caused by *Pseudoperonospora cubensis* (B. & C.) Rostow was reported only from New Jersey, where it was general and sometimes destructive. Bureau of Markets inspectors reported its presence in 10 cars of California cantaloupes, as follows: 5 cars with 10-25%, 5 cars with 3-10%, average 12%.

Wilt caused by *Fusarium* sp. was reported from California, where it occurred only in the sandy regions of the San Joaquin Valley, according to D. G. Milbrath.

Southern wilt caused by *Sclerotium rolfsii* Sacc. was said to be slightly more important than usual in Texas. It was found in light soils, especially where irrigated.

Root knot caused by *Heterodera radicicola* (Greef) Müll. was reported from Texas, where it was prevalent in sandy soils, and caused a loss estimated at 5%, and from California, where it occurred in the Imperial Valley and in the vicinity of Turlock in the San Joaquin Valley, according to D. G. Milbrath, who estimated the reduction in yield at 5%.

CUCUMBER

Bacterial wilt caused by *Bacillus tracheiphilus* EFS.

Bacterial wilt and mosaic seemed to be of about equal importance in 1920. The former was reported from New Hampshire, New York, New Jersey, Pennsylvania, Virginia, Texas, Indiana, Illinois, Michigan, Wisconsin, and Iowa. S. P. Doolittle, who watched cucumbers closely last summer, says of the disease:

> "Very prevalent in Michigan, Illinois, Indiana, and Wisconsin during July and early August. Found in practically all fields visited during this time, about 2 to 4% of the plants being affected. However, no serious losses occurred in any of these states. On Long Island the disease was of considerable importance, the injury varying from 8-10% in most cases, up to 50-70% in fields about Farmingdale."

Losses were estimated as follows by collaborators: New York, 15%; Indiana, 5%; Wisconsin, trace; Iowa, 12%; and as high as 75% and 50% were noted in individual fields in New York and Virginia, respectively.

Dates of first observation of bacterial wilt, 1920:

June 18 .... Lima, N. Y.
June 24 .... Marion County, Ind.
July 15 .... Luzerne County, Pa.
August 3 ....West Epping, N. H.
August 15 ......Madison, Wis.

Nothing on control or resistance was reported.

Mosaic (cause undetermined)

Reports of mosaic have been received from Massachusetts, Connecticut, New York, Pennsylvania, Virginia, Texas, Indiana, Illinois, Michigan, Wisconsin, Iowa, and California.

Average state reductions in yield were estimated by collaborators as follows: New York, 10-15%; Indiana, 3%; and Wisconsin, 7%.

S. P. Doolittle of the Office of Cotton, Truck, and Forage Crop Disease Investigations has prepared the accompanying comprehensive statement of the mosaic situation of 1920:

> "The season of 1920 was characterized chiefly by unusually severe losses from cucurbit mosaic throughout Illinois, Michigan, Wisconsin, and Indiana. The widespread injury from this disease was apparently due to abnormal weather conditions which favored the rapid increase of the cucumber aphids and through their agency the rapid dissemination of mosaic. Widespread infection occurred in Wisconsin, Illinois, Indiana, and Michigan, beginning about July 15. Seventy-five per cent of the fields in Wisconsin and northern Illinois showed from 60 to 100% of the plants affected with mosaic by September 15. Reports and observations indicate that the disease was at least equally as severe in most cucumber growing sections in Michigan and Indiana. The losses this season were more severe than in any year noted by the writer since 1914.
>
> "On Long Island the disease was equally prevalent, all the fields visited about the Farmingdale and Green Lawn sections being practically 100% mosaic on September 1."

Recent studies by Doolittle (Abstract in Phytopath. 11: 47. 1921) have shown that mosaic may be transmitted from cucumber to milkweed, *Asclepias syriaca*, pepper, *Capsicum annuum*, and *Martynia louisiana*, and from these plants back to cucumber. There is also some evidence that pigweed, *Amaranthus retroflexus*, is susceptible. As the milkweed is perennial it can easily act as an agent in over-wintering the mosaic virus. Doolittle has shown that the wild cucumbers transmit the causal factor through the seed and are one of the principal sources of infection. Considerable success has attended efforts to control mosaic by eradicating wild cucumbers in some of the pickle fields of the Lake States.

Significant results on the relation of temperature to cucurbit mosaic have been reported by Doolittle (Phytopath. 11: 47, 1921).

Angular leaf spot caused by *Bacterium lachrymans* EFS &. Bryan.

The following summary by S. P. Doolittle conforms with statements received from collaborators.

> "No injury of economic importance resulted from this disease in Michigan, Indiana, Illinois, or Wisconsin as far as the writer was able to determine. Angular leaf spot did not appear in Wisconsin or Illinois until late in the summer and on September 15 was present to some extent in 8-10% of the fields visited. Usually not over 10% of plants affected and then only slight injury."

M. W. Gardner of Indiana says further:

"The marked scarcity of this disease as compared with its prevalence in Heinz fields in 1915, 1916, and 1917 is very striking. All Heinz Company seed is treated in $HgCl_2$ (1-1000 for 5 minutes) and this has practically eliminated this disease from their fields."

Anthracnose caused by <u>Colletotrichum lagenarium</u> (Pass.) Ell. & Hals.

Apparently anthracnose was of very little consequence in 1920. The only states reporting much damage were Georgia, where 85% infection and 5% loss was estimated, and Arizona, where the disease was noted as severe in at least one garden. It was reported in the field also from New Hampshire, New York, Ohio, Indiana, Wisconsin, and Iowa, and was found by market inspectors in cucumbers from Alabama, Delaware, Maryland, and Texas.

S. P. Doolittle reported concerning this disease:

"Situation same as in the case of angular leaf spot. About 2% of fields in Wisconsin showed slight traces of anthracnose late in season but usually only a few plants (less than 1%) were affected. None noted in Illinois. No report of disease from Michigan."

Dates of first observation of cucumber anthracnose, 1920:

August 17 .... Center Harbor, New Hampshire.
September 5 .... Madison, Wisconsin.
September .... Suffolk County, New York.

Downy mildew caused by <u>Pseudoperonospora cubensis</u> (B. & C.) Rostow.

Mildew was reported along the Atlantic Coast from Massachusetts (about same, not serious as it occurred too late), Connecticut, New York (slight injury on Long Island), New Jersey, and Virginia. It was also reported in one greenhouse in Indiana.

Black rot caused by <u>Mycosphaerella citrullina</u> (C. O. Sm.) Gros.

F. C. Meier has reported on this disease in the Fruit and Vegetable Division, Bureau of Markets, Division Letter for May 27, 1920, as follows:

"Black rot caused by <u>Mycosphaerella citrullina</u> has been found frequently on Florida cucumbers this spring, particularly in the hampers marked 'culls'.

"This disease affords an interesting example of the part that the Food Products Inspector may play in contributing to our fund of pathological information, for this fruit rot was first noticed a year ago on specimens that were sent to New York from several of the outlying markets. This fungus, which causes a destructive and widespread blight of the watermelon in Florida, is also responsible for a small portion of the watermelon end rot found on the market.

"On the cucumber, fruit infection apparently occurs as a result of the transfer of spores from diseased vines to injuries on the surface of the fruit. Many cases have been noted where infection has occurred at the wound caused by pulling the cucumbers from the vines. In the course of experiments conducted in the New York laboratory, it has been found possible to secure infection by means of finger nail injuries after decayed cucumbers on which the fungus was fruiting had been handled."

In a letter to the Survey, dated November 5, Meier states further:

"This is a very interesting disease, particularly as the same fungus is responsible for a large per cent of the stem-end rot of watermelons that originate in south Florida.

"I have also collected the fungus on chayote, various squashes, and on honey dew melon in that state. It was only this year, however, that we have been able really to do any work on the disease. Dr. Brierly informs me that it is the most serious trouble that the cucumber hothouse growers have to contend with in England."

During May and June black rot was found by inspectors of the Bureau of Markets in 39 cars of cucumbers, as shown in the following table:

Table 96. Percentages of black rot of cucumbers caused by Mycosphaerella citrullina reported by inspectors of the Bureau of Markets during May and June, 1920.

State	Number of cars	Average percentage	Shipping point	Percentage of black rot
Florida	33	9.6	Brooksville	2
			Center Hill	20*, 15*
			Leesburg	16, 6
			Tampa	11, 15, 12.5, 9, 26, 6-12, 6-12*
			Wauchula	12-20 (An), 14, 25, 9*, 3*, 3*, 7*, 7*, 5, 3, 8, 8, 10, 2, 2, 5, 1.5, 6, 8
			Unknown	8-10, 3-5
Alabama	2	3	Mobile	2-4 (Ba), 2-3 (C)
Louisiana	1	5	New Orleans	5 (Ba)
Texas	3	4	Jacksonville	t, 4-5 (Bm), 7

*Cause of decay not given, probably Mycosphaerella.
(An) - associated with angular leaf spot.
(Ba) - mostly bacterial rot associated with Mycosphaerella.
(Bm) - associated with black mold.
(C) - associated with cucumber rot.

Other diseases.

Scab caused by Cladosporium cucumerinum Ell. & Arth. - Michigan (one location, St. Clair County, but not causing serious injury), California (cause of considerable rot, 3% reduction for state).

Wilt caused by Fusarium niveum EFS. - Ohio (less).

Powdery mildew caused by Erysiphe cichoracearum DC. - Indiana (in greenhouse, negligible), and California (10% loss in 800 acres in Alameda County).

Leaf spot caused by Alternaria brassicae nigrescens Pegl. - New Jersey.

Root rot caused by Sclerotinia sp. - New York (in greenhouse, plants appear healthy till blossoming time when they go down, with little or no fruit).

Root knot caused by Heterodera radicicola (Greef) Müll. reported as troublesome in greenhouses in Massachusetts, Ohio, and Indiana. In sandy soils in Texas causing .5% loss.

Watery soft rot caused by Sclerotinia libertiana Fckl. - reported in the field from Idaho, where it was noted in gardens after fall rains began, and reported by market inspectors on cucumbers from Florida (22 cars with 8% decay), Illinois (1 car with 18%), and Maryland (2 cars with 40%).

Fusarium rot caused by Fusarium sp. was found in carlots in cucumbers from Delaware (1 car, 20% decay), Florida (2 cars, 16%), Maryland (3 cars, 29%), South Carolina (6 cars, 11%), Texas (4 cars, 12%).

Soft rot of fruit caused by Rhizopus sp. - reported by market inspectors as follows:

Table 97. Losses from soft rot of cucumbers caused by Rhizopus sp., as reported by inspectors of the Bureau of Markets, 1920.

Origin of shipment	No. of cars with decay	Average percentage of decay	Origin of shipment	No. of cars with decay	Average percentage of decay
Delaware	2	15	South Carolina	7	9
Florida	8	15	Texas	6	9
Maryland	2	40	Unknown	1	2
New York	3	24			

Bacterial soft rot was one of the principal decays found in cucumber shipments during 1920.

PUMPKIN

Bacterial wilt caused by Bacillus tracheiphilus EFS. - Ohio (more than usual).

SQUASH

Mosaic (cause undetermined) - Connecticut (on summer squash, one report).

Bacterial wilt caused by Bacillus tracheiphilus EFS. - New York (probably occurs wherever squashes are grown, but reported from Albany County only, July 17), Indiana (local, negligible), Iowa (trace).

Wilt caused by Fusarium sp. - Texas (very important, reduction in yield 10%; very moist season).

Root rot caused by Ozonium omnivorum Shear - Texas (less important than usual).

WATERMELON

Anthracnose caused by Colletotrichum lagenarium (Pers.) E.& H.

Table 98. Percentages of anthracnose of watermelon in shipments from various states as determined by food-products inspectors of the Bureau of Markets August 27 to September 10, 1920. (For records prior to August 27 see Pl. Dis. Bul. 4: 62, 95.)

Origin of shipment	Market where inspected	Per-cent of anthrac-nose	Origin of shipment	Market where inspected	Per-cent of anthrac-nose	Origin of shipment	Market where inspected	Per-cent of anthrac-nose
Ala.	Pittsburgh	15	Mo.	Detroit	11	S. C.	New York	11
	"	4		"	2		"	90
		Av. 10		Indianapolis	9		Philadelphia	18
Ark.	St. Paul	9		Milwaukee	50		Pittsburgh	33
	"	2		Pittsburgh	85		"	35
	"	10		"	27		"	20
	"	57		"	20		"	47
	"	43		"	10		"	2
	"	55			Av. 30		Washington	20
		Av. 29	N. C.	Baltimore	100			Av. 31
Del.	Boston	40		"	20	Va.	Boston	30
	Cleveland	100		"	65		"	90
	New York	85		"	75		"	58
	Philadelphia	30		"	40		New York	25
	Pittsburgh	87		New York	10		"	20
		Av. 68		"	95		"	10
Ga.	New York	30		Pittsburgh	22		"	20
	"	24		"	20		"	75
	"	45		"	60		"	100
	Pittsburgh	45		"	2		"	60
	"	15			Av. 46		"	100
		Av. 16	Okla.	New Orleans	25			Av. 53
Ind.	Pittsburgh	8		"	15	Unkn.	Philadelphia	10
La.	Pittsburgh	20		"	95		"	60
Md.	Boston	100			Av. 45		"	37
	Cleveland	65	Tenn.	Pittsburgh	30		Pittsburgh	12
	New York	75	S. C.	Baltimore	35		"	18
	Philadelphia	20		"	10		"	15
	"	90		New York	30		"	17
	"	20		"	63		"	8
		Av. 61		"	35		"	65
Mo.	Buffalo	30		"	10			Av. 27
	Detroit	60						

In 1920 Mississippi and Arizona reported the presence of anthracnose to the Survey for the first time. In both states the disease was said to be local in occurrence, but while it caused slight damage in Mississippi, in Arizona the injury due to it was severe in the one case reported. In Alabama it caused as much as 5-15% loss in some fields and in Texas the reduction in yield for the state was estimated at 1%. In most cases it was unimportant as a field disease, however, and caused most loss on melons in transit. Table 98 shows the amounts of anthracnose found in cars examined between August 27 and September 10.

Stem-end rot caused by Diplodia sp.

Stem-end rot was also of little importance in the field, although it caused some damage in Georgia and Mississippi. In Indiana the disease commonly followed blossom-end injury on stunted or malformed fruits, but did not occur as a stem-end rot.

Stem-end rot caused considerable loss of melons in transit, as shown in Table 99, which gives the percentages of affected fruit found by inspectors in cars examined during the period from August 6 to September 10.

Table 99. Percentages of stem end rot of watermelon found in shipments examined at various markets by inspectors of the Bureau of Markets August 6 to September 10, 1920. (For records before August 6 see Pl. Dis. Bul. 4: 63.)

Origin of shipment	Market where inspected	Percent stem-end rot	Origin of shipment	Market where inspected	Percent stem-end rot	Origin of shipment	Market where inspected	Percent stem-end rot
Ala.	Pittsburgh	9	Ga.	Milwaukee	5	Ga.	Pittsburgh	3
	"	7		New Orleans	2		"	4
		Av. 8		"	18		"	17
Ark.	Kansas City	3		"	2		"	8
	St. Paul	25		"	11		"	3
	"	11		"	13		"	17
	"	16		Pittsburgh	13		"	9
	"	6		"	2		"	22
	"	2		"	10		"	8
	"	3		"	6		"	16
	"	13		"	18		"	17
	"	2		"	5		New Orleans	25
		Av. 9		"	3		"	5
Ga.	Buffalo	37		"	10		"	35
	"	68		"	6		"	7
	"	18		"	7		"	50
	"	45		"	9		"	15
	"	55		"	19		"	28
	"	30		"	5		"	10
	"	25		"	9		New York	45
	"	50		"	4		"	11
	Cleveland	18		"	27		"	40
	Indianapolis	20		"	19			Av. 18
	"	11		"	17			

Origin of shipment	Market where inspected	Percent stem-end rot	Origin of shipment	Market where inspected	Percent stem-end rot	Origin of shipment	Market where inspected	Percent stem-end rot
N. C.	Baltimore	5	S. C.	Pittsburgh	7	Unkn.	Buffalo	10
	"	5		"	18		Chicago	2
	New York	20		"	12		New York	50
	Pittsburgh	2		"	22		"	1
	"	9		"	2		"	15
	"	15		"	13		"	10
	"	2		"	9		"	20
	"	20		"	92		Omaha	5
	"	5			Av. 18		Philadelphia	37
	"	5	Tenn.	Pittsburgh	3		Pittsburgh	11
		Av. 9	Texas	Kansas City	15		"	28
S. C.	Buffalo	2		Omaha	15		"	65
	"	2		"	11		"	15
	New York	20		St. Louis	3		"	2
	"	20		"	5		"	11
	"	30			Av. 10		"	25
	"	2	Va.	Boston	2		St. Louis	5
	Philadelphia	28		Pittsburgh	17			Av. 18
	Pittsburgh	3			Av. 10			

Total number of cars inspected 656
Total number of cars with stem end rot 123
Average amount of stem end rot in 123 cars 15.6%

Blossom-end rot (cause unknown).

Blossom-end rot was reported from Texas (fairly important in poorly drained fields, reduction in yield .5%), Iowa (more, 2% loss), Idaho (probably due to *Fusarium* sp., important only on late crop).

While blossom-end rot was comparatively unimportant as a transit disease, it caused some loss, especially in South Carolina melons. It was found by Bureau of Markets inspectors in 16 cars, as follows: Georgia, 1 car with 2%; North Carolina, 1 car with 4-5%; South Carolina, 6 cars with 2-5%, 7 with 9-15%, 1 with 25%, total 14 cars with an average of 9%.

Wilt caused by *Fusarium niveum* EFS.

Fusarium wilt was apparently unimportant or only locally severe in most states, but it was said to be serious in Texas, Indiana, Iowa, and Utah. The loss in Texas, where the disease was found only in regions with sandy soils, was estimated at 4%, and in Utah at 3%. In Indiana the disease is the limiting factor in melon growing, and has caused a great reduction in acreage by rendering suitable lands unfit for this crop, according to M. W. Gardner. The 1920 record was the first received by the Survey from Utah, from which state B. L. Richards reported as follows:

"The Fusarium wilt has been responsible this year for serious losses to the crop in a number of truck-crop districts in the State. Davis and Salt Lake Counties have suffered very severely. A survey of the former county shows an average loss of 10 to 15% of the crop. The yield for the state was reduced approximately 3%. Irrigation rapidly distributes the disease in the field and from field to field. The trouble is reported to be definitely increasing in the state."

Other diseases.

Leaf blight caused by Alternaria brassicae nigrescens Pegl. - Indiana (Knox County, one field. Not destructive. Occurs where watermelons follow cantaloupes or are grown in same field with cantaloupes).

Leaf rot caused by Cercospora citrullina Cke. - Texas (negligible).

Mosaic (cause undetermined) - Michigan (Allegan County).

Bacterial wilt caused by Bacillus tracheiphilus EFS. - Ohio (more prevalent and more serious than ever before), California (San Fernando Valley; destroyed young plants during June; reduction in yield 2%).

Rot caused by Alternaria sp. - Whitman County, Washington.

Stem-end rot caused by Rhizopus sp. - reported by F. C. Meier as follows, (Bureau of Markets Div. Letter, Sept. 2, 1920:8):

"This disease is frequently found in shipments from all of the states in which watermelons are grown. It is quite different in appearance from the rot caused by Diplodia, the stem-end rot disease that is so common in shipments from the southeastern states."

DISEASES OF COTTON

Anthracnose caused by Glomerella gossypii (South.) Edg.

More anthracnose than last year was reported from Tennessee, North Carolina, and Louisiana, but in Georgia, Alabama, and Mississippi less damage than usual apparently occurred. In North Carolina it was present in all cotton growing counties but was most destructive in those of the Coastal Plain. In Mississippi it was mostly in the so-called Delta Region.

The injury took the form of a rotting of the bolls for the most part. As high as 75% infected bolls were observed in North Carolina and 100% in Louisiana. The accompanying map shows the estimated percentage losses and further estimates will be found in Supplement 18 of this Bulletin.

Collaborators had the following to report regarding weather conditions:

North Carolina (Jehle): "Late rains and warm weather were favorable for the disease."

Georgia (McClintock, Sept. 1): "Very small per cent in middle, Georgia, probably due to dry weather early in the season."

Mississippi (Neal): "Weather has not been favorable for its spread this season."

Louisiana (Edgerton): "Very abundant in some sections due to excessive rainfall."

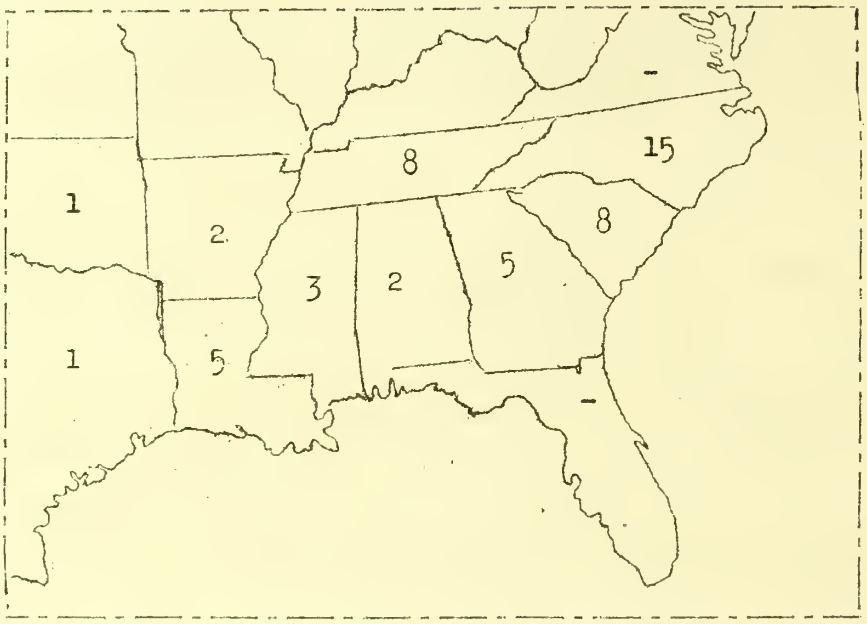

Fig. 51. Estimated percentage reduction in yield of cotton from anthracnose, 1920.

Dates of first observation:

June 20 .... Mississippi.
July .... Baton Rouge, Louisiana.
July .... Arkansas.
August 31 .... Chadbourne, North Carolina.

In Arkansas it was reported as especially severe on the variety Half and Half, the seed of which was brought in from east of the Mississippi River.

Wilt caused by Fusarium vasinfectum (Atk.)

Wilt was reported occurring on sandy soils in all the cotton states of the South as far west as Texas. It was also reported from California (one case reported by H. P. Severin of the Experiment Station at Berkeley). In general it was prevalent in about the normal amounts although in states along the Gulf Coast and in Arkansas somewhat more than usual was reported.

Losses by states have been estimated as follows:

7% .... Louisiana, Arkansas.
5% .... North Carolina, Alabama, and Mississippi.
3% .... South Carolina.
2% .... Georgia.
Less than 1% .... Tennessee, Texas, Oklahoma.

In Alabama from one-fourth to one-half of the plants in some counties were affected and in southern South Carolina hundreds of acrea were seen with 5-10% dead or dying plants.

The following was reported on varietal susceptibility:

North Carolina (Jehle): "Losses in many fields reduced by planting Dixie and Dixie-Triumph."

Georgia (McClintock): "Serious only on certain varieties and crosses of varieties. Resistant varieties quite largely planted."

Mississippi (Neal): "Tri-Cook has given good results in the hill section and Webber 49 is semi-wilt resistant and largely planted in the Delta."

Arkansas (Elliott) "Resistant - Dixie, Dix-Afifi, and Dixie-Mebane."

Angular leaf spot caused by Bacterium malvacearum EFS.

Leaf spot was reported from practically all of the cotton states. It was relatively unimportant in the eastern portion of the cotton belt but in Texas and Arizona it was the most serious cotton disease and in Arkansas also it was very severe and widespread. In Texas, where 2% loss was estimated, all forms of the disease, leaf spot, black arm, and boll rot were very prevalent, especially on poorly drained lands. In the Salt River Valley of Arizona it presents a serious problem, as the long staple Pima (Egyptian) cotton that is grown there is very susceptible to attack by B. malvacearum and last year it was estimated that 15-20% loss occurred in Arizona as a result of the disease.

Root knot caused by Heterodera radicicola (Greef) Müll.

Root knot occurred commonly in cotton fields on sandy soils in the South. Its close association with Fusarium wilt makes it very difficult to clearly separate the losses caused by the two troubles. Judging from the reports received for 1920, the largest losses occurred in Georgia where 3% reduction in yield was estimated. The Carolinas, Alabama, and Arkansas also reported considerable injury in sandy soils and a loss of 1% was estimated for these states. Collaborators in the other cotton states regarded the disease as unimportant.

Phoma blight caused by Phoma sp.

This new cotton disease was reported from Arkansas for the first time by J. A. Elliott (Phytopath. 10: 48. 1921. Abst.). It appeared in June in west-central Arkansas along the Petit Jean River in Logan and Yell Counties, and made rapid progress during a period of cool, wet weather. In small areas all plants were killed and in others the stand was greatly reduced. A change of weather conditions checked the disease. All parts of the plant above ground were attacked and progress of the fungus within the tissues was very rapid when the weather was favorable for it.

It is suggested that a sharp watch be kept for the appearance of this disease in other parts of the South this year.

Malnutrition (non-parasitic).

Malnutrition, or rust, as it is known in some sections, caused less damage than usual in most states, according to reports received. In Georgia it was said not to have been observed since 1918, due probably to the fact that farmers had been using more potash in their fertilizers. Moist weather in Louisiana and Arkansas prevented its occurrence to any great extent, although it was said to be common on the poorer soils in the latter state. In Louisiana it is reported as a serious trouble only during very dry seasons. In Mississippi the disease caused premature defoliation, but apparently had little effect on the yield, and seemed to hasten the maturity of the bolls. Reports in the Weekly Crop Notes of the Bureau of Crop Estimates indicate that "rust" was rather important in South Carolina, and it was also reported from Florida and Oklahoma.

Other diseases.

Leaf spot caused by Cercospora gossypina Cke. - Texas (unimportant, traces; Dallas and Bell Counties).

Rust caused by Aecidium gossypii E. & E. - Texas (unimportant, trace; Webb and Hopkins Counties).

Boll rots were apparently generally favored by moist weather and low temperatures according to reports in the National Weather and Crop Bulletin and the Weekly Crop Notes of the Bureau of Crop Estimates, during August and September. Boll rot or "black boll" due to Diplodia gossypina Cke. was reported by collaborators from Louisiana (worse than usual, worse than last year all over the state, due to excessive rainfall; reduction in yield 2-5%; first appeared in August at Baton Rouge, most injurious during August and September), and Arkansas (25% injury, 3% loss; first report in August). Fusarium sp. also caused some injury in Arkansas, which is included in the above estimate.

Root-rot caused by Ozonium omnivorum Shear - Texas (very important as usual in all black, waxy clay soils; reduction in yield 8%).

Damping-off and sore-shin caused by Rhizoctonia sp. - Mississippi (damping-off important, more so than usual or than last year; rather general; reduction in yield 2%; disease often causes poor stands, especially on rich, poorly drained soils; first reported May 22), Texas (sore-shin unimportant).

DISEASES OF SUGAR CANE

Mosaic (cause undetermined).

More mosaic was reported from our southern states last year. Collaborators' reports indicate that it is spreading and becoming more important, and E. W. Brandes of the Office of Sugar Plant Investigations says:

> "In general, our survey shows a rapid spread of mosaic everywhere but especially in the counties surrounding Grady in Georgia and in the Bayou La Fourche district of Louisiana."

Georgia (McClintock): Reported from Grady and Thomas Counties, causing serious damage. Cutting out diseases stalks during past season has not controlled the disease.

(Brandes) Occurred in Brooks, Mitchell, Decatur, and Colquitt Counties also.

Florida (Brandes): Escambia, Gadsden, Jackson, and Liberty Counties. Eradication was successful in Palm Beach County, no mosaic being reported in 1920. We have reports on 250 properties in this county.

Alabama (Brandes): Occurred in Baldwin County.

Mississippi (Neal): This disease is now present in 14 counties. During the past season 276 fields have been inspected and 34 of these have mosaic ranging from a trace to 100% or an average of about 7% to 8% for the state. The actual reduction in yield for the state does not exceed a trace. First observed this year in June at Gulfport.

Mississippi counties where mosaic was found.

1. Harrison
2. Jackson
3. Pearl River
4. Stone
5. George
6. Greene
7. Lamar
8. Marion
9. Walthall
10. Pike
11. Covington
12. Wayne
13. Lauderdale
14. Kemper

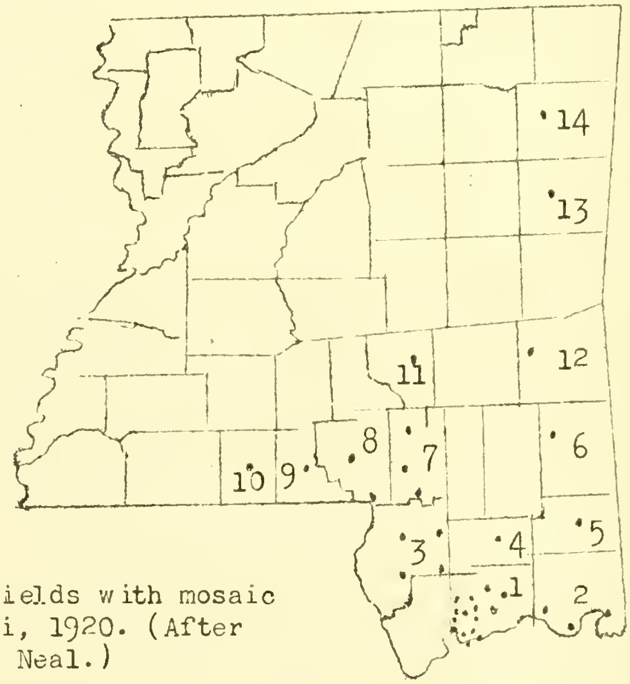

Fig. 52. Location of cane fields with mosaic in southern Mississippi, 1920. (After map furnished by D. C. Neal.)

Louisiana (Edgerton): Disease has spread very rapidly this year. It is in all the cane i. the river section and is beginning to show in other parts of the state. Very important, probably affecting about half the plants in the state and reducing the yield 3-5%. First observed in April at New Orleans and injurious all the season.

