THE PLANT DISEASE REPORTER

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PLANT DISEASE EPIDEMICS
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A PRELIMINARY LIST OF NICARAGUAN PLANT DISEASES

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The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Plant Disease Epidemics and Identification Section serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

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PLANT DISEASE EPIDEMICS AND IDENTIFICATION SECTION

Crops Research Division — Plant Industry Station, Beltsville, Maryland

A PRELIMINARY LIST OF NICARAGUAN PLANT DISEASES

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INTRODUCTION

Relatively little has been published on the plant diseases of Nicaragua and it seems desirable to present at this time available information on the subject. The records listed in this paper are based largely on the collections and observations of the senior author and his associates of the Department of Agronomy of the Servicio Tecnico Agricola de Nicaragua made during the course of the development of the cooperative agricultural research program in Nicaragua since 1952. Some records of collections by A. G. Kevorkian, P. C. Standley and F. W. Wellman have been included also. Identifications have been made by Paul L. Lentz and John A. Stevenson, National Fungus Collections, Beltsville, Maryland. Representative specimens have been, for the most part, deposited in the herbarium of the National Fungus Collections.

In the following account, plant diseases are presented on the basis of plants affected. The Latin or technical name as well as the English and Spanish names are included in the primary listing system. The pathogens of each plant are also listed in the three languages, the primary listing being in Latin and in alphabetical order. Causes other than fungi or bacteria are listed in English and Spanish.

Little attempt has been made to classify the plant diseases identified in the accompanying list as to their relative economic importance in Nicaragua. Most of the diseases encountered were distinctly damaging. Heaviest losses occurred under the most favorable conditions for disease development on completely susceptible plants. In most instances control measures are known and were prescribed to the grower.

Localities in which the different diseases were encountered are briefly described below for ready reference and interpretation:

Managua, Leon, Tipitapa, Chinandega, Rivas, Nandaimi, Chichigalpa, Granada, Corinto, and Homotepe are located on the Pacific side of the country at elevations of less than 500 feet above sea level, where the climate is typically tropical, the temperature and humidity high, and the rainfall distribution 6 months wet (May-October) and 6 months dry (November-May). The annual average rainfall varies between 35 and 80 inches, with Granada, Managua and Tipitapa averaging normally less than 55 inches per year, and the other locations normally receiving 70 to 80 inches. These centers are important producers of corn, cotton, beans, rice, sesame, sorghum, sugar cane, tobacco, and grass for dairying and some beef production.

Masatepe, Diriamba and Jinotepe are located on the fertile, volcanic ash soils on the Pacific side at elevations of 1,000 to 2,000 feet above sea level. The temperatures are more moderate than in the lower lying lands of the coastal plains of the Pacific and the rainfall averages between 75 and 85 inches per year. The dry season of 4 to 5 months is less severe than on the western coastal plains. In this zone about two-thirds of the annual coffee crop is produced.

Jinotega, Masatepe and Esteli are located at elevations of 2,500 to 4,500 feet above sea level in valleys of the Central American Cordillera, which extends from the northwest to the southeast. The soils are less fertile than the volcanic ash soils of western Nicaragua and for the most part are heavy in texture, or clay. The annual rainfall received is 75 to 100 inches per year and the rainy season lasts 6 to 9 months. The dry season is relatively cool. This area produces approximately one-third of the national coffee crop and in isolated sections are produced considerable amounts of corn, sorghum for grain, beans, wheat, potatoes, henequen,

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vegetable and fruit crops, and pasture for livestock. In the slightly lower and drier areas of this same general area such as Ocotol, Sebaco and Condega, cotton and tobacco are also grown. Under irrigation in the dry season onions, vegetable crops and tobacco are also extensively grown in these areas.

Masaya is located at an elevation of about 750 feet above sea level and has a climate intermediate between those of Managua and Diriamba. The fertile soil is of volcanic origin. The crops grown here are similar to those listed for the Pacific lowlands.

El Recreo is located on the Atlantic side of Nicaragua, which mostly consists of wet lowlands, largely covered by tropical forests and jungles. The dry season is of only 3 months duration (February-April). The principal agricultural product is the banana, although coconuts, plantains, oranges and pineapple are also grown. Recently the planting of cacao and African oil palm has been encouraged.

LIST OF DISEASES

AGAVE SPP. (Cabuya o Penca, Henequen)

Dothidella parryi (Farl.) Th. & Syd. (Endothia parryi (Farl.) Cke., Plowrightia williamsoniana Kell.) (Mancha circular de la hoja, Leaf spot)
Managua.

ALLIUM CEPA (Cebolla, Onion)

Alternaria porri (Ell.) Cif. (Mancha purpura, Purple blotch)
Sebaco, generally prevalent in this area where onions are extensively grown.

Aspergillus niger V. Tiegh. (Moho negro, Black mold)
Sebaco.

Erwinia carotovora (Jones) Holland (Pudricion del bulbo, Soft rot)
Sebaco.

Fusarium malli Taub. (Raiz rosada, Pink root)
Sebaco, on heavier soils with inadequate drainage or where improper irrigation is practiced.

Fusarium oxysporum Schlecht. (Marchitez, Wilt)
Sebaco.

ARACHIS HYPOGAEA (Mani, Peanut)

Cercospora arachidicola Hori (Mancha cercospora cafe, Brown leaf spot)
Managua.

Cercospora personata Berk. & Curt. (Mancha de la hoja, Leaf spot)
Managua.

Puccinia arachidis Speg. (Roya de la hoja, Leaf rust)
Managua.

Sclerotium rolfsii Sacc. (Pudricion del tallo, Stem rot)
Managua.

AVENA SATIVA (Avena, oats)

No diseases encountered in the limited plantings observed.

BETA VULGARIS (Remolacha, Beet)

Cercospora beticola Sacc. (Mancha de la hoja, Leaf spot)
Managua, Masatepe, Matagalpa.

Nematodes (Nemátodos)
Metagalpa, Sebaco, Masaya, Masatepe.

BOEHMERIA NIVEA (Ramie)

No diseases have been noted on this plant during the five years of observation at Managua.

BRASSICA OLERACEA CAPITATA L. (Repollo, Cabbage)

Rhizoctonia solani Kuehn (Mal del talluelo, Damping off)

Managua.

Nematodes (Nemátodos)

Metagalpa, Sebaco, and Masatepe.

BRASSICA PEKINENSIS (Repollo Chino, Chinese cabbage)

Alternaria brassicae (Berk.) Sacc. (Mancha foliar, Leaf spot)

Matagalpa.

BRASSICA RAPA (Nabo, Turnip)

Alternaria brassicae (Berk.) Sacc. (Mancha foliar, Leaf spot)

Managua, Matagalpa.

CAESALPINIA SP.

Lenzites striata Fr. (Pudricion de la madera, Wood rot)

General.

Polyporus licnoides Mont. (Pudricion de la madera, Wood rot)

General.

Polyporus sanguineus Fr. (Pudricion de la madera, Wood rot)

General.

CAJANUS CAJAN (Gandul, Pigeon pea)

Fusarium sp.

Managua.

Sclerotium rolfsii Sacc. (Podredumbre de la raiz y del cuello, Stem rot)

Managua.

Uromyces dolicholi Arth. (Roya de la hoja, Leaf rust)

Managua.

Virus (Mosaico)

A "crazy top" virus, new growths bushy, leafy, etc., was in epiphytotic proportions in all seedings of pigeon pea in the Managua area in 1956. Prior to this, infected plants were rare.

CANAVALIA ENSIFORMIS (Canavalia, Jack bean)

Unidentified wilt and virus diseases have been limiting factors in the utilization of this crop at Managua.

CAPSICUM FRUTESCENS (Chiltoma, Pepper)

Cercospora capsici Heald & Wolf (Mancha de la hoja, Leaf spot)

Managua.

Virus (Mosaico, Shoestring, yellowing, crinkle, etc.)

Unidentified viruses are frequently common in garden plantings.

CARICA PAPAYA (Papaya)

Asperisporium caricae (Speg.) Maubl. (Pucciniopsis caricae (Speg.) Seaver) (Mancha foliar, Leaf spot)

El Recreo, Managua.

Virus (Mosaico)

Characterized by severe malformation of older leaves and stunting and mottling of young growth, prevalent at Managua.

CARTHAMUS TINCTORIUS (Safflower)
Cladosporium herbarum Fr.
Managua.

Fusarium sp. (Marchitez, wilt)
Managua.

Rhizoctonia solani Kuehn (Mal del tallo, Stem rot)
Managua.

CENCHRUS PALLIDUS (Mozote o Abrojo de Arenales, Sandbur)
Puccinia cenchri Diet. & Holw. (Roya, Rust)
Chinandega. Observed in uredial stage.

Sorosporium syntherismae (Pk.) Farl. (Carbon, Smut)
Masaya, Realejo.

CHLORIS VIRGATA (Zacate pluma, Feather grass)
Helminthosporium sativum Pammel, King & Bakke (Mancha foliar, Leaf spot)
Managua.

Phyllachora boutelouae Rehm (Mancha alquitranosa, Tar spot)
Sebaco. Also on Chloris sp., Dept. Esteli.

CITRULLUS VULGARIS (Sandia, Watermelon)
Colletotrichum lagenarium (Pass.) Ell. & Halst. (Antracnosis, Anthracnose)
Managua.

Mycosphaerella citrullina (C. O. Sm.) Gross. (Pudricion del tallo, Stem rot)
Managua.

Pseudoperonospora cubensis (Berk. & Curt.) Rostow. (Mildiú, Downy mildew)
Managua.

CITRUS AURANTIUM (Naranjo agrio, Sour orange)
Rhizoctonia solani Kuehn (Mal del talluelo, Damping off)
Managua, Masatepe.

CITRUS SINENSIS (Naranja, Orange)
Fumago vagans Fr. (Fumagina, Sooty mold)
Managua, Masatepe.

Sphaceloma fawcettii Jenkins (Roña, Scab)
El Recreo.

Xylaria cornu-damae (Schw.) Berk. (Pudricion de la madera, Wood rot)
Managua.

COFFEA ARABICA (Cafe, Coffee)
Cercospora coffeicola Berk. & Cke. (Mancha cercospora, Leaf spot)
Esteli, Managua.

Colletotrichum coffeanum Noack (Antracnosis, Anthracnose)
General.

Corticium salmonicolor Berk. & Br. (Mal rosado, Pink disease)
General.

Helminthosporium sp. (Mancha foliar, Leaf spot)
General.

Omphalia flavida Maubl. & Rangel (Mycena citricolor (Berk. & Curt.) Sacc.)
(Ojo de gallo, Eye spot)
General.

Pellicularia koleroga Cke. (Pellejillo, Thread blight)
Diriamba, Masatepe.

Rhizoctonia solani Kuehn (Mal del talluelo, Damping off)
Managua, Masatepe, Jinotepe.

Rosellinia bunodes (Berk. & Br.) Sacc. (Pudricion de la raiz, Black root-rot)
General.

CROTALARIA STRIATA (Crotalaria)

Rhizoctonia solani Kuehn (Mal del talluelo, Damping off)
Managua.

Nematodes (Nemátodos)
Diriamba.

CUCUMIS MELO (Melon, Cantaloupe)

Colletotrichum lagenarium (Pass.) Ell. & Halst. (Antracnosis, Anthracnose)
Managua.

Pseudoperonospora cubensis (Berk. & Curt.) Rostow. (Mildiú, Downy mildew)
Managua.

Pseudomonas lachrymans (E. F. Sm. & Bryan) Carsner (Mancha angular de la hoja, Angular leaf spot)
Managua.

Virus (Mosaico).
The virus diseases common to other cucurbits are also found in the cantaloupe wherever grown.

CUCUMIS SATIVUS (Pepino, Cucumber)

Erysiphe cichoracearum DC. (Mildiú polvoriento, Powdery mildew)
Managua, Sebaco. Observed only in the oidium stage.

Colletotrichum lagenarium (Pass.) Ell. & Halst. (Antracnosis, Anthracnose)
Managua.

Pseudomonas lachrymans (E. F. Sm. & Bryan) Carsner (Mancha angular de la hoja, Angular leaf spot)
Managua.

Pseudoperonospora cubensis (Berk. & Curt.) Rostow. (Mildiú, Downy mildew)
At Managua and vicinity this is a common disease and often destructive.

Rhizoctonia solani Kuehn (Mal del talluelo, Damping off)
Managua.

Virus (Mosaico)
An unidentified virus characterized by severe mottling of leaves and stunting was prevalent in the Managua area on almost all of the older plantings.

CUCURBITA PEPO (Pipian, Squash)

Erysiphe cichorocearum DC. (Mildiú polvoriento, Powdery mildew)
Managua, Sebaco. Observed in the oidium stage.

Pseudoperonospora cubensis (Berk. & Curt.) Rostow. (Mildiú, Downy mildew)
Managua.

Virus (Mosaico)
An unidentified virus disease characterized by severe mottling of leaves and stunting is commonly encountered in the vicinity of Managua.

CYNODON DACTYLON (Zacate de gallina, Bermuda grass)

Helminthosporium cynodontis Marig. (Mancha foliar, Leaf blight)
Managua.

Helminthosporium giganteum Heald & Wolf (Mancha foliar, Leaf blight)
Managua.

Puccinia cynodontis Lacroix (Roya, Rust)
Chinandega, Jinotega, Managua. (At times at Managua common Bermuda grass lawns are devoid of green leaves because of this rust and the leaf spot fungi.)

CYPERUS ROTUNDUS (Coyolillo, Nut grass)

Puccinia canaliculata (Schw.) Lagh. (Roya, Rust)
Chinandega, Esteli, Managua.

DAHLIA VARIABILIS (Dalia, Dahlia)

Entyloma dahliae Syd. (Carbon foliar, Leaf smut)
Matagalpa.

DAUCUS CAROTA SATIVA (Zonahoria, Carrot)

Alternaria dauci (Kuehn) Groves & Skolko (Mustia foliar, Leaf blight)
Matagalpa.

Erwinia carotovora (Jones) Holland (Pudricion blanda, soft rot)
Sebaco.

Nematodes (Nemátodos)
Matagalpa, Sebaco, Masatepe, Masaya.