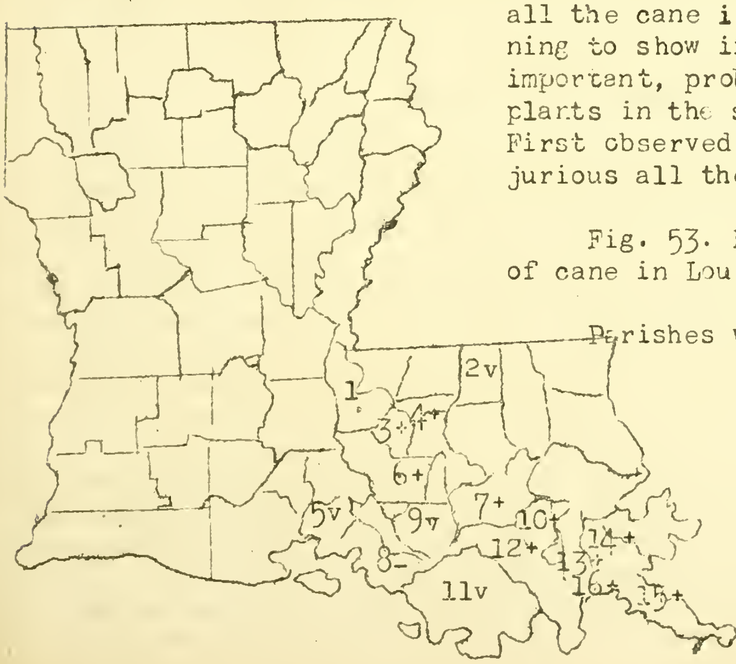

Fig. 53. Distribution and severity of mosaic of cane in Louisiana. (After map by C.W.Edgerton).

Parishes where mosaic occurred:

1. Pointe Campee	9. Assumption
2. St. Helena	10. St. James
3. W.Baton Rouge	11. Terre Bonne
4. E.Baton Rouge	12. La Fourche
5. Iberia	13. St. Charles
6. Iberville	14. Orleans
7. Ascension	15. Plaquemines
8. St. Mary	16. Jefferson

Porto Rico (Julius Matz): Mosaic has become widely spread all over the Island, although the eastern end is still free. The intensity of infestation is less, however. Growers have avoided infected seed wherever it was possible to obtain it disease free. Most of the infection now comes from the diseased stubble, and as these do not do well when infected they will be eliminated in the course of time. The situation is, therefore, not so bad as at the beginning of the eradication campaign. The disease has been eradicated from several large estates during the year.

The variety Uba is not susceptible and is making a good reputation for itself.

Hawaii (Kunkel): Mosaic or yellow stripe is next in importance to root rot. Eleven different varieties of cane are grown commercially here and none of them is immune but they do show great differences in susceptibility. It seems that the varieties that are grown at high elevations are particularly susceptible. I am not yet sure just how serious the yellow stripe is. It seems to be most prevalent on the Island of Hawaii.

Philippine Islands (H. A. Lee): This disease is of widespread distribution and general prevalence, and these facts lead me to the conclusion that the disease is of long duration in this country. I am of the opinion that the disease causes a large percentage of loss from the total production of this country, but as yet do not have any such detailed data to show this as was presented by Dr. Lyon of Honolulu. We find the disease very common upon the Luzon White and Pampanga Red varieties, and also upon Louisiana Stripe, but with less stunting effect than on the native canes. Yellow Caledonia is not commonly affected but when affected seems to be very severely stunted. I have not seen H 109 to be affected as yet. It is difficult to find a stool of either the Luzon White or Pampanga Red in a ratoon field which is not affected. The same holds for most fields of plant cane of these varieties after about six months. These varieties are the most generally planted here.

"Fiji disease" cause undetermined.

This destructive malady of sugar cane, heretofore known only in Fiji, New Guinea, and New South Wales, has now been definitely reported from the Island of Mindoro in the Philippines. Although the disease has been suspected in these Islands by persons at Manila for the last three years, the significance of its possible presence does not seem to have been appreciated and it was not until January, 1921 that the disease was positively identified and the seriousness of the situation realized. During the Christmas vacation (1920-21) Prof. Otto A. Reinking of the College of Agriculture at Los Banos, went to Mindoro and found the Fiji disease there doing great damage. According to one of the planters it has been present on the Island since at least 1916.

Prof. H. A. Lee of the Bureau of Agriculture at Manila also received and identified specimens of the Fiji disease collected by his assistant in Mindoro in January 1921. The reports of Reinking and Lee are the first authentic records of the presence of the disease in the Philippines.

Written accounts of the Fiji disease all agree that it is one of the most, if not the most, serious disease of sugar cane. Affected plants are dwarfed, produce many distorted leaves, many of which bear galls, and die early. The disease is very infectious and the organism is present in all parts of an infected plant, even if only a few leaves of one stalk show symptoms.

The causal organism, which is thought to be a Myxomycete of the plasmodiophora type, seems to be able to live for a considerable length of time in the soil and is readily carried from field to field with particles of soil. Marked differences in varietal susceptibility appear to exist. The trouble has not been studied to any great extent.

References:

1910 Muir, F. Hawaiian Planters Record 3: 197.

1910 Lyon, H. L. Hawaiian Planters Record 3: 200-205.

1911 Lyon, H. L. Hawaiian Planters Record 4: 230-232, 300.

1915 Lyon, H. L. Fiji disease in New Guinea. Hawaiian Planters Record 12: 200.

1920 Reinking, Otto A. Diseases of Sugar cane in the Philippines - Fiji disease. Sugar News 1: 17-19.

Gumming caused by Bacterium vascularum (Cobb) EFS.

A further statement on gumming, which was found in Porto Rico by Matz in February, 1920 and reported by him (Phytopath. 10: 429-430, 1920 and Pl. Dis. Bul. 4: 111, 1920), has been received.

> "In my work with gumming of sugar I have come to believe that this disease here, although identical with the gumming of cane in Australia and Pernambuco, is not the same as that of Java. The Java disease is similar to one which I have found here and is caused by a Plasmodiophora." (See dry top rot in this summary).

Root rots caused by Marasmius plicatus Wak. and other fungi.

Root rot probably caused a loss of about 5% for Louisiana, according to C. W. Edgerton. It was present in practically all fields affecting from 1-25% of the plants and as high as 50% in some fields. It was thought that the loss was not so great as usual on account of the wet season.

In Porto Rico root diseases were common and of importance, according to Matz, and in the Philippines Marasmius was said to be present but not causing any special injury.

Top rots due to various causes.

Dry top rot thought to be caused by Plasmodiophora sp., was reported by Matz for the first time from Porto Rico. Specimens were collected from most parts of the Island and it was found on the varieties Rayada, Cavengerie, D 109, Otaheite, Crystallina. The organism occurs in the vessels of the vascular bundles of sugar cane and causes stunting and drying of top leaves.

A top rot which is considered as the same as the one described by Wakker from Java in 1890, is found in the Philippines according to H. A. Lee who reported as follows:

> "The disease is localized on a few of the larger estates which have introduced cane from Java about five years ago. It causes a great amount of damage in affected fields and we know of one field which had to be plowed over and was a total loss due to this disease. The order of susceptibility of varieties as we have observed it is Yellow Caledonia, Louisiana Stripe, Luzon White, and Pampanga Red. H 109 we have not yet seen to be affected."

Top rot (non-parasitic) - Porto Rico (common, small loss, occurs on late shoots which are shaded by the taller and older stalks).

Other diseases.

Red rot caused by Colletotrichum falcatum Went - Louisiana (of considerable importance) and Mississippi.

Iliau caused by Gnomonia iliau Lyon - was reported by Edgerton from Louisiana as causing slight damage in the northern and central parts of the state.

Pineapple disease caused by Thielaviopsis paradoxa (De Seynes) Von Höhnel - Mississippi and the Philippine Islands. According to H. A. Lee there is much loss in the Philippines from this disease. Many fields had to be replanted or abandoned due to lack of seed piece germination.

Wilt caused by Cephalosporium sacchari Butler - reported by H. Atherton Lee from the Philippines as follows:

> "This disease reported previously only from India and the Union of South Africa was also sent in to me from Mindoro. The fungus which was isolated proved the identity of the disease. It is not of widespread occurrence but causes entire killing of a cane when once affected."

Rust (Puccinia kuehnii) - Philippines, causing slight injury to the variety Louisiana Stripe.

Smut caused by Ustilago sacchari Rab. was reported by mistake from New Mexico in 1919 (Pl. Dis. Bul. Suppl. 11: 287. 1920). As far as we know this serious cane disease is not present in the United States.

In 1920 it was reported from the Philippines by H. Atherton Lee as follows:

> "This disease is also of widespread distribution on Luzon. It affects especially the Luzon White and Pampanga Red varieties. Yellow Caledonia, H 109, and Louisiana Stripe I have not seen affected by the disease. The disease is a main factor which prevents ratooning of susceptible canes in the Philippines. Inasmuch as Pampanga Red and Luzon White have been the most commonly grown on Luzon, ratooning of cane has not been generally practiced here. I have seen a ratoon field in which four out of five plants were affected."

Sheath spot caused by Bakerophoma sacchari - observed by Lee in the Philippines causing slight injury to the variety Louisiana Stripe.

Leaf spot - cause undetermined - on old leaves of Louisiana Stripe in the Philippines.

Ring spot caused by Leptosphaeria sacchari Van B. de H. - Porto Rico (common, of no consequence).

Eye spot caused by Helminthosporium sacchari Butler - Porto Rico (common, of no consequence).

DISEASES OF SUGAR BEET

Leaf blight caused by Cercospora beticola Sacc. was reported by collaborators from Wisconsin, Iowa, Utah, and California, and by W. W. Robbins from western Nebraska, Montana, and Colorado, in the northern part of the state and the Arkansas Valley. It was of slight importance except in Iowa, where it affected 20% of the fields and caused a reduction in yield of 1% and in Morgan and Logan Counties and the Arkansas Valley in Colorado, where the loss was estimated at 1-2%. In Utah it occurred only in the Provo district in Utah County.

Curly top (cause not definitely determined). The Plant Disease Bulletin, Supplement 10: 254, curly top was erroneously reported as synonymous with mosaic, whereas they are two distinct diseases and should be reported as such. In 1919 curly top was reported by collaborators from Colorado, Idaho, and Washington; by D. G. Milbrath from California; and by the Office of Sugar Plant Investigations as occurring on specimens received from California, Utah, and Idaho. It was generally prevalent and very severe in Idaho, causing a loss estimated at 20%. In California, in the San Joaquin Valley, it was said to cause an almost total loss.

During 1920 it was reported from Idaho and California only, in both cases as less important than in the previous year. The loss in Idaho was estimated at 8%. From California it was reported by Eubanks Carsner as follows:

> "Curly-top varies very greatly in the amount of damage it does. According to my observation the disease occurs to some extent every year in every beet growing region of California. It is always more serious in the inland regions, where the temperatures are high, than in the cooler coastal districts. I made no extensive survey during the season of 1920, but my impression from reports which I consider reliable is that in general it was much less destructive during this past season than in 1919. To emphasize my point that the damage occurs each year but varies in amount I may state that several fields which came under my observation showed 100% of the plants diseased at the latter part of the past season, though of course not all of them were so badly affected as to make them worthless. During the season of 1919 I observed the most serious losses of any season for several years. Many hundred of acres were a total loss."

Mosaic (cause not definitely determined) was reported in 1919 from Colorado, and by the Office of Sugar Plant Investigations on specimens from Kansas, Colorado, and California. The disease was abundant in Colorado, but the amount of injury due to it was not determined.

In 1920 mosaic was reported from northern Colorado by W. W. Robbins (Phytopath. 11: 48. 1921. Abst.) as occurring in steckling and seed beet fields, and to a slight extent in commercial fields also. Robbins reported studies to show that diseased mother beets may act as centers of infection and suggests that separation of steckling and seed fields may be helpful in control. According to the Office of Sugar Plant Investigations great care should be exercised to select only healthy beets for seed production in the first place, and they should never be taken from fields that have any considerable percentage of mosaic in them.

Downy mildew caused by Peronospora schachtii Fckl. was reported from California as causing little damage.

Rust caused by Uromyces betae (Pers.) Tul. was reported as of slight importance from Kansas and California.

Leaf spot and root rot caused by Phoma betae (Oud.) Fr. were reported from Utah by B. L. Richards. The disease is a very important one in that state although it was less so last year than usual. The probable loss in 1920 was estimated at 1%. The root rot caused a loss of 1% in Idaho also. The leaf spot (reported as Phyllosticta sp.) was said by W. W. Robbins to occur occasionally in Colorado, western Nebraska, Wyoming, and Montana, and the root rot caused slight losses in all silos in the same region.

Rhizoctonia root rot caused by Corticium vagum solani Burt was reported from Ohio and Minnesota, where it was unimportant. Together with Phoma rot Rhizoctonia caused slight losses in Colorado, western Nebraska, Wyoming, and Montana, according to W. W. Robbins. A serious new type of dry rot caused by Rhizoctonia was reported from northern Utah and southern Idaho by B. L. Richards (Phytopath. 11: 48. 1921).

Black root caused by various fungi was reported by W. W. Robbins as follows:

> "Black root (caused chiefly by Phoma and Rhizoctonia) occurred in some degree in all sugar beet districts of northern Colorado, western Nebraska, Wyoming, and Montana. Severity of disease depended principally upon soil type and cultural practice. In the majority of fields there was some loss of seedlings from black root; the loss in many instances is so slight as to make no reduction in stand; in others it caused serious reduction of stand. Estimated reduction in yield is 1%."

Scab caused by Actinomyces scabies (Thax.) Güssow was reported from Wisconsin and Idaho as unimportant.

Tuberculosis caused by Pseudomonas beticola was reported by W. W. Robbins as prevalent in Morgan and Logan Counties in Colorado, causing losses through reduction in the quality of the root, rather than through reduction in yield.

Tip rot, cause unknown, occurred occasionally in northern Colorado, Nebraska, Wyoming, and Montana, according to W. W. Robbins.

The sugar beet nematode, Heterodera schachtii Schmidt, was reported from Utah as a very important trouble, and from California by Eubanks Carsner who stated that it was widespread in that state.

TOBACCO

Angular-spot caused by Bacterium angulatum Fromme & Murray.

Angular-spot was reported from Virginia, Kentucky, and Tennessee, and its occurrence is also suspected in Ohio. Prior to 1920 it had been reported to the Survey only from Virginia, where it was first noticed in 1917, although undoubtedly present before. In that year a serious outbreak occurred in Halifax County which caused the investigation of the disease (Fromme, F. D. and Murray,

T. J. Journn. Agr. Res. 16: 219-228. Feb. 24, 1919) with the result that it was found throughout the tobacco growing region of south-central Virginia. It is now known to occur all over the state, although it causes most damage in the south-central portion. In 1918 it was comparatively unimportant, but in 1919 and 1920 it became increasingly serious, causing losses estimated at more than 10% in 1919 and at 20% in 1920, according to Fromme. In 1920 angular-spot was found to be present in more than 80% of the fields inspected in Virginia.

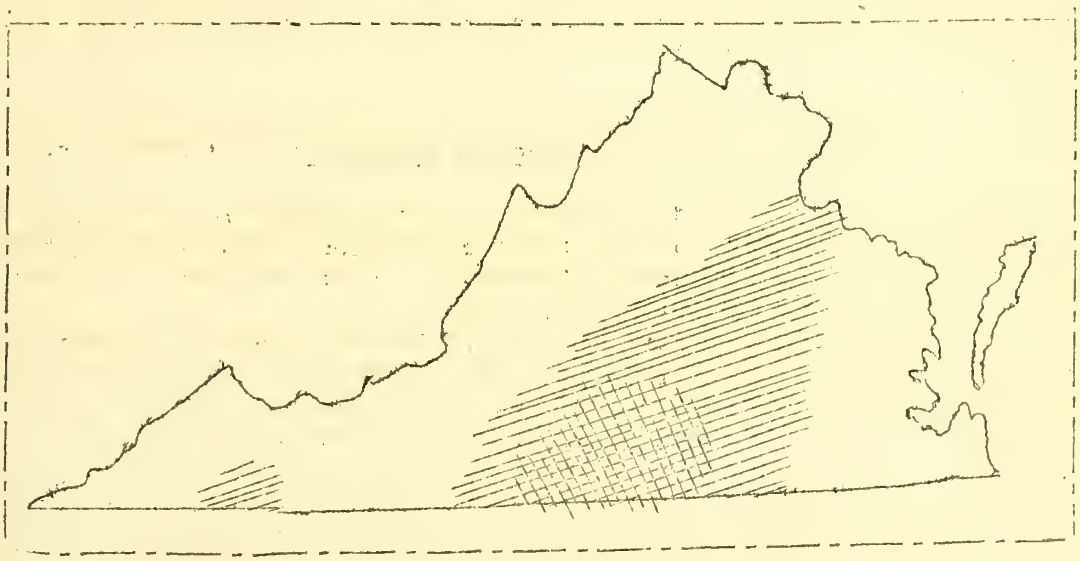

Fig. 54. Map showing distribution of angular-spot of tobacco in Virginia, according to Fromme. Heavy shading indicates regions of greatest severity.

In Kentucky in 1920 angular-spot was prevalent in the Burley and dark tobacco sections (see Pl. Dis. Bul. 4: 52 and 79) and together with wild fire caused a loss estimated at 25%. In Tennessee, according to J. U. Gilmore of the office of Southern Field-Crop Insect Investigations, the "Black Patch" tobacco in the vicinity of Clarksville suffered considerable loss due to wild fire and angular-spot.

The disease was reported in 1919 from North Carolina by F. A. Wolf and E. G. Moss, as follows (N. C. Dept. Agr. Bul. 40: 25. Dec. 1919):

> "Within North Carolina it (angular-spot) was fiest observed during the past season. It has been collected in Granville, Vance, Wake, Lee, Moore, and Johnston Counties and is probably quite generally distributed throughout the state."

The disease was first noticed in Virginia on May 25, in plant beds at Charlotte Court House, Charlotte County, but it caused greatest damage during August, when there was a period of excessive precipitation from the first to the twentieth. In Kentucky it was most injurious from July 10-13, and from August 15 to harvest. The severity and spread of angular-spot are directly connected with the weather conditions. It is said (Fromme and Murray, l. c.) that "Rainfall is an important aid to infection, and the development of the organism within the tobacco leaf is apparently dependent to a marked degree on those predisposing factors which promote a rapid and vigorous growth of the host."

Control measures are still in an experimental stage, but seed treatment with a 2% solution of formaldehyde, supplemented by the use of clean cloth for the plant bed cover, rotation and burning or steaming of the bed, and field rotation, is recommended by Fromme and Wingard (Phytopath. 11: 48-49, January, 1921). As a result of a seed treatment campaign conducted by the Virginia Experiment Station it is probable that more than 3,000 farmers will use treated tobacco seed in Virginia in 1921.

According to F. D. Fromme, "tests made in 1919 of a number of varieties showed some differences in susceptibility to angular-spot, but none was sufficiently resistant to give any promise of satisfactory control through choice of varieties."It was reported that in Kentucky the variety Yellow Prior "has been consistently more resistant when grown side by side with other dark strains. All Burley seems susceptible."

Wildfire caused by Bacterium tabacum Wolf & Foster.

Wildfire is more widely distributed than angular-spot but is very commonly associated with it so that the two diseases are often reported together. In 1920 both of them were unusually severe and attracted wide attention because of the loss they caused to the tobacco crop.

Wildfire was first noticed in 1917 in North Carolina, although it may have been present before. In that year it was found in 19 counties in North Carolina and in three in southern Virginia, and was said to occur also in Wisconsin (Wolf, F. A. and Foster, A. C. Journ. Agr. Res. 12: 449-458. February 18, 1918). No records of the occurrence of wildfire were received by the Survey in 1918, but in 1919 it was reported from Virginia, where it caused a loss estimated at 2% of the crop, and it was observed for the first time in Connecticut.

In 1920 the disease was reported from Massachusetts for the first time. It was also more prevalent in Connecticut than ever before and of unusual severity in Maryland, Virginia, Kentucky, Tennessee, and Ohio. (See Pl. Dis. Bul. 4: 52, 79, 98.) In Massachusetts and Wisconsin it was local and caused little damage. In both Connecticut and Virginia it was more important than in the preceding year and caused losses estimated at 5-10% and at 4%, respectively. It was found to be present to some extent in 20% of the fields inspected in Virginia. In Kentucky wildfire and angular-spot together caused a loss estimated at 25%. In Georgia wildfire was less destructive than during 1919, according to E. C. Westbrook, Field Agent in charge of tobacco work of the Georgia State College of Agriculture, who reported as follows (in letter to F. D. Fromme, Nov. 23, 1920):

> "In 1919 Georgia lost very heavily from wildfire. It was not unusual to see a 25 acre field almost totally destroyed. That year we had a very rainy season. Last year (1920) we did not have as much wildfire, but there was quite a little damage in some sections."

In Virginia, wildfire appeared at about the same time and was most injurious during the same period as the angular-spot. In Connecticut it was first noticed July 10 at Windsor and did most damage in July. In Kentucky the first observation was made May 21 in seed beds at Wilmore.

As with the angular-spot, the severity of wildfire is dependent upon weather conditions. Heavy rainfall is said to be essential both for the spread and the development of the disease. The unusual season of 1920 seemed to be particularly conducive to outbreaks of these leaf spots.

Control measures recommended are the same as for angular-spot.

In Kentucky the variety Yellow Prior was said to be resistant to the leaf spot diseases.

Black root rot caused by Thielavia basicola (B. & Br.) Zopf.

Root rot was apparently favored by weather conditions and was more severe than usual in most states where it occurred. It was reported from Massachusetts, Connecticut, Maryland, Virginia (Charlotte County only), Kentucky, Georgia, Ohio, and Wisconsin, and also from the Philippine Islands. In Massachusetts, tobacco fields were generally severely affected in the early part of the season, but outgrew the disease later. In Kentucky, root rot was said to be most serious in the sections where Burley tobacco was grown. In the Philippines it is the worst disease of tobacco, according to H. Atherton Lee.

The use of resistant strains is probably the best method of controlling the disease (See Phytopath. 11: 49, January 1921), and was reported as giving good results in Kentucky, where complete control was obtained, Ohio, and Wisconsin. In Ohio, steaming of the plant beds was also recommended.

Other diseases.

Mosaic (cause not definitely determined) was reported by collaborators from Massachusetts, Connecticut, Virginia, Kentucky, and Wisconsin, and by James Johnson from Maryland and Pennsylvania. Except in Massachusetts, where it was only locally severe, Pennsylvania, and Virginia, where it is said to be rarely serious, the disease was apparently more important than usual. (See Pl. Dis. Bul. 4: 80 and 99, 1920). In Wisconsin it is ordinarily not severe, but caused considerable damage in 1920.

According to H. Atherton Lee, the disease also occurs in the Philippine Islands, affecting practically every plant that reaches maturity. Although it caused no complaints of loss, it probably injures the quality of the tobacco.

Leaf spot caused by Cercospora sp. was reported from the Philippine Islands by H. Atherton Lee.

Leaf spot caused by Macrosporium sp. was reported from Missouri.

Rust (non-parasitic) was reported from Pennsylvania, Kentucky, Tennessee, Ohio, Indiana. and Wisconsin. It caused considerable damage in some sections of Kentucky. According to True Houser in Ohio the disease attacked mosaic plants more readily than others. Connecticut Broadleaf, among other varieties, was said to be more susceptible to rust in Wisconsin.

Various leaf spot diseases, of unknown cause, were reported from several states.

White spot, Hartford and Middlesex Counties, Connecticut, appearing first on July 24.

Large brown spots, Goochland County, Virginia, September.

Black rust, Graves County, Kentucky, August 17.

Yellow french, cause undetermined, was reported from Ohio in the vicinity of Germantown and the Miami Valley by True Houser.

Frenching, cause unknown, occurred in Virginia and Wisconsin. In the former state it was said to be most severe on poorly drained land. Probably the same thing was reported from Connecticut under the name of "string leaf".

Hollow stalk caused by Bacillus carotovorus Jones - was reported from Massachusetts as more prevalent than usual, particularly on Broadleaf type, probably due to continued wet weather after topping.

Stem canker caused by Sclerotinia sp. was reported from Middlesex County Connecticut, where it first appeared August 17 at Cromwell.

Bacterial wilt caused by Bacterium solancearum EFS. was reported from

Fluvanna County, Virginia, where it was severe in several cases, and was first observed on September 3. It was also reported by H. Atherton Lee from the Philippine Islands.

Wilt caused by Sclerotium rolfsii Sacc. was reported from the Philippine Islands, where it is said to be more serious in the foothills than on the lowlands, due likely to the longer dry season of the latter situation.

Root rot associated with Alternaria sp. was found once or twice in seed beds in Hartford County, Connecticut. It has not been definitely proven that the Alternaria is parasitic.

Damping-off and root rot caused by Rhizoctonia solani Kühn was general in Connecticut, occurring in both seed bed and field. Damping-off caused by Rhizoctonia sp. was also reported from Wisconsin, where soil sterilization was quite generally used as a control method, with good results.

Damping-off caused by Pythium debaryanum Hesse was reported from Connecticut and Wisconsin.

A seedling disease, caused by a fungus closely resembling Fusarium affine Faut. & Lamb, was described during 1920 by C. M. Slagg from Fayette County, Kentucky, where it was observed in June 1918 (Phytopath. 11: 49. 1921. Abst.) It causes spotting on the leaves and browning and girdling and, in humid air, damping-off of the stems.

Rosette, cause unknown, was reported as more abundant than usual in the Germantown and Miami Valley sections of Ohio by True Houser. Root rot, mosaic, and nematodes are said to be commonly found affecting plants with the rosette disease.

Fertilizer burn, caused chiefly by silicate of soda used too strong, was reported from Connecticut.

Lightning injury was reported from Windsor, Connecticut. A so-called "crookneck disease" which made its first appearance shortly after severe electrical storms and was thought to be due to lightning injury, was reported from Kentucky. Injured areas 40 feet in diameter were found in one field the day following a storm during which lightning struck several times.

DISEASES OF MISCELLANEOUS VEGETABLE CROPS.

ARTICHOKE (Globe)

Botrytis sp. was reported from California by G. K. K. Link as follows (News Notes of the Office of Cotton, Truck, and Forage Crop Disease Investigations, Feb. 28, 1920):

> "In the artichoke district near Half Moon Bay I found plenty of the Botrytis in the field killing green, succulent shoots and attacking the heads at the tips of the bracts. The fungus gets started in the wounds caused by cutting the heads."

The disease also occurred at Colma on the live plants as well as on trash. D. G. Milbrath estimated the reduction in yield from Botrytis at 2%.

Inspections at various markets showed the presence of gray mold rot in 11 cars of California artichokes, in amounts ranging from 2-100%, usually from 11-15%, averaging 33%.

ASPARAGUS

Rust caused by Puccinia asparagi DC. apparently did very little damage during 1920. It was reported from Vermont, New Jersey, Georgia, Texas, Ohio, Michigan, Minnesota, Iowa, Missouri, Washington, Oregon, and California. Dates when the disease was first noticed were June 27, Anoka County, Minnesota; September 20, Vermont.

Dwarfing, of undetermined cause, but with which Fusarium sp. was always associated, was again reported from New Jersey.

Winter injury was reported from Washington.

BEET (Garden)

Leaf blight caused by Cercospora beticola Sacc. was reported from New Jersey, West Virginia, Georgia, Texas, Ohio, Indiana, and Minnesota. It was of little importance, although common in some states.

Stem rot caused by Rhizoctonia sp. was reported from New York, Pennsylvania, and Washington. Only one report was received in each case. In Pennsylvania it occurred as a seedling disease, and in New York it caused large black cankers and rotting at the bases of the petioles.

Scab caused by Actinomyces scabies (Thax.) Güssow was reported from Connecticut and Ohio.

Root knot caused by Heterodera radicicola (Greef) Müll. was reported from Texas and Indiana. In the latter state it has occurred for the past six years in one area of muck soil near Goshen.

CARROT

Watery soft rot caused by Sclerotinia libertiana Fckl.

Sclerotinia rot was reported only from New York, where it was observed on May 13 at Orient, Long Island.

The following table shows the amount of watery soft rot found by inspectors of the Bureau of Markets in shipments of carrots:

Table 100. Prevalence of watery soft rot of carrot as determined by food-products inspectors of the Bureau of Markets, 1920.

Origin of shipment	No. of cars inspected	No. of cars with decay	Av. % of decay	Date of inspection	Market where inspected	Percent of decay	Remarks
Calif.	7	3 1/3	14	Mar. 31	St. Louis	12-15	
				June 30	Chicago	3-5	
				July 1	St. Paul	20-30	
				Aug. 9	New Orleans	10-15	1/3 of car.

Origin of shipment	No. of cars inspected	No. of cars with decay	Av. % of decay	Date of inspection	Market where inspected	Percent of decay	Remarks
Ill.	3	4	52	Dec. 17	Boston	4	
				Dec. 20	Chicago	25-30	Large pits at stem.
				"	"	75-100	Advanced stage.
				"	"	90	" "
La.	2	2	55	Mar. 16	Chicago	80-90	
				June 17	Detroit	25	With Rhizopus rot. Worst in upper tiers.
Miss.	1	1	45	June 18	Minneapolis	40-50	Decay in tops.
N. Y.	20	4	10	May 6	Washington	5	
				Nov. 1	New York	15-20	
				Nov. 9	"	15	
				Nov. 13	Pittsburgh	3-5	
Ohio	2	1	22	Dec. 9	Pittsburgh	20-25	
Ore.	2	2	20	Jan. 12	New Orleans	25-30	
				Feb. 9	Minneapolis	10-15	
Texas	3	2	20	May 4	St. Louis	2	
				May 28	Chicago	25-50	In tops.
Unknown	11	4	24	Feb. 16	New York	15	
				Mar. 17	Pittsburgh	15	
				Oct. 29	"	15-20	With slimy soft rot.
				Nov. 30	Washington	35-60	With gray mold rot and Rhizopus rot.

Total number of cars of carrots inspected 51
Total number of cars with watery soft rot 24

Other diseases.

Rot due to Bacillus carotovorus Jones caused complete loss of the crop of several fields in Philadelphia County, Pennsylvania.

Root knot caused by Heterodera radicicola (Greef) Müll. was reported from Ohio and from Indiana. In the latter state it occurred only near Goshen.

CELERY

Late blight caused by Septoria petroselini apii Br. & Cav.

Late blight was reported by collaborators from Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Ohio, Indiana, and California. In most of these states the disease was generally prevalent, occurring wherever celery was grown.

Most states reported late blight as being present in about the same amounts as usual, or less. In Massachusetts and Pennsylvania, however, it was said to be more important than usual, especially so in the former state, where it caused a reduction in yield estimated at 15%. No estimate was made of the average loss in Pennsylvania, but in individual fields it ranged as high as 50-75% of the crop, and in New York, where the average loss was reported at 2-4%, fields with 100% infection were observed. In California according to D. G. Milbrath the disease was more severe than during 1919, causing a 10% reduction in yield in most of the trucking districts except the Delta region, where no late blight occurred.

Late blight was found by inspectors of the Bureau of Markets in celery shipped from New York, Florida, Michigan, and California, as shown in the following table:

Table 101. Prevalence of late blight of celery in shipments examined by inspectors of the Bureau of Markets, 1920.

Origin of shipment	Market where inspected	No. of cars with decay	Date inspected	Percent affected plants	Remarks as to severity of late blight
Calif.	Omaha	2	Jan. 17-23	1 car 33 1 " 100	On top leaves.
	Kansas City	1	Feb. 25	50-100	In 2-4 leaves.
	St. Louis	1	Mar. 20	100	Outer leaves badly affected.
	Chicago	1	Mar. 30	100	" " " "
	Ft. Worth	1	Dec. 13	--	Most of stock showed late blight on leaves and stalks.
Fla.	Cleveland	1	Apr. 10	100	On practically all stalks.
Mich.	Columbus	1	Nov. 18	35	Badly spotted leaves.
N. Y.	Pittsburgh	1	Oct. 20	35-50	Leaves badly spotted.
	"	1	Dec. 15	--	Tops conspicuously spotted.
Unknown	Pittsburgh	1	Oct. 19	75	Leaves badly spotted.

Total number of cars of celery with late blight 11
Approximate number of cars of celery inspected........ 368

Dates when the disease was first noticed were reported as follows:

June 28 .... Albany, New York.
July 1 .... Amherst, Massachusetts.
September 7 .... Philadelphia County, Pennsylvania.

The exceptionally cool and wet season was probably partly responsible for the heavy loss in Massachusetts. Late blight was said to be most severe during

October in that state.

Varieties reported by collaborators as susceptible to the disease are Golden Self Blanching in Massachusetts, and Easy Self Bleaching, White Plume, Golden Self Blanching, and Winter Green in Pennsylvania. The green varieties were more resistant in Massachusetts.

Six applications of 5-5-50 Bordeaux were said to give satisfactory control of the disease in New York.

Early blight caused by <u>Cercospora apii</u> Fr.

Early blight was reported from Vermont, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Ohio, Indiana, and California. Apparently it caused very little damage in most cases, but in Indiana it was said to be of considerable importance, especially late in the fall, and Connecticut reported more than the usual amount. In New York it was found only in Albany County, where it caused no loss.

Inspectors of the Bureau of Markets reported the presence of the disease in shipments from Florida only. The following table shows the amounts found in individual cars.

Table 102. Prevalence of early blight of celery in shipments from Florida as reported by food-products inspectors of the Bureau of Markets, 1920.

No. of cars	Date inspected	% affected plants per car	Remarks.
3	Feb.27-Mar.4	10-15	-
		--	25% of crates showed decay ranging from a few spots in outer leaves to entire stalk.
		15-20	-
2	Mar. 10-13	--	All visible crates at doors showed early blight.
		66-75	Leaves or 2-5 outer branches slightly affected.
3	Apr. 8-10	--	Most outer leaves in top layer, an occasional leaf in second layer.
		--	Leaves in top layer show early blight.
		75	-
2	Apr. 13-21	About 100	Found in practically all crates.
		100	In tops of practically all stalks.
5	May 8-14	50-65	-
		50-65	-
		50-65	-
		--	Most tops in third layer affected.
		100	All stock with leaves and branches affected.
4	May 14-21	100	-
		100	-
		100	-
		100	-

Dates when the disease was first observed were reported as follows:

August 23 .... Westville, Connecticut.
September 1 .... Vermont.
September 15 .... Lancaster County, Pennsylvania.

Foot rot and watery soft rot caused by Sclerotinia libertinia Fckl.

Sclerotinia was reported from New York and New Jersey as unimportant in the field. In New York it occurred to some extent in all celery sections, but the loss caused was not more than a trace. In California and Florida foot rot was an important field disease in the early part of the year, according to G. K. K. Link and I. C. Jagger, respectively. Fields with 25% infection were noted in the vicinities of El Monte and Watsonville in the former state. The reduction in yield for the state is estimated at 3% by D. G. Milbrath. The disease is favored by the dirt bank method of blanching which is used and by the heavy fogs and cool weather prevailing in those section, as in most of the trucking districts of California.

Inspectors of the Bureau of Markets reported watery soft rot as occurring in shipments of celery from California, Canada, Florida, Michigan, New York, and Ohio. The amounts of infection are shown in the table below, in which the percentage figures refer to percentages of affected plants, not to severity of decay. In most cases the leaves and from 1-3 to 5-9 of the outer branches were involved. In a considerable number of cars, however, the decay was largely complete, especially in the upper tiers, as indicated in the following reports:

California: "Fifty to seventy-five per cent decay, one-third of which was complete and the balance in the outer branches." "Practically all crates in the top layer and in the bottom layers between the doors showed complete decay."

Table 103. Amounts of watery soft rot of celery found in carload shipments examined by food-products inspectors of the Bureau of Markets, 1920.

Origin of shipment	Total No. of cars shipped	Number of cars inspected	No. of cars with decay	Percentage of affected plants: Number of cars with t-10%	10-25%	25-50%	50-75%	75-100%	No. cars with percentage given	Av. % affected plants
Calif.	2273	95	49	7	6	5	6	13	37	53
Canada	--	2	1	-	-	-	-	1	1	75
Fla.	3010	167	114	10	23	36	18	5	92	38
Mich.	549	23	2	1	-	-	-	-	1	2
N. Y.	2628	77	35	1	6	7	4	14	32	59
Ohio	--	2	2	-	-	-	-	2	2	87
Unknown	--	12	3	1	-	-	1	-	2	32

Total number of cars shipped 9024
Approximate number of cars inspected 368
Total number of cars with decay 207

Florida: "Fifty to seventy-five percent decay in top layers and 15-40% in the bottom layers, one-third of the decay being complete." "All stalks in top layer showed decay, being practically worthless; one-fourth to two-thirds of the stalks in the lower layers were decayed."

New York: "Practically all stalks completely decayed."

Yellows caused by Fusarium sp.

Yellows, or the stunting disease, as it has been previously known, was reported from Indiana as less important than in previous years, due to the use of the variety Easy Bleaching instead of the extremely susceptible Golden Self Blanching. G. H. Coons and R. Nelson report as follows concerning this disease (Phytopath. 11: 1921):

"The stunting disease of celery first discovered at Kalamazoo in 1914, as a serious disease of the Golden Self Blanching variety, has increased in extent so that practically all soil in the immediate vicinity of that city is no longer able to raise this particular variety. The disease is also known from all other extensive celery districts in the state. It is also a serious disease in New Jersey, Indiana, Massachusetts, and Connecticut. Although first suspected as being of bacterial origin, and reported by other observers as due to the joint action of bacteria and Fusarium, definite proof is now available for assigning to a new species of Fusarium the causal relationship of this disease for which the name Celery Yellows is proposed. The variety Easy Bleaching and all of the so-called green varieties are tolerant to this disease. In the golden varieties excessive stunting occurs, accompanied by yellowing and thickening of the foliage, together with reddening of the vascular system.

Other diseases.

Bacterial crown and heart rot, due to organisms of the Bacillus carotovorus and B. apivorus type, was reported from New Jersey, where it was said to have caused heavy losses for a number of years, particularly where the Golden Self Blanching variety was grown on muck soils. If planted before May 15, however, this variety usually produces a good crop. The green varieties are only slightly susceptible. Sterilization of the seed bed soil each year greatly reduces the loss from this disease. (Poole, R. F. Recent studies on bacteriosis of celery (Abstract) Phytopath. 11: 1921).

Black heart, cause undetermined, was reported from the vicinity of Sanford, Florida in the early part of April by I. C. Jagger, as follows:

"Black heart of celery has become quite destructive during the past few days, apparently having resulted from the setting in of more or less continuous warm weather. Probably 90% of the Golden Self Blanching celery has been harvested, but apparently a considerable percentage of the remaining fields are going to show losses from black heart."

The disease was also reported from the Delta region and Los Angeles

County in California by D. G. Milbrath, who states that it was more important than during 1919, and caused a loss of 2%.

Bacterial leaf spot was reported from New York (as bacterial blight) and from Indiana. In New York the disease was found in all celery sections and although less severe than during 1919 and previous years, caused a loss of 3-5%. About a third of the fields were infested, in amounts from a trace to 100%. Because of dry weather in the early summer, the disease appeared late, August 1, and caused greatest damage later in the season. Bordeaux 5-5-50 in six applications gave satisfactory control in New York.

Gray mold rot, caused by Botrytis sp., was reported by G. K. K. Link in March as prevalent in most of the trucking sections of California, being favored by the heavy fogs and cool weather of the winter and spring months.

Rhizoctonia was said to be more prevalent than usual in Ohio, due to the abundant moisture.

A root rot of unknown cause was reported from Massachusetts as less prevalent than usual. The susceptible variety Golden Self Blanching is now little grown in that state.

Root knot due to nematodes was found in one area near Goshen, Indiana.

A wilted condition of outer leaves was reported from the vicinity of Sacramento, California by G. K. K. Link, as follows (News Notes of the Office of Cotton, Truck, and Forage Crop Investigations, Feb. 28, 1920):

> "The most serious thing in celery this year has been a wilted, dried-out, pithy condition of the outer leaves, that is, petioles, and a brown yellowish condition of the leaf blades. This condition has been laid at the door of the carriers by some and attributed to field freezing by others. There is no doubt that it originated in the field."

EGGPLANT

Fruit rot caused by Phomopsis vexans (Sacc. and Syd.) Harter.

In 1920 fruit rot was reported by collaborators from New Jersey, Louisiana, and Iowa, and by inspectors of the Bureau of Markets in shipments from Florida (6 cars, average amount of fruit rot 15%). In Louisiana the disease was, as usual, very severe throughout the state, affecting nearly all fields and causing a reduction in yield estimated at 50-75%. It was first noticed in June at Baton Rouge, and caused most injury during the period from June to September.

In former years this disease has been reported to the Survey from all of the states east of the Mississippi River except northern New England, Maryland, North Carolina, and Kentucky, and from Iowa, Missouri, Nebraska, Louisiana, Texas, Oklahoma, California, and Porto Rico. It does considerable damage annually in New Jersey, Florida, Alabama, and Louisiana.

In most cases the cause has been reported as Phyllosticta hortorum Speg. According to Harter (Journ. Agr. Res, 2: 331-338. 1914) true Phyllosticta hortorum does not occur in this country, and the disease which has been generally reported as due to that fungus is caused by Phomopsis vexans.

Bordeaux mixture has not given satisfactory results in controlling the disease in Louisiana, Virginia, and Porto Rico. In Florida, seed bed sterilization, clean seed, and crop rotation are recommended.

Other diseases.

Bacterial wilt caused by Bacterium solanacearum EFS. - reported from Ohio (first noticed September 22).

Verticillium wilt caused by Verticillium sp. was reported from Massachusetts as very important (first observation 1919), and from New Jersey as generally destructive.

Root rot caused by Fusarium sp. was reported from New York as follows:

> "Reported only from Albany County where it evidently injured 10-15% of the crop. Did great damage in cold frames. Becoming serious in many fields - spreading fairly rapidly. First observed May 24."

Alternaria sp. - reported from Pennsylvania.

Anthracnose caused by Gloeosporium melongenae Ell. & Hal. - reported from West Virginia by J. L. Sheldon as follows:

> "Several times during the summer I saw badly diseased fruits in the Morgantown, Monongalia County, markets. Some of these were raised near town while the early ones were shipped in."

LETTUCE

Drop and watery soft rot caused by Sclerotinia libertiana Fckl.

Drop was reported by collaborators from Massachusetts, New York, New Jersey, Texas, Ohio, and Minnesota, and from Florida and California by I. C. Jagger and G. K. K. Link, respectively. In New York and Texas it was said to

Table 104. Amounts of watery soft rot of lettuce, caused by Sclerotinia libertiana, in shipments examined by food-products inspectors of the Bureau of Markets, 1920.

Origin of shipment	Number of cars inspected	No. of cars with decay	Percentage of affected plants in individual cars: Number of cars with 1-10%	10-25%	25-50%	50-75%	75-100%	No. of cars with % given	Average percent affected plants
Ariz.	11	6	-	-	-	2	2	4	79
Calif.	408	63	7	2	2	3	27	41	75
Fla.	59	16	2	3	8	2	1	16	32
Minn.	1	1	-	-	-	1	-	1	50
N. Y.	59	8	2	-	5	-	1	8	36
S. C.	6	2	1	-	-	-	1	2	55
Texas	21	8	-	-	3	2	3	8	59
Wash.	14	4	-	2	1	-	1	4	44

Total number of cars inspected 613
Total number of cars with decay 108

be unimportant. In Massachusetts, however, it caused an estimated loss of 15% in greenhouse lettuce, and in Minnesota the loss in the field was placed at 10%.

Inspectors of the Bureau of Markets found watery soft rot in lettuce shipped from New York, South Carolina, Florida, Texas, Minnesota, Arizona, Washington, and California. Table 104 gives the percentages of affected plants reported.

Soil sterilization was useful as a control measure in Massachusetts. In Minnesota it was reported that no treatment was used, and that continued cropping of lettuce on peat bogs was increasing the severity of the disease.

Gray mold rot caused by Botrytis cinerea Pers.

Gray mold rot was reported from Massachusetts, New York, Ohio, Indiana, and Iowa, and by G. K. K. Link from California. In Massachusetts, Indiana, and Iowa it was, as usual, an important greenhouse disease, causing a loss of 1% of the crop in Iowa. In New York it caused slight damage, although found occasionally in all lettuce sections. The disease was severe in the field in many parts of California in the early part of the year.

Bureau of Markets Inspectors reported Botrytis rot in lettuce from New York (8 cars) and California (7 cars) only.

Downy mildew caused by Bremia lactucae Regel.

Downy mildew occurred as a greenhouse disease in Massachusetts, Ohio, Indiana, Michigan, and Iowa. In Indiana and Iowa it was reported as causing serious losses. I. E. Melhus reported as follows concerning the disease in the latter state (Same as abstract in Phytopath. 11: 1921):

> "Under Iowa conditions Bremia lactucae has caused serious losses to the greenhouse lettuce crop. It is most rampant on plants in the seedling stage. This organism, like some species of Cystopus and Phythphthora, flourishes only at low temperatures and in an atmosphere of very high humidity. The optimum temperature for its spore germination is from 6 to 10°C., a temperature which prevails in the lettuce houses during the winter and spring months. The wild species of Lactuca: L. scariola var. integrata, L. canadensis, L. sagittifolia, and L. ludoviciana, are common as foul weeds about compost piles, vacant lots, and fence corners. All of the above species are readily infected with Bremia lactucae occurring on cultivated lettuce and vice versa. The downy mildew probably spreads from the wild to the cultivated lettuce. In this latitude the wild species of Lactuca are winter annuals and may serve as means for carrying the organism over from one season to the next in the vegetative stage. Although very frequent search has been made for oospores in cultivated lettuce plants, none have been found. Bremia is able to survive in hot-house soil from year to year, providing it is not allowed to freeze. The control of this disease has been effected by spraying the lettuce seedlings with Bordeaux mixture (4-4-50) two or three times before they are transplanted."

The disease was reported on field-grown lettuce in New York and Texas, where it was unimportant, and in California, where it caused a loss of 2%, according to D. G. Milbrath.

Downy mildew was found by Bureau of Markets inspectors in lettuce shipped from New York (5 cars, average percentage affected plants 69%) and California (42 cars, average percentage affected plants 81%).

Stem rot and rosette caused by *Rhizoctonia* sp.

Rhizoctonia was reported as an important disease only from New York, where it was generally destructive and caused a 15-20% reduction in yield. Many fields were a total loss and were plowed up without harvesting. The Romaine type of lettuce was less frequently attacked than the Boston head, which touches the ground.

The disease was also reported from Pennsylvania and Ohio.

Dates of first appearance were reported as follows:

February 17 .... Ohio.
June 26 .... Williamson, New York.
July .... Pennsylvania.

Tip-burn (non-parasitic).

Tip-burn apparently was not so generally serious as in the previous year. It was reported from New York, Texas, and Idaho, and California. In New York it was said to be, as usual, very severe, particularly in the middle of the summer, causing a loss of about 10%. It was first noticed June 26 at Williamson. In California the disease appears on butter head varieties only, according to D. G. Milbrath, who estimated a loss of 20% in the southern part of the state. It was first noticed in January.

The disease was unimportant in Texas and Idaho, although one grower in the Boise Valley in the latter state lost 13 acres, which he had planted too late in the spring.

On lettuce in transit the disease was also less prevalent than in 1919, at least, it was reported by markets inspectors in shipments from New York, Florida, and California only, as shown in the following table:

Table 105. Losses caused by tip-burn of lettuce as shown by examination of cars at destination by food-products inspectors of the Bureau of Markets, 1920.

Origin of shipment	Number of cars inspected	Number of cars with tip-burn	Average percentage of tip-burn	Range of percentage of tip-burn: No. of cars	Range of percentage of tip-burn: Percent
California	408	3	15	3	5-25
Florida	59	2	--	1	20
New York	59	7	63	2	100
				4	45-65
				1	t

Approximate number of cars inspected 613
Total number of cars with tip-burn 12

Leaf spots caused by Septoria lactucae Pass. and S. consimilis E. & M.

Both Septoria lactucae and S. consimilis have been reported to the Survey several times during previous years, as shown in the following table. In every case they were local in occurrence and caused no particular damage.

Table 106. Occurrence of Septoria lactucae and S. consimilis in the United States, as reported to the Plant Disease Survey.

Year	State reporting	Species
1903	Alabama	S. lactucae and S. consimilis (on Lactuca canadensis).
1906	New York	S. consimilis
	Virginia	S. lactucae
	North Carolina	"
1909	Ohio	S. consimilis
1913	Pennsylvania	S. consimilis
1915	New Jersey	S. lactucae
	Virginia	"
1916	Pennsylvania	S. consimilis
1918	New York	S. lactucae
	Pennsylvania	" (?)
	Arkansas	"
1920	Pennsylvania	S. lactucae

Other diseases.

Bacterial soft rots were reported from Florida, Texas, Ohio, Minnesota, and Washington. In Ohio the disease occurred generally in greenhouses, and was said to be especially bad on head varieties at maturity. Sug-irrigation gave good results in controlling it. In Minnesota it was of considerable importance in greenhouses.

The South Carolina bacterial disease, caused by Bacterium vitians Brown, was observed in a greenhouse at State College, Pennsylvania, December 13.

Black heart, cause undetermined, was reported by G. K. K. Link in March as an important disease in the Coachella and Imperial Valleys in California. According to D. G. Milbrath (January 2, 1921, in News Notes of the Office of Cotton, Truck, and Forage Crop Disease Investigations, January 22) this disease is one factor which will ruin the lettuce industry in the Imperial Valley if not controlled. Black heart was found also in shipments of lettuce from Washington examined at Chicago.

A bacterial root rot, apparently a new disease, was reported from Ohio as present in greenhouses. It was first observed November 8. Soil sterilization was suggested as a control measure.

Root rot caused by Ozonium omnivorum Shear, was reported from Graham County, Arizona, September 8.

A root rot of unknown cause, which caused a failure of the greenhouse crop in Kentucky and was also very severe in the field, was reported by W. D. Valleau as follows:

> "Both the butter-head and crisp head types of lettuce have been a failure under greenhouse conditions. The plants make a normal growth in the young stages, but later manifest various symptoms depending upon the variety. The butter-head types generally do not head, but produce large outer leaves with very small etiolated leaves in the center. The variety Hothouse often made small, very solid heads consisting of dark green leaves very much foreshortened, due to stunting of the mid-vein. Other varieties produced small rosettes of extremely wrinkled small, dark green leaves. The crisp head types developed normally until the time of filling out of the head when growth ceased, resulting in very loose leafy heads.
>
> "Tip-burn later appeared on most of the plants with the development of numerous laterals and an early elongation of the central axis. This was found to be particularly characteristic of the leaf variety Grand Rapids both in station greenhouse and in commercial houses at Louisville. Tip-burn was less marked on the leaf and crisp head than on the butter-head types.
>
> "A severe rotting of the roots was found in association with the various physiological conditions. The root-rot in commercial seed beds is very evident if young plants are dug and the roots carefully washed. It often results in the development of small wrinkled central leaves with small dead areas identical with the early stages of tip-burn.
>
> "Field observations indicate that the disease is widespread in Kentucky on both the leaf and head lettuce, resulting generally in a loss of more than 75% of the crop of the butter-head and a smaller per cent of the crisp types. Here also the root-rot is found to be associated with the losses.
>
> "Thus far steam sterilization and formaldehyde treatment of greenhouse soils have failed to control the trouble completely, but there are indications that more thorough methods may prove effective."

Root knot caused by Heterodera radicicola (Greef.) Müll. was reported from Massachusetts, Ohio, Indiana, and Arizona.

Internal necrosis was reported from King County, Washington.

MANGEL-WURZEL

Crown gall caused by Bacterium tumefaciens Smith and Towns. was reported from Bradford County, Pennsylvania, where it was first noted November 1.

Frost injury was reported from Pacific County, Washington.

OKRA

Wilt caused by Fusarium vasinfectum Atk. was reported from Georgia, where it occurred in the lighter soils in the southern part of the state, and caused a 2% reduction in yield.

Verticillium wilt caused by Verticillium albo-atrum McA. was reported from Burlington County, New Jersey.

Root rot caused by Ozonium omnivorum Shear was prevalent in Texas, causing a loss estimated at 6%, and was also reported from Graham County, Arizona.

Root knot due to Heterodera radicicola (Greef) Müll. occurred in sandy soils in Texas, where it caused a reduction in yield estimated at .1%. In Arizona it caused severe damage in a garden in Thatcher, Graham County.

PARSLEY

Rot caused by Sclerotinia sp. was reported from a greenhouse in Albany County, New York, as completely destroying two beds of parsley.

Root canker caused by Rhizoctonia sp. was reported July 12 from Albany County, New York.

PARSNIP

Root knot caused by Heterodera radicicola (Greef.) Müll. was reported from Ohio (first collection, first observed October 2) and Indiana (negligible; in one area near Goshen).

PEA

Blight caused by Mycosphaerella pinodes Berk. and Blox.

Blight was reported from Massachusetts, New York, New Jersey, Pennsylvania, Delaware, Maryland, Ohio, Wisconsin, Montana, and California. In most cases it was general in distribution but caused little damage, although in Massachusetts it was said to be somewhat more important than usual, and in California it caused a reduction in yield of 6% in Alameda and San Diego Counties, according to D. G. Milbrath. In Montana it has been found only on low wet ground subject to flooding in spring and early summer.

Bacterial blight caused by Pseudomonas pisi Sackett.

Bacterial blight was reported from Pennsylvania as common but probably not important in Erie County, and from Montana. In the latter state it was said that certain short-stemmed varieties were apparently most susceptible.

Root rots caused by various organisms.

Root rots caused more loss to the pea crop than any other trouble, especially where adequate crop rotation was not practiced. In Wisconsin the loss from root rot alone was estimated at 1%, and from root rot, bad weather, and lice at probably 25%. In Montana it was more than 5%. In Utah also root rots caused serious losses in some sections. In Delaware the disease was not nearly so serious as during 1919. The pea crop in that state was said to be the largest in years in spite of the serious outbreak of root rots in 1919.

Fusarium spp. are the most generally reported causes of root rot, but Pythium sp, and Rhizoctonia sp. are also important, usually in combination with each other or Fusarium, or both. Phytophthora cactorum has been reported from Connecticut, and Thielavia basicola from several states.

Fusarium root rot was reported from New York, New Jersey, Maryland, Virginia, West Virginia, Michigan, Wisconsin, Utah, and Oregon. In most cases it was said to be serious only in soils which had grown peas for a number of years in succession, and especially in home gardens. In Mason County, Michigan the variety Alaska was commonly affected by a serious root rot thought to be due to a Fusarium, and in Oregon a disease apparently caused by Fusarium sp. was observed for the first time in the vicinity of Salem. In New York the disease was first noticed April 7 in Suffolk County.

Pythium sp. was reported from Delaware, Maryland, Michigan, Wisconsin, Montana, and Utah. In Wisconsin it seemed to be the most important of the organisms causing root rot, and was generally distributed in old pea soils. Dates when the disease was first observed were reported as follows: May 13, Delaware; July 1, Madison, Wisconsin.

Rhizoctonia sp. was the most important cause of root rot in Montana, according to F. R. Jones. It was also reported from Wisconsin, Utah, and Washington.

Phythphthora cactorum (Lebert & Cohn) Schr. was reported from Connecticut in the vicinity of Westville, where it first appeared June 21. The disease probably occurred in 1919, but was reported as "Pythium sp. (?)".

Thielavia basicola (B. & Br.) Zopf. was reported as local in Connecticut, New York, and Pennsylvania. In Pennsylvania it was said to be confused with Fusarium and Rhizoctonia probably.

Septoria blight caused by Septoria pisi West.

Septoria blight was not particularly important although it was prevalent in most of the states where it occurred. It was reported from New York, Pennsylvania, Delaware, Maryland, Michigan, Wisconsin, and Montana. In Wisconsin it caused considerable damage in a few fields in old pea-growing sections in Sauk County. The disease was first observed at Madison, Wisconsin on June 25 and in Tompkins County, New York on August 20.

Powdery mildew caused by Erysiphe polygoni DC.

Powdery mildew was reported from Vermont, New York, Pennsylvania, Ohio, Minnesota, Idaho, and Washington. It caused little injury. Dates when it was first observed were reported as follows:

August 15 .... Minnesota.
August 20 .... Tompkins County, New York.
September 30 .... Vermont.

Erysiphe sp. was reported from California by D. G. Milbrath, who states that he does not think it was Erysiphe polygoni. It destroyed both the leaves and the vines, and caused a loss of 3% in San Diego, Riverside, and Los Angeles Counties. Sulphur dust was used as a means of control.

Other diseases.

Sclerotinia libertiana Fckl. was reported from State College, Pennsylvania, where it attacked a few plants trailing on the ground.

PEANUT

Leaf spot caused by Cercospora personata (B. & C.) E. was reported from western Tennessee, Georgia, Alabama, Mississippi, Louisiana, and Arkansas. It apparently was local and of little importance except in Louisiana, where it caused a reduction in yield estimated at 1%, and Arkansas, where it was said to be more severe than usual. The variety White Spanish was said to be more commonly affected than others in Tennessee, due perhaps to the fact that it was more mature at the time of the report (October 15).

A leaf blight with which Botrytis sp. was associated was reported from Tennessee as "fairly common in a field observed at Jackson in September by Sherbakoff".

Root rot caused by Sclerotium rolfsii Sacc. was reported from western Tennessee, and from Louisiana, where it was rather common but caused little injury.

Texas root rot caused by Ozonium omnivorum Shear was reported from Texas as unimportant on peanuts, which are usually grown in sandy soils where the disease does not occur.

PEPPER

Anthracnose caused by Colletotrichum nigrum E. & H. was reported from New Jersey and Georgia.

Mosaic, cause undetermined, was reported from New Jersey as apparently of very little importance, and from Lawrence County, Pennsylvania.

Fruit rot caused by Macrosporium sp. was reported from New Jersey.

Bacterial wilt caused by Bacterium solanacearum EFS. was reported from Texas as unimportant.

Wilt caused by Sclerotium rolfsii Sacc. was reported from Georgia, where it was said to be less important than usual, although it caused a reduction in yield estimated at 10%. It attacked all varieties.

Wilt, caused by Fusarium sp. caused a reduction in yield of chili and pimento peppers of 5% in Orange County, California, according to D . G. Milbrath.

Damping-off, cause unknown was reported from Rensselaer County, New York, where it first appeared May 24 at Troy.

Nematodes were reported from Luzerne County, Pennsylvania.

RHUBARB

Leaf spot caused by Phyllosticta straminella Bres. was reported from Albany County, New York, July 7. A Phyllosticta leaf spot was reported from Pennsylvania also.

Leaf spot caused by Ascochyta rhei E. & E. was reported from Indiana as probably generally distributed.

Crown rot caused by a new species of Phytophthora was reported by W. S. Beach (Phytopath. 11: 55-56. Jan. 1921) as prevalent in Philadelphia County, Pennsylvania. The disease is most severe in wet weather. A similar crown rot, due to another species of Phytophthora is reported by G. H. Godfrey as occurring to a serious extent in Maryland, District of Columbia, and Virginia.

Root rot caused by Bacillus carotovorus Jones was reported from Ohio.

Root rot caused by an undetermined fungus was reported from Stoddard County, Missouri.

SALSIFY

White rust caused by Albugo tragopogonis (DC.) Gray was reported from Vermont and Iowa, causing little injury in both cases.

SPINACH

Blight (cause undetermined).

Blight (mosaic) was reported from Beaver County, Pennsylvania (first report for state) where it was rather serious, from Texas as unimportant, from the vicinity of Goshen, Indiana, and from California by D. G. Milbrath. In California it was said to be prevalent in Los Angeles County where the Bloomsdale and Prickly varieties were grown. The crop was unfit for shipment and was used for canning. The loss for the county was estimated at 30%, and for the state at 1%.

Downy mildew caused by Peronospora effusa Rabenh.

Downy mildew was reported from Texas as very important wherever spinach was grown, causing a reduction in yield estimated at 10%. It was said to be more prevalent than during the preceding year, due perhaps to the very wet weather. The disease also caused heavy losses in the Imperial Valley in California where it was becoming the limiting factor in spinach culture, according to D. G. Milbrath. The crop was largely plowed under. Twelve hundred acres that were expected to ship two hundred cars of spinach shipped only ten. The reduction in yield was estimated at 60%.

Other diseases.

Anthracnose caused by Colletotrichum spinaciae E. & H. was reported from

Texas as unimportant.

Scab or *black mold*, caused by *Cladosporium macrocarpum* Preuss. - reported from Beaver County, Pennsylvania (first report for state, not serious), and from Texas.

Root rot and *wilt* caused by *Fusarium* sp. - reported from Idaho, where it occurred in gardens at Moscow.

Rhizoctonia sp. - reported from Philadelphia County, Pennsylvania.

SWISS CHARD

Leaf spot caused by *Cercospora beticola* Sacc. was reported from Pennsylvania as unimportant though generally prevalent.