DIANTHUS CARYOPHYLLUS (Clavel, Carnation)

Colletotrichum dematium (Fr.) Grove (Antracnosis, Anthracnose)
Matagalpa.

Septoria dianthi Desm. (Mancha foliar, Leaf blight)
Matagalpa.

DIGITARIA DECUMBENS (Zacate pangola, Pangola grass)

Piricularia grisea (Cke.) Sacc. (Mancha foliar, Leaf spot)
Managua.

DOLICHOS LABLAB (Dolicos, Hyacinth bean)

Cercospora canescens Ell. & G. Martin (Mancha cercospora, Leaf spot)
Chinandega, Managua

Leveillula taurica (Lév.) Arn. (Mildiú, Mildew)
Managua. Observed in the conidial stage.

EMILIA sp.
    Puccinia emiliae P. Henn. (Roya, Rust)
        Managua.

ERAGROSTIS sp.
    Uromyces eragrostidis Tracy (Roya, Rust)
        Esteli.

EUCHLAENA MEXICANA (Teosinte)
    Claviceps tripsaci F. L. Stevens & Hall (Cornezuelo, Ergot)
        General.

EUPHORBIA PULCHERRIMA (Pascua, Poinsetta)
    Sphaceloma poinsettiae Jenkins & Ruehle (Roña, Spot anthracnose)
        Managua.

FICUS CARICA (Higo, Fig)
    Physopella fici (Cast.) Arth. (Roya de la hoja, Leaf rust)
        Managua.

GLYCINE MAX (Frijol soya, Soy bean)
    Cercospora canescens Ell. & G. Martin (Mancha cercospora, Leaf spot)
        Managua.

    Cercospora kikuchii (Mats. & Tomoy.) Gardner (Mancha purpura, Mancha foliar, Purple speck, Leaf spot)
        Managua, Jinotega.

    Helminthosporium vignicola (Kawamura) L. Olive (Corynespora cassiicola (Berk. & Curt.) Wei) (Mancha foliar, Target spot)
        Managua.

    Xanthomonas phaseoli (E. F. Sm.) Dows. var. sojensis (Hedges) Starr & Burkh. (Pustula bacterial, Bacterial pustule)
        Managua, Jinotega.

    Virus (Mosaico)
        Various unidentified virus diseases were observed at Managua and if soybeans became a commercial crop virus would probably become an important production factor.

GONOLOBUS sp. (Bejuco)
    Puccinia gonolobi Rav. (Roya, rust)
        Granada.

GOSSYPIUM HIRSUTUM (Algodon, Cotton)
    Alternaria macrospora Zimm. (Mancha foliar, Leaf blight)
        Managua, Tipitapa.

    Diplodia gossypina Cke. (Podredumbre de la guayaba, Boll rot)
        Managua. (May have been secondary as it was found growing profusely on plants believed destroyed by lightning and occasionally on rotted bolls.)

Fumago vagans Fr. (Fumagina, Sooty mold)
Chinandega, Leon, Malpaiesello, Managua.

Fusarium moniliforme Sheldon (Pudricion rosada de la guayaba, Pink boll rot)
Chinandega.

Fusarium oxysporum Schlecht. (Marchitez, Fusarium wilt)
Managua.

Fusarium roseum Lk. (Pudricion de la guayaba, Boll rot)
Chinandega.

Fusarium solani (Mart.) Appel & Wr. (Pudricion de las guayabas, Boll rot)
Chinandega.

Fusarium vasinfectum Atk. (Marchitez, Fusarium wilt)
Chinandega, Managua.

Pythium sp. (Mal del tallulo, Damping off)
Managua, Tipitapa.

Ramularia areola Atk. (Mildiú areolado, Areolate mildew)
Chinandega, Esteli, Leon, Managua, Matagalpa, Ocotol, Pueblo Nuevo, Rivas, Tipitapa.

Rhizoctonia solani Kuehn (Mal de las plantulas y Mancha foliar, Sore shin, Leaf blight)
San Rafael del Sur, Managua, Masaya, Tipitapa.

Verticillium albo-atrum Reinke & Berth. (Marchitez, Verticillium wilt)
Homotepe, Leon, Managua, Masaya, Chinandega.

Xanthomonas malvacearum (E. F. Sm.) Dows. (Mancha angular, Angular leaf spot)
Chinandega, Esteli, Managua, Matagalpa, Rivas, Tipitapa. (This bacterium has been responsible for boll rot and black arm. At present it is considered one of the most destructive of all the cotton diseases.)

Lightning Damage (Daño de rayo)
The sudden appearance of variously-sized areas with plant portions above ground dead and the roots yet sound usually signifies destruction by lightning. Damage from lightning is heavy in some areas.

2, 4-D Damage (Daño de 2, 4-D)
Distorted elongated leaves, malformed flowers, squares, etc., have been observed where spraying machinery has previously been used for weed control in sugar cane or rice. In some cases vapor from plots treated with 2, 4-D has caused damage. In all cases the cotton plants recovered. Farmers are being constantly warned of this danger.

BHC Toxicity (Toxicidad de BHC)
A third non-infectious difficulty at times alarming to cotton farmers has been the heavier-than-recommended use of BHC insecticide. If several times in excess, severe burning of the foliage and young stems may result, but if over-dose is only moderate the vegetative growths may only be reduced, yellowed, and malformed.

Virus (Mosaico)
At least three unidentified virus diseases can be recognized. None of them have reached epiphytotic proportions as yet. Infections are always greatest near the borders of the fields. Cotton plants infected early with virus may produce none or very few bolls.

HELIANTHUS ANNUUS (Girasol, Sunflower)

Fusarium sp. (Mal del tallo, Stem canker)

Managua.

Macrophomina phaseoli (Maubl.) Ashby (Ashby blight)

Managua.

HEVEA BRASILIENSIS (Hule, Rubber)

Dothidella ulei P. Henn. (Mancha Sud Americana, South American leaf disease)

El Recreo.

Helminthosporium heveae Petch (Ojo de pajaro, Bird's eye spot)

El Recreo.

HIBISCUS CANNABINUS (Kenaf)

Rosellinia solani Kuehn (Mal del tallo, Stem rot)

Managua.

Virus (Mosaico)

At least one unidentified virus has been prevalent in the plantings at Managua.

HIBISCUS SABDARIFFA (Rosella, Roselle)

Rhizoctonia solani Kuehn (Mal del talluelo, Pudricion radicular, Root rot)

Managua.

HYPARRHENIA RUFA (Zacate de Jaragua, Jaragua grass)

Helminthosporium sp. (Mancha foliar, Leaf spot)

Managua. (There are no reports of any imperfect fungi on this grass; an expert might consider naming this species).

HYPTIS SUAVEOLENS (Menta, Wild mint)

Puccinia medellinensis Mayor (Roya, Rust)

Realijo.

IPOMOEA BATATAS (Camote or Batata, Sweetpotato)

Colletotrichum gloeosporioides Penz. (Antracnosis, Anthracnose)

Managua.

Phyllosticta batatas (Thuem.) Cke. (Mancha foliar, Leaf spot)

Managua.

IXOPHORUS UNICETUS (Zacate dulce o Chompipe, Turkey grass)

Puccinia chaetochloae Arth. (Roya foliar, Leaf rust)

Managua.

JACQUINIA AURANTIACA

Phyllachora inclusa (Berk. & Curt.) Sacc. (Mancha alquitranosa, Tar spot)

Dept. Chontales.

LUPINUS ANGUSTIFOLIA (Lupino, Lupine)

Colletotrichum dematium (Fr.) Grove (Antracnosis, Anthracnose)

Managua.

Rhizoctonia solani Kuehn (Pudricion radicular Root rot)

Managua.

LYCASTE sp. (Orquidie, Orchid)

Gloeosporium maxillariae Allesch. (Antracnosis, Anthracnose)

General distribution.

LYCOPERSICON ESCULENTUM (Tomate, Tomato)

Alternaria solani (Ell. & G. Martin) Sor. (Mustia temprana, Early blight)
Managua, Sebaco.

Phytophthora infestans (Mont.) d By. (Mustia tardia, Late blight)
Managua.

Nematodes (Nemátodos)
Matagalpa, Sebaco.

Virus (Mosaico).
Wherever tomatoes are grown individual plants are variously infected with virus -- leaf mottling, stunting, yellowing, etc.

MANIHOT UTILISSIMA (Yuca, Cassava)

Cercospora caribaea Chupp & Cif. (Mancha blanca de la hoja, White leaf spot)
Managua.

Cercospora henningsii Allesch. (Mancha grande de la hoja, Large leaf spot)
Managua.

Virus (Mosaico)
An unidentified virus was observed in the Rivas area. The leaves become mottled and deformed and the plants dwarfed.

MEDICAGO LUPULINA (Lupulina, Yellow trefoil)

Rhizoctonia solani Kuehn (Tizon, Blight)
Managua.

MEDICAGO SATIVA (Alfalfa)

Bacterium alfalfae Riker, F. R. Jones & Davis (?).
Bacterial leaf spots collected at Managua are designated as this species although verification has not been made.

Colletotrichum dematium (Fr.) Grove
Managua.

Colletotrichum graminicola (Ces.) G. W. Wils. (Antracnosis, Anthracnose)
Managua.

Sclerotium rolfsii Sacc. (Podredumbre de la raiz y del cuello, Southern blight)
Managua. Prevalent in both young and older plants.

Uromyces striatus Schroet. (Roya, Rust)
Managua. At this lower elevation it is serious, especially if the crop is allowed to go to seed.

Xanthomonas alfalfa (Riker, L. R. Jones & Davis) Dows. (Mancha bacterial, Bacterial leaf spot)
Managua.

MUCUNA DEERINGIANUM (Frijol terciopelo o Stizolobium, Velvet bean)

Cercospora stizolobii Syd. (Mancha cercospora, Leaf spot)
Managua. On older plants defoliation may be complete.

Sclerotium rolfsii Sacc. (Podredumbre de la raiz y del cuello, Southern blight)
Managua. On younger plants stand losses may be high.

MUSA PARADISIACA SAPIENTUM (Banano, Banana)

Cercospora musae Zimm. (Sigatoka o Chamusco, Leaf blight)

Masatepe. This disease caused banana production to be reduced from a major enterprise to one of minor importance on the Atlantic Coast of Nicaragua.

Fusarium sp. (Marchitez, Wilt)

Managua, Rivas, Tipitapa.

Helminthosporium torulosum (Syd.) Ashby (Mancha negra de foliaje, Black spot)

Masatepe.

NICOTIANA TABACUM (Tobaco, Tobacco)

Cercospora nicotianae Ell. & Ev. (Mancha cercospora, Leaf spot)

Managua.

Pythium sp. (Pudricion radicular, Root rot)

Managua.

Rhizoctonia solani Kuehn (Mal del tallulo, Damping off)

Managua.

Virus (Mosaico).

Several types of mosaic have been observed in the tobacco areas although no attempt has been made to identify them.

OLYRA LATIFOLIA

Puccinia deformata Berk. & Curt. (Roya, Rust)

Dept. Chontales.

ORYZA SATIVA (Arroz, Rice)

Cercospora oryzae Miyake (Mancha cercospora, Leaf spot)

Managua.

Helminthosporium oryzae Breda de Haan (Mancha de la hoja, Brown spot)

Chinandega, Managua, Rivas. This is generally the most prevalent of the rice diseases.

Phaeosphaeria oryzae Miyake (Trematosphaerella oryzae (Miy.) Padwick)

Managua.

Piricularia oryzae Cav. (Cabezas mustias, Blast)

Chinandega, Leon, Managua, Rivas. In some fields and during some years losses have been great.

Ustilaginoidea virens (Cke.) Tak. (Carbon falso, False smut)

Masaya, Nandaime.

Xanthomonas oryzae (Uyedo & Ishiyama) Dows. (Tizon bacterial, Bacterial blight)

Managua.

PANICUM MAXIMUM (Zacate de Guinea, Guinea grass)

Cercospora fusimaculans Atk. (Mancha cercospora, Leaf spot)

Managua.

Helminthosporium sp. (Mancha foliar, Leaf spot)

Managua.

PANICUM PILOSUM

Balansia strangulans (Mont.) Diehl

El Recreo.

PANICUM POLYGONATUM
Dothichloë nigricans (Speg.) Chardon
El Recreo.

PANICUM PURPURASCENS (Zacate de Para, Paragrass)
Fusarium sp.
Managua.

PASPALUM CONJUGATUM
Myriogenospora paspali Atk.
Cukra Hill.

PASPALUM NOTATUM (Zacate Bahia, Bahia grass)
Cladosporium herbarum Fr. (Mancha foliar, Leaf spot)
Managua.

Curvularia sp. (Mancha foliar, Leaf spot)
Managua.

Ramularia sp. (Mancha foliar, Leaf spot)
Managua.

PASPALUM VAGINATUM (Seashore paspalum)
Phyllachora cornispora Atk. (Mancha alquitranosa, Tar spot)
Managua.

PENNISETUM CLANDESTINUM (Zacate kikuyu, Kikuyu grass)
Piricularia grisea (Cke.) Sacc. (Mancha foliar, Leaf spot)
Managua. At these lower elevations this leaf spot fungus limits Kikuyu grass as a forage producer.

PENNISETUM PURPUREUM (Zacate Elefante o Napier, Napier grass)
Fusicladium sp. (Mancha foliar, Leaf spot)
Casa Colorado, Chinandega, Managua. This may be an undescribed species.

PERSEA AMERICANA (Aguacate, Avocado)
Cercospora purpurea Cke. (Mancha de la fruta y hoja, Leaf and fruit spot)
Found on fruit from Managua.

PHASEOLUS AUREUS (Frijol mungo, Mung bean)
Erysiphe polygoni DC. (Mildiú polvoriento, Powdery mildew)
Chinandega, Jinotega, Managua. Extent of the powdery mildew disease at all locations was very heavy. Successive plantings were more quickly infected.

Fusarium oxysporum Schlecht. f. vasinfectum (Atk.) Snyder & Hansen.
Managua.

Phyllosticta phaseolina Sacc. (Mancha foliar, Leaf blotch)
Managua.

Virus (Mosaico)
At Jinotega a yellow leaf mottling was evident in 100 percent of the plants. At lower elevations this was apparently not expressed.

PHASEOLUS VULGARIS (Frijol, Bean)
Colletotrichum lindemuthianum (Sacc. & Magn.) Scribner (Antracnosis, Anthracnose)
Chinandega, Esteli, Jinotega, Managua, Matagalpa.

Colletotrichum truncatum (Schw.) Andrus & Moore (Antracnosis, Stem Anthracnose)
Managua.

Erysiphe polygoni DC. (Mildiú polvoriento, Powdery mildew)
Esteli, Jinotega.

Fusarium sp. (Marchitez, Wilt)
Managua.

Isariopsis griseola Sacc. (Mancha angular de la hoja, Angular leaf spot)
Esteli, Matagalpa, Managua. Some damage from this angular leaf spot has been observed wherever beans are grown.

Ramularia phaseolina Petrak (Mancha foliar, Leaf spot)
Esteli.

Rhizoctonia solani Kuehn (Chancro del tallo, Damping off)
Managua.

Sclerotium rolfsii Sacc. (Podredumbre de la raiz y del cuello, Southern blight)
Managua.

Uromyces phaseoli (Reb.) Wint. (Roya, Rust)
Esteli, Jinotega, Matagalpa. Some damage by defoliation from rust has been observed wherever beans are grown.

Xanthomonas phaseoli (E. F. Sm.) Dows. (Tizon bacterial, Bacterial blight)
Managua.

Virus (Mosaico)
At the lower elevations especially a number of virus diseases (dwarfing, rugose, yellowing, mottling, etc.) manifest themselves and in many instances become limiting factors in growing a crop.

PSIDIUM GUAJAVA (Guayaba o Guava, Guava)
Meliola psidii Fr. (Tizon negro, Black mildew)
Castillo Viejo.

RICINUS COMMUNIS (Higuerilla, Castor bean)
Cercospora ricinella Sacc. & Berl. (Mancha cercospora, Leaf spot)
Managua.

Sclerotinia ricini Godfrey (Moho gris, Gray mold)
Managua.

Xanthomonas ricinicola (Elliott) Dows. (Mancha bacterial, Bacterial spot)
Managua.

ROSA ODORATA (Rosa, Rose)
Actinonema rosae (Lib.) Fr. (Mancha negra, Black spot)
Managua, Matagalpa, Masatepe, Chinandega, Masaya. This common leaf spot disease caused severe defoliation, especially during the rainy season.

Sphaerotheca pannosa (Wallr.) Lév. (Mildiú polvoriento, Powdery mildew)
Masatepe, Matagalpa, Jinotega.

SACCHARUM OFFICINARUM (Cana de azucar, Sugar cane)
Colletotrichum falcatum Went (Physalospora tucumanensis Speg.) (Podredumbre roja o pudricion de la semilla)
Chichigalpa, Managua.

Fusarium moniliforme Sheldon (Pudricion del cogollo o Pokkah boeng, Top rot)
Chichigalpa, Managua.

Helminthosporium sacchari (Breda de Haan) Butl. (Mancha de ojo, Eye spot)
Chichigalpa, Managua.

Virus (Mosaico)
Streak and stunt virus are the most common types prevalent.

SCIRPUS sp. (Cola de caballo, Sedge)
Puccinia obtecta Pk. (Roya, rust)
Granada.

SECHIUM EDULE (Chayote)
Erysiphe cichoracearum DC. (Mildiú polvoriento, Powdery mildew)
Esteli, Leon, Managua, Matagalpa, Ocotol, Sebaco. Generally severe on newly formed branches and foliage.

SESAMUM INDICUM (Ajonjoli, Sesame)
Alternaria sp. (Follaje mustio, Leaf spot)
Chinandega, Managua. This and Cercospora leaf spot are the most destructive diseases of sesame.

Cercospora sesami Zimm. (Mancha de la hoja, Leaf spot)
Managua.

Fusarium oxysporum Schlecht. (Tizon del tallo, Stem canker)
Managua.

Helminthosporium sesami Miyake (Tizon del tallo, Stem canker)
Managua.

Sclerotium rolfsii Sacc. (Podredumbre de la raiz y del cuello, Southern blight)
Managua.

SOLANUM TUBEROSUM (Papa, Potato)
Alternaria solani (Ell. & G. Martin) Sor. (Mustia temprana, Early blight)
Esteli, Jinotega, Matagalpa.

Erwinia carotovora (L. R. Jones) Holland (Pudricion blanda, Black-leg)
Esteli, Jinotega, Sebaco.

Fusarium sp. (Pudricion seca, Dry rot)
Matagalpa.

Phytophthora infestans (Mont.) d By. (Mustia tardia, Late blight)
Jinotega, Matagalpa. During the dry season under irrigation damage is local, but when warm moist seasons are frequent the disease spreads rapidly and severe attacks occur.

Rhizoctonia solani Kuehn (Pudricion del tallo, Stem rot)
Masatepe.

Streptomyces scabies (Thaxt.) Waksman & Henrici (Sarna, Scab)
Esteli, Jinotega, Masatepe, Matagalpa. On susceptible varieties always severe.

Virus (Mosaico)
Several virus diseases have been observed -- leaf rolling, yellowing, bronzing, and rugose. No attempt has been made to give a complete list.

SORGHUM VULGARE (Sorgo para grano, Grain sorghum)

Colletotrichum graminicola (Ces.) G. W. Wils. (Antracnosis, Anthracnose)
Managua.

Gloeocercospora sorghi D. Bain & Edg. (Mancha anular, Zonate leaf spot)
Managua.

Macrophomina phaseoli (Maubl.) Ashby (Pudricion seca, Dry root rot)
Chinandega, Managua.

Puccinia purpurea Cke. (Roya, Rust)
Managua.

Spacelotheca sorghi (Lk.) Clint. (Carbon cubierto del grano, Covered smut)
Esteli, Managua.

Sphacelotheca cruenta (Kuehn) Potter (Carbon polvoriento del grano, Loose smut)
Managua, Esteli, Condega.

Virus (Mosaico)
A streak virus is uncommonly observed in the Managua area.

SORGHUM VULGARE Pers. var. SUDANENSE (Zacate sudan, Sudan grass)

Collectotrichum falcatum Went
Managua.

Colletotrichum graminicola (Ces.) G. W. Wils. (Antracnosis, Anthracnose)
Managua.

Gloeocercospora sorghi D. Bain & Edg. (Mancha anular, Zonate leaf spot)
Managua.

Helminthosporium turcicum Pass. (Follaje mustio, Leaf blight)
Managua.

Puccinia purpurea Cke. (Roya, Rust)
Managua, Matagalpa.

SORGHUM VULGARE TECHNICUM (Sorgo para Escoba, Broom corn)

Helminthosporium turcicum Pass. (Follaje mustio, Leaf spot)
Managua, Leon, Chinandega. Generally prevalent and may cause complete defoliation of plants.

STENOTAPHRUM SECUNDATUM (Zacate San Agustin, St. Augustine grass)

Piricularia grisea (Cke.) Sacc. (Mancha foliar, Leaf spot)
Managua.

STIZOLOBIUM: See MUCUNA

THEOBROMA CACAO (Cacao, Cacao)

Diplodia theobromae (Pat.) Nowell (Pudricion de la mazorca, Brown rot)
Corinto.

TRIFOLIUM RESUPINATUM (Trebol Persa, Persian clover)

Cercospora zebrina Pass. (Mancha foliar, Leaf spot)
Managua.

TRIPSACUM LAXUM (Zacate Guatemala, Guatemala grass)

Puccinia polysora Underw. (Roya, Rust)
Managua.

TRITICUM AESTIVUM (Trigo, Wheat)

Cladosporium herbarum Fr. (Mycosphaerella tulasnei (Jacz.) Lindau) (Mancha foliar, Leaf spot)
Managua.

Gibberella zeae (Schw.) Petch (Sarna, Scab)
Matagalpa.

Helminthosporium sativum Pam., King & Bakke (Pudricion radicular y el cuello, Crown rot, Root rot)
Diriamba.

Puccinia graminis Pers. (Roya negra del tallo, Stem rust)
La Concordia, Matagalpa.

Puccinia recondita Rob. ex Desm. (Roya de la hoja, Leaf rust)
Matagalpa.

VANILIA PLANIFOLIA (Vainilla, Vanilla)

Uredo scabies Cke. (Roya, Rust)
General.

VIGNA SINENSIS (Frijol de vaca, Caupi, Cowpea)

Cercospora canescens Ell. & G. Martin (Mancha cercospora, Leaf spot)
Managua.

Cercospora cruenta Sacc. (Mancha cercospora grande, Large leaf spot)
Managua. Results in heavy defoliation.

Erysiphe polygoni DC. (Mildiú polvoriento, Powdery mildew)
Chinandega, Jinotega, Managua. Collected mostly in the Oidium stage; however, the conidial stage, Leveillula taurica (Lév.) Arn., was collected in July at Managua.

Sclerotium rolfsii Sacc. (Podredumbre de la raiz y del cuello, Southern blight)
Managua.

Virus (Mosaico)
Several virus diseases have been observed, with greatest prevalence and symptom intensity in the Managua area. Mottling and yellowing are the most common.

ZEA MAYS (Maiz, Corn)

Angiopsora zeae Mains (Roya, rust)
Granada, Managua. Observed for first time in January 1957.

Gibberella zeae (Schw.) Petch (Pudricion de la mazorca, Ear, seed rot)
Esteli, Jinotega.

Helminthosporium maydis Nisikado & Miyake (Mancha pequena de la hoja, Leaf blotch)
Chinandega, Esteli, Jinotega, Managua.

Helminthosporium turcicum Pass. (Mancha grande de la hoja, Leaf blight)
Chinandega, Esteli, Jinotega, Managua, Matagalpa. Common and widespread, causing much damage by leaf destruction, especially on susceptible introduced varieties.

Macrophomina phaseoli (Maubl.) Ashby (Pudricion chancrosa del tallo, Charcoal rot)
Managua.

Phyllachora maydis Maubl. (Mancha alquitranosa, Tar spot)
Esteli, Managua, Matagalpa.

Physoderma maydis Miyake (Mancha de la vaina, Brown spot)
Chinandega, Managua.

Puccinia polysora Underw. (Roya, Rust)
Chinandega, Esteli, Jinotega, Managua, Matagalpa.

Puccinia sorghi Schw. (Roya, Rust)
Jinotega.

Ustilago maydis (DC.) Cda. (Carbon, Smut)
Esteli, Managua, Jinotega. This common corn smut has been much more prevalent at the higher elevations.

Virus (Mosaicos -- Estriamento y Enanismo)
At least two types of virus disease have been observed in the Managua area. So far the least damaging type, a streak virus, has been observed only in the Managua area; whereas the stunt virus (typical symptoms are dwarfing, yellowing to reddish foliage, slight streaking, early death of leaves, reduced production of pollen and ear or seed) has been observed causing serious damage in the Managua and Rivas areas. These two virus diseases were both recognized for the first time during the 1956 growing season. Extent of the damage with corn stunt appeared to depend on infection time; if at an early stage the plant produced little or no growth or ears. On occasion, infected plants were observed to possess an abnormal number of small ears. Later infection meant an ear but possibly reduced in size. In a 10-manzana crossing block of Rocamex H-501 the male parent exhibited more than 30 percent plants infected at tasseling and almost 100 percent at maturity. The yield losses varied according to the distance of the apparent source of infection.

The streak virus has been considered less destructive, the infected plants making a partial recovery as they become older. Streaked plants have been observed in PD $(MS)_6$, Hawaiian Sugar Sweet corn, and a Criollo strain referred to as Chinandega White.

ZOYSIA spp. (including Z. japonica, Z. matrella and a number of hybrid selections).
Curvularia lunata (Wakker) Boed. (Crown rot, leaf spot)
Managua. Associated with a rotting at the crown of infected plants with some leaf spotting. The disease was studied by Mrs. Lucy Hastings de Gutiérrez of the Instituto Interamericano at Turrialba, Costa Rica.

INTERNATIONAL COOPERATION ADMINISTRATION, SERVICIO TECNICO AGRICOLA DE NICARAGUA OF THE MINISTRY OF AGRICULTURE IN NICARAGUA; AND NATIONAL FUNGUS COLLECTIONS, CROPS RESEARCH DIVISION, AGRICULTURAL RESEARCH SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE

THE PLANT DISEASE REPORTER

Issued By

PLANT DISEASE EPIDEMICS
and
IDENTIFICATION SECTION

AGRICULTURAL RESEARCH SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE

HOST INDEX OF VERTICILLIUM ALBO-ATRUM REINKE & BERTH. (INCLUDING VERTICILLIUM DAHLIAE KLEB.)

Supplement 244 June 15, 1957

The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Plant Disease Epidemics and Identification Section serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

THE PLANT DISEASE REPORTER

PLANT DISEASE EPIDEMICS AND IDENTIFICATION SECTION

Crops Research Division Plant Industry Station, Beltsville, Maryland

HOST INDEX OF VERTICILLIUM ALBO-ATRUM REINKE & BERTH. (INCLUDING VERTICILLIUM DAHLIAE KLEB.)

Arthur W. Engelhard[1]

Plant Disease Reporter
Supplement 244

June 15, 1957

INTRODUCTION

This is an index of plants reported to be hosts of Verticillium albo-atrum Reinke & Berth. Plants reported as hosts of V. dahliae Kleb. are also included, as some mycologists and pathologists consider this pathogen identical with V. albo-atrum. The Index was prepared as a convenience and guide for persons wanting a quick and handy reference to reported hosts of V. albo-atrum. It should not be considered as a final reference or source when determining if a plant in question is a recorded host of V. albo-atrum. The final source of information should be the original publication in which the plant was cited.

An attempt was made to include: 1) all plants reported as hosts in the United States, and 2) all plants reported in some other country but not for the United States. Reports of plants susceptible to Verticillium sp. or spp., Verticillium disease, Verticillium hadromycosis, etc., are not included. It should also be borne in mind that, owing to the nature of this pathogen, plants are reported as being hosts after successful isolation of V. albo-atrum from them. Many of the citations listed herein are of this type.