THE PLANT DISEASE BULLETIN

Issued By

THE PLANT DISEASE SURVEY

SUPPLEMENT 17

Diseases of Forest and Shade Trees, Ornamental and Miscellaneous Plants

in the United States in 1920

June 15, 1921

BUREAU OF PLANT INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE

1920

G. R. Lyman, Pathologist in Charge.

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Delaware.......	Dr. T. F. Manns
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	Prof. C. R. Orton
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South Dakota...	Dr. Arthur T. Evans
Tennessee......	Prof. S. H. Essary
	Dr. L. R. Hesler
	Prof. C. D. Sherbakof
Texas..........	Dr. J. J. Taubenhaus
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	Mr. B. F. Dana
	Mr. A. M. Frank
West Virginia..	Dr. N. J. Giddings
	Prof. Anthony Berg
	Dr. J. L. Sheldon
Wisconsin......	Dr. R. E. Vaughan

DISEASES OF FOREST AND SHADE TREES, ORNAMENTAL AND MISCELLANEOUS PLANTS IN THE UNITED STATES IN 1920

Prepared by
G. Hamilton Martin, Jr.

CONTENTS

Foreword

The summary of the diseases of forest and shade trees, ornamental and miscellaneous plants has been prepared by utilizing the following sources of information: (1) collaborators (2) specialists in the offices of Forest Pathology and Blister Rust Control (3) articles in botanical journals, and (4) special reporters. Initials in place of the full name have been used in a considerable number of cases to indicate the person furnishing the reports. These are as follows:

T. D. B. = Thomas D. Burleigh, University of Georgia, Athens.
J. F. C. = J. Franklin Collins, Office of Forest Pathology, Providence, R.I.
A. O. G. = A. O. Garrett, Smuts and Rusts of Utah, IV, Mycology 13: 101.
A. G. H. = A. G. Henn, City Forester, Mt. Vernon, New York.
L. C. M. = L. C. Miller.
W. A. M. = W. A. Murrill, The Fungi of Blacksburg, Virginia, Mycology 12:322.
J. L. S. = John L. Sheldon, Morgantown, West Virginia.

Due to the greater attention which should be given to the reporting of the diseases of forest, shade and ornamental trees, shrubs and miscellaneous plants, letters were addressed to a considerable number of foresters and other workers to see if they were interested in tree diseases and willing to cooperate in securing information on that subject. A favorable, and in many cases enthusiastic, response was received from a large number of those addressed, which indicated the need for further information of this kind. It is hoped that the interest created in this subject may continue to increase and develop as there is a growing realization of the value of our trees and ornamental plants, and of the necessity for protecting them from the ravages of disease.

The special write-up on the status of the white pine blister rust control in 1920-21 has been featured at the close of this summary due to the importance which is felt should be shown it.

There has been a demand for references by tree workers for Government and state publications as well as association lists and books which deal with the diseases of forest, shade and ornamental trees, shrubs and plants. Thus the preliminary list of recent publications which is appended to the summary.

ACACIA (Acacia sp.)

Pink disease caused by Corticium salmonicolor B. & Br. reported from Philippine Islands (serious. H. A. L.).

AMALANCHIER (Amalanchier spp.)

Rust caused by Gymnosporangium inconspicuum Kern reported from Utah (on A. jonesiana, Iron Co., July 29; on A. prunifolia, Washington Co., July 22; on A. utahensis, Iron Co., July 16, Washington Co., July 22, Millard Co., Aug. 7 A.O.G.).

Rust caused by Gymnosporangium nelsoni Arth. reported from Utah (on A. jonesiana, Iron Co., July 19; on A. mormonica, Beaver Co., Aug. 3; A. polycarpa, Iron Co., July 17; A.O.G.).

Rust caused by Gymnosporangium juvenescens Kern reported from Utah (A. oreophila, Piute Co., June 28, A.O.G.).

ARBOR VITAE (Thuja sp.)

Leaf blight caused by Keithia thujina Durand reported from Virginia (Richmond, Henrico County, Nov. 1, produced defoliation).

Blight caused by Pestallozia conigena Lev. reported from Minnesota (Minneapolis, Hennepin Co., Aug. 1. Not important, local).

Blight caused by Pestallozia funerea Desm. present in Virginia (J.F.C.).

Winter injury reported from Ohio (reported from widely scattered counties throughout the state,- Athens, Wayne, Williams and Wood. Frequent sleets with changing temperatures were responsible; mulching has been suggested as a possible treatment).

Blight, cause undetermined, reported from Texas (specimens and reports were received from Dallas concerning a blight which has been attacking at least 10% of the trees and eventually killing many of the finest arbor vitae in this city - upon examination a fungus (Diplodia sp.) was found which may be causing the trouble or acting as a secondary cause).

ASH (Fraxinus spp.)

Anthracnose caused by Gloeosporium aridum Ell. & Holw. reported from Massachusetts (on F. americana, J.F.C.); District of Columbia (on F. americana, J.F.C.); Virginia, and Ohio (Butler and Wayne Counties, especially severe on young trees, the abundant rainfall and relatively high temperature promoting a favorable disease condition; Bordeaux mixture is suggested as a treatment. June 4).

Leaf and twig rust caused by Puccinia fraxinata (Lk.) Arth., reported from Massachusetts (on F. americana, J.F.C.); Connecticut (Hartford County - average amount less prevalent than in preceding year); Indiana (F. viridis, J.F.C.); Minnesota (Pipestone and Wabash Counties, June 23).

Witches' broom caused by Taphrina cerasi (Fcl.) Sad. (Exoascus cerasi), reported from Ohio.

Leaf spot caused by Phyllosticta viridis E. & K. reported from Minnesota (on F. americana, Washington County, Aug. 11.).

Leaf spot caused by meteorological conditions reported from Connecticut (Windham County).

ASH, Mountain (Sorbus americana)

Canker caused by Nummularia discreta (Schw.) Tul. reported from Minnesota (Olmstead and Rochester Counties July 14, unimportant).
Scab caused by Venturia inaequalis (Cke.) Aderh. reported from Minnesota (unimportant).
Winter injury reported from Washington (Lincoln Co.).

BASSWOOD (Tilia sp.)

Leaf spot caused by Gloeosporium sp., reported from Minnesota (Wabasha Co., June 28).

BEACH (Fagus americana)

Coriolus nigromarginatus (Schw.) Murr. (Polyporus hirsutus Fries) (Polystictus hirtellus Fries) reported from Georgia (collected at Athens. T.D.B.)

BIRCH (Betula sp.)

Leaf spot caused by Septoria betulae (Lib.) Westd. reported from Minnesota (Fairmont and Martin Counties, Aug. 7).
Leptothyrium sp. reported from New York. (J.F.C.)

Leaf blotch caused by Guignardia aesculi (Pk.) Stewart (Phyllosticta paviae Desm.) (P. sphaeropsidea E. & E.) reported from Ohio (Cuyahoga, Knox, Lake, Morrow and Wayne Counties - more prevalent than in previous years - favorable weather conditions existed).

BUCKTHORN (Rhamnus sp.)

Rust caused by Puccinia coronata Cda., (Ae. rhamni) reported from Tennessee (on R. caroliniana) and Minnesota (moderately severe in Rice and Waseca Counties, slight in Dodge and Ramsey Counties, May 22).

BUTTERNUT (Juglans cinerea)

Anthracnose caused by Gnomonia leptostyla (Fr.) Ces. & d. Not. (Marssonia juglandis) reported from West Virginia (Morgantown, Monongalia County, found on some small trees two to five feet in height which were growing on a shaded bank), Iowa (about 90% of the trees were infested, producing about a 10% reduction in yield).

CAMPHOR (Cinnamomum camphora)

Anthracnose caused by Gloeosporium camphorae Sacc. reported from Texas (Bell Co., a trace only).
Canker, caused by Diplodia sp. reported from Texas (Harris Co., unimportant).

CATALPA (Catalpa sp.)

Leaf spot caused by Alternaria catalpae reported from New York (Cayuga, Monroe and Suffolk Counties, Aug. 2 at Auburn). Alternaria sp. reported from Ohio (Stark and Wyandot Counties, Aug. 31, more prevalent than in 1919.
Leaf spot caused by Phyllosticta catalpae E. & M. reported from New

Jersey (found throughout the state, causing heavy leaf fall at times - more serious on some individuals than on others), Ohio (Cuyahoga, Portage and Summit Counties, Aug. 18, prevalence general), and Missouri (Boone and Buchanan Counties). Phyllosticta sp. reported from New York (Lockport, Niagara Co., Aug. 19, unimportant).

A leaf spot caused probably by Macrosporium catalpae E. & M. reported from West Virginia (very destructive to some trees in a planting near Westover, Monongalia Co.; certain trees of C. bungei at Morgantown were also attacked).

Powdery mildew caused by Microsphaeria alni var. vaccinii (Schw.) Salm. (M. elevata Burr.) reported from West Virginia (found in small amounts on C. bungei at Morgantown, Monongalia Co.)

Heart rot caused by Polystictus versicolor Fries. reported from Ohio.

Sap rot caused by Stereum versicolor Fries. reported from Ohio.

Leaf wilt caused by Sclerotinia sp. reported from Ohio (Cuyahoga County, April 3,- of more than usual prevalence).

Wilt, cause undetermined, produced some loss in northern Indiana and Ohio. No cankers nor discolorations were found on the affected branches or any of its wood. According to D. C. Babcock the trees die back, death starting at the tip of the branches. So far no effect has been found on the roots.

Leaf spot, cause undetermined, was reported from New Jersey (J.F.C.) and West Virginia (first noticed on C. bignonioides by John L. Sheldon; on July 27 he found it abundant and very destructive on trees of C. bungei which were growing in several lawns about Morgantown, -- has been present in this locality for several years but not until 1920 was it definitely decided that the disease was caused by a specific fungus). A leaf spot reported also from Michigan.

CHESTNUT (Castanea dentata)

Blight caused by Endothia parasitica (Murr.) Aud. (prepared by G. F. Gravatt, Office of Forest Pathology).

> "In New England the blight is now found everywhere that the native chestnut occurs in any quantity. In the western parts of New York and Pennsylvania, the disease is reported as present in all chestnut counties but the percent of trees infected is low. The blight was reported as present in Lake County, Ohio.
>
> "On a brief inspection trip the blight was found in eight new counties in West Virginia, making a total of 17 counties in the northeast quarter of that state which are now infected. In the southwest part of Virginia the disease was noted in three new counties,- Giles, Pulaski and Floyd. In the northwestern corner of North Carolina, the blight was found in seven new counties. The above noted infections show that the disease is steadily spreading southward and less rapidly westward through the Southern Appalachians. Where the disease has been present for considerable time such as in New Jersey, around New York City and in eastern Pennsylvania, less than 1% of the original trees are now alive."

Reported to the Plant Disease Survey from Maine, New York, New Jersey, Pennsylvania, West Virginia, Virginia and Ohio.

Leaf spot caused by Marssonia ochroleuca B. & C. reported from West Virginia (Morgantown, Monongalia Co., found on a few trees - first report to the Plant Disease Survey), Ohio (Athens Co., less prevalent than in 1919 - weather conditions were unfavorable due to low temperature and delayed development).

Late flowering was reported from West Virginia (Morgantown - John L. Sheldon reported seeing a large tree in full bloom on Oct. 2 - a short time before rubbish had been burned - he also noticed a few burs that had opened from which the chestnuts had fallen out. These were the fruits of the spring blooms).

CHOKE CHERRY (Prunus sp.)

Black knot caused by Plowrightia morbosa (Schw.) Sacc., reported from Minnesota (on P. serotina Kittson Co. Aug. 26; on P. virginiana Goodhue and Ramsey Counties May 16). Plowrightia sp. reported from Washington.

Powdery mildew caused by Podosphaera oxyacanthae var. tridactyla (Wallr.) Salm., reported from Minnesota (Pennington Co., Aug. 28).

Leaf spot caused by Coccomyces lutescens Higg., reported from Washington (on P. demissa, Whitman Co.).

Sclerotinia sp. reported from Washington (on P. demissa, Whitman Co.).

Coriolus sericeohirsutus (Klotzsch) Murr. reported from Georgia (at Athens T.D.B.).

DOGWOOD (Cornus sp.)

Powdery mildew caused by Phyllactinia corylea (Pers.) Karst., reported from Washington (Whitman Co.).

Tubercularia sp. reported from District of Columbia (on Cornus macrophylla. J.F.C.)

Leaf spot caused by Septoria sp. reported from District of Columbia and Minnesota (Hennepin Co., Aug. 18).

ELDER (Sambucus canadensis)

Powdery mildew caused by Microsphaera grossulariae (Wallr.) Lev. reported from West Virginia (Morgantown, Monongalia Co.)

ELM (Ulmus americana)

White elm canker caused by Sphaeropsis sp. on Ulmus americana. (Prepared E. E. Hubert, Office Forest Pathology).

> "A canker of the white elm (Ulmus americana) was investigated in Madison, Wisconsin during 1920. The disease was found to be widespread in Madison and vicinity and considerable damage and death to shade and ornamental elms as well as to nursery stock was evident. Dr. Fracker, State Entomologist of Wisconsin has reported that an elm disease which appears to be the same as the one herein mentioned has been under observation for the past five years and has been reported as occurring in practically every nursery in the state in which white elms are grown. Reports have not been received from other states. Reports of somewhat similar diseases, Sphaerop-

sis conglobata Sacc. on birch and Sphaeropsis malorum Berk. on oaks are on record.

"The cankers appearing on white elm branches resemble very closely those caused by Sphaeropsis malorum Pk. on branches and trunks of apple, pear and quince trees. The fungus in the infected branches of elm spreads from the main branch to the laterals and eventually a 'stag-head' appearance characterizes the infected trees.

"Trees up to six inches in diameter have gradually died, the infection progressing from the tip of the branch until it pervades the entire tree. The roots remain living until the last and often send up sprouts after the top of the tree is dead.

"Observations and cultural experiments point to the fungus, Sphaeropsis ulmicola E. & E. as the causal organism. Pure cultures of the fungus when inoculated into fresh apples have produced symptoms resembling closely those produced by S. malorum."

ELM (Ulmus spp.)

Leaf spot, black spot, anthracnose, or leaf scab caused by Gnomonia ulmea (Schw.) Thüm (Dothidella ulmea (Schw.) E. & E.) (Gloeosporium ulmeum Miles) (Systremma ulmi (Schleich.) Thiess. & Syd.) reported from Connecticut (New London Co., Aug. 26, more prevalent than in 1919), New Jersey (J.F.C.), Tennessee (J.F.C.), Ohio (Butler Co., May 31, more prevalent than in 1919), and Minnesota (Anoka, Benton, Pine, Rice, Roseau and Wadena Counties, June 27). Also present in the following states according to L. C. Miles: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, New York, Pennsylvania, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Texas, Ohio, Indiana, Illinois, Michigan, Wisconsin, Iowa, Missouri, North Dakota, South Dakota, and Nebraska. He also states that it has not been seen on any European or other foreign elm, however, collected in this country or abroad, nor is there any account of its occurrence on such. The leaf spot caused by Gnomonia ulmea (Schw.) Thüm is often reported under the name of Systremma ulmi (Schleich.) Thiess and Syd., but the true S. ulmea occurs only in Europe. Gnomonia ulmea has been reported in the United States on the following elm species: wing elm (U. alata), white elm (U. americana), cedar elm (U. crassifolia), slippery elm (U. pubescens = U. fulva), cork elm (U. racemosa), red elm (U. serotina).

Leaf spot caused by Mycosphaerella ulmi Kleb. (Phleospora ulmi (Fr.) Wallr.) (Septoria ulmi Fr.) (Cylindrosporium ulmicolum E. & E.) (Septogloeum ulmi (Fr.) Bri. & Cav.), present in New York (in the conidial stage it is said sometimes to do considerable damage to nursery stock and young trees - Stewart states that, according to L. C. Miles, it has been observed several times to cause extensive defoliation of young elms in New York, L.C.M.), Mississippi (on leaves of U. alata, L.C.M.). It has also been reported found on Ulmus compestris, U. glabra and U. americana.

Leaf spot caused by Septogloeum profusum (E. & E.) Sacc. has been reported on wing leaves of Ulmus alata and U. americana, L.C.M.

Leaf spot caused by Ceratophorum ulmicolum Ell. & Hark. (on living leaves of Ulmus pubescens, noted from several places in the United States, L.C.M.).

Leaf spot caused by Coryneum tumoricolum Peck. present in New York (on living leaves of Ulmus americana in the Adirondack Mountains L.C.M.).

Leaf spot caused by Excipula ulmicola Schw. present in Pennsylvania (reported as somewhat rare on cast-off leaves of Ulmus pubescens = U. fulva about Bethlehem, L.C.M.).

Leaf spot caused by Gloeosporium ulmicolum Miles, present in Wisconsin (Oconomowoc, Aug. 22, 1919, habitat on living leaves of U. americana L.C.M.).

Melasmia ulmicola B. & C., present in New Jersey (Cook speaks of it as the Melasmia stage of Rhytisma ulmi and reports it as very common in New Jersey, L.C.M.).

Rhytisma ulmi Fr. present in North America (reported on leaves of Ulmus in North America L.C.M.)

Phoma cincta B. & C. present in South Carolina (reported on leaves of U. americana in South Carolina L.C.M.)

Phyllosticta confertissima E. & E. present in Kansas (on leaves of U. pubescens = U. fulva in Kansas L.C.M.)

Phyllosticta ulmicola Sacc. present in Michigan (on Ulmus pubescens (U. fulva) L.C.M. and Wisconsin (on Ulmus americana & U. racemosa, Tisch Mills, Aug. 3, 1917).

Sphaeria apertiuscula Schw. present in New York (recorded as occurring on the lower side of leaves of Ulmus pubescens (U. fulva) L.C.M.

Root rot caused by Ozonium omnivorum Shear., reported from Texas (Bell, Burleson, Dallas, Denton, and Falls Counties - the elm is fairly resistant to the root rot which accounts for the disease being so far unimportant in the state).

Heart rot caused by Coriolopsis occidentalis (Klotsch.) Murr. (Polyporus occidentalis Klotsch.) reported from Ohio (Medina Co., Mar. 20).

Brown wood rot caused by Pleurotus ulmarius Bul. reported from Ohio (Lorain and Wayne Counties, Mar. 20).

Leaf burning, cause questioned, reported from Michigan (Iron Co.).

EUCALYPTUS (Eucalyptus diversicolor)

Botrytis sp. reported from California. (J.F.C.)

HACKBERRY (Celtis sp.)

Leaf spot caused by Phyllosticta celtidis Ell. & Kell., reported from Minnesota (Hennepin Co., Aug. 24).

Witches broom caused by Phytoptus sp. reported from West Virginia (Morgantown, Monongalia Co., scarcely a tree that was not badly infested).

HAWTHORNE (Crataegus sp.)

Rust caused by Gymnosporangium globosum Farl., reported from Michigan (Kent Co.).

HAZLENUT (Corylus sp.)

Leaf spot caused by Gnomoniella coryli (Batsch.) Sacc. reported from Minnesota (Marshall Co., July 26).

HEMLOCK (Tsuga sp.)

Stysamus (stemonites ?) reported from West Virginia. (J.F.C.)

HICKORY (Carya sp.)

Witches' broom caused by Microstroma juglandis (Ber.) Sacc. reported from West Virginia (Morgantown, Monongalia Co., while the brooms were not as conspicuous as those reported for the white oak, they were more plentiful and the destructive effect was more pronounced. J.L.S.)

Anthracnose, cause questioned as to whether it was Marssonia sp. or Gnomonia caryae Wolf (Gloeosporium caryae) reported from West Virginia.

Hexagona alveolaris (DC.) Murr. reported from Virginia:

> "Found during the latter half of July by writer. Common on fallen hickory branches. H. striatula was also common on the same host but not on the same actual branch. I think it is undoubtedly only a variety of H. alveolaris. In Europe, this species causes a serious disease of the English walnut and we must be prepared to expect it in our walnut and hickory orchards in this country." (W. A. Murrill)

HORSE CHESTNUT (Aesculus hippocastanum)

Leaf blotch caused by Guignardia aesculi (Pk.) Stewart, (Phyllosticta paviae Desm.) (P. sphaeropsidea E. & E.) reported from Maine (J.F.C.), New York (very severe, affecting 75% of the trees in the state, producing defoliation and a weakened condition of the tree. A. G. Henn, city forester at Mt. Vernon, reported that the trees in his city suffered from leaf spot and drop by mid-summer, a large percentage of their leaves being lost), New Jersey, Ohio (Warren Co., June 24), Michigan (Oakland Co.). Nectria canker (Nectria cinnabarina (Tode.) Fr. very often follows leaf blotch, causing the trees to die.

JUNEBERRY (Amelanchier sp.)

Powdery mildew caused by Podosphaera oxyacanthae (DC.) De Bary, reported from Minnesota (Roseau Co., Aug. 25).

Brown rot caused by Sclerotinia fructigena (Pers.) Schw. reported from Ohio. Sclerotinia sp. reported from Washington (Whitman Co.).

JUNIPER (Juniperus spp.)

Rusts caused by Gymnosporangium spp.:

- Gymnosporangium juniperi-virginianae Schw. (G. macropus Lk.) reported from New Jersey (Burlington, Cape May and Monmouth Counties), Ohio (throughout the southern counties and up the Ohio River as far as Belmont Co.), Minnesota (the southeastern part of the state, more than in 1919 - see also apple rust in Pl. Dis. Sup. 14, Apr. 1, 1921).
- Gymnosporangium clavariaeforme Jacq. reported from Michigan (Ingham Co.).
- Gymnosporangium globosum Farl. reported from New York (Tanghannock Falls, Tompkins Co., June 5 - probably of greater distribution than reports indicate.

Gymnosporangium germinale (Schw.) Kern. reported from New York.
Gymnosporangium juniperinum (L.) Mart. reported from Utah (on J. siberica, Piute Co., June 28 - this is the first collection of this rust reported from Utah. A.O.G.)
Gymnosporangium juvenescens Kern, reported from Utah (on J. scopulorum, Iron Co., July 19. A.O.G.)
Gymnosporangium inconspicuum Kern. reported from Utah (on J. utahensis (Engelm.) Lemmon, Iron Co., July 17. A.O.G.)
Gymnosporangium nelsoni Arth. reported from Utah (on J. scopulorum, Utah Co., June 23, Iron Co., July 17; on J. utahensis (Engelm.) Lemmon, San Pete Co., June 25, Garfield Co., Iron Co. A.O.G.)

Blight caused by Sphaeropsis (juniperi ?) reported from New York. (J.F.C.)

Winter injury caused by meteorological conditions. (Prepared by G. F. Gravatt, Office Forest Pathology):

"In a zone extending from northern Virginia to a little north of New York City, winter injury to evergreens was very severe. In the District of Columbia and nearby territory many large native red cedars, Juniperus virginiana, some of which were nearly a hundred years old, were killed. In some localities up to 25% of these trees were completely killed. Planted conifers suffered severely, the damage varying from the partial loss of the needles to complete death. The pines were the least affected of this class. In addition to variations in damage according to species, variety, and exposure, there was considerable individual variation. Thus some of the trees in a row of the same species were killed while others of the same species growing under the same conditions were uninjured."

LINDEN, European (Tilia sp.)

Leaf scorch caused by meteorological conditions reported from New York (Mt. Vernon. A.G.H.).

LOCUST, black (Robinia pseudacacia)

Rot caused by Polyporus glivus Fr. reported from West Virginia (large sporophore found growing out of a knot hole in a live tree at Morgantown. J.L.S.)

Heart rot caused by Polyporus rimosus B. (Fomes rimosus Cke.) reported from West Virginia.

Witches' broom cause unknown, reported from West Virginia.

Late flowering reported from West Virginia (noted at Morgantown on a tree that had lost its leaves early but about the first of October continued to bloom for several weeks. J.L.S.).

MAPLE (Acer spp.)

Leaf spot caused by Gloeosporium decolorans Ell. & Ev. on A. rubrum, reported from New York (J.F.C.); G. (oblongisporum ?), on A. saccharinum reported from Arkansas (J.F.C.), and G. apocryptum Ell. & Ev. on A. sp. reported from Ohio (Marion and Wayne Counties, June 30), and G. sp. from Michigan (Calhoun Co.)

Leaf spot caused by Phyllosticta minima (B. & C.) E.& E., (P. acericola C. & E.) reported from West Virginia (on A. rubrum, Dellslow and Westover), Tennessee (on A. saccharinum, P. sp. questioned. J.F.C.), Ohio (on A. sp. Fairchild and Stark Counties, normal amount of prevalence, July 31).

Leaf spot caused by Phyllosticta aceris Sacc. reported from Minnesota (Brown and Isanti Counties, July 24).

Tar leaf spot caused by Rhytisma acerinum Fries., reported from Massachusetts (J.F.C.), New York (on A. negundo, A. rubrum, A. saccharinum, Greene, Monroe, Montgomery and Tompkins Counties, Aug. 19 - rather common during 1919 in nearly all places in the state where maples are grown - no damage done), New Jersey (rarely found), Ohio (Belmont, Clermont, Cuyahoga, Scioto and Wayne Counties, June 11, more prevalent than in previous years), Minnesota (Dodge, Filmore, Hennepin, Lesueur, Lyon, Martin, Wilkin, Rice, and Stearns Counties, July 24.)

Black speck leaf spot caused by Rhytisma punctatum Fries, reported from New York (on A. spicatum, Tompkins Co., July, collected several times) and Minnesota (Itasca Co., Sept. 3).

Wilt caused by Verticillium sp. reported from Virginia (Lynchburg, Campbell Co., found on a single tree of Norway maple (A. platanoides) fifteen years old). This is a disease of which little is known so far in the United States. It has been reported in North America only from New York, District of Columbia, and Virginia, in the United States, and from Ontario, Canada. In order to keep a close watch for its appearance a few salient points as to its appearance might be worth while here. The external symptom is a blanching and quick wilting of the leaves during the middle of the summer, and the foliage on a branch or the entire side of the tree may suddenly appear scorched. On examining the sapwood of the affected part of the tree, streaks of longitudinal lines of greenish color will be found in the outer layers. This discoloration may extend upward or downward and may even enter the roots.

Steganosporium piriforme (Hoff.) Cord. reported from District of Columbia and Virginia (Acer (platanoides ?) J.F.C.).

Rot caused by Stereum versicolor (Lev.) Fr. reported from Georgia (on A. negundo at Athens. T.D.B.).

White butt rot caused by Fomes applanatus Fries. reported from Connecticut (Litchfield Co., on living tree, causes an injury to the heartwood).

Root rot caused by Armillaria mellea (Vahl.) Quel. reported from New York (on A. saccharum , Monroe Co., Sept. 13).

Leaf scorch (non-parasitic) reported from Connecticut (Fairfield and Windham Counties, July 12), New York (Cayuga, Erie, Long Island, Schenectady, Tompkins and Wayne Counties, July 10, rather common, produced a weakened condition of the tree, more prevalent in the Hudson Valley and along the Lake regions than in other parts of the state, period of greatest injury during dry spells of July and August).

Winter injury (non-parasitic) occurred in Ohio (Ashtabula, Rike and Tuscarawas Counties, June 15 - ice sheets and low temperature furnished favorable conditions.

OAK, white (Quercus alba)

Leaf spot caused by Gnomonia veneta (Sacc. & Speg.) Klebahn., reported from Iowa (more prevalent than in 1919, affected about 8% of the trees in the state).

Pestalozzia monochaete Desm. (P. peckii Clinton) reported from Rhode Island (J.F.C.).

Leaf blister caused by Taphrina coerulescens (Mont. and Desm.)

Tulasne, occurred in Rhode Island (J.F.C.) and New York (Orange and Tompkins Counties, July 26 - not important).

Anthracnose caused by Gloeosporium canadense Ell. & Ev. occurred in Rhode Island (J.F.C.) and Connecticut (New Haven Co.).

Gloeosporium quercinum West. reported from Tennessee.(J.F.C.)

Twig blight caused by Sphaeropsis (malorum ?)occurred in Virginia. (J.F.C.)

Witches' broom caused by Microstroma album (Desm.) Sacc. present in West Virginia. Quoting from John L. Sheldon

> "I have watched a tree in a pasture near Morgantown for years, from the time the brooms were only a foot or two tall. Now two of the brooms must be at least five feet tall, being very compact and symmetrical. Last year I succeeded in collecting leaves which contained the fungus."

OAK, scarlet (Quercus coccinea)

Bulgaria polymorpha (Oed.) Wett. present in New York. (J.F.C.)

OAK, water (Quercus nigra)

Cerrena unicolor (Bull.) Murr. occurred in Georgia (Athens. T.D.B.).

OAK, chestnut (Quercus prinus)

Leaf spot caused by Marssonia sp. present in West Virginia (Morgantown, Monongalia Co., in small amounts on young growth. J.L.S.).

Twig blight caused by Sphaeropsis malorum Berk. (Physalospora cydoniae Arnaud) or Diplodia longispora C. & Ell. (Prepared by G. F. Gravatt, Office of Forest Pathology):

> "Twig blight caused by Pysalospora cydoniae or Diplodia longispora was very prevalent in Maryland, District of Columbia, West Virginia, Virginia, North Carolina and parts of Tennessee during 1920. Some large chestnut oaks were apparently dying from the cumulative effects of this disease. Twigs and limbs on small trees were killed but new growth was putting out further back. The fungus was collected on various other forest trees but seems to be of practical importance chiefly on the chestnut oak.
>
> "This disease has been very much more prevalent in Virginia during the past two years than during the preceding six or eight years. Its irregular distribution and rapid increase during recent years leads one to think that at least this strain of the fungus is not native to the Southern Appalachians."

OAK, English (Quercus robur)

Canker caused by Cytospora chrysosperma (P.) Fr. present in Rhode Island. (J.F.C.)

OAK, red (Quercus rubra)

Leaf spot caused by Septoria quercicola Sacc. reported from Minnesota

(St. Paul, Ramsey Co., Aug. 1 - unimportant).

Lactiporus speciosus (Batt.) Murr. (L. sulphureus) reported from Georgia (found at Athens). (T.D.B.)

OAK (Quercus spp.)

Anthracnose caused by Gnomonia veneta (S. & S.) Kleb., (Gloeosporium nervisequum (Fckl.)) reported from Ohio (Hamilton Co., Aug. 21).

Leaf spot caused by Gloeosporium sp. reported from Michigan (Isabella Co.).

Powdery mildew caused by Microsphaera alni (Wallr.) Salm. reported from Ohio (Morgan, Muskingum, Scioto, and Wayne Counties).

Nummularia billiardi Tul. present in Virginia. (J.F.C.)

OSAGE ORANGE (Maclura aurantiaca)

Blight caused supposedly by bacteria, reported from Tennessee (a case was observed at Columbia; resembled fire blight but it is not now suggested that it was due to fire blight. L. R. Hesler).

PINE, short leaf (Pinus echinata)

Coriolus versicolor (L.) Quel. (Polyporus versicolor Fr.) reported from Ga. Athens. T.D.B.)