This Host Index is divided into four parts as follows:

Section A -- Woody Plants

Part 1	Trees
Part 2	Shrubs, bushes, small fruits, lianas

Section B -- Herbaceous Plants

Part 3	Field crops, vegetables, small fruits
Part 4	Ornamentals, "flowers", weeds

As some plants may be listed in more than one part, it is suggested that all possible places where a plant in question may be listed be checked. This is true where certain shrubs may also be small trees. The genus Aralia, for example, includes species that are trees, shrubs, and herbaceous plants.

The scientific names of the hosts are usually listed as presented by the original author. When no scientific name was given by the author, and one was needed for alphabetizing purposes, the generic name is usually added in parentheses, for example (Ribes ____). Where several scientific names are extant in the literature, the preferred names given in the eighth edition of "Gray's Manual of Botany" by Fernald and/or "Manual of Cultivated Plants" by Bailey are used.

Common names are usually listed only when the author of the original citation gave one.

Literature citations listed under the "Reference" column were abbreviated so they would fit the page more easily. Below are examples of abbreviations used followed by the full name of the publication.

B.A.	Biological Abstracts
P.D.R.	Plant Disease Reporter
P.D.R. Suppl.	Plant Disease Reporter Supplement
R.A.M.	Review of Applied Mycology
Rud.	Rudolph, B.A. (See page 24 for complete citation and comment)

[1] Illinois Natural History Survey, Section of Applied Botany and Plant Pathology, Urbana, Illinois.

Weiss	Refers to the five volumes of the "Index of Plant Diseases in the United States" by Freeman Weiss and Associates (see page 24 for complete citation)
Weiss P. D. R. Index.	See Weiss above.

The "Remarks" columns in the tables were used to include extra items of information that were considered important enough to mention. Some of the items listed in the "Remarks" column are explained below.

V. dah.	All plants in this Index are hosts of V. albo-atrum unless otherwise indicated. V. dah. indicates that the plant was reported as a host of V. dahliae. V. a-a or V. dah. indicates that no distinction was made between the two fungi by the author and the original publication should be consulted for more definite information.
1st report etc.	When the original author indicated that a particular plant was not previously reported to be a host in a certain State, the United States, or the world, such a statement was included under the "Remarks" column. First report, as stated by an author, apparently indicates the first world report.

The literature surveyed in the preparation of this Host Index is listed below:

1. Biological Abstracts: Vol. 1, 1927 through Vol. 27, 1953.
2. Illinois State Academy of Science Proceedings: Vol. 1, 1908 through Vol. 47, 1955.
3. Phytopathology: Only a few issues.
4. Plant Disease Reporter: Vol. 1(1), 1917 through Vol. 39(12), 1955.
5. Plant Disease Reporter Supplements: No. 1, 1918 through No. 235, 1955.
6. Review of Applied Mycology: Vol. 1, 1922 through Vol. 32, 1953.
7. Rudolph, B. A.: 1931. Verticillium hadromycosis. Hilgardia 5(9): 197-353. (This is an excellent review of Verticillium hadromycosis and should be consulted for comments on older contributions in the field).
8. Weiss, Freeman: 1940-1942. Revised Checklist of Diseases of Economic Plants of the United States. Plant Disease Reporter 24(7), 1940 through Vol. 26(23), 1942. (This checklist includes only woody plants and was issued in sections in the above indicated volumes. All of the information in this checklist was apparently included in the 1950-1953 checklist by Weiss and Associates -- see No. 9)
9. Weiss, Freeman: 1950-1953. Index of Plant Diseases in the United States. U. S. Dept. Agr. Plant Disease Survey Special Publication 1 (Muriel J. O'Brien is co-author of Parts IV & V).

1950:	Part I.	Acanthaceae - Compositae
	Part II	Convolvulaceae - Gnetaceae
	Part III	Gramineae
1952:	Part IV	Guttiferae - Phytolaccaceae
1953:	Part V	Pinaceae - Zygophyllaceae

10. United States Department of Agriculture. 1953. Plant Diseases. Yearbook of Agriculture 1953.

HOSTS OF VERTICILLIUM ALBO-ATRUM REINKE & BERTH. (INCLUDING V. DAHLIAE KLEB.)

A — WOODY PLANTS — Part 1. TREES

Scientific Name	Common Name	Location	Reference	Remarks
Acer macrophyllum Pursh.	bigleaf maple	Cal., Oregon, Wash.	Weiss I: 19. 1950	
Acer mono	painted maple	Tenn.	P.D.R. 39(11): 882.'55	
Acer negundo L.	boxelder	N.E. and north-central states to Va., Tenn., and Ill.	Weiss I: 12. 1950	
Acer negundo var. californicum (Torr. & Gray) Sarg.	California boxelder		Weiss I: 20. 1950	
Acer nigrum Michx.f.	black maple	Ill.	P.D.R. 22(12): 253-4.'38	
Acer palmatum Thunb.	Japanese maple		Weiss I: 20. 1950	V.a-a or dah.
Acer palmatum Thunb. var. rubrum Schweren	Japanese red maple	See ref.	Rud. 308. 1931	
Acer platanoides L.	Norway maple	Ill.	P.D.R. 22(12):253-4.'38	
Acer platanoides L.	Norway maple	General - U.S.	Weiss I: 21. 1950	
Acer platanoides schwedleri Koch	Schwedler's maple	Ill.	P.D.R. 22(12):253-4.'38	
Acer pseudoplatanus L.	sycamore maple	Conn., Mo., Va.	P.D.R. 24(10):198. 1940	
Acer pseudoplatanus L.	sycamore maple		Weiss I: 20. 1950	V.a-a or dah.
Acer rubrum L.	red maple	Ill.	P.D.R. 22(12):253-4.'38	

A -- WOODY PLANTS - Part 1. (Continued)

Scientific Name	Common Name	Location	Reference	Remarks
Acer rubrum L.	red maple		Weiss I: 12. 1950	See ref.
incl. A. r. drummondii (Hook. & Arn.) Sarg.	Drummond maple			
A. r. trilobum (K. Koch)	trident maple			
Acer saccharinum L.	silver maple		Weiss I: 12. 1950	
Acer saccharum Marsh.	hard maple	Ill.	P. D. R. 22(12):253-4. '38	1st Ill. case 1926.
Acer saccharum Marsh.	sugar maple		Weiss I: 12. 1950	
Aesculus hippocastanum	horse chestnut	Germany	R. A. M. 9:6. 1930	Apparently 1st report
	horse chestnut	Germany	R. A. M. 12: 117. 1933	
Ailanthus altissima (Mill.) Swingle	ailanthus, Tree-of-heaven	N. Y., Pa., Va.	Weiss 5: 1092. 1953	
Ailanthus glandulosa		France	Biol. Abst. 7:20513. 1933	V. dah.
Ailanthus glandulosa		Italy	Biol. Abst. 11(3): 5478. 1937	
Catalpa bignonioides Walt.	southern catalpa	Ill., N. J., N. Y.	Weiss I: 91. 1950	
Catalpa speciosa Warder	western catalpa	Ill.	P. D. R. 22(12): 253-4 1938	Carter 1st report
Catalpa speciosa Warder	northern catalpa	Ill., N. J., N. Y.	Weiss I: 91. 1950	
Ceratonia siliqua L.	carob, St. John's bread	Cal.	Weiss IV. 594. 1952	

A -- WOODY PLANTS - Part 1. (Continued)

Scientific Name	Common Name	Location	Reference	Remarks
Cercis canadensis L.	redbud	Ill.	P.D.R. 29(3):95-96. 1945	Carter
Cercis siliquastrum		Italy	Biol.Abst. 11(3): 5478. 1937	Isolates considered identical with V. a-a.
Cinnamomum camphora Nees & Eberm.	camphor tree	Calif.	P.D.R. 39:693. 1955	1st report
Clasdrastis lutea Koch	yellow wood	Ill.	P.D.R. 24(6):133-4. 1940	1st report in Ill.
(Cydonia ________)	Quince	France	B.A. 15:1278. 1941	V. dahliae
	Quince	England	Ann.Rpt.E.Malling Res.Sta. 1936: 189. 1936	
	Quince seedlings	Belgium	R.A.M. 19:157. 1940	V. dahliae (on seedlings imported from Holland and France)
Diospyros kaki L.f.	Japanese persimmon	Texas	P.D.R.Sup. 135:41 1942	
Diospyros texana Scheele	Texas persimmon	Texas	Weiss II. 301. 1950	
(Fagus ______)	beech	Germany	R.A.M. 9: 6. 1930	
Fraxinus pennsylvanica lanceolata	green ash	Colorado	P.D.R. 34:83. 1950	1st report
	ash	Baarn, Holland	R.A.M. 12:665. 1933	
	ash	Holland	R.A.M. 31:478. 1952	V. dahliae

A -- WOODY PLANTS - Part 1. (Continued)

Scientific Name	Common Name	Location	Reference	Remarks
(*Juglans regia* L.)	English walnut	France	B.A. 4:327. 1930	*V. dahliae*
Koelreuteria paniculata	goldenrain-tree	Italy	B.A. 11(3):5478.1937	Isolates considered identical with *V.a-a.*
Liriodendron tulipifera	tulip tree	France	B.A. 5:22793. 1931	*V. dahliae*
Maclura aurantiaca L.		Italy	B.A. 11(1):258.1937	Apparently 1st report
Musa sapientum L.	banana	Brazil	Rud. 304. 1931	Vert (?) see ref.
Musa ______	banana		R.A.M. 12:39. 1933	
	banana	West Indies	R.A.M. 9:6. 1930	
Olea europea L.	olive	Cal.	P.D.R. 34:26-7. 1950	1st U.S. Report
	olive	Italy	R.A.M. 27:317. 1948	
Persea americana Mill.	avocado	Cal.	Weiss IV: 576. 1952	
Pistacia vera L.	pistachio	Cal.	P.D.R. 34(1):26-7. 1950	1st world report
Populus tremula	aspen	Germany (East Prussia)	R.A.M. 13:338. 1934	
Prunus amygdalus Batsch	almond	Cal., Ill.	Weiss V: 964. 1953	
Prunus communis Fritsch	almond	Ill.	P.D.R. 22(12):253-4 1938	
	almond	Rhone Valley (Germany)	R.A.M. 12:76. 1933	*V. dahliae*

A -- WOODY PLANTS - Part 1. (Continued)

Scientific Name	Common Name	Location	Reference	Remarks
Prunus armeniaca L.	apricot	Wash.	P. D. R. 33:99. 1939	1st Wash. report
	apricot	Hungary	R. A. M. 27:139. 1948	
Prunus armeniaca L.	apricot	Cal., Utah, Wash.	Weiss V: 957. 1953	
Prunus avium L.	sweet cherry	Cal.	P. D. R. 38(7):438. 1954	
	sweet cherry	British Columbia	P. D. R. 38(2): 74. 1954	*V. dah.*
	Cultivated cherry 5 varieties	Holland	R. A. M. 4:495. 1925	*V. a-a*, or *V. dah.*
Prunus cerasifera	Myrobalan, cherry-plum	Hungary	R. A. M. 27:139. 1948	
Prunus cerasus acida Ehrh.	sour cherries		Rud. 302. 1931	
Prunus cerasus austera		Holland	R. A. M. 4:495. 1925	*V. a-a*, or *V. dah.*
Prunus domestica L.	garden plum, prune	Cal.	Weiss V: 960. 1953	
	Burbank plum	Italy	B. A. 11(3):4478. 1937	
	Victoria plum	England	R. A. M. 24: 153. 1945	
Prunus mahaleb		Holland	R. A. M. 4:495. 1925	*V. dah.* or *V. a-a*
Prunus mahaleb L.	Mahaleb cherry	Cal.	P. D. R. 38(7):438. 1954	
Prunus mume Sieb & Zucc.	Ja, .nese apricot	Cal., Utah, Wash.	Weiss V: 957. 1953	
Prunus persica (L.) Batsch	peach	N. East States, Cal., Ore.	Weiss V: 967. 1953	
	peach	N. J.	P. D. R. Sup. 28:344. 1923	

A -- WOODY PLANTS - Part 1. (Continued)

Scientific Name	Common Name	Location	Reference	Remarks
	peach, South Haven variety	New York	P. D. R. 16(12): 132-133. 1932	
Prunus spp.	plum, prune	See ref.	Rud. 303. 1931	
(Pyrus ____)	pear	Holland	R. A. M. 31:477. 1952	V. dahliae
(Pyrus ____)	apple	Bulgaria	R. A. M. 11:7456. 1932	
Quercus sp.		France	Biol. Abst. 5:22793. 1931	V. dahliae
Robinia pseudo-acacia L.	black locust	Ill.	P. D. R. 22(12):253-4 1938	1st U.S. Rpt.
Robinia pseudo-acacia		Baarn, Holland	R. A. M. 12:665. 1933	
Robinia pseudo-acacia		Italy	B. A. 11(3):5478. 1937	
Schinus terebinthifolia Raddi	Brazil pepper-tree	Cal.	Weiss I:42. 1950	
Sophora japonica	Japanese pagoda tree	Italy	R. A. M. 15:474. 1936	V. a-a = V. dah. = all other spp.
Sophora japonica		Italy	B. A. 11(3):5478. 1937	Isolates considered identical with V. a-a
Theobroma cacao L.	cacao		Rud. 304:1931	See ref.
Tilia americana L.	American linden	Ill.	Weiss V:1141. 1953	
Tilia glabra Vent.	American linden	Ill.	P. D. R. 24(6):133-4. 1940	1st report in Ill.
Tilia cordata	lime	Germany	R. A. M. 9:6. 1930	1st report
Tilia euchlora	lime	Germany	R. A. M. 9:6. 1930	1st report

A -- WOODY PLANTS - Part 1. (Concluded)

Scientific Name	Common Name	Location	Reference	Remarks
Tilia parvifolia	lime	Germany	R. A. M. 12:117. 1933	
Ulmus americana L.	American elm	Ill.	P. D. R. 22:253-4. 1938	
Ulmus americana L.	Littleford elm	Ill.	P. D. R. 24:133-4. 1940	
Ulmus americana L.	Moline elm	Ill.	P. D. R. 24:133-4. 1940	
Ulmus montana	elm	Germany	R. A. M. 12:117. 1923	
Ulmus procera Salisb.	English elm	Conn., Mass., N. J., N. Y.	Weiss V: 1154. 1953	Several other European elms incl. -see ref.
Ulmus campestris		Italy	B. A. 11(3):5478. 1937	Isolates considered identical with V. a-a.
Ulmus rubra Muhl.	slippery elm	Pa., Wis.	Weiss V: 1153. 1953	
Ulmus spp.	elm		Rud. 306. 1931.	See ref.

A -- WOODY PLANTS -- Part 2. SHRUBS, BUSHES, SMALL FRUITS, LIANAS

Scientific Name	Common Name	Location	Reference	Remarks
Abroma		Uganda	R. A. M. 18: 575. 1939	*V. dahliae*
Ampelopsis		Holland	R. A. M. 31:478. 1952	*V. dahliae*
Aucuba japonica Thunb.	Aucuba	N. J.	Weiss II:226. 1950	
Berberis thunbergii	Japanese barberry	Mass.	P. D. R. 14(19): 201. 1930	
Berberis thunbergii DC.	Japanese barberry	Ill., Mich. Conn. to Va.	Weiss I: 70. 1950	
Berberis thunbergii	Japanese barberry	N. J.	P. D. R. 20(4):80 1936.	*V. dahliae*
Berberis vulgaris L.	European barberry	Conn.	Weiss I: 70. 1950	
Campsis radicans (L.) Seem.	trumpet vine	Ill.	P. D. R. 29(3): 95-6. 1945	
Capsicum frutescens L.	red pepper, sweet pepper	Cal., Colo., Conn., N. Y., Tex.	Weiss V: 1096. 1953	
Capsicum annum var. *Anaheim Chili*	pepper	Cal.	P. D. R. 21(22): 404. 1937	
Capsicum annum var. *Mexican Chili*	pepper	Cal.	P. D. R. 21(22): 404. 1937	
Cistus purpureus Lam.	rock-rose	Cal.	P. D. R. 39:693 1955	1st world report
Clematis sp.		Belgium	R. A. M. 19:134 1946	

A -- WOODY PLANTS - Part 2. (Continued)

Scientific Name	Common Name	Location	Reference	Remarks
Coffea arabica L.	Coffee		Rud. 305. 1931	See ref.
(Coffea ______)	Coffee	Brazil	R. A. M. 5:422. 1926	
Erica australis Hort.	Heather	Cal.	P. D. R. 34(1):26-7. 1950	1st world report
Erica persoluta L.	Heather	Cal.	P. D. R. 34(1):26-7. 1950	1st world report
Fremontia californica Torr.		Cal.	P. D. R. 24(20):424-5. 1940	1st lit. report
Fremontia spp.		Cal.	P. D. R. 24(20):424-5. 1940	
Fuchsia hybrida Voss		Cal.	P. D. R. 24(20):424-5. 1940	1st lit. report
Fuchsia spp.	Fuchsia	Cal.	Weiss IV: 783. 1952	
Ligustrum amurense Carr.	Amur privet	Ill.	P. D. R. 29(3):95-6. 1945	
Parthenium argentatum A. Gray	Guayule	Cal.	P. D. R. 29(6):180. 1945 P. D. R. 27(2):63-66. 1943	
Parthenium argentatum A. Gray	Guayule	Ariz. Cal. N. Mex. Tex.	Weiss I:200. 1950	
(Photinia ______)	Photinia	Holland	R. A. M. 31:478. 1952	V. dahliae
Pittosporum tobira Ait.	Japanese pittosporum	Cal.	Rud. 327. 1931	
Pittosporum spp.	Pittosporum	Cal.	Weiss V:861. 1953	
Prunus laurocerasus L.	English cherry-laurel	Cal.	Weiss V:976. 1953	
Prunus lusitanica L.	Portugal-laurel	Cal.	Weiss V:976. 1953	
Raphiolepis indica Lindl.	India hawthorn	Cal.	P. D. R. 39:693. 1955	1st report
Raphiolepis umbellata var. integerrima Rehd.	Yeddo hawthorn	Cal.	P. D. R. 39:693. 1955	1st report

A -- WOODY PLANTS - Part 2. (Continued)

Scientific Name	Common Name	Location	Reference	Remarks
(Rhododendron ______)	azalea	Mass.	P. D. R. Suppl. 96:263. 1936	
Rhus aromatica Ait.	fragrant sumac	Mass.	Weiss I:39. 1950	
Rhus canadensis Marsh	fragrant sumac	?Europe see ref.	Rud. 310. 1931	
Rhus canadensis Marsh. var. trilobata (Nutt.) Gray	ill-scented sumac	Iowa	Rud. 310. 1931	
Rhus cotinus		Holland	R. A. M. 4:288. 1925	
Rhus cotinus L.	smoke tree	Europe see ref.	Rud. 310. 1931	
Cotinus coggyria Scop	smoke tree	Va.	P. D. R. 21(1):10. 1937	1st U.S. report; present in Europe
Cotinus coggyria Scop.	common smoke-tree	Conn., Ill., Nebr., N. J. N. Y.	Weiss I: 35. 1950	
Rhus glabra		Holland	R. A. M. 4:288. 1925	
Rhus glabra L.	smooth sumac	Europe-see ref.	Rud. 310. 1931	
Rhus glabra L.	smooth sumac	Ill.	P. D. R. 22(12):253-4. 1938	
Rhus trilobata Nutt.	skunkbush sumac	Iowa	Weiss I: 39. 1950	
Rhus typhina	staghorn sumac	Holland	R. A. M. 4:288. 1925	
Rhus typhina	staghorn sumac	Iowa	Weiss I: 39. 1950	
Rhus typhina		Wis.	R. A. M. 12:470. 1933	V. dahliae
Ribes sanguineum var. lombartii		Holland	R. A. M. 4:495. 1925	V. a-a or V. dah.

A -- WOODY PLANTS - Part 2. (Continued)

Scientific Name	Common Name	Location	Reference	Remarks
Ribes sanguineum Pursh. var. lombartii	Lombart's flowering currant	Probably Holland see ref.	Rud. 330. 1931	V. dah.
Ribes ______		Holland	R.A.M. 9:546.1930	
(Ribes ______)	currants	New South Wales	R.A.M. 29:497.1950	
	black currants	Holland	R.A.M. 4:495.1925	V.a-a, or V. dah.
(Ribes _____)	gooseberry	New Zealand	R.A.M.30:362.1951	
	gooseberries	Holland	R.A.M. 4:495. 1925	V.a-a or V. dah.
Rosa spp.	cultivated rose	Cal., Ill., N.J.	Weiss V: 992. 1953	
	rose	N.Y.	R.A.M. 31:65. 1952	
Rubus allegheniensis Porter	Crandall blackberry	Cal.	P.D.R. 34(1):26.7.1950	1st Cal. report
Rubus spp.	blackberries	Cal., Minn. N.Y., Wash.	Weiss V: 997. 1953	
Rubus idaeus	red raspberry	N.Y.	P.D.R. Suppl. 147. 150-151. 1944	
	red raspberry		P.D.R. 37(2): 117.1953	
Rubus occidentalis	black raspberry	N.Y.	P.D.R. Suppl. 147: 150-151. 1944	
Rubus spp.	black raspberry	Mass. to N.Y. and Ohio; Ore., Wash.	Weiss V: 1006. 1953	
	purple raspberry	N.Y.	P.D.R. Suppl. 128: 321-322. 1940	
Rubus rosaefolius var. loganobaccus Bailey	Boysenberry	Wash.	P.D.R. Suppl. 119. 191 1939	
Rubus spp.	dewberries, eastern type	Cal.	Weiss V: 1001. 1953	

A -- WOODY PLANTS - Part 2. (Concluded)

Scientific Name	Common Name	Location	Reference	Remarks
Rubus spp.	dewberries -western type	Cal., N.Y., Ore.	Weiss V: 1002, 1953	
	Youngberry (hybrid dewberry)	Cal.	P.D.R.Suppl.128.322.1940	
Rubus ursinus	Pacific coast trailing blackberry	Cal.	R.A.M. 30:332. 1951	
Rubus spp.	dewberries, black-berries, youngberries		Rud. 313-4. 1931	See ref.
Sambucus racemosa		Holland	R.A.M. 4:495. 1925	V.a-a or V.dah.
Sambucus spp.	elder	Md.	Weiss I: 117. 1950	See ref.
Sechium edule Schwartz	chayote	Brazil	Rud. 289. 1931	V.a-a ? see ref.
(Spiraea ______)	Spiraea	Germany	R.A.M.16:286.1937	V.a-a
Syringa vulgaris	lilac	Holland	R.A.M. 4:495. 1925	V.a-a, V.dah.
Viburnum lantana L.	wayfaring-tree	Ill.	P.D.R. 1938.22(12): 253-4	1st report
Viburnum lantana L.		Ind.	P.D.R. 25(9):274.1941	
Viburnum lentago L.	nannyberry	Ore., Wash.	Weiss I: 121. 1950	
Viburnum tinus L.	laurestinus	Ore.	Weiss I: 122. 1950	
Viburnum tomentosum Thunb.	Japanese snowball	Ind.	Weiss I: 122.1950	
Vitis spp.	American bunch grapes		U.S.D.A. Yearbook 1953: 760.	

B --'HERBACEOUS PLANTS -- Part 3. FIELD CROPS, VEGETABLES, SMALL FRUITS

Scientific Name	Common Name	Location	Reference	Remarks
Abutilon avicennae	American jute	Namangan (Turkestan) Russian Central Asia	R. A. M. 13:369. 1934.	V. dahliae
Apium graveolens L.	celery	Cal.	P. D. R. 20(7):125-6. 1936.	
Apium graveolens L. var. dulce DC.	celery	Cal.	Weiss V: 1158. 1953	
Archis hypogaea	peanuts	Europe or Asia ?	B. A. 14:5663. 1940	V. dahliae
Armoracia rusticana Gaertn. Mey. & Scherb.	horse-radish	Mich., Wash.	Weiss II: 237. 1950	
	horse-radish	Bavaria	R. A. M. 16:361. 1937	V. dahliae
Beta vulgaris	sugar beet	Col.	P. D. R. Suppl. 149:350. 1944	
	sugar beet	Col.	P. D. R. 27(23):645. 1943	root rot
Beta vulgaris L.	beet	Holland (see ref.)	Rud. 289. 1931.	
Brassica napobrassica Mill.	rutabaga	Cal.	Weiss II: 242. 1950	
Brassica oleracea var. napo-brassica	rutabaga	Cal.	P. D. R. Suppl. 128:254. 1940	
Brassica oleracea var. capitata L.	cabbage	Cal.	P. D. R. 34(1):26-7. 1950	1st world report
Brassica oleracea var. gemmifera Zenk.	brussels sprouts	Cal.	P. D. R. 34(1):26-7. 1950	1st world report
Cannabis sativa	hemp	Namangan (Turkestan) Russian Central Asia	R. A. M. 13:369. 1934	V. dahliae
Citrullus vulgaris Schrad.	watermelon	Cal.	P. D. R. 20(7):125-6. 1936.	1st lit. report.

B -- HERBACEOUS PLANTS - Part 3. (Continued)

Scientific Name	Common Name	Location	Reference	Remarks
(Citrullus vulgaris Schrad. var. citroides)	citron, preserving melon		U.S.D.A. Yearbook 1953: 485	
Corchorus capsularis	jute	Namangan (Turkestan) Russian Central Asia	R.A.M. 13: 369. 1934	V. dahliae
Cucumis melo L.	muskmelon, Persian melon	Cal.	P.D.R. 20(7):125-6.1936	
Cucumis melo	cantaloupe		P.D.R.Suppl. 103:187.1937	
Cucumis melo L.	muskmelon	Probably Holland See ref.	Rud. 293. 1931	
Cucumis melo L. var. inodorus Naud.	honeydew melon	Cal.	P.D.R. 22(22):447. 1938	
Cucumis melo L. var. reticulatus Naud.	cantaloupeof trade	Cal., Ore.	Weiss II: 263. 1950	
Cucumis sativus L.	cucumber	Me., Ohio, Ore., Wash., Wis.	Weiss II: 265. 1950	
Cucumis sativus L.	cucumber	Probably Holland see ref.	Rud. 289. 1931	
Cucurbita maxima Dcne.	winter squash	Ore.	Weiss II:267. 1950	
Cucurbita pepo L.	pumpkin		U.S.D.A. Yearbook 1953: 485.	
Cynara scolymus L.	artichoke	France ? see ref.	Rud. 289. 1931	V. dah.
Fragaria chiloensis Duchesne var. ananassa Bailey	strawberry	Cal., N.Y. Ore.	Weiss V: 936. 1953	

B -- HERBACEOUS PLANTS - Part 3. (Continued)

Scientific Name	Common Name	Location	Reference	Remarks
(Fragaria ______)	strawberry	Ore.	P.D.R. 20(16):261.1936	1st Ore. report
(Glycine ______)	soy beans	Namangan (Turkestan) Russian Central Asia	R.A.M. 13:369. 1934	V. dahliae
Gossypium barbadense L.	Sea-Island cotton (cultivated cotton)	widespread	Weiss: IV: 7280. 1952	
Gossypium herbaceum	cotton	Germany	R.A.M. 12:117. 1933	
Gossypium herbaceum L.	Levant cotton (cultivated cotton)	widespread	Weiss IV: 728. 1952	
Gossypium hirsutum L.	upland cotton (cultivated cotton)	widespread	Weiss IV: 728. 1952	
	cotton	Uganda	R.A.M. 18:575. 1939	V. dah.
Hibiscus esculentus	okra	Namangan (Turkestan) Russian Central Asia	R.A.M. 13:369. 1934	V. dah.
Hibiscus esculentus L.	okra	N. Mex.	P.D.R. 35(3): 169. 1951	
Humulus lupulus L.	common hop	Me., Ore., Ohio, Wis.	Weiss IV: 750. 1952	
Ipomoea batatas (L.) Lam.	sweet potato	Cal.	Weiss II: 223. 1950	
(Linum ______)	flax	Belgium	R.A.M. 24:491. 1945	V. dahliae
Lycopersicon esculentum Mill.	tomato	Cal.	P.D.R. 34(1):26. 1950	
	tomato	Utah	P.D.R. 15(7):65. 1931	
Lycopersicon esculentum var. cerasiforme (Dun.) A. Gray	cherry tomato	Throughout U.S.	Weiss V: 1104. 1953	