PINE, piñon (Pinus edulis)

Rust caused by Cronartium occidentale (Hedgec.) Bethel and Hunt, occurred in Utah (Iron and Piute Counties, June 27. A.O.G.).

PINE, rock (Pinus ponderosa scopulorum)

Rust caused by Cronartium filamentosum (Peck) Hedgec. and Long (Peridermium filamentosum Peck) occurred in Utah (Garfield Co., July 1, first record of this Peridermium in Utah. A.O.G.).

Rust caused by Cronartium pyriforme (Peck) I. Hedgec. and Long (C. comandrae Pk.) (Peridermium pyriforme Pk.) occurred in Utah Wasatch Co., July 15, first report of this Peridermium in Utah although the Cronartium has previously been reported from several localties. A.O.G.)

PINE, eastern white (Pinus strobus)

Caliciopsis pinae Pk. occurred in Maine. (J.F.C.)

Capnodium pini B. & C. reported from Connecticut (Litchfield Co., Oct. 29, unimportant).

PINE, Scotch (Pinus sylvestris)

Colletotrichum sp. reported from Michigan (Lawrence Co., Sept. 27 - Bordeaux spray was used with promising results).

PINE (Pinus spp.)

A physiological blight reported from Connecticut (Hartford and Kensington Counties, July 3 - one report).

Canker, cause unknown, reported from Michigan (Ingram Co.).

POPLAR (Populus sp.)

Leaf drop, cause unknown, reported from New York (Mt. Vernon, A.G.H.).

PSEUDOTSUGA MUCRONATA

Rust caused by Melampsora albertensis Arth. I. (Caeoma occidentalis Arth.) occurred in Utah (Iron Co., July 27 - this is the first recorded collection of this Caeoma for Utah although the Melampsora on Populus tremuloides has been reported from San Juan Co. A.O.G.).

SERVICE BERRY (see Juneberry)

SEQUOIA (Sequoia washingtoniana)

Seedling rot caused by Botrytis douglassi Tub. reported from Ohio.

SPRUCE, Engelmann (Picea engelmanni)

Rust caused by Peridermium coloradense (Dietel) Arth. and Kern. occurred in Utah (Iron Co., July 9 A.O.G.).

SPRUCE (Picea sp.)

Leaf scorch caused by meteorological conditions reported from New York (probably more prevalent than in 1919, occurred all over the state but especially in the Hudson Valley, where it is reported mostly by owners of large estates.

TULIP POPLAR (Liriodendron tulipifera)

Powdery mildew causal organism not given - reported from Ohio.

SYCAMORE (Platanus occidentalis)

Anthracnose caused by Gnomonia veneta (Sacc. & Speg.) Klebahn. (Gloeosporium nervisequum (Fcl.) Sacc.) reported from New York (Mount Vernon - spraying with Bordeaux was tried, and although it helped a little the result was not wholly satisfactory, A.G.H.), New Jersey (throughout the state, very abundant), West Virginia (much less in the vicinity of Morgantown than in 1919, J.L.S.), Arkansas (throughout the northeastern part of the state, less severe than usual, about 75% of the trees were affected - April), Ohio (abundant around Cincinnati C.M.S.), and Iowa (common, only a trace of loss).

Powdery mildew, causal organism not given, reported from Virginia (Hilton Village, caused severe defoliation on one year old trees in streets, Sept. 17).

Root rot caused by Armillaria mellea (Vahl.) Quel. reported from West Virginia, J.L.S.).

UMBRELLA TREE (Melia sp.)

Texas root rot caused by Ozonium omnivorum Shear reported from Texas (Bell, Brazos, Falls and Harrison Counties - prevalent, important as a disease of ornamentals, causes total destruction of trees, found throughout state wherever cotton dies from root rot in wax-clay soils, attacks the host in all stages - very wet weather conditions during the year).

WALNUT (Juglans sp.)

Leaf spot caused by Marssonia juglandis (Lib.) Sacc. reported from West Virginia (a small amount on young trees growing in shaded places near Morgantown, Monongalia Co. J.L.S.).

Scab caused by Cladosporium juglandis reported from Minnesota (Invergrove, Dakota Co., July 28 - unimportant).

Crown gall caused by Bacterium tumefaciens Sm. and Town. reported from Pennsylvania. (J.F.C.)

Dying back caused by frost reported from Michigan (Kent Co.).

Frost injury reported from Washington (King Co.).

Winter injury reported from Ohio (Cuyahoga and Wood Counties, July 19, more prevalent than in previous year - ice and freezing important in producing the diseased condition) and Washington (Clark and Cowlitz Counties).

WILLOW, Watson's (Salix watsonii)

Rust caused by Melampsora confluens (Pers.) Jackson (Caeoma confluens (Pers.) Schröt.) reported from Utah (Summit Co., June 21).

WILLOW (Salix spp.)

Powdery mildew caused by Uncinula salicis (D.C.) Wint., reported from Ohio, Minnesota (Lancaster, Aug. 24, general throughout the state, unimportant) and Iowa (common, about 2% infection, trace of loss).

Rust caused by Melampsora bigelowii Thüm reported from Minnesota (Bemidji, Aug. 5, general throughout the state - unimportant), Iowa (common, about 15% infestation, trace of loss), and Washington (Whitman Co.).

Rust caused by Melampsora sp. reported from West Virginia (Monongalia Co.).

Tar spot caused by Rhytisma salicium Fries., reported from Minnesota (Aitkin, Fillmore, Itasca, Marshall, Pennington and Roseau Counties, July 19).

Canker caused by Cytospora (Chrysosperma ?) reported from Minnesota (Clearwater Co., July 3).

Leaf blight caused by Cylindrosporium sp. reported from Washington (Whitman Co.).

WITCHHAZEL (Hamamelis virginiana)

Leaf spot caused by Phyllosticta hamamelidis Cook reported from West Virginia (Sturgis City, Rock Forge and Morgantown, July 7).

DISEASES OF ORNAMENTAL PLANTS

AMPELOPSIS sp.

Leaf spot caused by Guignardia bidwellii (E.) V. & R. (Phyllosticta ampelopsidis) reported from New Jersey (range throughout entire state), West Virginia, and Minnesota (Anoka, Ramsey, and Rice Counties, June 21).

Powdery mildew caused by Plasmopara viticola (B. & C.), Berl. & De Ton. reported from New York (New York City, August 9).

Powdery mildew caused by Uncinula necator (Schw.) E. & E. (U. ampelopsidis Peck) reported from West Virginia (found in small amounts on wild plants at Dellslow, Monongalia Co.) and Minnesota (Clay and Polk Counties, Aug. 21).

ASTER, China (Callistephus chinensis)

Septoria leaf spot caused by Septoria callistephi Gloyer, reported from New York. A Septoria leaf spot (Septoria sp.) was also found in Michigan.

Wilt caused by Fusarium conglutinans callestephi reported from New York (generally severe - produced a dwarfing, yellowing and wilting of the plants as well as a failure to flower - period of greatest injury was during July and August), Michigan (Hillsdale, Kalamazoo, and Wayne Counties), and Minnesota (Ramsey and Wabasha Counties, July 16).

Stem rot or wilt caused by Fusarium sp. reported from New Hampshire (Hillsboro Co., Aug. 26), Ohio (Lucas and Erie Counties, Feb. 28), Indiana (Tippecanoe Co. - a limiting factor in aster growing in the state), and Washington (Walla Walla Co.).

Botrytis sp. reported from Connecticut (New London, New London Co., Aug. 13).

Dodder (Cuscuta sp.) reported from New York (Schenectady, Schenectady Co., Aug. 23 - not important).

Yellows, cause undetermined, reported from New Jersey, Pennsylvania (found July 26 at Philadelphia), and West Virginia (Morgantown, Monongalia Co., May 18).

BARBERRY (Berberis sp.)

Rust caused by Puccinia mirabilissima Pk. reported in Washington (Whitman Co.)

Rust caused by Puccinia graminis Pers., reported from Vermont, Rhode Island (species questioned), Tennessee, Michigan (Kent Co), and Minnesota (nine counties throughout southern and southeastern section of state, May 18).

Angular leaf spot, cause bacterial, reported from Washington (Whitman Co.).

BARBERRY, Japanese (Berberis regeliana)

Leaf spot caused by Gloeosporium berberidis Cke. reported from Minnesota (Dakota Co., July 28).

BEGONIA sp.

Root gall caused by Heterodera radicicola (Greef.) Müller present in Ohio.

BOX (Buxus sempervirens)

Macrophoma candolei Berl. and Vogl., reported from New York. (J.F.C.)

CARNATION (Dianthus caryophyllus)

Wilt caused by Fusarium sp. was more prevalent in Ohio than in the past. Earliest report Mar. 25.

Rust caused by Uromyces caryophyllinus (Sch.) Wint. reported from New Jersey (common but not serious) and Ohio (in greenhouse, Cuyahoga, Fairfield, Franklin, and Lucas Counties.

Stem rot caused by Botrytis sp. occurred in Ohio.

Root rot caused by Rhizoctonia sp. was reported from New Jersey as of common occurrence but not serious in extent of damage.

Root knot caused by Heterodera radicicola (Greef.) Müller reported from Texas as unimportant.

CHRYSANTHEMUM (Chrysanthemum hortorum)

Leaf spot caused by Septoria chrysanthemi Cav. (S. chrysanthemella (Cav.) Sacc.) reported from Texas (Navarro Co. - unimportant).

Sooty mold caused by Fumago sp. reported from Texas (Matagorda Co. - unimportant).

Powdery mildew caused by Erysiphe cichoracearum D.C. (Oidium chrysanthemi) reported from Ohio (Wayne Co. - normal prevalence).

A leaf spot, cause undetermined, was reported from Ohio.

CELASTRUS SCANDENS

Leaf spot caused by Ramularia celastri Pk. reported from Minnesota (Wright Co., July 27).

DAHLIA (Dahlia sp.)

Powdery mildew caused by Erysiphe cichoracearum D.C. reported from Ohio (Montgomery Co., Oct. 28 - moist weather conditions were favorable).

DAISY

Leaf spot caused by Cercospora sp. reported from Minnesota (St. Louis Co., Aug. 17).

DELPHINIUM (Delphinium sp.)

Leaf spot caused by Phyllosticta sp. reported from New York (Little Falls, Herkimer Co., July 16).

Powdery mildew caused by Erysiphe sp. reported from New York (Poughkeepsie, Dutchess Co., June 14).

EVONYMUS (Evonymus sp.)

Leaf spot caused by Exosporium concentrichum (Heald) Wolf reported from Texas (Bexar, Brazos, Grimes, Harris, and Waller Counties - rather important).

GERANIUM (Geranium sp.)

Gray mold caused by Botrytis cinerea Pers. reported from Ohio (Madison Co., Mar. 29).

Stem rot, cause undetermined, reported from Washington (Grant Co.).

GLADIOLUS (Gladiolus sp.)

Hard rot caused by Septoria gladioli Passer. reported from New York. It is found within the state wherever the gladiolus is extensively grown. All varieties are reported to be susceptible.

GOLDEN GLOW (Rudbeckia laciniata)

Powdery mildew caused by Erysiphe cichoracearum D.C. reported from West Virginia (Monongalia Co).

Rust caused by Uromyces rudbeckiae Arth. & Holw., reported from Minnesota (Becker, Clay, and Goodhue Counties, May 16).

GOLDEN ROD (Solidago spp.)

Rust caused by Coleosporium solidaginis (Schw.) Thüm. reported from Vermont (common during fall months, Sept. 30) and West Virginia (common on several species in Monongalia Co.).

Rust caused by Puccinia asteris Duby, reported from Minnesota (July 30).

HOLLYHOCK (Althea rosea)

Rust caused by Puccinia malvacearum Mont. reported from Vermont (average prevalence - small percent of crop injury - earliest report September 1), New York (severe, found wherever hollyhocks are grown), New Jersey, West Virginia, Iowa, and Washington. Common throughout New York and New Jersey.

Leaf spot caused by Phyllosticta althaeina Sacc. reported from Ohio.

Leaf spot caused by Cercospora althaeina Sacc. reported from Minnesota (Nobles Co., July 16).

Root rot caused by Ozonium omnivorum Shear, reported from Texas (Bell, Dallas, Denton and Kauffman Counties - found in soils where cotton dies - 2% reduction in yield).

HUCKLEBERRY (Gaylussacia baccata)

Exobasidium vaccinii (Fckl.) Woron. reported from Rhode Island. (J.F.C.)

HYDRANGEA (Hydrangea hortensia)

Rust caused by Pucciniastrum hydrangeae (B. & C.) Arth. reported from West Virginia (abundant in certain localities in vicinity of Morgantown, Monongalia Co.).

IRIS (Iris spp.)

Bulb rot caused by Bacillus caratovorus Jones reported from Ohio (found June 10 in Van Wert Co.).

Rhizoctonia caused by Rhizoctonia sp. reported from Washington.

Leaf spot caused by Didymellina iridis (Desm.) Von H. (Heterosporium gracile (Wal.) Sacc.) reported from New York (moderately severe, causing a spotting of the leaf, occurs each year on the Cornell University campus at Ithaca) and Minnesota (Hennepin, Kittson and Ramsey Counties, July 2).

JONQUIL (Narcissus sp.)

Blight caused by Botrytis sp. reported from Washington (King Co.)

LILAC (Syringa spp.)

Powdery mildew caused by Microsphaera alni (Wallr.) Wint. reported from New York (found wherever lilacs are grown), New Jersey (throughout state, abundant but not serious), West Virginia (generally present late in the season around Morgantown, Monongalia Co. - so far not considered important), Ohio (present in Montgomery and Wayne Counties, less prevalent during 1920 - earliest appearance Oct. 28), Minnesota (reported from eleven counties - earliest report July 16), and Iowa (common).

Leaf spot caused by Phyllosticta halstedii E. & E. reported from New Jersey (common).

Leaf spot caused by Cercospora sp. reported from Minnesota (local and unimportant, earliest report Aug. 23 at Arizona).

An interesting case of late flowering was observed and reported by John L. Sheldon of Morgantown, Monongalia Co., West Virginia. A brush pile had been burned near a lilac bush. Blossoms were observed on the fire side of the bush about the middle of October.

MATRIMONY VINE (Lycium sp.)

Downy mildew caused by Microsphaera sp. occurred in Ohio.

MORNING GLORY (Ipomoea spp.)

White rust caused by Albugo ipomoeae-panduranae (Schw.) Sw. (Cystopus convolvulacearum), reported from West Virginia (abundant and destructive to the wild morning glories, near Morgantown, Monongalia Co.), and Georgia (of general range over the state; unimportant during current year, produced leaf and fruit spot or lesions).

PALM (Phoenix sp.)

Smut caused by Graphiola phoenicis (Mong.) Poit. reported from Texas (a trace found - unimportant).

PALM, Date (Phoenix dactylifera)

Leaf spot caused by Exosporium palmovorum Sacc. reported from Texas (Harris Co. - important only when found in the greenhouses).

PEONY (Paeonia officinalis)

Leaf spot caused by Botrytis paeoniae Oud., reported from New York (of little importance), Pennsylvania (Center and Philadelphia Counties, June 12), Ohio (less prevalent), and Minnesota (reports only from southeastern portion of state - Rice Co., June 29). While the weather conditions were favorable to the disease in Pennsylvania it was unfavorable in Ohio where the soil water supply was abundant. Ohio reports no treatment used. In Minnesota the bud and root were mainly attacked.

Cladosporium peoniae Pass. reported from Minnesota (Dakota, Dodge and Wabasha Counties - earliest report from Dakota Co. July 28).

Scab caused by Cladosporium sp. reported from Washington (Whitman Co.).

A questionable mosaic was reported from Michigan.

PERIWINKLE (Vinca sp.)

Rust caused by Puccinia vincae (D.C.) Berk. reported from Michigan (Kent and Muskegon Counties - first report for state).

PHLOX (Phlox sp.)

Leaf spot caused by Cercospora phlagina Peck. reported from Minnesota (Hennepin Co., July 31).

PRIMROSE (Primula spp.)

Gray mold caused by Botrytis cinerea Pers., reported from Ohio (Occurred in greenhouse; percent of crop injury slight - earliest report March - varietal resistance was noted in that P. obconica was not affected while P. malicoides was very susceptible).

PRIVET (Ligustrum vulgare)

Anthracnose caused by Gloeosporium cingulatum Atk. occurred in Texas (Bell Co., unimportant) and Ohio (Knox Co., Apr. 14 - of normal prevalence, the loss being light.)

Leaf spot caused by Exosporium concentricum Heald and Wolf, reported from Texas (Harris Co., neither prevalent nor important within the state).

Root rot caused by Ozonium omnivorum Shear present in Texas (Ellis Co. - serious).

Winter injury caused by low temperature and snow was general in Ohio.

Drought breakdown caused by Physiological condition reported from Ohio, (Seneca Co., Oct. 22).

PYROLA (Pyrola rotundifolia)

Melampsoropsis pyrolae II. Arth., reported from Massachusetts. (J.F.C.)

ROSE (Rosa spp.)

Powdery mildew caused by Sphaerotheca pannosa (Wal.) Lev. reported from New York (var. rosae), New Jersey, Pennsylvania, West Virginia, Texas, Arkansas, Ohio, Minnesota, Missouri, Arizona, Idaho, Washington, and Oregon. The disease was of general occurrence in all the states heard from. In Texas and Arkansas it was more severe than in the previous year and in Ohio it was less troublesome. In New Jersey it was very abundant and frequently injurious. Also important in West Virginia, Texas and Oregon. All parts of the plant above ground were reported as being attacked. In New York a curling of the leaf, as well as bud blasting and dwarfing, were found. Moist weather conditions in Texas assisted to bring about a 1% reduction in yield. Although moist conditions prevailed in Minnesota, the cool temperature prevented severe injury. The ramblers and climbers were the most susceptible varieties in New York, Pennsylvania, West Virginia and Oregon, although the Dorothy Perkins was severely attacked in Arizona, as were other varieties in West Virginia growing in the shade.

Dates of appearance:

May	- Arkansas	July 22	- West Virginia
June 14	- Minnesota	September 22	- Arizona
June 23	- Ohio		

Rust caused by Phragmidium montivagum Arth. was found on Rosa neomexicana in Utah (June 28 Piute Co., Aug. 23 Cache Co., and Sept. 18 in Parleys Canyon), on Rosa pulverulenta (July 19 Iron Co., and Aug. 3 Beaver Co.).

Rust caused by Phragmidium rosae-californicae reported from Washington (Whitman Co.) and Phragmidium spp. from New York (was severe in the rose test garden at Ithaca for the first time) and Oregon (general in western part of the state). Phragmidium rosa-setigerae Diet. occurred in Ohio.

Rust caused by Earlea speciosa (Fr.) Arth. reported from Minnesota (Olmstead Co., June 9 - also found in Sherburn, Jackson, Martin, Freeborn and Mower Counties).

Crown gall caused by Bacterium tumefaciens Sm. & Towns. reported as greenhouse trouble from New York and Michigan.

Anthracnose caused by Gloeosporium rosae Hals. reported from Texas (Harrison Co. - unimportant) and Ohio.

Crown canker caused by Cylindrocladium scoparium Morgan reported from New York (reduction in the number of blooms on the Ophelia variety was noticed in a greenhouse at Irondequoit).

Leaf spot caused by Cercospora rosicola Pass. reported from Minnesota Marshall and Dodge Counties, July 26).

Cane blight caused by Coniothyrium fuckelii Sacc. reported from New Jersey (sometimes destructive).

Texas root rot caused by Ozonium omnivorum Shear reported from Texas (Denton, Tarrant, Dallas, Bell and Falls Counties - very important when rose plants are grown in black waxy soils - reduction in yield for the state amounted to about 1%.

Nematode, Heterodera sp., was reported from Michigan (Kent Co.).

Winter injury and frost blister caused by meteorological factors reported from Washington. The former occurred in Whitman County, the latter in King and Yakima Counties.

Black spot caused by Diplocarpon rosae Wolf, (Actinomena rosae Lib.) Fr.) reported from New York, Connecticut, New Jersey, Virginia, West Virginia, Texas, Arkansas, Ohio, Minnesota, Missouri, Washington, Oregon. The disease was of general prevalence in New York, Ohio and along the western portion of Oregon. About 70% of the plants in New York state were affected. In Texas it was very important and more prevalent than in 1919. In West Virginia it was abundant locally. In Arkansas it was quite severe and produced a crop injury of around 10%. The nature of the injury was mostly that of foliage spotting and premature defoliation. In New York the bush varieties were mostly attacked, especially hybrid perennials and hybrid teas. In Connecticut and New Jersey it is primarily a greenhouse trouble. In West Virginia the disease was abundant in shaded localities. In Texas and Ohio favorable moisture conditions existed which allowed the disease to be most prevalent.

Salt injury reported from Michigan (rose plants were affected by salt in the greenhouses located in Saginaw and Wayne Counties).

SUNFLOWER (Helianthus annuus)

Rust caused by Puccinia helianthi Schw. was reported from New York (about Ithaca it was very prevalent - moderately severe in state) and Utah (Zion's Canyon, Washington Co. A.O.G.).

SWEET PEA (Lathyrus odoratus)

Root rot caused by Thielavia basicola (B. & Br.) Zopf. reported from New York (occurred in several houses under glass).

SYRINGA (Philadelphus occidentalis)

Rust caused by Gymnosporangium gracilens (Peck.) Kern and Bethel reported found in Utah (Zion Canyon, Washington Co. - this extends the distribution of this Gymnosporangium about 200 miles westward. A.O.G.)

VIOLET (Viola odorata L.)

Root rot caused by Thielavia basicola (B. & Br.) Zopf. reported from New York (found by two growers who grew them under glass).

DISEASES OF MISCELLANEOUS PLANTS

Allium tricoccum Ait. — Leek, wild
  Septoria viridi-tingens Curt. — Leafspot
    Minnesota (Goodhue Co., May 1)

Amaranthus blitoides Wats. — Amaranth
  Albugo bliti (Biv.) Kze. — White rust
    Minnesota (Clay & Norman Counties, July 7)

Amaranthus retroflexus L. — Amaranth, green
  Albugo bliti (Biv.) Kze. — White rust
    Minnesota (Anoka, Clay, Isanti, Kittson, Marshall, Norman, Pennington, Red Lake, Ramsey, Sherburne, & Waseca Counties, June 22)

Ambrosia artemisiifolia L. — Ragweed
  Erysiphe cichoracearum DC. — Powdery mildew
  (E. ambrosiae Schwein.)
    Minnesota (September 11)

Ambrosia trifida L. — Ragweed, great
  Erysiphe cichoracearum DC. — Powdery mildew
  (E. ambrosiae Schwein.)
    Minnesota (Kittson, Polk, Rice, Waseca Counties July 22)

  Plasmopara halstedii (Farl.) B. & de T. — Downy mildew
    Minnesota (Dakota & Ramsey Counties, May 30)

  Puccinia xanthii Schw. — Rust
    Minnesota (Red Lake Co., Aug. 14)

Amphicarpa monoica (L.) Ell. — Peanut, hog
  Synchytrium decipiens Farl. — Blight
    Minnesota (Hennepin, Ramsey, Red Lake Counties, May 30)

  Uromyces appendiculatus (Pers.) Lev. — Rust
    Minnesota (Isanti Co., July 14)

Arisaema sp. — Jack in the Pulpit
  Uromyces arisaemae Cke. — Rust
    Minnesota (Ramsey Co., May 22)

Astragalus humistratus A. Gray — Locoweed
Uromyces punctatus Schrot. — Rust
Utah (July 19, Iron Co., A.O.G.)

Astragalus sonorae A. Gray — Locoweed
Uromyces punctatus Schrot. — Rust
Utah (July 19, Iron Co. A.O.G.)

Astragalus sp. — Locoweed
Uromyces punctatus Schrot. — Rust
Utah (July 19, Iron Co. A.O.G.)

Bidens frondosa L. — Beggarticks
Sphaerotheca humuli (DC.) Burr. — Powdery mildew
Minnesota (Clay Co., Sept. 7)

Brodiaea douglasii S. Wats. — Hyacinth, wild
Uromyces brodiaeae Ell. & Hark. I. — Rust
Utah (June 21, Summit Co. A.O.G.)

Bursa bursa-pastoris (L.) Weber — Shepherds purse
Albugo candida (Pers.) Roussel. — White rust
Minnesota (Clay and Norman Counties, July 7)

Cannabis sativa (Town.) L. — Hemp
Septoria cannabina Pk. — Leaf spot
Minnesota (Nobles Co., July 19)

Chamaesyce rugulosa (Engelm.) Rydb. — Spurge
Uromyces proeminens (DC.) Pass. — Rust
(U. euphorbiae Cook & Peck)
Utah (Aug. 3, Beaver Co. A.O.G.)

Chenodopium album L. — Pigweed
Peronospora effusa (Grev.) Rab. — Rust
Minnesota (Becker, Blue Earth, Kittson, Sherburne, Stevens, Waseca Counties, June 22)

Chrysopsis horrida Rydb. — Aster, golden
Puccinia grindeliae Peck — Rust
Utah (July 22, Washington Co. A.O.G.)

Cirsium arvense (L.) Scop. — Thistle, Canada
Albugo tragopogonis (Pers.) Kze. — White rust
Minnesota (Kittson, Pennington, Red Lake, Roseau, & Sherburne Counties, July 29)

Coffea sp. — Coffee
Corticium salmonicolor B. & Br. — Pink disease
Philippine Islands

Cogswellia sp. — Cous
Puccinia jonesii Peck — Rust
Utah (July 17, Iron Co. A.O.G.)

Convolvulus sepium L. — Bindweed, hedge
Puccinia convolvuli (Pers.) Cast. — Rust
Minnesota (June 27)

Echinocystis lobata (Michx.) T. & G. — Balsam-apple, wild
Plasmopara australis (Speg.) Swing. — Downy mildew
Minnesota (Dakota & Ramsey Counties, June 26)

Erigeron canadensis L. — Horseweed
Puccinia asteris Duby — Rust
Minnesota (July 5)

Erigeron ramosus (Walt.) B.S.P. — Fleabane, Daisy
Puccinia asteris Duby — Rust
Minnesota (Anoka Co., July 5)

Eriogonum spp. — Eriogonum
Uromyces intricatus Cooke — Rust
(U. eriogoni Ell. & Hark.)
Utah (Iron and Washington Counties. A.O.G.)

Euphorbia sp. — Euphorbia
Uromyces proeminens (DC.) Lev. — Rust
(U. euphorbiae Cke. & Pk.)
Minnesota (Anoka, Hennepin & Kittson Counties, June 27)

Geranium maculatum L. — Cranesbill, wild
Puccinia polygoni-amphibii Pers. — Rust
Minnesota (Anoka, Chisago and Rice Counties, June 5)

Grindelia squarrosa (Pursh.) Dunal — Tarweed
Erysiphe cichoracearum DC. — Powdery mildew
(E. lamprocarpa Kickx.)
Minnesota (Wadena Co., Sept. 15)

Grossularia inermis (Ryd.) Cov. & Britt. — Gooseberry, wild
Melampsora confluens (Pers.) Jackson — Rust
(Caeoma confluens (Pers.) Schrot.)
Utah (July 1, Garfield Co. A.O.G.)

Grossularia leptantha (A. Gray) Cov. & Britt. — Gooseberry
Cronarticum occidentale (Hedge.) Bethel & Hunt — Rust
Utah (Aug. 3, Beaver Co. A.O.G.)

Melampsora confluens (Pers.) Jackson — Rust
(Caeoma confluens (Pers.) Schrot.
Utah (July 1, Garfield Co. A.O.G.)

Puccinia micrantha D. Griff. I. — Rust
Utah (Aug. 3, Beaver Co. This collection moves the range of the species at least 200 miles westward (A.O.G.)

Hepatica acutiloba DC. — Hepatica
Tranzschelia punctata (Pers.) Arth. — Rust
Minnesota (Goodhue Co., May 15.)

Urocystis anemones (Pers.) Wint. — Smut
Minnesota (Goodhue Co., May 15)

Hieracium griseum Ryd. — Hawkweed
Puccinia hieracii (Schum.) Mart. — Rust
Utah (July 15, Summit Co. A.O.G.)

Hydrastis canadensis L. — Golden Seal
Botrytis sp. — Stem rot
Connecticut (Middlesex, New London Counties. Found at Mt. Carmel June 2). New York

Mosaic (cause undetermined) — Mosaic
Connecticut (a new disease in state - not prevalent)

Hydrophyllus virginianum L. — Waterleaf
Sphaerotheca humuli var. fuliginea (Schlect.) Lahn. — Powdery mildew
Minnesota (Becker and Benton Counties, July 16)

Impatiens pallida Nutt. — Touch-Me-Not
Ramularia impatientis Pk. — Leaf spot
Minnesota (Blue Earth Co., June 22)

Ivesia gordonii (Hook.) T. & G. — Ivesia
Phragmidium horkeliae Garrett — Rust
Utah (Aug. 16, Salt Lake Co. A.O.G.)

Kentrophyta impensa (Sheld.) Ryd. — Rust
Uromyces punctatus Schrot.
Utah (July 17, Iron Co. A.O.G.)

Lactuca canadensis L. — Lettuce, wild
Septoria lactucae Pass. — Leaf spot
Minnesota (June 1)

Madronella oblongifolia Ryd. — Horse-mint, western
Puccinia monardellae Dudley & Thompson II. — Rust
Utah (July 20, Iron Co. A.O.G.)

Mentha spicata L. — Mint
Puccinia menthae Pers. II. — Rust
Utah (July 28, Iron Co., Aug. 20, Cache Co. Not before reported on this host for Utah. A.O.G.)

Monarda fistulosa L. — Bergamot, wild
Puccinia menthae Pers. — Rust
Minnesota (Clay, Isanti, Red Lake and Rice Counties, July 4)

Oenothera biennis L. — Primrose, evening
Erysiphe polygoni DC. — Powdery mildew
(E. communis Grev.)
Minnesota (Aitkin, Beltrami Counties, Sept. 15)

Puccinia peckii (De Toni) Kellerm. Rust
Minnesota (Anoka, Isanti, Roseau Counties, June 1)

Osmorrhiza sp. Osmorrhiza
Puccinia osmorrhizae (Pk.) C. & P. Rust
Minnesota (May 16)

Panax quinquefolium L. Ginseng
Septoria sp. Leaf spot
Minnesota (Sherburne Co. July 2)

Non-parasitic "Rust"
Washington (Skagit Co.)

Undetermined Rot
Ohio (Tuscarawas Co. June 21)

Peucedanum graveolens Br. & H.
Heterosphaeria patella Grev. Rust
(Sphaeria patella Pers.) (S. penetrans a. patella Tode)
Minnesota (Wright Co., Aug. 29)

Physalis sp. Ground Cherry
Entyloma australe Speg.
Minnesota (Beltrami, Fillmore, Hennepin, Pipestone and Rice Counties, July 13)

Plantago major L. Plantain
Erysiphe cichoracearum DC. Powdery mildew
(E. lamprocarpa Kickx.)
Minnesota (Cass, Dakota, Itasca, Kanabec, Marshall, Mille Lacs, Poke, Rice, Roseau, Ramsey, Waseca Counties, June 23).

Ramularia plantagoinis E. & M. Leaf spot
Minnesota (July 2)

Polygonatum commutatus (R. & S.) Dietr. Solomon's Seal
Puccinia sessilis Schneid. Rust
Minnesota (Anoka & Rice Counties, June 20)

Polygonum aviculare L. Knot weed
Cercospora avicularis Wint. Leaf spot
Minnesota (Anoka and Norman Counties, July 5)

Erysiphe polygoni DC. Powdery mildew
Minnesota (Anoka, Clay, Isanti, Kittson, Marshall, Pennington, Ramsey, Red Lake, Roseau and Stevens Counties, June 23).

Puccinia polygoni amphibii Pers. Rust
(P. polygoni)
Minnesota (Pennington Co., June 5)

Uromyces polygoni (Pers.) Fuckel — Rust
Minnesota (Beltrami, Red Lake, Rice, Roseau and Waseca Counties, July 20)

Polygonum convolvulus L. — Bindweed
Puccinia polygoni-amphibii Pers. — Rust
P. polygoni convolvuli DC.)
Minnesota (Beltrami, Cass, Itasca, Kanabec, Pennington Counties, Aug. 5).

Polygonum erectum L.
Cercospora avicularis Wint. — Leaf spot
Minnesota (Anoka, Becker, Harman, Isanti, Rice and Roseau Counties, June 20)

Erysiphe polygoni DC. — Powdery mildew
Minnesota (Anoka, Beltrami, Kittson, Marshall, Norman, Pennington, Pipestone, Red Lake, Roseau, and Stevens Counties, June 27).

Polygonum muhlenbergii (Meisn.) Wats.
Puccinia polygoni amphibii Pers. — Rust
Minnesota (Itasca, Marshall Counties, Aug. 6).

Polygonum pennsylvanicum L.
Septoria polygonorum Desm. — Leaf spot
Minnesota (Ramsey Co., July 25)

Polygonum persicaria L. — Lady's Thumb
Ustilago utriculosa (Nees.) Tul. — Smut
Minnesota (Itasca, & Pennington Counties, Aug. 6)

Portulaca oleracea L. — Purslane, common
Albugo portulacens (DC.) Kze. — White rust
Minnesota (Beltrami Co., Aug. 5)

Potentilla canadensis L. — Cinquefoil
Frommea obtusa Arth. — Rust
(Uredo obtusa Strauss.)
Minnesota (Anoka Co., June 5)

Potentilla pulcherrina Lehm. — Cinquefoil
Phragmidium ivesiae Sydow II, III. — Rust
(Ph. affine Sydow.)
Utah (Aug. 20, Cache Co. A.O.G.)

Potentilla sp. — Cinquefoil
Phragmidium potentillae (Pers.) Karst. — Rust
(P. triarticulatum Farl.)
Michigan (Ingram Co.)

Ptilocalais tenuifolia Osterhout
Puccinia rugosa Billings — Rust
(P. troximontis Pk.)
Utah (June 21, Summit Co. A.O.G.)

Radicula palustris (L.) Moench. — Marsh cress
Albugo candida (Pers.) Roussel. — White rust
Minnesota (Isanti Co., July 12)

Ranunculus cymbaria Pursh. — Butter cup
Puccinia clematidis (DC.) Lagerh. — Rust
Utah (June 28, Piute Co., A.O.G.)

Ricinus communis L. — Castor bean
Ozonium omnivorum Shear — Root rot
Texas (found throughout state in soils where cotton dies. Ten percent reduction)

Ribes aureum Pursh. — Currant
Cronartium occidentale Hedge., Bethel & Hunt — Rust
Utah (July 29, Iron Co., Aug. 3, Beaver Co., Aug. 6 Millard Co., Aug. 20, Cache Co., Aug. 24, Morgan Co. A.O.G.)

Ribes cereum Dougl. — Currant
Coleosporium ribicola (C. & E.) Arth. II — Rust
Utah (July 17, Iron Co., Aug. 4, Beaver Co. A.O.G.)

Cronartium occidentale Hedge, Bethel & Hunt
Utah (Aug. 3, Beaver Co. A.O.G.)

Ribes cynosbati L. — Gooseberry, prickly
Puccinia ribis DC. — Rust
(P. grossulariae)
Minnesota (Anoka, Goodhue, Ramsey, Rice, Scott, Steele Counties, May 15)

Ribes gracile Michx. — Gooseberry, European
Puccinia ribis DC. — Rust
(P. grossulariae)
Minnesota (Goodhue, Ramsey Counties, May 15)

Ribes floridum L. Her. — Currant (wild black)
Puccinia ribis DC. — Rust
(P. grossulariae)
Minnesota (Goodhue & Ramsey Counties, May 16)

Ribes nigrum L. — Currant (black)
Puccinia ribis DC. — Rust
(P. grossulariae)
Minnesota (Scott Co., Aug. 30)

Ribes oxycanthoides L. — Gooseberry (smooth)
Puccinia ribis DC. — Rust
(P. grossulariae)
Minnesota (July 31)

Ribes petiolare Dougl. — Currant
Melampsora confluens (Pers.) Jackson — Rust
(Caeoma confluens (Pers.) Schrot.)
Utah (Aug. 16, Big Cottonwood Canyon)

Rubus (strigosus ?) Phragmidium imitans Arth. Utah (July 27, Iron Co. A.O.G.)	Raspberry Rust
Rubus villosus Ait. Gymnoconia interstitialis (Schl.) Lag. Rhode Island (J.F.C.)	Dewberry Rust
Rubus sp. Septória ribi West. Minnesota (Beltrami Co., Sept. 18)	Black berry (wild) Leaf spot
Rumex paucifolius Nutt. Uromyces fuscatus Arth. Utah (July 15, Summit Co. A.O.G.)	Dock Rust
Saponaria officinalis L. Macrosporium saponariae Pk. Minnesota (Stearns Co., Aug. 10)	Bouncing Bet Leaf spot
Saxifraga pennsylvanica L. Puccinia saxifragae Schlecht. Minnesota (Ramsey Co., May 30)	Saxifrage, swamp Rust
Scrophularia leporella Bickness Septoria scrophulariae Pk. Minnesota (July 3)	Figwort Leaf spot
Shepherdia canadensis Nutt. Aecidium allenii Clinton Utah (July 27, Iron Co. A.O.G.)	Buffalo Berry Rust
Sisymbrium officinale (L.) Scop. Altugo candida (Pers.) Roussel. Minnesota (Becker, Cass and Ramsey Counties, June 23)	Mustard, hedge White rust
Sisymbrium sp. Albugo candida (Pers.) Roussel West Virginia (J.L.S.)	Hedgemustard Blister blight
Smilacina stellata (L.) Desf. Puccinia sessilis Schneid. (Aecidium convallariae) Minnesota (Rice Co., June 30)	False Solomon's Seal Rust
Symphoricarpus occidentalis Hook Microsphaera diffusa Cke. & Pk. (P. symphoricarpi E. C. Howe) Minnesota (Kittson, Wadena Counties, Aug. 24)	Wolfberry Powdery mildew
Symphoricarpus racemosus Michx. Puccinia symphoricarpi Hark (probably) (Aecidium abundant) Oregon (Forest Grove)	Snowberry Rust

Microsphaera diffusa Cke. & Pk. — Powdery mildew
Washington (Whitman Co.)

Taraxacum officinale Weber — Dandelion
Puccinia taraxaci Plow. — Rust
West Virginia (common at Morgantown, Monongalia Co. J.F.C.)
Minnesota (reported from 19 counties throughout state, Apr. 29)

Ramularia taraxaci Karst. — Leaf spot
Minnesota (June 29)

Sphaerotheca humuli var. fuliginea (Schlect.) Lahn. — Powdery mildew
(S. castagnei)
Minnesota (Marshall, Ramsey, Waseca Counties, June 23)

Theobroma cacao L. — Cacao
Corticium salmonicolor B. & Br. — Pink disease
Philippine Islands (serious)

Tragopogon porrifolius L. — Salsify
Albugo tragopogonis (Pers.) Kze. — White rust
Washington (Whitman Co.)

Trillium dectinatum (Gray) Gleason — Trillium
Vermicularia peckii Sacc. — Leaf spot
Minnesota (Goodhue Co., May 16)

Urtica sp. — Nettle
Puccinia urticae Lagerh. — Rust
(Dicaeoma urticae (Shum.) Kunte.)
Michigan (Ingram Co.
Minnesota (Goodhue, Hennepin, Ramsey & Washington Counties, May 16)

Verbena hastata L. — Vervain, blue
Erysiphe cichoracearum DC. — Powdery mildew
(E. verbenae Schwein.)
Minnesota (Mille Lac and Polk Counties, Oct. 1)

Vernonia sp. — Ironweed
Coleosporium vernoniae B. & C. — Rust
West Virginia (in vicinity of Morgantown, Monongalia Co.)

Viola pubescens Ait. — Violet, Downy Yellow
Puccinia violae (Schw.) DC. — Rust
Minnesota (Clay Co., July 13)

Viola sororia Willd. — Violet
Puccinia violae (Schw.) DC. — Rust
Minnesota (Ramsey Co., May 23)

Vitis sp. — Grape, wild
Uncinula necator (Schw.) Burr. — Powdery mildew
Minnesota (Hennepin Co., July 3)

STATUS OF WHITE PINE BLISTER RUST CONTROL IN 1920-21.

(Prepared by S. B. Detwiler, Office of Blister Rust Control)

"Blister rust is present throughout the white pine regions of New England and New York. The disease is to be found on practically every square mile where wild Ribes are found, but the per cent of infected bushes is small, as yet, except in the worst localities. On 330 check plots in New Hampshire and Massachusetts, State crews examined 146,000 wild Ribes in 1920 and report 1.7 per cent of the wild gooseberry bushes and 2.6 per cent of the skunk currant plants as being infected. In sections where pine infection is heavy and producing aeciospores copiously, from 50 to 80 per cent of the wild Ribes are infected. The uninfected and lightly infected bushes are small suppressed plants growing under cover, and frequently, also, bushes growing in dry, exposed situations, where their leaves become thick and leathery and therefore difficult to infect. Of the cultivated Ribes, R. nigrum is nearly always heavily infected, R. americanum, R. vulgare, and R. grossularia only occasionally. Heavy infection on the three latter species occurs most frequently on bushes growing in moist, shaded sites, or where there has been heavy production of aeciospores in close proximity. Infection on these species also varies with the seasons, being heavier in wet years.

"Pine infection is increasing rapidly over extensive areas. The infection on 1919 wood, which is just now becoming visible, is so great as to change previous conceptions regarding the rate of pine infection. The wave-like spread of the rust is becoming apparent. The period from 1900 to 1912 may be considered as the period of introduction and dissemination of this disease over wide areas. In 1914 and 1915, and again in 1918 and 1919, rapid increase in general pine infection took place. From now on, aeciospores will be produced so generally and in such great quantity close to Ribes that another and greater wave of pine infection must be expected in the near future. Drouth during late summer and autumn may be expected to retard this overwhelming infection, since evidence is accumulating that shows high humidity as the chief controlling factor in conditions favoring pine infection. In general, the rapidity and severity of pine infection may be considered as being proportional to the Ribes leaf area adjacent to the pines, since this mainly governs the volume of sporidia produced. Species of Ribes also has a bearing, since there is a marked difference in the abundance of telial columns produced on heavily infected leaves of various species. However, all Ribes found in the northeastern states produce a sufficient number of sporidia to cause damage to pine when aeciospores are produced nearby in large quantities. The distance to which Ribes infect pine is governed principally by the size (especially height) of the bushes, degree and character of their screening, and topography, since these appear to be the chief factors in retarding or accelerating the dissemination of the sporidia. York has reported that the sporidia failed to germinate after a period of ten minutes, under seemingly favorable conditions (p. 10 Bulletin 4, American Plant Pest Committee). This is evidently the reason for the short distance to which Ribes ordinarily infect pine. Excluding Ribes nigrum, R. odoratum and R. aureum, white pine can be grown commercially as a rule when separated at least 200 yards from

Ribes. Isolated wild gooseberry bushes have been found around which pine infections centered for a distance of 500 feet. In most cases, the infecting range of wild Ribes does not exceed 100 to 200 feet. The foregoing conclusions are the results of field observations, and do not refer to the scientific investigations on this disease conducted by the Office of Forest Pathology. So far as determined, however, the scientific facts agree with the field observations.

"The degree of pine infection is shown by the accompanying tabulation. This study was made by running compass lines across country, examining all pines on a strip one rod wide. At points where infection was greatest on or adjacent to the compass lines, small square plots were laid off and the data recorded separately.

Strip	Miles	Acres	No. pine examined	Infected with blister rust	No. plots	Acres	No. pine examined	Infected with blister rust
Littleton to Piermont, N.H. (1919)	39.5	79	6,161	12.5%	213	49.1	7,014	51.5%
Wells River to Barnett - Vt. (1919)	28	56	4,002	3.1%	7	1.8	385	6.2%
Lewis to Ausable Forks - N. Y. (1919)	22.9	55.8	10,501	4.9%	13	14.4	12,986	15.8%
Douglas - N. Y. (1919)	5.5	11	1,796	6.8%	3	.75	1,469	32.8%
Ipswich - Mass. (1919)	4.4	8.8	871	5.7%	9	3	637	27.0%
Brunswick to Farmingdale to Woolwich, Me. (1920)	38.5	77	7,046	6.3%	11	2.75	970	14.4%
Totals	138.8	287.6	30,377	7.0%	256	71.85	23,461	27.7%

"Demonstration control work was conducted in 1920 in cooperation with the States where blister rust is present, as in previous years. The results confirm the conclusions reached in 1919, namely, that it is practicable to eradicate wild and cultivated currant and gooseberry bushes as a means of controlling the blister rust. Thus, in the town of Petersham, Mass., Mr. C. C. Perry reports that on 11,426 acres from which 650,076 Ribes bushes were eliminated, there are 7,075 acres of pine (65 per cent of the area in young growth) within the boundaries of this local control area. The cost of clearing the land of Ribes was 39 cents per acre, or 63 cents per acre of exclusive pine growth. The merchantable pine on this area was accurately estimated, and its total value fixed at $241,460. It required an expenditure of 1.85 per cent of the pine value to protect this area for a period of at least five years. The average cost of control in all States was 35 cents.

per acre in 1920, 54 cents per acre in 1919, and 66 cents in 1918. These figures include the cost of labor, supervision, and transportation of field men. The total cost averaged only 24 cents per acre for 263,005 acres in the New England States in 1920. The efficiency of the crew work was determined by 682 checks on areas totaling approximately 6,000 acres. The results show that an average of 97.2 per cent of the total number of wild currant and gooseberry bushes (containing over 99 per cent of the Ribes leafage) were destroyed by the crews in the first working of the ground. Of these checks, 112 plots totaling 316 acres were gone over four to six times each. The crews destroyed 65,104 bushes (97 per cent) in the first working of these plots, and found only 1,965 bushes in the checks.

"These favorable results are due to systematic work. The methods used are not complicated, although based on scientific principles. Unskilled labor can be taught quickly to do first class work under the direction of an experienced supervisor. The few bushes missed in the first working are small and well covered, as a rule, and therefore not a serious menace for at least five to ten years, when the ground should be gone over again. The owners of cultivated currants and gooseberries have shown a fine spirit of cooperation in destroying their bushes, even when the pines thus protected are on adjacent property. In New Hampshire, out of 2,139 owners of cultivated bushes, only nine claimed compensation from the State. The following table summarizes the work accomplished by the various states in cooperation with the Bureau of Plant Industry.

State	Total acreage white pine growth*	%acreage bearing growth under 20 years*	Value white pine in State	No. acres from which Ribes eradicated. 1917-1920, inc.	Average Ribes per acre	Average cost per acre
Maine	3,000,000	50%	$50,000,000	29,529	22	$0.69
N. H.	2,500,000	90%	50,000,000	456,889	11	.229
Vt.	86,000	28%	4,420,400	17,659	14.5	1.01
Mass.	775,000	38%	58,000,000	48,944	36	.70
R. I.	125,000	80%	1,250,000	84,526	0.8	.184
Conn.	180,000	10%	1,280,000	8,970	15.3	.95
N. Y.	1,500,000	40%	50,000,000	59,588	63.4	2.48
Sub-totals	8,266,000	58%	217,950,400	706,105	14.0	0.494
Wis.	800,000	75%	17,000,000	11,651	73.9	$0.75
Minn.	5,500,000	10%	160,000,000	5,278	69.4	2.79
Totals	14,566,000	46%	394,950,400	723,034	18.4	$0.515
Acreage for which accurate costs not available				213,068		
Total acreage 1917-1920 inc.				936,102		

*Estimated by the State Forester of the respective states.

"The first area in New England where currant and gooseberry bushes were uprooted on a large scale to control this disease is located in the town of Lenox, Mass. The work on this area was done in July, 1916. The crews had no previous experience in such work and consequently found and removed only about 75 per cent of the bushes. In 1920, a critical study was made on the Lenox area, which showed that ten times as many pine infections took place in the three years prior to 1916 as occurred in the three years after control work was done. Every pine on plots covering twelve acres was carefully examined in this study. Many blister rust cankers were cut out of the trees on this area in 1916, but there is no way of determining the number thus destroyed in the study area as records in 1916 were not kept by plots.

"A more definite comparison of the effectiveness of this control work is furnished in a study of an infection area at New Boston, Mass. Infection began in this area in 1911, and at Lenox in 1906. No control work has been done at New Boston, but otherwise conditions are similar to those at Lenox. On this area the amount of pine infection for the three years after 1916 was approximately the same as in the three years before 1916, but for every infection at Lenox since 1916, 22 infections took place at New Boston during the same period, basing the comparison on 10,000 trees in each area. The control methods used at Lenox were greatly inferior to those since developed, yet the work reduced the rate of pine infection to less than one-twentieth of that at New Boston. It is therefore conservative to state that destruction of 75 per cent of the currants and gooseberries has resulted in reducing pine infection at least 90 per cent. Improved methods now insure the removal of over 95 per cent of the bushes in going over the ground once. This should give commercial protection to pine stands for at least five to ten years.

"It should be borne in mind that the blister rust was not found on native pine in the United States under forest conditions until the fall of 1915. The field work in 1916 was devoted to an attempt to eradicate infection in the known areas, and at the same time to scout for the disease. Such Ribes eradication work as was done in 1916 was not well organized because of inexperience and the pressure to cover ground ahead of the disease. When it was realized that the disease could not be prevented from spreading throughout the range of Pinus strobus, serious attention was concentrated on the possibilities of controlling the disease locally. The results of the early work in uprooting Ribes is now becoming fully apparent. The long incubation period of the disease (one known case in New York being 17 years) makes it unsafe to accept present results as absolutely accurate in percentages. However, the majority of the cankers become visible in the third or fourth season after infection takes place. Infection is considered to have taken place on the year's wood on which the center of the canker is located. The writer believes that most of the pines are infected through the needles, and that needles of the season's growth are attacked chiefly. Some infection may take place on needles two, three, four, or even five years old, and for this reason percentages of infection by years may not be entirely exact.

"Fortunately, Ribes eradication on some of the early control areas was thorough, and consequently no infection is showing in 1921 on wood that grew since 1916.

"At Kittery Point, Maine, Ribes were eradicated in 1917 and an average of 15 wild Ribes per acre were destroyed. Ten acres of this area on which pine was most heavily infected from wild and cultivated Ribes, were selected as a study area. In 1917-18, all pines in the area were located on a map by quarter acre plots, and the infection on each tree recorded, and each tree numbered and tagged. In August 1921, four plots representing 10 per cent of the study area were reexamined, and failed to reveal a single infection on wood later than 1916. The Ribes were removed early in the spring of 1917 and no other bushes were found in checks made in 1918, 1919 and 1921. Infection in 1916 and earlier is abundant on pine in the plots, hence the destruction of the Ribes in 1917 must be responsible for completely stopping infection after 1916. It is interesting to note that the four plots rechecked in 1921 contained 612 trees in 1917, of which 363 trees were infected at that time. In 1921 there were only 333 infected trees because the blister rust mycelium in the cankers on 30 trees had died out, due to the death of the branch before the mycelium reached the stem. However, of the 333 infected trees found in 1921, 204 were dead. Although these dead trees were mostly 10 to 20 years old, the loss is compensated to some extent by 146 seedling pines which have seeded in since 1917. None of these seedlings are infected.

"Dr. L. H. Pennington states that in 1918 a considerable amount of Ribes eradication was done north of Lewis, N. Y., on the east side of the road. No pine infections have been found upon growth younger than that of 1917 in the area from which Ribes were removed. Many infections are found upon the 1918 and 1919 growth in the pine on the west side of the road where the Ribes were not eradicated. Also, in the Boulder Cut plantation near Saranac Lake, N. Y., Dr. Pennington has been unable to find any infections on growth younger than 1917, although many cankers are present on 1917 and earlier growth. The Ribes were eradicated in and around this plantation early in the spring of 1918. Dr. H. H. York reports that he has been unable to find a single canker later than 1916 in origin on an infection area at North Conway, N. H., where the Ribes were removed early in 1917. He also examined 250 small pine trees in a 3¼ acre swamp where in 1917 more than 16,000 skunk currant bushes were pulled. Not a single canker dating later than 1916 could be found. One hundred and four cankers of 1916 origin or previous thereto were found. In 1918, Dr. York established check plots in this swamp where patches of skunk currant were pulled in 1917. In these plots the skunk currant seedlings in 1918 were so numerous that there were not less than two per square inch. Today 99½ per cent are gone, due to natural death. The few remaining are 2 to 6 inches in height and are so densely covered with red raspberry, sedges, hardhack and other plants that it does not seem possible, in Dr. York's opinion, for the seedling Ribes to become a serious menace to the pine for 5 years, at least, from the present time. The sprouts from root stocks are so densely screened that they have made very little growth, and they too, in most instances, are of little serious concern, with the exception of a few small areas where they should be pulled in 1922. If this is done thoroughly, Dr. York states that he sees no need for a third eradication of Ribes for the succeeding 15 years, with conditions in the swamp continuing as at present. Dr. York also reports no infection after 10,000 Ribes were removed on a 300 acre tract of pine in 1917 and concludes his statement as follows: "Again I wish to state that only eradication of the Ribes will save the pine, and only this will make the growing of white pine possible on a commercial scale in the future. The Ribes can be eradicated at a cost to amply warrant doing this work. What has been done here is sufficient proof."

"Observations made abroad on the susceptibility of sugar pine and western white pine show that these species are as readily attacked and as severely damaged as our eastern white pine, and limber pine is even more susceptible. This fact is of especial significance to the United States. The widespread abundance of wild currants and gooseberries in the Pacific Coast and Rocky Mountain regions, places these valuable western species in an extremely hazardous position today. It is not overstating the case to predict that once the blister rust is permitted to enter into the Far West, it will threaten the future position of these species in the timber markets of the world. According to Mr. W. S. Moir, who investigated blister rust conditions in Norway, Sweden, Denmark, Belgium, France and England in 1920, strict enforcement of the Federal quarantine prohibiting shipment of blister rust host plants west of the Great Plains is essential to the safety of these western forests. State and Federal inspectors have intercepted 310 shipments of blister rust host plants during the past four years, as they entered the West in violation of the quarantine.

"The U. S. Department of Agriculture has entered into cooperative agreements with practically all of the States in the Far West, for the purpose of obtaining concerted action to keep out the blister rust. Quarantine officers of western states are informed of the dangerous character of this disease and realize that the responsibility of preventing introduction of blister rust hosts rests primarily with them. Persistent searching in the five-leaved pine forests of the Rocky Mountain and Pacific Coast regions indicates that the white pine blister rust has not become established west of the Great Plains. (August 31, 1921)"

PRELIMINARY LIST OF PUBLICATIONS ON DISEASES OF FOREST, SHADE AND ORNAMENTAL TREES AND SHRUBS.

Blakeslee & Jarvis. Trees in winter.
The MacMillan Company, New York, 1913.

Clark, W. D. Facts for farmers. The Ext. Ser. of Mass. Agr. Col. Vol. III, No. 10.

Collins, J. Franklin. Tree surgery. Farmers' Bul. 1178, 1920, U. S. Dept. Agr., Washington, D. C.

Corbett, L. C. Pruning. Farmers' Bul. 181, U. S. Dept. Agr., Washington, D. C.

Foster, J. H. and Krausz, Harry B. Tree planting needed in Texas. Bul. 2 of the Agr. & Mech. Col. of Tex., Dept. of For. Jan. 10, 1917 Vol. III, No. 1.

Garcia, Fabian. Shade trees and other ornamentals. New Mexico Agr. Sta. Bul. 47. Mesilla Park, 1903.

Gaskill, Alfred. A shade tree guide.
Hudson Printing Company, Union Hill, 1918.

Gaskill, Alfred. The planting and care of shade trees. New Jersey forest commission.
State Gazette Publishing Company, Trenton.

Gaylord, F. A. State of New York conservation commission division of lands and forests. (Bul 7 - Shade trees).
J. B. Lyon Company, Albany, 1912.

Hansen, N. E. Evergreens for South Dakota. S. Dak. Agr. Expt. Sta. Bul. 102. Brookings, 1907.

Kennedy, P. Beveridge. Ornamental and shade trees. Nev. Agr. Expt. Sta. Bul. 61. Reno, 1906.

Metcalf, Haven (pathologist in charge of the laboratory of forest pathology, Bureau of Plant Industry). Rep. from yearbook for 1907, Washington, D. C.

Morris, O. M. Tree culture. Okla. Agr. Expt. Sta. Bul. 86. Stillwater, 1910.

Nelson, Aven. Shade tree suggestions. Wyo. Agr. Expt. Sta. Bul. 37. Laramie, 1903.

Nelson, Aven. The winter-killing of trees and shrubs. Wyo. Agr. Expt. Sta. Bul. 15. Laramie, 1893.

Ness, H. Notes on forest and ornamental trees on the grounds of the agricultural and mechanical college of Texas. Tex. Agr. Expt. Sta. Bul. 105. College Station, 1908.

Parkhurst, H. E. Trees, shrubs and vines.
Charles Scribner's Sons, New York, 1903.

Peets, Elbert. Practical tree repair.
McBride, Nast & Company, New York, 1913.

Secrest, Edmund. Protection for shade trees. Ohio Agr. Expt. Sta. Mo. Bul. Vol. V No. 6, Wooster.

Shuler, M. R. Trees for northern North Dakota.
Bulletin - Forestry State Normal School, Bottineau.

Solotaroff, William (secretary-treasurer forest park reservation commission). Shade tree federation of New Jersey.
MacCrellish & Quigley, Trenton, 1919.

Stone, Geo. E. Shade trees,- characteristics, adaptation, diseases and care. Mass. Agr. Expt. Sta. Bul. 170.
Amherst, 1916.

Thornber, W. S. Trees in Washington. Wash. Agr. Expt. Sta. Pop. Bul. 23. Pullman, 1909 (reprinted 1911).

Thornber, W. S. Forest, shade and ornamental trees in Washington. Wash. Sta. Bul. 90., Pullman, 1909.

------- Seventh annual report of the shade tree commission. Newark, 1910. (N.J.)

------- Bul. of Mass. tree wardens and foresters' association. Vol. II, No 3. Harold J. Neald, Worcester (for reprints).

THE PLANT DISEASE BULLETIN

Issued By

THE PLANT DISEASE SURVEY

SUPPLEMENT 18

Crop Losses from Plant Diseases in the United States in 1920

July 1, 1921

BUREAU OF PLANT INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE

PLANT DISEASE SURVEY

1920

G. R. Lyman, Pathologist in Charge.

R. J. Haskell, Asst. Pathologist. G. H. Martin, Jr., Asst. Pathologist.

List of Collaborators of the Plant Disease Survey who have made the principal contribution to the 1920 annual Summary.

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Arizona.......	Prof. J. G. Brown
Arkansas......	Dr. J. A. Elliott
	Prof. H. R. Rosen
Colorado......	Prof. C. D. Learn
Connecticut...	Dr. G. P. Clinton
Delaware......	Dr. T. F. Manns
Georgia.......	Prof. J. A. McClintock
Idaho.........	Prof. C. W. Hungerford
Illinois......	Dr. H. W. Anderson
	Dr. F. L. Stevens
	Prof. G. H. Dungan
Indiana.......	Dr. M. W. Gardner
Iowa..........	Dr. I. E. Melhus
Kansas........	Prof. L. E. Melchers
Kentucky......	Dr. W. D. Valleau
Louisiana.....	Dr. C. W. Edgerton
Maryland......	Prof. C. E. Temple
Massachusetts.	Prof. A. V. Osmun
	Mr. W. S. Krout
Michigan......	Dr. E. A. Bessey
	Dr. G. H. Coons
	Mr. Ray Nelson
Minnesota.....	Dr. E. C. Stakman
	Prof. J. G. Leach
Mississippi...	Prof. D. C. Neal
Missouri......	Dr. E. F. Hopkins
Montana.......	Prof. D. B. Swingle
	Dr. H. M. Jennison
Nebraska.......	Prof. R. W. Goss
Nevada.........	Prof. C. W. Lantz
New Hampshire..	Dr. O. R. Butler
New Jersey.....	Dr. M. T. Cook
New York.......	Dr. Chas. Chupp
North Carolina.	Dr. R. A. Jehle
North Dakota...	Prof. H. L. Bolley
	Dr. Wanda Weniger
Ohio...........	Prof. A. D. Selby
	Mr. R. C. Thomas
Oregon.........	Prof. H. P. Barss
	Prof. C. R. Orton
Pennsylvania...	Prof. H. W. Thurston
Porto Rico.....	Mr. Julius Matz
South Dakota...	Dr. Arthur T. Evans
Tennessee......	Prof. S. H. Essary
	Dr. L. R. Hesler
	Prof. C. D. Sherbakoff
Texas..........	Dr. J. J. Taubenhaus
Utah...........	Dr. B. L. Richards
Vermont........	Dr. B. F. Lutman
	Prof. A. H. Gilbert
Virginia.......	Dr. F. D. Fromme
Washington.....	Dr. F. D. Heald
	Mr. B. F. Dana
	Mr. A. M. Frank
West Virginia..	Dr. N. J. Giddings
	Prof. Anthony Berg
	Dr. J. L. Sheldon
Wisconsin......	Dr. R. E. Vaughan

CROP LOSSES FROM PLANT DISEASES IN THE UNITED STATES IN 1920.