B -- HERBACEOUS PLANTS - Part 3. (Continued)

Scientific Name	Common Name	Location	Reference	Remarks
Lycopersicon esculentum f. pyriforme (Dun.) C.H. Mull.	pear tomato	Throughout U.S.	Weiss V:1104. 1953	
Manihot utilissima Pohl	tapioca plant	Brazil	Rud. 310. 1931	V. a-a? see ref.
(Manihot ______)	cassava	Uganda	R.A.M. 18:575. 1939	V. dah.
Medicago hispida	bur clover	Cal.	R.A.M. 10:757. 1931	
(Medicago sativa L.)	lucerne (alfalfa)	Denmark, Islands of Fünen, Möen	R.A.M. 24:451-452. 1945	
	alfalfa	Germany	B.A. 24:25186. 1950	
Mentha piperita	peppermint	Mich.	P.D.R. 19(20):313-314. 1935	V. dahliae
	peppermint	Ind., Mich.	P.D.R. 34(12):392. 1950	V. a-a var. menthae Nelson
Mentha piperita L.	peppermint	Ind., Mich., Ore.	Weiss. P.D.R. Index IV: 565. 1952	
Mentha spicata L.	spearmint	Ind., Mich.	Weiss. P.D.R. Index IV: 565. 1952	
Nicotiana tabacum L.	tobacco	Tenn.	Weiss V: 1112. 1953	
	tobacco	Ky.	P.D.R. 18(12):153. 1934	
Onobrychis sativa	sainfoin	Germany	R.A.M. 17: 754. 1938	V. a-a
(Onobrychis ______)	sainfoin	England	B.A. 20:18615. 1946	V. dahliae
Phaseolus vulgaris L.	kidney bean	Brazil, see ref.	Rud. 293. 1931	
Raphanus sativus L.	icicle radish	Cal.	P.D.R. 34(1):26-7. 1950	1st world report
Rheum rhaponticum Linn	rhubarb	Cal., Ireland	P.D.R. 39:693. 1955	

B -- HERBACEOUS PLANTS - Part 3. (Concluded)

Scientific Name	Common Name	Location	Reference	Remarks
Ricinus communis	castor bean	Europe or Asia?	B.A.14:5663. 1940	V. dahliae
Sesamum indicum	sesame	Namangan (Turkestan) Russian Central Asia	R.A.M.13:369. 1934	V. dahliae
Sesamum indicum	sesamum	Europe or Asia?	B.A. 14:5663. 1940	V. dahliae
Sesamum orientale	simsim	Uganda	R.A.M.18:575. 1939	V. dahliae
Solanum integrifolium Poir	scarlet or tomato egg plant	N.Y.	Weiss V: 1118. 1953	
Solanum melongena		N.Y.	B.A. 5:16542. 1931	V. dahliae
	egg plant	Mass	P.D.R. 12(10): 119. 1928	
Solanum tuberosum	potato	Maine	P.D.R. 37(9):456. 1953	
Solanum tuberosum L.	potato	General in U.S.	Weiss V: 1127. 1953	
(Spinacia _____)	spinach		R.A.M. 31:224. 1952	V. dahliae (on seeds)
Tetragonia expansa Thunb.	New Zealand spinach	Cal.	P.D.R. 39:693. 1955	1st report
Tephrosia		Uganda	R.A.M. 18:575. 1939	V. dah.
(Trifolium _______)	clover	Germany	R.A.M. 16:361. 1937	V. dah.
Vigna sesquipedalis W.F. Wright	Chinese yard-long bean	Cal.	P.D.R. 39:693. 1955	1st report
Vigna sinensis Endl.	cow pea	Cal.	P.D.R. 20(7):125-6.1936	

B - HERBACEOUS PLANTS -- Part 4. ORNAMENTALS, "FLOWERS", WEEDS

Scientific Name	Common Name	Location	Reference	Remarks
Abutilon sp.	flowering maple	New Jersey	P. D. R. 24(12):243. 1940	
Abutilon			Phytopath 6: 393. 1914	weed
Aconitum napellus		Holland	R. A. M. 4: 496. 1925	
Amaranthus retroflexus	rough pigweed	Cal.	R. A. M. 10: 757. 1931	
Amaranthus sp.	pigweed	Ore.	R. A. M. 16: 192. 1937	
Antirrhinum majus		Holland	R. A. M. 4: 495. 1925	V. a-a or V. dah.
Antirrhinum majus L.	snapdragon	Cal., Conn., Me., Mass., Minn., N. J., Pa., N. Y.	Weiss V: 1082. 1953	
Aralia cordata Thunb.	udo	Md.	Weiss I: 59. 1950	herb
Aralia cordata Thunb.	udo		P. D. R. Suppl. 34: 243. 1924	perennial not woody
Aralia racemosa L.	American spikenard	N. Y.	Weiss I: 59. 1950	per. herb
Aralia racemosa L.	American spikenard	N. Y.	Rud. 319. 1931	V. dah.
Aster sp.	aster	Other than U. S.	Rud. 319. 1931	See ref.
Aster spp. (See ref.)	aster	Conn.	Weiss I: 161. 1950	
Atropa belladonna	belladonna	Cal.	P. D. R. Suppl. 149:381. 1944	herb
Begonia spp.	begonia	Conn., N. Y.	Weiss I: 68. 1950	
Calceolaria spp.	slipperwort	N. Y., Wash.	Weiss V: 1084. 1953	
Callirhoe papaver (Cav.) A. Gray	poppy-mallow	N. Y.	Weiss IV: 724. 1952	herb
Callistephus chinensis Nees.	aster	Cal.	P. D. R. 24(20):424-5. 1940	1st U. S. report common in Europe

B -- HERBACEOUS PLANTS - Part 4. (Continued)

Scientific Name	Common Name	Location	Reference	Remarks
Campanula isophylla	bell flower	England	R.A.M. 30: 416. 1951	herb
Capsicum		Uganda	R.A.M. 18: 575. 1939	V. dah.
Capsicum sp.	pepper	Europe ? see ref.	Rud. 294. 1931	
Carthamus tinctorius	saffron (safflower)	Europe or Asia ?	B.A. 14:5663. 1940	V. dahliae herb.
Celosia argentea var. cristata		Cal.	P.D.R. 30(6):210.1946	annual
Centaurea cyanus L.	cornflower, bachelors-button	N.Y.	Weiss I: 168. 1950	herb
Centaurea cyanus			P.D.R. 30(6):210. 1946	annual
Centaurea imperialis		Cal.	P.D.R. 30(6):210. 1946	"apparently new host"
Chenopodium album		Holland	R.A.M. 4: 495. 1925	V.a-a or V.dah.
Chenopodium album	fat hen	New Zealand	R.A.M. 30: 20. 1951	
Chenopodium album L.		Prob. Holland See ref.	Rud. 330. 1931	V. dah.
Chenopodium	goosefoot	Germany	R.A.M. 15:237. 1936	
Chrysanthemum frutescens L.	marguerite	N.J.	Weiss I: 170. 1950	
Chrysanthemum frutescens		N.J.	P.D.R. Suppl. 96:266. 1936	V. dahliae
Chrysanthemum hortorum		N.J., Wash.	P.D.R. Suppl. 96:267. 1936	V. dahliae
Chrysanthemum indicum Cass	Italian chrysanthemum	N.J.	Rud. 322. 1931	
Chrysanthemum indicum		Holland	R.A.M. 4:495. 1925	V. a-a or V. dah.

B -- HERBACEOUS PLANTS - Part 4. (Continued)

Scientific Name	Common Name	Location	Reference	Remarks
Chrysanthemum leucanthemum L.	ox-eye daisy	N. J.	Rud. 322. 1931	
Chrysanthemum leucanthemum		Holland	R. A. M. 4: 495. 1925	V. a-a or V. dah.
Chrysanthemum maximum var. Shasta Daisy		Cal.	P. D. R. 30(6):210. 1946	"apparently new host"
Chrysanthemum morifolium		Germany	R. A. M. 12:117. 1933	V. a-a
Chrysanthemum morifolium (Ramat.) Hemsl. (see ref.)	chrysanthemum	Ill., Ind., Md., Mass., Mich., N. J., N. Y., Ohio, Pa., Wash.	Weiss I: 169. 1950	
Cichorium intybus	French endive	Europe-possibly Holland	B. A. 13: 4961. 1939	V. dahliae
(Cichorium ______)	chicory	Belgium	R. A. M. 31:101. 1952	V. dahliae
Clarkia elegans Dougl.	Clarkia	Cal.	Weiss IV: 781. 1952	
Coreopsis lanceolata L.	tickseed	N. Y.	Weiss I: 175. 1950	
Crotalaria juncea	sann hemp	Uganda	R. A. M. 18: 575. 1939	V. dahliae
Crotalaria juncea	sann hemp		R. A. M. 29:210. 1950	V. dahliae
Crotalaria striata		Uganda	R. A. M. 18: 575. 1939	V. dahliae
Dahlia variabilis		Holland	R. A. M. 4:495. 1925	V. a-a or V. dah.
Dahlia variabilis (Willd.) Desf. (see ref.)	dahlia	Ill., Mich., Mo., N. J., Ohio, Tex.	Weiss I: 178. 1950	
Daphne mezereum		Holland	R. A. M. 4: 495. 1925	V. a-a or V. dah.
Daphne mezereum L.	Daphne	Prob. Holland see ref.	Rud. 325. 1931	V. dah.

B -- HERBACEOUS PLANTS - Part 4. (Continued)

Scientific Name	Common Name	Location	Reference	Remarks
Delphinium ajacis L.	rocket larkspur	N. Y.	Weiss V: 908. 1953	
Delphinium cultorum Voss or D. hybridum Hort.	larkspur	Wash.	Weiss V: 908. 1953	
Dianthus caryophyllus	carnation		P. D. R. Suppl. 90:110. 1935	V. dahliae
Dianthus caryophyllus L.	carnation	N. J.	Weiss I: 128. 1950	V. dahliae
Digitalis purpurea L.	fox-glove	N. Y.	Weiss V: 1085. 53	
Dimorphotheca aurantiaca DC	Cape marigold	Iowa	Weiss I: 178. 1950	
Erigeron canadensis		Holland	R. A. M. 4: 496. 1925	V. a-a or V. dah.
Erigeron canadensis L.		Probably Holland see ref.	Rud. 330. 1931	V. dah.
Erigeron spp. (see ref.)	fleabane	Mass.	Weiss I: 182. 1950	
Eschscholtzia californica		Holland	R. A. M. 4: 495. 1925	V. dah. V. a-a
Eschscholtzia californica	California poppy	Cal.	R. A. M. 15:150. 1936	
Euphorbia milii Desmoul.	crown of thorns	N. J.	Weiss II: 332. 1950	
(Geranium ________)	geranium	Ore.	P. D. R. 36(2):51	
Gerbera jamesoni Bolus	Transvaal daisy	Cal.	P. D. R. 34(1):26. 1950	1st world report
Gnaphalium margaritaceum			Rud. 330. 1931	V. dah.
(Helianthus ________)	sunflower	Siberia	R. A. M. 22:111. 1943	V. dah. (loc. cit.)
Helichrysum bracteatum	strawflower	Cal.	P. D. R. 30(6):210. 1946	
Heliotropium arborescens L.	common heliotrope	Md.	Weiss I: 96. 1950	

B -- HERBACEOUS PLANTS - Part 4. (Continued)

Scientific Name	Common Name	Location	Reference	Remarks
Heliotropium peruvianum	common heliotrope	Wash. D. C.	P. D. R. Suppl. 73:385. 1929	
Impatiens balsamina L.	garden balsam	N. Y.	Weiss I: 66. 1950	
Lathyrus odoratus L.	sweet pea	Europe-see ref.	Rud. 333. 1931	
Lathyrus odoratus L.	sweet pea	N. J., N. Y.	Weiss-P. D. R. Index IV: 614 1952.	
Liatris pycnostachya Michx.	gay-feather	N. J.	Weiss I: 198. 1950	
Liatris scariosa Willd.	gay-feather	N. J.	Weiss I: 198. 1950	
Liatris sp.	gay-feather	N. J.	P. D. R. Suppl. 90:113. 1935	
Lupinus polyphyllus		Holland	R. A. M. 4:495. 1925	V. a-a or V. dah.
Lychnis chalcedonica L.	Maltese cross	Prob. Holland see ref.	Rud. 329. 1931	
Malva sp.	mallow	Cal.	R. A. M. 10:757. 1931	
Mathiola incana R. Br.	garden stock		P. D. R. 34(1):26-7. 1950	
Monarda didyma L.	Oswego tea	Prob. Holland see ref.	Rud. 330. 1931	V. dah.
Monarda fistulosa L.	wild bergamot	Mich.	R. A. M. 31:576. 1952	V. a-a var. menthae n. var.
Paeonia lactiflora Pall.	peony	Ill., Kan., Md., N. Y., Ohio	Weiss V: 913. 1953	(includes V. dahliae)
Paeonia officinalis L.	peony	Ill., Kan., Md., N. Y., Ohio	Weiss V: 913. 1953	(includes V. dahliae)
Panax quinquefolium L.	American ginseng	Ind., Ky., Mich., N. J., N. Y. Ohio, Pa., Tenn., Wis.	Weiss I: 62. 1950	
Papaver bracteatum		Germany	R. A. M. 12:117. 1933	

B -- HERBACEOUS PLANTS - Part 4. (Continued)

Scientific Name	Common Name	Location	Reference	Remarks
Papaver orientale L.	oriental poppy	N. Y.	Weiss IV: 802. 1952	
Papaver orientale	oriental poppy	England	R. A. M. 32:626. 1953	
Papaver spp.	poppy	N. Y.	Weiss IV: 802. 1952	
Pelargonium domesticum Bailey	Lady Washington type	Cal.	P. D. R. 24(20):424-425. 1940	1st lit. rept.
Pelargonium hortorum		Cal.	P. D. R. 24:424-5. 1940	1st lit. rept.
Pelargonium hortorum (x P. zonale Willd.)	fish geranium	Cal.	Weiss II:378. 1950	
Petunia hybrida		Cal.	P. D. R. 30(6):210. 1946	1st report.
Phlox carolina L.	thick-leaf phlox	Minn.	Weiss V: 870. 1953	
Phlox decussata		Holland	R. A. M. 4:496. 1925	
Phlox decussata		Hungary	R. A. M. 15:444. 1936	
Phlox drummondii Hook	phlox	N. Y.	Weiss V: 870. 1953	
Phlox paniculata L. (incl. hort. forms and hybrids termed P. decussata Hort.)	summer perennial phlox	N. Y.	Weiss V: 870. 1953	
Phlox spp.	phlox	Minn.	P. D. R. Suppl. 28:370. 1940	
Physalis alkekengi L.	Chinese lantern-plant, winter cherry	N. Y.	Weiss V: 1116. 1953	
Physalis francheti	Lantern groundcherry		P. D. R. Suppl. 119. 284. 1939	1st report
Polemonium spp.	Polemonium	N. Y.	Weiss V: 870. 1953	

B -- HERBACEOUS PLANTS - Part 4. (Continued)

Scientific Name	Common Name	Location	Reference	Remarks
Pyrola asarifolia Michx.	pink pyrola or wintergreen	Mass., N. J., N. Y.	Weiss V: 900. 1953	
Pyrola elliptica Nutt.	shinleaf, wild lily-of-the-valley	Mass.	Weiss V: 900. 1953	
Reseda odorata L.	mignonette	N. Y.	Weiss V: 917. 1953	
Rudbeckia hirta L.	black-eyed susan	N. Y.	Weiss I:203. 1950	
Salpiglossis sinuata Ruiz & Pav.	painted-tongue	N. Y.	Weiss V: 1117. 1953	
Salvia farinacea		Cal.	P. D. R. 30(6):210. 1946	
Schizanthus pinnatus		Cal.	P. D. R. 30(6):210. 1946	
Senecio cruentus (Mass.) DC. (including hybrids derived mainly from this)	florists' cineraria	N. J., N. Y., Wash.	Weiss I: 205. 1950	
Senecio vulgaris	groundsel	Ore.	R. A. M. 16:192. 1937	
Senecio vulgaris		Holland	R. A. M. 4:495. 1925	V. a-a or V. dah.
Senecio spp.	groundsel, ragwort	Wash.	Weiss I: 207. 1950	
Sida spinosa L. (a weed)	prickly mallow	South Africa	R. A. M. 27:473. 1948	V. dah.
Sisymbrium irio (L.) Britton	blue-eyed-grass, satin flower	N. Mex.	P. D. R. 35(3):169. 1951	1st report
Solanum carolinense L.	Carolina horsenettle	Maryland, N. Y.	Weiss V: 1120. 1953	

B -- HERBACEOUS PLANTS - Part 4. (Concluded)

Scientific Name	Common Name	Location	Reference	Remarks
Solanum elaeagnifolium Cav.	silverleaf nightshade, white horsenettle	N. Y.	Weiss V: 1120. 1953	
Solanum floridanum Shuttlew.	wild Florida eggplant		Rud. 334. 1931	Vert. ? see ref.
Solanum marginatum L.			Rud. 327. 1931	Vert. ? see ref.
Solanum nigrum		Holland	R. A. M. 4: 496. 1925	V. a-a or V. dah.
Solanum nigrum L.	nightshade weed	Cal.	P. D. R. 34(1):26-7. 1950	1st U.S. report
Solanum nigrum	black nightshade	New Zealand	R. A. M. 30:20. 1951	
Solanum nigrum L. (incl. var. villosum Mill.)	black nettle	Cal.	Weiss V: 1120. 1953	
Solanum pyracanthum Jacq.			Rud. 327. 1931	Vert. ? see ref.
Solanum rostratum Dunal	beaked nettle, buffalo bur	N. Y.	Weiss V: 1120. 1953	
Solanum torvum Sw.	berenjena cimarrona	General in U. S.	Weiss V: 1122. 1953	
Taraxacum officinale	dandelion	Cal.	R. A. M. 10: 757. 1931	
Tephrosia		Uganda	R. A. M. 18: 575. 1939	V. dahliae
Trapopogon porrifolius L.	salsify	N. Y.	Weiss I: 214. 1950	
Urtica urens		Holland	R. A. M. 4:495. 1925	V. a-a or V. dah.
Urtica	stinging nettle	Germany	R. A. M. 15:237. 1936	
Venidium sp.		N. J.	P. D. R. Suppl. 96:288. 1936	V. dahliae
Xanthium commune Britton		N. Mex.	P. D. R. 35(3):169. 1951	
Xanthium			Phytopath. 6:393. 1914	

THE PLANT DISEASE REPORTER

Issued By

PLANT DISEASE EPIDEMICS
and
IDENTIFICATION SECTION

AGRICULTURAL RESEARCH SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE

PHYSIOLOGIC RACES OF PUCCINIA GRAMINIS IN THE UNITED STATES IN 1956

Supplement 245

June 15, 1957

The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Plant Disease Epidemics and Identification Section serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

THE PLANT DISEASE REPORTER

PLANT DISEASE EPIDEMICS AND IDENTIFICATION SECTION

Crops Research Division — Plant Industry Station, Beltsville, Maryland

PHYSIOLOGIC RACES OF PUCCINIA GRAMINIS IN THE UNITED STATES IN 1956[1,2]

D. M. Stewart, R. U. Cotter[3], and B. J. Roberts[4,5]

Plant Disease Reporter
Supplement 245

June 15, 1957

Summary

Twenty-five races and subraces[6] of Puccinia graminis tritici were identified in 1,005 isolates from 686 uredial collections. Races 56 and 15B comprised 31 and 30 percent, respectively, of the isolates; the 17-29 race-group[7], 14 percent; race 11 (with 32), 13 percent; 38, 4 percent; 48A, 2 percent; 15, 1 percent. These races totaled 95 percent. The remaining 5 percent included 16 other races and subraces.

Four races were identified in 38 isolates from 25 collections of rusted wild barley made in Minnesota, North Dakota, and South Dakota. Race 15B was isolated more frequently than races 11, 56, or 38.

Seventeen races of wheat stem rust were isolated from 18 aecial collections. Races 56, the 17-29 race group, 11, 32, and 147 were isolated from two to four times each; other races once. Unusual races included 75, 118, 126, 142, and 147.

Certain varieties of wheat were found to be useful as supplemental differential varieties in distinguishing subraces. The varieties Triticum timopheevi, C.I. 3255, and N.D. 3 (C.I. 13159) differentiated four subraces of race 11; the first two, with Tremez Molle, differentiated four subraces of 15B; and C.I. 3255, N.D. 3, Towner, and R.L. 3206 differentiated five subraces of the 17-29 group.

Conley, Yuma, and Langdon were resistant in the seedling stage to subraces of race 11 at temperatures of 65°, 75°, and 85°F and mostly resistant to subraces of the 17-29 group at the same three temperatures.

From 408 collections of P. graminis avenae, race 7 comprised 66 percent of the 476 uredial isolates identified. Race 7A decreased from 4.5 percent in 1955 to 2 percent in 1956. Race 2 (with 5) comprised 17 percent of the isolates; race 8, 14 percent. Four races were identified in six aecial collections. One

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[1]Cooperative investigations of the United States Department of Agriculture and the Minnesota Agricultural Experiment Station. Paper No. 3753, Scientific Journal Series, Minnesota Agricultural Experiment Station.

[2]For summaries for the years 1939 through 1942, see 522 and 522A to C in the Bureau of Entomology and Plant Quarantine E-series; for 1943, 1944, 1945-49, and subsequent reports through 1953, see unnumbered publications in the Physiologic Races series; for 1954, see ARS-81-3; for 1955, see Plant Disease Reporter Supplement 239, July 15, 1956.

[3]Plant Pathologists, Plant Pest Control Division, Agricultural Research Service, United States Department of Agriculture.

[4]Agent, Crops Research Division, Agricultural Research Service, United States Department of Agriculture.

[5]E. C. Stakman continued leadership in the search for supplemental differential varieties and assisted in race identification at various times. Acknowledgment for collections is made to Donald G. Fletcher, of the Rust Prevention Association, and to members of the two Divisions and of the State Experiment Stations.

[6]A race comprises many subraces that may be distinguished from each other by different infection types on the standard differentials and/or supplemental varieties. The term biotype is restricted to cultures derived from single urediospores or aeciospores which may or may not be the same genotype as a subrace.

[7]Race-group is a term applied to closely related races that can be distinguished from each other only under certain environmental conditions.

of the isolates is a new subrace to which Bond is moderately resistant. This is the first indication, so far as known, that Bond has a gene or genes for resistance to stem rust.

PUCCINIA GRAMINIS TRITICI

In the United States, 25 races and subraces of P. graminis tritici were identified in 1,005 isolates from 686 uredial collections on wheat, barley, and grasses (Table 1). Races 56 and 15B were about equally prevalent, comprising 31 and 30 percent, respectively, of the total number of isolates. The 17-29 race group comprised 14 percent; race 11 and the closely related race 32, 13 percent; 38, 4 percent; 48A, 2 percent; race 15, 1 percent. These races totaled 95 percent. The remaining 5 percent included 16 other races, as follows: 1, 10, 14, 24, 31, 33, 34, 36, 48B, 59, 59A, 59B, 59C, 61, 133, and 147.

This was the first year since 1950 that race 15B has been equaled or surpassed in prevalence. When compared with the prevalence of races in 1955, 15B decreased 16 percent, whereas race 56 increased 12 percent. In 1953, when race 15B reached its peak with 63 percent of all isolates, race 56 comprised only 18 percent of the total (Fig. 1).

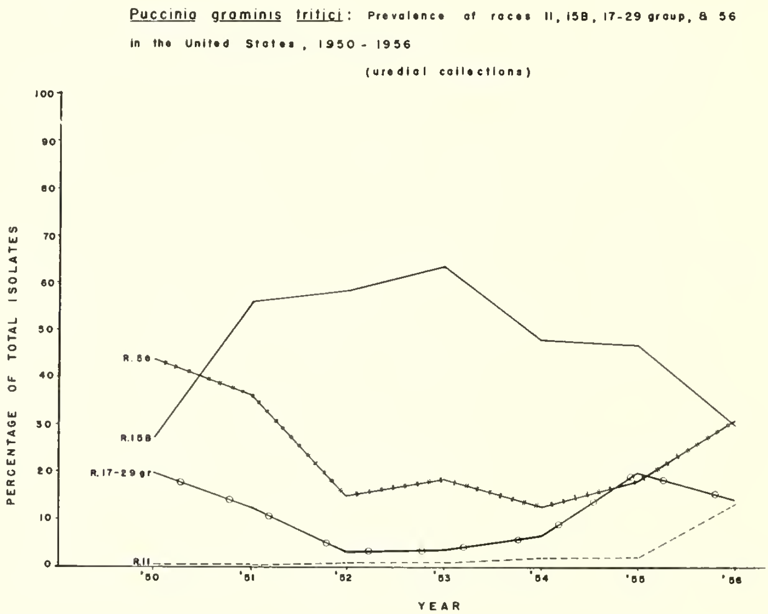

FIGURE 1

Race 11 increased from 2 percent in 1955 to 13 percent in 1956 and extended its geographic distribution from 9 States to 24. It comprised 17 percent of the total isolates from Minnesota, North Dakota, and South Dakota. It was found from California and Oregon eastward to Pennsylvania and from North Dakota south to Texas and eastward to Tennessee and Virginia. Race 11 also was isolated from barberry in Michigan, Pennsylvania, and Washington. This race is important because certain isolates are especially virulent on some of the Kenya wheats and their derivatives, used in breeding for rust resistance. Race 32, which is closely related to race 11, was found in California, Idaho, Michigan, Oregon, and Washington.

Race 15 increased in prevalence from 2 isolates in 1955 to 11 isolates, or 1.1 percent of the total, in 1956. There are indications that certain isolates of race 15 are more virulent than 15B on seedling plants of the new durums, Yuma and Langdon.

Subraces of the 17-29 group (mostly 29) decreased in prevalence from 20 percent in 1955 to 15 percent in 1956. The geographic range, however, increased from 21 States in 1955 to 26 in 1956. The races in the 17-29 group were fairly common in Texas, Illinois, Indiana, Ohio, and Pennsylvania but were found less frequently in other States from Oregon eastward to Pennsylvania and from North Dakota south to Oklahoma and eastward to Florida and South Carolina.

The new bread-wheat variety Selkirk, now rather widely grown in the spring-wheat area of the United States and Canada, is susceptible to certain isolates in this group.

Race 38 increased in prevalence from 2 percent in 1955 to 4 percent in 1956. It was collected four and five times in Pennsylvania and Ohio, respectively, and fewer times in other States.

Race 48A, which can cause heavy infection on Bowie, Selkirk, and Travis wheats, decreased in prevalence from 5 percent in 1955 to 2 percent in 1956. It was most common in Texas and was found once or twice in seven other States -- Idaho, Illinois, Ohio, Pennsylvania, South Dakota, Virginia, and Wisconsin.

Race 48B comprised 1 percent of the total isolates. It was collected five times in Oregon, less commonly in four other States. This subrace is differentiated from 48 and 48A on three of the standard differential varieties, as follows:

	Infection Types		
	Marquis	Reliance	Kota
48	1	0;[8]	1+
48A	2	0	2
48B	2	2	2

Race 56, with 31 percent of the isolates, was widely distributed in 27 of 33 States.

Because many wheat varieties now grown in the hard red spring-wheat area of Minnesota, North Dakota, and South Dakota are resistant to certain races, a special effort was made to identify collections from wild grasses, especially *Hordeum jubatum*, which apparently is susceptible to many races of stem rust. From 25 collections of stem rust on this grass from the three States, 38 isolates were identified. Race 15B comprised 45 percent of the isolates; race 11, 29 percent; race 56, 24 percent; and race 38, 2 percent. The only isolate of race 38 obtained from Minnesota in 1956 came from *H. jubatum*.