Supplement 18. July 1, 1921

CONTENTS

Tables showing disease losses by states for the following crops:

Foreword

In preparing the 1920 crop loss estimates the usual sources of information were utilized and the same methods followed as in 1918 and 1919. The symbols adopted last year also have been employed and a condensed key to these is given here. (For more detailed explanation see Pl. Dis. Bul. Suppl. 12: 308. 1920).

- = No data.
t = Trace, less than 1%.
+ = Loss occurred but amount not known.
* = Occurrence.
*- = Occurrence, no data as to loss.
*0 = Occurrence, but no loss.

Crop losses from plant diseases in 1920.

Although the loss to the cereal crops was not so great in 1920 as in 1919, the toll taken by diseases of other crops, such as potatoes, beans, peaches, and apples, was in excess of that taken in 1919, so that the total disease losses for the eleven crops listed here average about the same for the two years.

The following table gives a comparison of the estimated total disease losses of the years 1919 and 1920.

Table 107. Estimated losses to eleven crops from plant diseases in 1919 and 1920.

Crop	1920 % loss	1920 Bushels loss (000 omitted	1919 % loss	1919 Bushels loss (000 omitted	Crop	1920 % loss	1920 Bushels loss (000 omitted	1919 % loss	1919 Bushels loss (000 omitted
Wheat	11.7	104,129	16.96	192,275	Sweet potato	25.8	39,150	36.23	58,841
Rye	1.98	1,406	1.74	1,572	Dry beans	4.3	404	3.7	435
Barley	4.6	9,747	5.9	10,445	Cotton	13.4	2,002*	13.59	1,742*
Oats	4.8	78,199	5.9	78,353	Peach	19.4	10,505	12.04	7,026
Corn	6.39	220,862	6.41	200,050	Apple	16.5	47,474	11.37	18,920
Potato	21.7	119,474	19.5	86,997					

*Bales.

Estimated reduction in yield of wheat due to scab (Fusarium sp.), leaf rust (Puccinia triticina), stem rust (Puccinia graminis), bunt (Tilletia laevis and T. tritici), loose smut (Ustilago tritici), and other diseases, 1920.

State	Production: 1920 Bushels (000 omitted)	Estimated reduction in yield due to diseases: Scab %	Scab Bushels (000 omitted)	Leaf rust %	Leaf rust Bushels (000 omitted)	Stem rust %	Stem rust Bushels (000 omitted)	Bunt %	Bunt Bushels (000 omitted)	Loose smut %	Loose smut Bushels (000 omitted)	Other diseases %	Other diseases Bushels (000 omitted)	All diseases %	All diseases Bushels (000 omitted)
Me.	159	-	-	-	-	-	-	-	-	1.	2	-	-	1.	2
N. H.	-	-	-	-	-	-	-	-	-	2.	+	-	-	2.	+
Vt.	209	-	-	t	+	t	+	0	0	2.	4	-	-	2. +	4+
Mass.	-	-	-	-	-	-	-	-	-	2.	+	-	-	2.	+
R. I.	-	-	-	-	-	-	-	-	-	2.	+	-	-	2.	+
Conn.	-	-	-	-	-	-	-	-	-	1.	+	-	-	1.	+
N. Y.	10,998	t	+	t	+	t	+	t	+	3.	344	1.	114	4. +	458+
N. J.	1,520	1.	16	t	+	t	+	1.	16	3.	49	2.	33	7. +	114+
Pa.	25,284	1.	265	t	+	t	+	t	+	2.5	661	1.	265	4.5+	1191+
Dela.	2,040	.5	11	.2	4	t	+	1.	22	2.	43	1.5	32	5.2+	112+
Md.	11,390	1.	123	1.5	185	t	+	1.	123	3.5	431	.5	62	7.5+	924+
Va.	11,425	t	+	2.	247	t	+	.5	61	2.8	345	2.	247	7.3+	900+
W. Va.	4,250	1.	48	t	+	3.	145	2.	97	5.	242	1.	48	12. +	580+
N. C.	8,471	t	+	3.	282	t	+	2.	188	4.	377	1.	94	10. +	941+
S. C.	1,760	t	+	2.	38	t	+	1.	19	3.	56	1.	19	7. +	132+
Ga.	2,110	t	+	2.	46	2.	46	1.	23	3.	69	.5	12	8.5+	196+
Ohio	28,698	.5	151	t	+	t	+	.5	151	2.	604	2.	604	5. +	1,510+
Ind.	23,540	.5	124	.1	25	.1	25	.3	74	2.	495	2.	495	5.	1,238
Ill.	40,670	2.	884	.5	221	.5	221	t	+	3.	1,326	2.	884	8. +	3,536+
Mich.	14,275	t	+	t	+	8.	1,298	3.	487	1.	162	t	+	12. +	1,947+
Wis.	5,152	1.5	113	t	+	30.	2,273	t	+	.5	38	t	+	32. +	2,424+
Minn.	29,116	2.	889	t	+	30.	13,336	t	+	.5	222	2.	889	34.5+	15,336+
Iowa	13,011	.5	72	1.	144	7.	1,006	.5	72	.5	72	t	+	9.5+	1,366+
Mo.	32,721	2.	693	1.	346	.5	173	1.	346	1.	346	t	+	5.5+	1,904+

State	Production 1920 Bushels (000 omitted)	Scab %	Scab Bushels (000 omitted)	Leaf rust %	Leaf rust Bushels (000 omitted)	Stem rust %	Stem rust Bushels (000 omitted)	Bunt %	Bunt Bushels (000 omitted)	Loose smut %	Loose smut Bushels (000 omitted)	Other diseases %	Other diseases Bushels (000 omitted)	All diseases %	All diseases Bushels (000 omitted)
N. D.	68,400	1.	918	1.5	1,377	20.	18,363	.5	459	.5	459	2.	1,836	25.5	23,412
S. D.	26,282	15.	6,410	1.	427	20.	8,547	.5	214	1.	427	1.	427	38.5	16,452
Nebr.	60,480	1.	720	1.	720	12.	8,640	1.	720	1.	720	-	-	16.	11,520
Kans.	137,056	t	+	t	+	t	+	5.	7,213	t	+	-	-	5. +	7,213+
Ky.	5,610	2.	119	1.	59	t	+	.5	30	1.	59	1.	59	5.5+	326+
Tenn.	4,028	t	+	t	+	2.	86	1.	43	3.	128	t	+	6. +	257+
Ala.	653	t	+	2.	14	1.	7	1.	7	2.	14	t	+	6. +	42+
Miss.	100	t	+	4.	4	t	+	1.	1	1.5	2	t	+	6.5+	7+
La.	-	-	-	t	+	-	-	-	-	t	+	t	+	+	+
Texas	15,925	1.	168	1.	169	1.	169	.5	84	2.	337	t	+	5.5+	927+
Okla.	46,240	t	+	2.	984	t	+	1.	492	1.	492	2.	983	6. +	2,951+
Ark.	1,197	t	+	2.	26	t	+	3.	39	3.	40	1.	13	9. +	118+
Mont.	19,850	0	0	0	0	0	0	4.	845	2.	422	t	+	6. +	1,267+
Wyo.	5,080	-	-	-	-	t	+	-	-	-	-	-	-	+	+
Colo.	22,821	-	-	t	+	1.	233	1.	233	t	+	-	-	2. +	466+
N.Mex.	6,375	-	-	t	+	t	+	-	-	t	+	-	-	+	+
Ariz.	864	-	-	t	+	5.	47	2.	19	1.	9	-	-	8. +	75+
Utah	5,366	0	0	t	+	5.	288	1.	58	1.	58	* -	-	7. +	404+
Nev.	420	-	-	t	+	t	+	1.	4	t	+	-	-	1. +	4+
Ida.	23,600	-	-	t	+	t	+	2.	502	2.	502	2.	502	6. +	1,506+
Wash.	37,982	-	-	t	+	t	+	2.	787	.5	197	1.	391	3.5+	1,378+
Ore.	22,900	-	-	t	+	t	+	2.	472	t	+	1.	235	3. +	708+
Calif.	9,100	-	-	t	+	t	+	2.	187	t	+	1.	91	3. +	281+
U. S.	787,128	1.3	11,724	.6	5,318	6.2	54,903	1.6	14,088	1.1	9,754	.9	8,342	11.7	104,129

Estimated reduction in yield due to diseases.

RYE

Estimated reduction in yield of rye due to smut (Ustilago sp.), ergot (Claviceps purpurea), leaf rust (Puccinia dispersa), stem rust (Puccinia graminis), and other diseases, 1920.

State	Production: 1920 Bushels (000 omitted)	Smut %	Smut Bushels (000 omitted)	Ergot %	Ergot Bushels (000 omitted)	Leaf rust %	Leaf rust Bushels (000 omitted)	Stem rust %	Stem rust Bushels (000 omitted)	Other diseases %	Other diseases Bushels (000 omitted)	All diseases %	All diseases Bushels (000 omitted)
Vt.	20	-	-	-	-	-	-	-	-	-	-	-	-
Mass.	105	t	+	-	-	t	+	-	-	t	+	+	+
Conn.	140	-	-	t	+	t	+	-	-	-	-	+	+
N. Y.	1,872	t	+	t	+	t	+	t	+	t	+	+	+
N. J.	1,155	t	+	-	-	-	-	t	+	-	-	+	+
Pa.	2,656	t	+	.5	13	t	+	-	-	t	+	.5+	13+
Del.	60	-	-	-	-	t	+	-	-	-	-	+	+
Md.	462	t	+	0	0	1.	5	t	+	-	-	1.+	5+
Va.	864	t	+	t	+	t	+	t	+	t	+	+	+
W. Va.	165	-	-	t	+	t	+	-	-	-	-	+	+
N. C.	912	-	-	-	-	-	-	-	-	-	-	-	-
S. C.	264	-	-	-	-	1.	3	-	-	-	-	1.	3
Ga.	290	1.	3	-	-	2.	6	2.	6	t	+	5.+	15+
Ohio	1,152	-	-	.5	6	t	+	-	-	.5	6	1.+	12+
Ind.	4,340	.1	4	t	+	t	+	t	+	-	-	.1+	4+
Ill.	3,276	t	+	t	+	-	-	t	+	-	-	+	+
Mich.	9,702	-	-	t	+	t	+	t	+	-	-	+	+
Wis.	7,728	t	+	.5	41	t	+	5.	411	.5	41	6.+	493+
Minn.	8,160	1.	85	1.	85	t	+	t	+	1.5	126	3.5+	296+
Iowa	1,071	t	+	t	+	.5	5	t	+	-	-	.5+	5+
Mo.	600	-	-	t	+	-	-	t	+	-	-	+	+

State	Production: 1920 Bushels (000 omitted)	Estimated reduction in yield due to disease.											
		Smut		Ergot		Leaf rust		Stem rust		Other diseases		All diseases.	
		%	Bushels (000 omitted)	%	Bushels (000 omitted)	%	Bushels (000 omitted)	%	Bushels (000 omitted)	%	Bushels (000 omitted)	%	Bushels (000 omitted)
N. D.	9,340	-	-	.2	19	t	+	-	-	-	-	.2+	19+
S. D.	4,320	-	-	1.	49	-	-	10.	485	-	-	11.	534
Nebr.	3,722	-	-	t	+	t	+	t	+	-	-	+	+
Kans.	1,612	-	-	-	-	t	+	-	-	-	-	+	+
Ky.	480	-	-	.2	1	t	+	-	-	-	-	.2+	1+
Tenn.	300	0	0	0	0	2.	6	-	-	t	+	2. +	6+
Ala.	44	-	-	-	-	-	-	-	-	-	-	-	-
Miss.	-	-	-	-	-	t	+	-	-	-	-	+	+
La.	-	-	-	-	-	t	+	-	-	-	-	+	+
Texas	48	t	+	-	-	-	-	t	+	-	-	+	+
Okla.	375	-	-	-	-	t	+	t	+	-	-	+	+
Ark.	40	-	-	t	+	-	-	t	+	-	-	+	+
Mont.	880	0	0	0	0	0	0	t	+	t	+	+	+
Wyo.	540	-	-	-	-	-	-	-	-	-	-	-	-
Colo.	1,357	-	-	-	-	-	-	-	-	-	-	-	-
Utah	124	0	0	t	+	-	-	t	+	-	-	+	+
Ida.	252	-	-	-	-	-	-	t	+	-	-	+	+
Wash.	370	-	-	-	-	-	-	-	-	-	-	-	-
Ore.	520	0	0	0	0	0	0	0	0	-	-	-	-
Calif.	-	-	-	-	-	t	+	t	+	-	-	+	+
U. S.	69,318	.13	92	.3	214	.04	25	1.27	902	.24	173	1.98	1406

BARLEY

Estimated reduction in yield of barley due to stripe (*Helminthosporium gramineum*), loose smut (*Ustilago nuda*), covered smut (*Ustilago hordei*), leaf rust (*Puccinia simplex*), stem rust (*Puccinia graminis*), and other diseases, 1920.

State	Production: 1920 Bushels (000 omitted)	Stripe %	Stripe Bushels (000 omitted)	Loose smut %	Loose smut Bushels (000 omitted)	Covered smut %	Covered smut Bushels (000 omitted)	Leaf rust %	Leaf rust Bushels (000 omitted)	Stem rust %	Stem rust Bushels (000 omitted)	Other diseases %	Other diseases Bushels (000 omitted)	All diseases %	All diseases Bushels (000 omitted)
Me.	104	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N. H.	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vt.	336	t	+	2.	7	2.	7	t	+	t	+	-	-	4. +	14+
N. Y.	3,480	t	+	2.	73	1.	36	t	+	t	+	1.	36	4. +	145+
N. J.	-	-	-	2.	+	t	+	-	-	-	-	-	-	2. +	+
Pa.	480	-	-	2.	10	t	+	-	-	-	-	-	-	2. +	10+
Md.	165	-	-	3.	5	1	2	t	+	-	-	-	-	4. +	7+
Va.	405	t	+	5.	21	t	+	t	+	t	+	-	-	5. +	21+
Ohio	2,825	1.	29	2.	59	1.	29	t	+	-	-	-	-	4. +	117+
Ind.	2,025	1.	21	2.	43	1.	21	-	-	t	+	1.	21	5. +	106+
Ill.	6,080	1.	62	1.	62	.5	31	t	+	t	+	-	-	2.5+	155+
Mich.	6,240	1.	63	.5	32	.5	32	t	+	-	-	-	-	2. +	127+
Wis.	15,913	t	+	.3	52	.2	35	t	+	3.	522	5.	869	8.5+	1,478+
Minn.	25,000	1.	279	.5	140	1.5	419	*0	0	5.	1397	2.5	698	10.5+	2,933+
Iowa	7,810	2.	196	1.	98	.5	49	t	+	17.	1670	-	-	20.5+	2,013+
Mo.	224	t	+	1.5	3	1.	2	-	-	-	-	-	-	2.5+	5+
N. D.	22,680	t	+	t	+	.5	114	t	+	t	+	-	-	.5+	114+
S. D.	26,825	.5	136	.5	136	.5	136	-	-	-	-	-	-	1.5	408
Nebr.	7,424	t	+	1.	75	.5	38	-	-	t	+	-	-	1.5+	113+
Kans.	21,285	-	-	2.	443	2.	443	-	-	t	+	-	-	4. +	886+

State	Production: 1920 Bushels (000 omitted)	Stripe %	Stripe Bushels (000 omitted)	Loose smut %	Loose smut Bushels (000 omitted)	Covered smut %	Covered smut Bushels (000 omitted)	Leaf rust %	Leaf rust Bushels (000 omitted)	Stem rust %	Stem rust Bushels (000 omitted)	Other diseases %	Other diseases Bushels (000 omitted)	All diseases %	All diseases Bushels (000 omitted)
						Estimated reduction in yield due to disease.									
Ky.	112	-	-	3.	3	1.	1	t	+	-	-	-	-	4.+	4+
Tenn.	225	t	+	5.	12	2.	5	t	+	0	0	t	+	7.+	17+
Texas	253	-	-	1.	3	1.	3	t	+	t	+	1.-	2	3.+	8+
Okla.	3,120	t	+	1.	32	1.	32	-	-	t	+	-	-	2.+	64+
Mont.	1,540	t	+	3.	49	2.5	40	t	+	t	+	t	+	5.5+	89+
Wyo.	1,008	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Colo.	4,674	-	-	.5	24	1.	47	-	-	-	-	-	-	1.5	71
N.Mex.	630	-	-	.5	3	1.	6	-	-	-	-	-	-	1.5	9
Ariz.	680	t	+	t	+	1.	10	25.	242	4	39	-	-	30.+	291+
Utah	685	t	+	t	+	1.	7	-	-	t	+	-	-	1.+	7+
Nev.	304	-	-	-	-	1.	3	-	-	-	-	-	-	1.	3
Ida.	4,256	t	+	t	+	2.	89	-	-	t	+	2.-	88	4.+	177+
Wash.	3,883	t	+	t	+	1.	39	-	-	-	-	-	-	1.+	39+
Ore.	2,576	t	+	t	+	1.	26	t	+	t	+	-	-	1.+	26+
Calif.	28,750	t	+	t	+	1.	290	t	+	t	+	-	-	1.+	290+
U. S.	202,024	.4	786	.7	1,385	.9	1,992	.1	242	1.7	3,628	.8	1,714	4.6	9,747

OATS

Estimated reduction in yield of oats due to loose and covered smuts (Ustilago avenae and U. levis), stem rust (Puccinia graminis), crown rust (Puccinia coronata), and other diseases, 1920.

State	Production 1920 Bushels (000 omitted)	Loose and covered smuts %	Loose and covered smuts Bushels 000 omitted	Stem rust %	Stem rust Bushels 000 omitted	Crown rust %	Crown rust Bushels 000 omitted	Other diseases %	Other diseases Bushels 000 omitted	All diseases %	All diseases Bushels 000 omitted
Me.	4,974	-	-	-	-	-	-	-	-	-	-
N. H.	546	2.	11	-	-	-	-	-	-	2.	11
Vt.	2,835	3.	89	t	+	1.	29	-	-	4. +	118+
Mass.	518	1.5	8	t	+	t	+	-	-	1.5+	8+
R. I.	28	2.+	1	-	-	-	-	-	-	2. +	1
Conn.	744	2.	15	-	-	-	-	-	-	2.	15
N. Y.	44,275	3.	1,398	t	+	t	+	2.	932	5. +	2,330+
N. J.	2,720	2.	55	-	-	t	+	-	-	2. +	55+
Pa.	45,825	3.	1,417	-	-	-	-	t	+	3. +	1,417+
Del.	198	2.	4	-	-	.5	1	1.	2	3.5	7
Md.	2,112	4.	88	-	-	t	+	.5	11	4.5+	99+
Va.	4,818	4.	201	-	-	t	+	-	-	4. +	201+
W. Va.	5,400	5.	290	t	+	2.	116	t	+	7. +	406+
N. C.	3,960	5.	220	-	-	5.	220	-	-	11.	440
S. C.	10,416	5.	560	-	-	2.	224	-	-	7.	784
Ga.	11,550	3.	373	2.	248	2.	248	-	-	7.	869
Fla.	1,020	-	-	-	-	-	-	-	-	-	-
Ohio	71,339	2.	1,486	-	-	t	+	2.	1,486	4. +	2,972+
Ind.	76,875	3.	2,378	t	+	t	+	-	-	3. +	2,378+
Ill.	161,950	5.	9,098	t	+	1.	1,820	5.	9,098	11. +	20,016+
Mich.	56,430	2.	1,163	-	-	1.	582	-	-	3.	1,745
Wis.	107,878	1.	1,118	.5	559	1.	1,118	1.	1,118	3.5	3,913
Minn.	126,488	1.5	1,966	1.	1,311	t	+	1.	1,311	3.5+	4,588+
Iowa	229,866	1.5	3,536	.5	1,179	.5	1,179	t	+	2.5+	5,894+
Mo.	54,138	3.	1,674	-	-	-	-	-	-	3.	1,674

State	Production 1920 Bushels (000 omitted)	Estimated reduction in yield due to disease. Loose and covered smuts %	Bushels 000 omitted	Stem rust %	Bushels 000 omitted	Crown rust %	Bushels 000 omitted	Other diseases %	Bushels 000 omitted	All diseases %	Bushels 000 omitted
N. D.	59,640	2.	1,230	1.	615	t	+	t	+	3. +	1,845+
S. D.	75,446	1.5	1,293	10. +	8,623	t	+	1.	862	12.5+	10,778+
Nebr.	83,040	2.	1,695	–	–	–	–	–	–	2.	1,695
Kans.	68,799	2.	1,419	–	–	–	–	1.	709	3.	2,128
Ky.	8,225	2.	168	–	–	–	–	–	–	2.	168
Tenn.	8,225	3.	268	0	0	5.	447	t	+	8. +	715+
Ala.	6,551	3.	207	t	+	2.	138	–	–	5. +	345+
Miss.	4,012	3.	127	0	0	2.	84	0	0	5.	211
La.	1,380	1.	15	0	0	5.	73	–	–	6.	88
Texas	44,100	5.	2,450	4.	1,960	–	–	1.	490	11.	4,900
Okla.	48,000	3.	1,485	–	–	–	–	t	+	3. +	1,485+
Ark.	8,800	5.	506	0	0	5.	506	3.	303	13.	1,315
Mont.	16,800	6.	1,072	t	+	t	+	t	+	6. +	1,072+
Wyo.	11,400	–	–	–	–	–	–	–	–	–	–
Colo.	8,058	2.	164	t	+	–	–	–	–	2. +	164+
N.Mex.	2,278	2.	46	–	–	–	–	–	–	2.	46
Ariz.	481	5.	25	t	+	0	0	t	+	5. +	25+
Utah	3,143	5.	165	t	+	–	–	–	–	5. +	165+
Nev.	252	2.	5	t	+	–	–	–	–	2. +	5+
Ida.	8,000	2.	167	t	+	–	–	2.–	166	4. +	333+
Wash.	15,052	2.	307	–	–	0	0	–	–	2.	307
Ore.	12,045	1.	122	t	+	0	0	–	–	1. +	122+
Calif.	5,425	1.	58	5.	288	t	+	t	+	6. +	346+
U. S.	1,526,055	2.5	40,143	.9	14,783	.4	6,785	1.	16,488	4.8	78,199

CORN

Estimated reduction in yield of corn due to smut (*Ustilago zeae*), leaf rust (*Puccinia sorghi*), Physoderma (*Physoderma zeae-maydis*), root and ear rots (*Fusarium* spp.) and other diseases, 1920.

State	Production 1920 Bushels (000 omitted)	Smut %	Smut Bushels (000 omitted)	Leaf rust %	Leaf rust Bushels (000 omitted)	Physoderma %	Physoderma Bushels (000 omitted)	Root and ear rots %	Root and ear rots Bushels (000 omitted)	Other diseases %	Other diseases Bushels (000 omitted)	All diseases %	All diseases Bushels (000 omitted)
Me.	226	-	-	-	-	0	0	-	-	-	-	-	-
N. H.	405	-	-	-	-	0	0	-	-	-	-	-	-
Vt.	1,175	3.	36	-	-	0	0	0	0	-	-	3.	36
Mass.	840	.5	4	t	+	0	0	t	+	-	-	.5+	4+
R. I.	320	.5	2	-	-	0	0	t	+	-	-	.5+	2+
Conn.	1,804	.5	9	-	-	0	0	1.	18	-	-	1.5+	27+
N. Y.	32,595	1.	347	t	+	0	0	4.	1,387	1.	347	6. +	2,081+
N. J.	11,440	1.	122	-	-	-	-	5.	608	-	-	6.	730
Pa.	67,050	1.	753	-	-	0	0	10.	7,534	-	-	11.	8,287
Del.	7,125	1.	85	-	-	-	-	15.	1,272	-	-	16.	1,357
Md.	25,795	1.	274	-	-	-	-	5.	1,372	-	-	6.	1,646
Va.	50,100	1.	533	-	-	-	-	4.	2,132	1.	533	6.	3,198
W. Va.	22,100	1.	225	-	-	-	-	1.	226	t	+	2. +	451+
N. C.	64,032	2.	1,472	-	-	1.	736	10.	7,360	-	-	13.	9,568
S. C.	42,370	2.	921	-	-	1.	460	5.	2,303	-	-	8.	3,684
Ga.	76,500	2.	1,663	t	+	1.	831	5.	4,158	-	-	8. +	6,652+
Fla.	10,530	-	-	-	-	-	-	-	-	-	-	-	-
Ohio	162,099	1.	1,743	-	-	-	-	5.	8,715	1.	1,743	7.	12,201
Ind.	184,072	2.	3,959	t	+	-	-	5.	9,896	-	-	7. +	13,855+
Ill.	294,168	2.	6,259	t	+	0	0	4.	12,518	-	-	6. +	18,777+
Mich.	65,000	.5	327	t	+	0	0	t	+	-	-	.5+	327+
Wis.	86,044	t	+	t	+	0	0	.5	432	-	-	.5+	432+
Minn.	118,125	1.	1,193	t	+	0	0	t	+	t	+	1. +	1,193+
Iowa	473,800	1.	4,885	-	-	0	0	2.	9,769	-	-	3.	14,654
Mo.	198,880	2.	4,187	-	-	t	+	3.	6,280	-	-	5. +	10,467+

State	Production: 1920 Bushels (000 omitted)	Smut %	Smut Bushels (000 omitted)	Leaf rust %	Leaf rust Bushels (000 omitted)	Physoderma %	Physoderma Bushels (000 omitted)	Root and ear rots %	Root and ear rots Bushels (000 omitted)	Other diseases %	Other diseases Bushels (000 omitted)	All diseases %	All diseases Bushels (000 omitted)
		Estimated reduction in yield due to disease.											
N. D.	17,064	.5	87	t	+	0	0	1.	173	–	–	1.5	260
S. D.	105,600	1.	1,123	–	–	0	0	5.	5,617	–	–	6.	6,740
Nebr.	255,528	5.	14,196	–	–	t	+	5.	14,196	–	–	10. +	28,392+
Kans.	137,535	8.	13,418	–	–	–	–	10.	16,772	–	–	18.	30,190
Ky.	100,650	2.	2,236	–	–	t	+	8.	8,947	–	–	10 +	11,183+
Tenn.	93,100	1.	996	t	+	.5	498	5.	4,978	t	+	6.5+	6,472+
Ala.	67,149	1.	722	–	–	1.	722	5.	3,610	–	–	7.	5,054
Miss.	63,680	1.	688	1.	688	.5	344	5.+	3,443	–	–	7.5+	5,163+
La.	36,595	.5	197	1.	396	1.	396	5.	1,978	–	–	7.5	2,967
Texas	174,200	2.	3,573	–	–	–	–	.5	893	t	+	2.5+	4,466+
Okla.	89,320	2.	1,880	–	–	–	–	3.	2,821	–	–	5.	4,701
Ark.	55,224	2.	1,194	–	–	.5	299	5.	2,985	–	–	7.5	4,478
Mont.	3,580	t	+	–	–	0	0	–	–	t	+	+	+
Wyo.	1,560	t	+	–	–	0	0	–	–	–	–	+	+
Colo.	17,450	5.	918	–	–	0	0	–	–	–	–	5.	918
N.Mex.	7,155	2.	146	–	–	0	0	–	–	–	–	2.	146
Ariz.	644	5.	34	–	–	0	0	–	–	–	–	5.	34
Utah	521	1.	5	–	–	0	0	–	–	–	–	1.	5
Nev.	33	t	+	–	–	0	0	–	–	–	–	+	+
Ida.	1,800	t	+	–	–	0	0	–	–	–	–	+	+
Wash.	2,808	t	+	–	–	0	0	t	+	–	–	+	+
Ore.	1,426	t	+	0	0	0	0	t	+	–	–	+	+
Calif.	3,150	2.	64	–	–	0	0	t	+	–	–	2. +	64+
U. S.	3,232,367	2.04	70,477	.03	1,084	.12	4,286	4.12	142,393	.08	2,623	6.39	220,862

POTATO

Estimated reduction in yield of potatoes due to mosaic, leaf roll, late blight (*Phytophthora infestans*), Rhizoctonia (*Rhizoctonia solani*), and black leg (*Bacillus atrosepticus*), 1920.

State	Production 1920 Bushels 000 omitted	Estimated reduction in yield due to disease									
		Mosaic		Leaf roll		Late blight		Rhizoctonia		Black leg	
		%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted
Me.	22,140	7.	2,279	2.	651	20.	6,512	1.	326	t	+
N. H.	1,950	8.	230	1.	29	20.	575	1.	29	.2	6
Vt.	3,510	8.	493	2.	123	30.	1,847	t	+	0	0
Mass.	4,000	8.	427	1.	53	15.	800	t	+	t	+
R. I.	345	3.	13	1.	4	15.	66	t	+	t	+
Conn.	2,760	3.	100	1.	33	10.	333	1.	33	t	+
N. Y.	46,250	1.5	934	1.5	934	15.	9,337	1.	622	t	+
N. J.	14,820	3.	631	2.	420	5.	1,051	5.	1,051	t	+
Pa.	36,455	1.	736	10.	7,365	25.	18,412	3.	2,209	.5	368
Del.	1,166	2.	27	–	–	3.	41	4.	54	t	+
Md.	6,120	1.	74	2.	147	10.	737	2.	147	t	+
Va.	13,608	t.	+	2.	289	1.	145	2.	289	t	+
W. Va.	6,840	t.	+	2.	157	10.	786	t	+	t	+
N. C.	5,940	1.	59	2.	117	1.	59	4.	234	t	+
S. C.	3,100	1.	34	–	–	–	–	4.	136	t	+
Ga.	1,623	20.	486	5.	122	–	–	5.	122	t	+
Fla.	2,625	–	–	–	–	1.	29	–	–	0	0
Ohio	11,500	1.	153	2.	307	10.	1,533	1.	153	t	+
Ind.	7,680	t	+	t	+	0	0	.5	42	t	+
Ill.	8,775	t	+	1.	98	0	0	.5	49	t	+
Mich.	35,700	1.	413	t	+	1.	413	3.	1,238	.5	206
Wis.	33,264	t	+	t	+	1.	360	2.	719	.3	108
Minn.	20,025	2.	648	t	+	t	+	2.	648	1.5	486
Iowa	11,440	t	+	–	–	0	0	–	–	t	+
Mo.	7,790	–	–	–	–	0	0	–	–	t	+

State	Production 1920 Bushels 000 omitted	Estimated reduction in yield due to disease. Mosaic %	Mosaic Bushels 000 omitted	Leaf roll %	Leaf roll Bushels 000 omitted	Late blight %	Late blight Bushels 000 omitted	Rhizoctonia %	Rhizoctonia Bushels 000 omitted	Black leg %	Black leg Bushels 000 omitted
N. D.	7,110	t	+	t	+	0	0	2.	159	1.5	119
S. D.	8,904	t	+	-	-	0	0	2.	200	1.	100
Nebr.	8,415	t	+	t	+	0	0	3.	294	t	+
Kans.	5,780	t	+	-	-	0	0	6.	381	1.	64
Ky.	6,435	1.	74	5.	370	t	+	3.	222	t	+
Tenn.	3,569	t	+	t	+	t	+	t	+	0	0
Ala.	3,216	6.	217	t	+	-	-	t	+	0	0
Miss.	1,392	6.	96	t	+	0	0	t	+	0	0
La.	1,755	10.	206	t	+	0	0	t	+	0	0
Texas	2,340	t	+	t	+	0	0	t	+	0	0
Okla.	3,318	t	+	t	+	0	0	t	+	0	0
Ark.	2,418	5.	134	t	+	0	0	t	+	t	+
Mont.	5,060	t	+	t	+	0	0	t	+	3.	160
Wyo.	3,375	-	-	-	-	0	0	2.	71	1.	35
Colo.	10,920	1.	117	-	-	0	0	1.	117	t	+
N.Mex.	475	-	-	-	-	0	0	-	-	0	0
Ariz.	450	-	-	-	-	0	0	10.	54	0	0
Utah	3,298	1.	39	t	+	0	0	2.	78	3.	116
Nev.	1,032	t	+	-	-	0	0	1.	13	3.	38
Ida.	7,380	1.	97	t	+	0	0	5.	486	3.	291
Wash.	8,680	t	+	-	-	t	+	10.	1,046	2.	209
Ore.	5,590	t	+	t	+	3.	221	10.	735	1.	74
Calif.	13,015	t	+	-	-	t	+	8.	1,352	t	+
U. S.	430,458	1.6	8,717	2.	11,219	7.9	43,257	2.	13,309	.4	2,380

POTATO (Continued)

Estimated reduction in yield of potatoes due to Fusarium wilt (*Fusarium oxysporum*), tip burn, early blight (*Macrosporium solani*), and other diseases, 1920.

State	Production 1920 Bushels 000 omitted	Fusarium wilt %	Fusarium wilt Bushels 000 omitted	Tip burn %	Tip burn Bushels 000 omitted	Early blight %	Early blight Bushels 000 omitted	Other diseases %	Other diseases Bushels 000 omitted	All diseases %	All diseases Bushels 000 omitted
Me.	22,140	0	0	t	+	t	+	2.	651	32. +	10,419+
N. H.	1,950	0	0	t	+	t	+	2.	57	32.2+	926+
Vt.	3,510	0	0	t	+	t	+	3.	185	43. +	2,648+
Mass.	4,000	0	0	t	+	t	+	1.	53	25. +	1,333+
R. I.	345	0	0	1.	4	t	+	1.	4	21. +	91+
Conn.	2,760	-	-	1.	33	t	+	1.	33	17. +	565+
N. Y.	46,250	.5	311	1.	622	.2	125	5.	3,112	25.7+	15,997+
N. J.	14,820	t	+	2.	420	2.5	526	10.	2,102	29.5+	6,201+
Pa.	36,455	3.	2,209	2.	1,473	2.	1,473	4.	2,946	50.5	37,191
Del.	1,166	1.	13	-	-	3.	41	1.	13	14. +	189+
Md.	6,120	t	+	-	-	1.	74	1.	74	17. +	1,253+
Va.	13,608	t	+	t	+	t	+	1.	145	6. +	868+
W. Va.	6,840	1.	79	t	+	t	+	t	+	13. +	1,022+
N. C.	5,040	2.	117	1.	59	t	+	3.	175	14. +	820+
S. C.	3,100	1.	34	t	+	1.	34	2.	68	9. +	306+
Ga.	1,628	t	+	t	+	1.	24	2.	48	33. +	802+
Fla.	2,625	-	-	-	-	5.	144	3.	87	9. -	260
Ohio	11,500	4.	613	t	+	2.	307	5.	767	25. +	3,833+
Ind.	7,680	2.	170	4.	339	t	+	3.	255	9.5+	806+
Ill.	8,775	2.	195	2.	195	1.5	146	3.	292	10. +	975+
Mich.	35,700	2.	825	3.	1,238	t	+	3.	1,238	13.5+	5,571+
Wis.	33,264	t	+	2.	719	.2	72	2.	719	7.5+	2,697+
Minn.	28,025	.5	162	2.5	810	t	+	5.	1,620	13.5+	4,374+
Iowa	11,440	-	-	10.	1,362	1.	136	5.	681	16. +	2,179+
Mo.	7,790	-	-	-	-	t	+	-	-	+	+

State	Production 1920 Bushels 000 omitted	Estimated reduction in yield due to disease. Fusarium wilt %		Tip burn %		Early blight %		Other diseases %		All diseases %	
		%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted	%	Bushels 000 omitted
N. D.	7,110	4.	318	1.	79	t	+	2.	159	10.5+	834+
S. D.	8,904	4.	400	-	-	t	+	4.	400	11. +	1,100+
Nebr.	8,415	6.	587	-	-	t	+	5.	489	14. +	1,370+
Kans.	5,780	t	+	2.	127	t	+	t	+	9. +	572+
Ky.	6,435	1.	74	-	-	2.	148	1.	74	13. +	962+
Tenn.	3,569	t	+	t	+	4.	149	t	+	4. +	149+
Ala.	3,216	t	+	t	+	3.	108	2.	72	11. +	397+
Miss.	1,392	t	+	t	+	3.	48	4.	64	13. +	208+
La.	1,755	0	0	1.	21	t	+	4.	83	15. +	310+
Texas	2,340	1.	24	-	-	1.	24	1.	24	3. +	72+
Okla.	3,318	-	-	-	-	t	+	1.	34	1. +	34+
Ark.	2,418	3.	81	-	-	t	+	2.	54	10. +	269+
Mont.	5,060	2.	106	t	+	0	0	t	+	5. +	266+
Wyo.	3,375	-	-	-	-	.5	18	1.	35	4.5	159
Colo.	10,920	2.	234	-	-	.5	58	2.-	233	6.5+	759+
N.Mex.	475	-	-	-	-	t	+	2.	10	2. +	10+
Ariz.	450	-	-	2.	11	3.	16	2.	11	17.	92
Utah	3,298	4.	155	1.	39	t	+	4.	155	15. +	582+
Nev.	1,032	10.	127	t	+	-	-	5.	64	19. +	242+
Ida.	7,380	5.	486	t	+	t	+	10.	971	24. +	2,331+
Wash.	8,680	t	+	-	-	0	0	5.	523	17. +	1,778+
Ore.	5,590	t	+	t	+	t	+	10.	735	24. +	1,765+
Calif.	13,015	10.	1,690	-	-	*-	-	5.	845	23. +	3,887+
U. S.	430,458	1.6	9,010	1.4	7,551	.7	3,671	3.7	20,360	21.7	119,474

SWEET POTATO

Estimated reduction in yield of sweet potatoes due to stem rot (*Fusarium hyperoxysporum* and *F. batatatis*), foot rot (*Plenodomus destruens*), black rot (*Sphaeronema fimbriatum*), storage rots, pox (*Cystospora batata*), and other diseases, 1920.

State	Production: 1920 Bushels (000 omitted)	Estimated reduction in yield due to disease. Stem rot %	Stem rot Bushels (000 omitted)	Foot rot %	Foot rot Bushels (000 omitted)	Black rot (Field losses) %	Black rot (Field losses) Bushels (000 omitted)	Storage rot %	Storage rot Bushels (000 omitted)	Pox %	Pox Bushels (000 omitted)	Other diseases %	Other diseases Bushels (000 omitted)	All diseases %	All diseases Bushels (000 omitted)
N. J.	2,002	12.	511	t	+	16.	682	25.	1,065	t	+	-	-	53.	2,258+
Pa.	280	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Del.	1,024	15.	197	-	-	6.	79	-	-	1.	13	-	-	22.	289
Md.	1,386	10.	165	-	-	5.	82	-	-	1.	17	-	-	16.	264
Va.	4,032	8.	538	-	-	2.	134	30.	2,016	t	+	-	-	40.	2,688+
W. Va.	238	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N. C.	10,605	1.	166	-	-	10.	1,657	25.	4,142	-	-	-	-	36.	5,965
S. C.	9,240	1.	125	-	-	-	-	25.	3,121	-	-	-	-	26.	3,246
Ga.	13,764	t	+	-	-	5.	983	25.	4,916	0	0	-	-	30.	5,899+
Fla.	4,275	t	+	-	-	-	-	-	-	-	-	-	-		+
Ohio	103	2.	2	-	-	-	-	-	-	-	-	-	-	2.	2
Ind.	360	1.	4	-	-	t	+	-	-	-	-	-	-	1.	4+
Ill.	873	2.	18	-	-	1.	9	-	-	-	-	-	-	3.	27
Iowa	436	5.	22	-	-	-	-	-	-	-	-	-	-	5.	22
Mo.	1,430	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kans.	540	10.	67	t	+	5.	34	5.	34	-	-	-	-	20.+	135+
Ky.	1,890	-	-	-	-	-	-	15.	334	-	-	-	-	15.	334
Tenn.	4,284	t	+	0	0	10.	659	25.	1,648	0	0	t	+	35.	2,307+
Ala.	17,460	1.	236	-	-	5.	1,180	20.	4,719	-	-	-	-	26.	6,135
Miss.	11,330	1.	165	0	0	10.	1,654	20.	3,308	0	0	.5	83	31.5	5,210
La.	8,080	t	+	0	0	4.	455	25.	2,845	-	-	-	-	29.	3,300+
Texas	9,345	t	+	-	-	5.	503	-	-	1.	100	1.	100	7.	703+
Okla.	2,760	1.	28	-	-	2.	57	-	-	-	-	-	-	3.	85
Ark.	5,145	2.	107	-	-	2.	107	-	-	-	-	-	-	4.	214
N.Mex.	300	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ariz.	150	-	-	-	-	-	-	5.	8	-	-	-	-	5.	8
Calif.	1,056	3.	33	-	-	2.	22	-	-	-	-	-	-	5.	55
U. S.	112,368	1.6	2,384	-	+	5.4	8,297	18.6	28,156	.1	130	.1	183	25.8	39,150

DRY BEANS

Estimated reduction in yield of dry beans due to anthracnose (Colletotrichum lindemuthianum), bacterial blight (Bacterium phaseoli), mosaic, root rots, and other diseases, 1920.

State	Production 1920 Bushels (000 omitted)	Anthracnose %	Anthracnose Bushels (000 omitted)	Bacterial blight %	Bacterial blight Bushels (000 omitted)	Mosaic %	Mosaic Bushels (000 omitted)	Root rots %	Root rots Bushels (000 omitted)	Other diseases %	Other diseases Bushels (000 omitted)	All diseases %	All diseases Bushels (000 omitted)
N. Y.	1,260	10.	155	1.5	23	3.	46	1.+	16	3.	46	18.5+	286
Mich.	3,575	t	+	3.	111	t	+	-	-	-	-	3.+	111+
Colo.	504	0	0	-	-	-	-	-	-	-	-	-	-
N.Mex.	811	0	0	-	-	-	-	-	-	-	-	-	-
Ariz.	75	0	0	8.	7	-	-	-	-	-	-	8.	7
Calif.	2,850	-	-	-	-	-	-	-	-	-	-	-	-
U. S.	9,075	1.6	155	1.5	141	.5	46	.2	16	.5	46	4.3	404

COTTON

Estimated reduction in yield of cotton due to anthracnose (Colletotrichum gossypsii), angular leaf spot (Bacterium malvacearum), Fusarium wilt (Fusarium vasinfectum), root knot (Heterodera radicicola), and other diseases, 1920.

State	Production 1920 Bales (000 omitted)	Anthracnose %	Anthracnose Bales (000 omitted)	Angular leaf spot %	Angular leaf spot Bales (000 omitted)	Fusarium wilt %	Fusarium wilt Bales (000 omitted)	Root knot %	Root knot Bales (000 omitted)	Other diseases %	Other diseases Bales (000 omitted)	All diseases %	All diseases Bales (000 omitted)
Va.	19	5.	1	t	+	2.	+	t	+	-	-	7.+	1+
N. C.	840	15.	166	t	+	5.	55	1.	11	3.	33	24.+	265+
S. C.	1,530	8.	144	t	+	3.	54	1.	18	3.	54	15.+	270+
Ga.	1,400	5.+	83	2.	33	2.	33	3.	49	3.	49	15.	247
Fla.	18	-	-	-	-	-	-	-	-	-	-	-	-
Mo.	85	-	-	-	-	-	-	-	-	-	-	-	-
Tenn.	310	8.	27	t	+	t	+	0	0	t	+	8.+	27+
Ala.	660	2.	15	1.	7	5.	37	1.	7	1.	7	10.	73
Miss.	885	3.	30	1.	10	5.	49	t	+	2.	20	11.+	109+
La.	380	5.	23	1.	5	7.	32	t	+	5.	23	18.+	83+
Texas	4,200	1.	48	2.	95	.1	5	t	+	9.	430	12.1+	578+
Okla.	1,300	1.	14	-	-	t	+	-	-	5.	69	6.+	83+
Ark.	1,160	2.	28	3.	42	7.	98	1.	14	4.	56	17.	238
Ariz.	110	-	-	15.	21	*-	-	-	-	5.	7	20.	28
Calif.	75	-	-	-	-	*0	0	-	-	-	-	-	-
Others	15	-	-	-	-	-	-	-	-	-	-	-	-
U. S.	12,987	3.9	579	1.4	213	2.4	363	.7	99	5.	748	13.4	2,002

Estimated reduction in yield of peaches due to leaf curl (Exoascus deformans), brown rot (Sclerotinia cinerea), and other diseases, 1920

State	Production: 1920	Estimated reduction in yield due to disease							
		Leaf curl		Brown rot		Other diseases		All diseases	
	Bus. (000 omitted)	%	Bus. (000 omitted)	%	Bus. (000 omitted)	%	Bus. (000 omitted)	%	Bus. (000 omitted)
N. H.	0	-	-	-	-	-	-	-	-
Mass.	4	t	+	-	-	-	-	+	+
R. I.	3	t	+	-	-	-	-	+	+
Conn.	10	t	+	t	+	-	-	+	+
N. Y.	2,307	2.	49	1.	24	3.	74	6.	147
N. J.	1,056	1.	12	10.	126	5.	63	16.	201
Pa.	1,744	5.	124	15.	374	10.	249	30.	747
Del.	248	10.	38	15.	57	10.	38	35.	133
Md.	897	10.	120	10.	120	5.-	59	25.	299
Va.	1,470	1.	16	5.	81	3.	48	9.	145
W. Va.	992	1.	11	10.	115	3.	35	14.	161
N. C.	1,909	1.	23	10.	227	5.	114	16.	364
S. C.	1,110	1.	14	15.	211	5.	70	21.	295
Ga.	3,799	t	+	40.	2,763	5.	345	45.+	3,108+
Fla.	162	-	-	-	-	-	-	-	-
Ohio	2,241	1.	28	5.	142	15.	426	21.	596
Ind.	957	5.	52	1.	10	2.	21	8	83
Ill.	1,350	2.	29	1.	14	3.	43	6.	86
Mich.	1,500	3.	47	t	+	1.	16	4.+	63+
Iowa	135	10.	15	1.	1	-	-	11.	16
Mo.	789	2.	17	1.	9	5.	43	8.	69
Nebr.	5	0.	0	t	+	1.	+	1.+	+
Kans.	70	0.	0	t	+	2.	1	2.+	1+
Ky.	1,560	3.	68	25.	565	3.	68	31.	701
Tenn.	1,000	4.	49	10.	123	5.	62	19.	234
Ala.	1,508	4.	77	15.	290	3.	58	22.	425
Miss.	425	2.	11	15.	82	5.	27	22.	120
La.	-	0.	0	25.	+	5.	+	30.	+
Texas	480	t	+	1.	5	5.	26	6.+	31+
Okla.	61	t	+	2.	1	5.	3	7.+	4+
Ark.	117	1.	1	2.	3	5.	6	8.	10
Colo.	585	-	-	-	-	-	-	-	-
N.Mex.	6	-	-	-	-	-	-	-	-
Utah	825	-	-	-	-	-	-	-	-
Ida.	40	2.	1	-	-	5.	2	7.	3
Wash.	423	2.	9	t	+	3.	13	5.+	22+
Ore.	100	3.	3	-	-	3.	3	6.	6
Calif.	13,800	5.	812	5.	812	5.-	811	15.	2,435
U. S.	43,697	3.	1,626	11.4	6,155	5.	2,724	19.4	10,505

APPLE

Estimated reduction in yield of apples due to bitter rot (*Glomerella cingulata*), black rot (*Physalospora cydoniae*), blotch (*Phyllosticta soliteria*), and cedar rust (*Gymnosporangium juniperi-virginianae*), 1920.

State	Production 1920	Estimated reduction in yield due to disease.							
		Bitter rot		Black rot		Blotch		Cedar rust	
	Bus. (000 omitted)	%	Bus. (000 omitted)	%	Bus. (000 omitted)	%	Bus. (000 omitted)	%	Bus. (000 omitted)
Me.	1,930	0	0	t	+	0	0	–	–
N. H.	1,320	0	0	t	+	0	0	–	–
Vt.	1,600	0	0	t	+	0	0	–	–
Mass.	3,680	t	+	1.5	61	0	0	t	+
R. I.	340	t	+	1.	4	0	0	t	+
Conn.	2,520	t	+	t	+	0	0	t	+
N. Y.	55,650	*0	0	1.	636	0	0	.5	318
N. J.	4,134	2.	93	t	+	t	+	1.	46
Pa.	23,937	1.	279	.5	139	1.	277	1.	277
Del.	1,017	–	–	–	–	t	+	t	+
Md.	3,330	1.	38	5.	188	.5	19	–	–
Va.	15,210	1.	185	3.	557	t	+	5.	927
W. Va.	7,000	1.+	87	3.	259	1.	86	1.+	87
N. C.	7,900	3.	416	5.	693	10.	1,386	8.	1,109
S. C.	1,482	3.	68	10.	228	8.	182	2.	46
Ga.	1,764	3.	69	5.	114	2.	46	t	+
Ohio	13,193	t	+	1.	149	1.	149	1.	149
Ind.	6,097	t	+	2.	133	1.	66	.2	14
Ill.	6,175	t	+	1.	75	4.	302	.2	15
Mich.	16,500	0	0	t	+	0	0	*0	0
Wis.	3,650	0	0	t	+	0	0	t	+
Minn.	1,462	0	0	t	+	0	0	1.	18
Iowa	4,410	0	0	–	–	t	+	t	+
Mo.	5,082	1.	63	3	188	4.	251	t	+
N. D.	–	0	0	–	–	0	0	*0	0
S. D.	323	0	0	–	–	t	+	t	+
Nebr.	750	0	0	t	+	3.	26	1.	9
Kans.	1,144	0	0	t	+	10.	145	t	+
Ky.	5,780	5.	425	3.	255	10.	850	1.	85
Tenn.	5,304	10.	947	1.	95	10.	947	1.	95
Ala.	1,260	3.	53	2.	35	10.	175	*–	–
Miss.	126	3.	5	2.	3	5.	8	.5	1
La.	–	*–	–	–	–	*–	–	*0	0
Texas	351	t	+	1.	4	5.	19	*0	0
Okla.	548	–	–	1.	6	8.	53	*0	0
Ark.	3,620	2.	86	.5	21	5.	216	.5	21
Mont.	1,155	0	0	0	0	0	0	0	0
Wyo.	–	0	0	–	–	0	0	0	0
Colo.	2,760	0	0	t	+	0	0	–	–
N.Mex.	566	0	0	t	+	0	0	0	0
Ariz.	100	0	0	–	–	0	0	0	0
Utah	918	0	0	0	0	0	0	0	0
Nev.	–	0	0	–	–	0	0	0	0
Ida.	3,631	0	0	–	–	0	0	0	0
Wash.	13,420	0	0	t	+	0	0	0	0
Ore.	3,300	0	0	t	+	0	0	0	0
Calif.	6,003	0	0	t	+	0	0	0	0
U. S.	240,442	1.	2,812	1.3	3,843	1.8	5,203	1.1	3,217

Estimated reduction in yield of apples due to fire blight (Baculus amylororus), scab (Venturia inaequalis), and other diseases, 1920.

State	Fire blight %	Fire blight Bus. (000 omitted)	Scab %	Scab Bus. (000 omitted)	Sum of traces and no data for six diseases %	Sum of traces and no data for six diseases Bus. (000 omitted)	Other diseases %	Other diseases Bus. (000 omitted)	All diseases %	All diseases Bus. (000 omitted)
Me.	–	–	8.	171	–	–	2.	43	10. +	234+
N. H.	t	+	10.	148	.2	3	1.	15	11.2+	166+
Vt.	1.	18	7.	123	.2	3	1.	18	9.2+	162+
Mass.	1.	41	7.	286	.5	20	t	+	10. +	408+
R. I.	.5	2	3.	11	1.	4	2.	7	7.5+	28+
Conn.	.5	13	3.	81	1.	27	2.	54	6.5+	175+
N. Y.	1.	636	5.	3,180	–	–	5.	3,180	12.5	7,950
N. J.	.5	23	5.	232	.5	23	2.	93	11. +	520+
Pa.	2.	553	6.	1,660	–	–	2.	553	13.5	3,736
Del.	t	+	5.	57	4.	46	2.	23	11. +	126+
Md.	1.	38	3.5	131	.5	19	–	–	11.5+	433+
Va.	t	+	4.	742	–	–	5.	927	18. +	3,338+
W. Va.	t	+	8.	691	–	–	5.	432	19. +	1,642+
N. C.	5.	693	10.	1,386	–	–	2.	277	43.	5,960
S. C.	5.	114	5.	114	–	–	2.	46	35.	798
Ga.	5.	114	5.	114	–	–	3.	69	23. +	526+
Ohio	.5	75	5.	745	–	–	3.	447	11.5+	1,714+
Ind.	0	0	3.	199	–	–	2.	133	8.2+	545+
Ill.	t	+	8.	604	–	–	5.	377	18.2+	1,373+
Mich.	1.	185	8.	1,483	–	–	2.	371	11. +	2,039+
Wis.	10.	451	7.	315	–	–	2.	90	19. +	856+
Minn.	5.	88	8.	140	1.	18	2.	35	17. +	299+
Iowa	2.	103	4.	205	3.	154	5.	256	14. +	718+
Mo.	.5	31	5.	314	.5	31	5.	314	19. +	1,192+
N. D.	2.	+	2.	+	–	–	1.	+	5.	+
S. D.	*–	–	15.	58	1.	4	1.	4	17. +	66+
Nebr.	t	+	5.	44	1.	9	5.	44	15. +	132+
Kans.	t	+	7.	101	1.	14	3.	44	21. +	304+
Ky.	t	+	10.	850	–	–	3.	255	32. +	2,720+
Tenn.	t	+	20.	1,894	–	–	2.	189	44. +	4,167+
Ala.	8.	140	3.–	52	–	–	2.	35	28.	490
Miss.	8.	13	1.5	2	–	–	2.	3	22.	35
La.	–	–	–	–	–	–	–	–	–	–
Texas	2.	8	0	0	–	–	3.	12	11. +	43+
Okla.	t	+	5.	33	–	–	3.	20	17. +	112+
Ark.	1.	43	2.	86	–	–	5.	216	16.	689
Mont.	2.	24	2.	24	–	–	t	+	4. +	48+
Wyo.	–	–	–	–	5.	+	–	–	5.	
Colo.	–	–	–	–	5.	145	–	–	5. +	1
N.Mex.	t	+	–	–	12.	77	–	–	12. +	
Ariz.	10.	12	–	–	5.	6	–	–	15.	
Utah	*–	–	0	0	5.	48	*–	–	5.	
Nev.	1.	+	0	0	4.	+	–	–	5.	
Ida.	2.	81	.5	20	–	–	8.	325	10	
Wash.	t	+	.2	30	.8	119	9.	1,342	1'	
Ore.	.5	21	15.	623	–	–	5.	207		
Calif.	1.	67	.5	33	–	–	9.	604		
U. S.	1.2	3,587	6.	16,982	.3	770	3.8	11,060		

Estimated percentage reduction in yield of tomatoes due to Septoria blight (<u>Septoria lycopersici</u>), Fusarium wilt (<u>Fusarium lycopersici</u>), bacterial wilt (<u>Bacillus solanacearum</u>), early blight (<u>Macrosporium solani</u>), and other diseases, 1920. (Production figures not available.)

State	Estimated percentage reduction in yield due to disease.					
	Septoria blight	Fusarium wilt	Bacterial wilt	Early blight	Other diseases	All diseases
Me.	-	0	0	0	1.	1.
N. H.	-	0	0	*0	1.	1.
Vt.	-	0	0	0	1.	1.
Mass.	t	*0	0	t	2.	2. +
R. I.	t	0	0	t	2.	2. +
Conn.	t	0	0	t	2.	2. +
N. Y.	.7	t	0	.7	4.	5.4+
N. J.	8.	t	0	3.	5.	16. +
Pa.	1.	1.	0	3.	4.	9.
Del.	10.	5.	0	1.	5.	21.
Md.	40.	7.	0	.5	4.	51.5
Va.	30.	1.	t	1.	11.	43. +
W. Va.	5.	t	0	1.	5.	11. +
N. C.	10.	5.	5.	1.	4.	25.
S. C.	5.	10.	4.	-	6.	25.
Ga.	1.	65.	2.	-	10.	78.
Fla.	t	5.	5.	20.	10.	40. +
Ohio	4.	10.	0	5.	15.	34.
Ind.	4.	2.	0	.2	12.	18.2
Ill.	5.	2.	0	.5	10.	17.5
Mich.	3.	*0	0	.5	5.	8.5
Wis.	t	*0	0	t	4.	4. +
Minn.	t	0	0	0	5.	5. +
Iowa	5.	t	0	t	14.	19. +
Mo.	5.	5.	-	-	8.	18.
N. D.	t	t	0	0	t	+
S. D.	t	0	0	0	-	+
Nebr.	1.	-	0	0	-	1.
Kans.	5.	1.	0	0	1.	7.
Ky.	15.	5.	0	0	5.	25.
Tenn.	10.	10.	0	2.	2.	24.
Ala.	2.	20.	1.	3.	15.	41.
Miss.	3.	15.	1.	5.	15.	39.
La.	t	25.	2.	10.	10.	47. +
Texas	3.	1.	t	2.	7.	13. +
Okla.	3.	2.	t	-	4.	9. +
Ark.	5.	3.	1.	-	5.	14.
Mont.	0	0	0	-	-	-
	0	0	0	-	-	-
	t	-	0	-	-	+
	0	-	0	-	-	-
	0	-	5.	-	10.	15.
		-	0	-	-	-
		-	0	0	8.	8.
		0	0	0	30.	30.
		0	0	0	13.	13.
		0	0	0	11.	11.
		3.	0	-	-	3.

THE PLANT DISEASE BULLETIN

Issued By

THE PLANT DISEASE SURVEY

Supplement 19

Index to Supplements 14-18

December 31, 1921

BUREAU OF PLANT INDUSTRY

UNITED STATES DEPARTMENT OF AGRICULTURE

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ERRATA AND EXPLANATION

Page

11 Read "Arkansas (Elliott)" instead of "North Carolina (Elliott)".

36 Read "Arkansas (Elliott)" instead of "Alabama (Elliott)".

77 Line 26, read "1%" instead of "10%".

84 and 88 Read "Podosphaera oxyacanthae" instead of "Podosphaera oxycanthae".

85 Read "Penicillium" instead of "Penicilium".

103 Read "Gymnoconia" instead of "Gymnosconia".

148 Read "Urocystis occulta" instead of "Urocystis occulata".

174 Under headings Rusts and Smuts, read "Hordeum jubatum" instead of "Hordeum jabatum".

Read "Ustilago lorentziana" instead of "Ustilago lorentiziana".

175 Under Claviceps purpurea, read "Phleum pratense" instead of "Phelum pratense".

224 Read "Phytophthora terrestris" instead of "Phytophthora terrestria".

229 Read "Cystospora batata" instead of "Cytospora batata".

237 Read "Fusarium malli" instead of "Fusarium mallii".

238 Read "Heterodera radicicola" instead of "Heterodera radicicila".

279 Downy mildew of Lettuce, read "Phytophthora" instead of "Phythphthora".

284 Read "Phytophthora cactorum" instead of "Phythphthora cactorum".

289 Read "Amelanchier" and "Amelanchier sp." instead of "Amalanchier".

Arbor vitae read "Pestalozzia" instead of "Pestallozia".

290 After Leptothyrium sp. on birch insert as heading "Buckeye (Aesculus glabra)".

293 Read "Ulmus campestris" instead of "Ulmus compestris".

296 Read "Polyporus gilvus" instead of "P. glivus" on black locust.

297 Line 1, read "A. saccharinum" instead of "A. saccharimum".

300 Sequoia, read "Botrytis douglasii" instead of "Botrytis douglassi".

301 Willow, read "Rhytisma salicinum" instead of "Rhytisma salicium".

Page

302 Aster, read "Fusarium conglutinans callistephi" instead of "Fusarium conglutinans callestephi".

303 Evonymus, read "Exosporium concentricum" instead of "Exosporium concentrichum".

304 Iris, read "Bacillus carotovorus" instead of "Bacillus caratovorus".

Read "Althaea" instead of "Althea".

305 Date palm, read "Exosporium palmivorum" instead of "Exosporium palmovorum".

307 Read "Actinonema" instead of "Actinomena".

308 Read "Ambrosia artemisiaefolia" instead of "Ambrosia artimisifolia".

309 Read "Chenopodium" instead of "Chenodopium".

310 Gooseberry, read "Cronartium" instead of "Cronarticum".

311 Read "Hydrophyllum" instead of "Hydrophyllus".

312 Plantain, read "Ramularia plantaginis" instead of "Ramularia plantagoinis".

313 Purslane, read "Albugo portulacae" instead of "Albugo portulacens".

Read "Potentilla pulcherrima" instead of "Potentilla pulcherrina".

314 Read "Ribes oxyacanthoides" instead of "Ribes oxycanthoides".

315 Rubus sp., read "Septoria rubi" instead of "Septoria ribi".

Read "Symphoricarpos" instead of "Symphoricarpus".

334 Read "Colletotrichum gossypii" instead of "Colletotrichum gossypsii".

336 Read "Phyllosticta solitaria" instead of "Phyllosticta soliteria".

337 Read "Bacillus amylovorus" instead of "Bacullus amylororus".