From 18 aecial collections from barberry, 28 isolates of wheat stem rust were identified, comprising 17 races (Table 2). Races 56, the 17-29 group, 11, and 32 were identified from several States; most of the other races were found only once. Unusual races included race 75, obtained from *Berberis fendleri* in southwestern Colorado. This race has been identified only twice during the past 18 years, both times from or near barberry in Washington. Other unusual races were 118 and 142 from Washington, 126 from Virginia, and 147, a race that attacks Vernal emmer, from Virginia and Iowa.

Beginning in 1954, special sets of wheat varieties additional to the standard differential varieties were inoculated with selected isolates of certain races of rust that are difficult to identify on the standard differentials even under different environmental conditions. Additional differentials were used in an attempt to obtain more precise information on some of the race-group complexes and to obtain varieties useful as supplemental differentials. In 1956, all rust isolates were tested on the 12 standard differentials plus Lee (C.I. 12488), Bowie (Texas Sel. 3708-22), Texas Sel. 131 (which is essentially the same as Bowie in rust reaction), Kenya Farmer (C.I. 12880), Selkirk (C.I. 13100), McMurachy (C.I. 11876), Kenya 360H (P.I. 177187) and Golden Ball (C.I. 5059). An additional 19 supplemental test varieties were inoculated with selected isolates of certain races. Following is the list of these varieties:

1. *Triticum timopheevi*

2. Common wheats
   - Frontana x (K58-Nwth) II-50-17 (C.I. 13154)
   - Gabo (C.I. 12795)
   - Kenya 117A (C.I. 12568)
   - Kenya 117A (Australia 1347)
   - Khapstein (Australia 1451)
   - Magnif G (Argentina, S.A.) (P.I. 197663)
   - Newthatch (C.I. 12318)
   - Conley (ND 1) (C.I. 13157)
   - N.D. 3

[8] 0; denotes hypersensitive necrotic flecks.

3. Durum wheats
   - C. I. 3255 (Spain)
   - C. I. 7905 (Ethiopia)
   - Yuma (Ld 364) (C. I. 13245)
   - Ramsey (Ld 369) (C. I. 13246)
   - Towner (Ld 370) (C. I. 13247)
   - Langdon (Ld 372) (C. I. 13165)
   - R. L. 3206 (C. I. 13141)
   - Sentry (Ld 356) (C. I. 13102)
   - Tremez Molle (Portugal)

During 1956, over 200 sets of supplemental test varieties, each comprising 19 wheats and Kindred barley, were inoculated with 20 selected races and subraces. Seedling plants were used in all of these studies. Some of the tests were made under controlled temperatures of 65°, 75°, and 85° F.[9] Following is a summary of results with respect to the most prevalent races and race groups.

Race 11 -- From 25 isolates tested, four subraces were differentiated on *T. timopheevi*, C. I. 3255, and N. D. 3 (C. I. 13159) at temperatures of 65°, 75°, and 85° F. Some subraces could be distinguished on certain varieties at 65° and 75°, others at 75° only, and one at 65° only. As an example of the influence of temperature on rust reaction, one of the subraces produced infection type 0; on Bowie wheat at 65°, type 2 at 75°, and type 4 at 85°. The other three subraces produced a range in type from 0; to 2 on Bowie at all three temperatures. The reaction of C. I. 3255 to all subraces was almost identical with that of R. L. 3206 and Golden Ball. Conley, Yuma, and Langdon were resistant to all subraces of race 11 at all temperatures at which they were tested. Selkirk and N. D. 3 were resistant to the four subraces at 65°, susceptible to some at 75°, and others at 85° only, as shown below.

	T. timopheevi		N.D.3 (C.I.13159)		C.I.3255		Bowie		
Subrace	65°	75°	65°	75°	65°	75°	65°	75°	85°
11A	1	0; 1	1-	2+	3	3^{+}_{-}	0;	2≡	1-
11B	1	1	1+	3	3	3-	0;	1=	2-
11C	0; 1	3 4	0	4	2-	2	0;	2-	3 4
11D	1	1-	1-	3 4	0;	3-	0;	2	2

Race 15B -- From 86 isolates tested, four subraces of 15B can be differentiated on *T. timopheevi*, C. I. 3255, and Tremez Molle at temperatures of 65° and 85° F. Golden Ball, C. I. 3255, and R. L. 3206 were similar in rust reaction to 80 isolates; they were resistant to about 35 percent and susceptible to 65 percent of the isolates. Conley, N. D. 3, and Towner were resistant to about 35 percent, moderately resistant to 12 percent, and susceptible to 53 percent of the isolates. Yuma and Langdon were resistant or moderately resistant to the 80 cultures to which they were tested. Selkirk was susceptible to all of the isolates.

Race 15 -- The supplemental test varieties were inoculated with eight isolates of this race. For the most part, the rust reactions of most varieties were similar to their reactions to isolates of 15B. However, Yuma and Langdon were susceptible to two isolates of race 15 which were collected in South Dakota in 1956.

Race 17-29 group -- From 41 isolates tested, five subraces of this race group were differentiated on N. D. 3, Towner, R. L. 3206, and C. I. 3255. Since no temperature control studies were made, it may not be possible to distinguish all subraces at all temperatures. The reaction of C. I. 3255, R. L. 3206, and Golden Ball to these subraces was very similar. The three varieties were resistant to 9 of the 28 isolates to which they were tested, or 31 percent, and susceptible to 19 or 69 percent. Conley, Yuma, and Langdon were mostly resistant. N. D. 3, Ramsey, and Towner were almost equally resistant to 14 cultures and susceptible to 14 but not always to the same isolates. Selkirk was moderately susceptible or susceptible to all samples tested.

[9] During the period from November 1, 1956, to February 15, 1957, when most of these studies were made, the standard deviations at the three temperature levels ranged from 1.7° to 3.1° F.

Race 56 -- All the supplemental test varieties were resistant to the eight isolates tested. The samples used in this study were obtained from various parts of the United States.

PUCCINIA GRAMINIS AVENAE

Race 7 of oat stem rust was the predominant race for the seventh consecutive year, although it decreased slightly in 1956, comprising 66 percent of the 476 uredial isolates identified. Race 7A, which can attack oat varieties with the so-called Canadian type of resistance, decreased from 4.5 percent in 1955 to 2 percent in 1956. Shifts in prevalence of other races also were slight. The race 2-5 group comprised 17 percent of the isolates, and race 8, 14 percent (Table 3).

The potentially dangerous race 6 was identified twice from New York and once from Missouri, and the closely related race 13 once from Maine. The identification of race 6 from Missouri is noteworthy, as this is the second time this race has been identified from rust collected outside of the northeastern States. It was first found in 1955 near Columbia, Missouri. In 1956 an isolate was collected in September on oats near Unionville. This may be further evidence that race 6 has extended its geographic range independent of barberry.

Four races of oat stem rust were identified from six aecial collections: 3, 5, 7, and an isolate tentatively identified as a subrace of race 1. The subrace of 1 was obtained from Michigan. Bond (C.I. 2733) is moderately resistant (infection type X-) to this culture, and the three regular differentials are highly resistant (0 and 0;). Nine of the supplemental varieties are resistant, but Clinton[2] X Ark. 674 (C.I. 6643) and Minnesota Selection 1953, II-47-11 are only moderately resistant (X-). Gopher (C.I. 2027) is susceptible (4) to this new subrace. The pathogenicity of this culture indicates for the first time, as far as is known, that Bond has some gene or genes for stem-rust resistance and may be useful as a supplemental differential variety. Gopher may be a more susceptible and suitable host on which to increase stem-rust cultures than Bond. Gopher, Bond, and Victory (C.I. 1145) -- the oat variety originally used by Stakman and Bailey[10] for increasing oat rust inoculum -- are therefore being evaluated as hosts at the Cooperative Rust Laboratory.

Race 3 was obtained from Pennsylvania and New York. This is the first time this race has been found in aecial or uredial collections in the past 18 years.

The same varieties or lines of oats used in 1954-55 were again added to the three standard differentials in all identifications made in 1956.

PLANT PEST CONTROL DIVISION AND CROPS RESEARCH DIVISION
AGRICULTURAL RESEARCH SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE
IN COOPERATION WITH THE MINNESOTA AGRICULTURAL EXPERIMENT STATION
ST. PAUL, MINNESOTA

[10]Stakman, E. C. and D. L. Bailey. 1923. Biologic forms of Puccinia graminis on varieties of Avena spp. Jour. Agr. Res. 24: 1013-1017.

Table 1. Physiologic races of *Puccinia graminis tritici* isolated from uredial collections in the United States in 1956

State	Race and number of times isolated																									Total number of--		
	1	10	11	14	15	15B	24	17-29	29	31	32	33	34	36	38	48A	48B	56	59	59A	59B	59C	61	133	147	Isolates	Races	Collections
Alabama	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1
California	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2
Colorado	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	5	2	4
Florida	-	-	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	10	3	5
Georgia	-	-	-	-	-	-	-	1	-	-	-	-	-	-	2	-	-	8	-	-	-	-	-	-	-	11	3	8
Idaho	-	2	8	-	-	-	-	1	4	2	3	-	-	1	3	1	2	5	-	-	-	2	-	1	-	35	13	25
Illinois	-	-	4	-	-	10	-	1	8	-	-	-	-	-	2	2	-	17	-	-	-	-	-	-	-	44	7	27
Indiana	-	-	5	-	-	5	-	9	4	-	-	-	-	-	-	-	-	12	-	-	-	-	-	-	-	35	5	23
Iowa	-	-	2	-	-	16	-	-	2	-	-	-	-	-	-	-	-	18	-	-	-	-	-	-	-	38	4	21
Kansas	-	-	2	-	-	8	-	1	1	-	-	-	1	-	2	-	1	8	-	-	-	-	-	-	-	24	8	15
Kentucky	-	-	2	-	-	1	-	2	2	-	-	-	-	-	2	-	-	10	-	-	-	-	-	-	-	19	6	12
Louisiana	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2
Michigan	-	-	10	-	-	2	1	3	3	-	1	-	-	-	3	-	-	26	-	-	-	-	-	-	-	49	8	35
Minnesota	-	-	12	-	1	22	-	-	2	-	-	-	2	-	1	-	-	17	-	-	-	-	-	-	-	57	7	41
Missouri	-	-	3	-	1	10	-	4	2	-	-	-	-	-	2	-	-	16	-	-	-	-	-	-	-	38	7	25
Montana	-	-	1	-	-	5	-	1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	10	4	6
Nebraska	-	-	8	-	1	10	-	1	1	-	-	-	1	-	1	-	-	16	-	-	-	-	-	-	-	39	8	26
New Mexico	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1
New York	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	1	-	2	-	-	-	-	-	5	4	2
North Carolina	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	1	1
North Dakota	-	-	16	-	5	62	-	3	1	-	-	-	1	-	1	-	-	6	-	-	-	-	-	-	-	95	8	79
Ohio	-	1	9	-	1	4	-	6	5	-	-	-	-	-	5	1	-	17	-	-	-	-	-	-	-	49	9	30
Oklahoma	-	-	7	-	-	7	-	2	1	-	-	-	-	-	1	-	-	5	-	-	-	-	-	-	-	23	6	14
Oregon	-	1	7	-	-	1	1	1	-	-	1	-	-	-	1	-	5	-	-	-	1	-	1	-	-	20	10	15
Pennsylvania	-	-	3	-	-	2	-	4	8	-	-	-	-	-	4	1	-	19	-	-	-	-	-	-	-	41	7	22
South Carolina	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-	9	-	-	-	-	-	-	-	12	3	11
South Dakota	-	-	13	-	-	51	-	1	8	-	-	-	1	-	-	1	-	10	-	-	-	-	-	-	-	85	7	62
Tennessee	-	-	1	-	-	-	-	1	3	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	-	8	5	4
Texas	-	-	5	-	2	66	-	17	14	-	-	-	-	-	2	9	-	26	-	-	-	-	-	-	1	142	9	96
Virginia	-	-	1	1	-	2	-	-	7	-	-	1	-	-	3	2	-	24	2	2	-	-	-	-	-	45	10	30
Washington	2	1	-	-	-	1	1	1	-	-	1	-	-	-	1	-	1	-	-	-	-	1	-	-	-	10	9	7
West Virginia	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	1	1	-	-	-	-	13	4	11
Wisconsin	-	-	5	-	-	13	-	1	2	-	-	-	-	-	-	1	-	14	-	-	-	-	-	-	-	36	6	23
Totals	2	5	129	1	11	302	3	64	82	2	7	1	6	1	38	18	10	308	2	5	2	3	1	1	1	1,005	25	686
Percentage of isolates	0.2	0.5	12.8	0.1	1.1	30.1	0.3	6.3	8.1	0.2	0.7	0.1	0.6	0.1	3.8	1.8	1.0	30.7	0.2	0.5	0.2	0.3	0.1	0.1	0.1	100.0		

Table 2. Physiologic races of Puccinia graminis tritici isolated from aecial collections in the United States in 1956

State	Race and number of times isolated																	Total number of--		
	11	19	24	17-29	29	32	37	38	47	48A	56	59	75	118	126	142	147	Isolates	Races	Collections
Colorado	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	1	1
Iowa	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-	-	1	4	4	3
Michigan	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1
Pennsylvania	1	-	-	-	1	-	-	-	1	1	2	-	-	-	-	-	-	6	5	6
Virginia	-	1	-	1	-	-	1	-	-	-	1	-	-	-	1	-	1	6	6	3
Washington	1	-	1	-	1	1	-	-	-	-	-	1	-	1	-	1	-	7	7	2
Wisconsin	-	-	-	-	2	-	-	1	-	-	-	-	-	-	-	-	-	3	2	2
Totals	3	2	1	1	4	2	1	1	1	1	4	1	1	1	1	1	2	28	17	18
Percentage of isolates	10.7	7.1	3.6	3.6	14.2	7.1	3.6	3.6	3.6	3.6	14.2	3.6	3.6	3.6	3.6	3.6	7.1	100.0		

Table 3. Physiologic races of Puccinia graminis avenae isolated from uredial collections in the United States in 1956

State	Race and number of times isolated									Total number of--		
	2	5	6	7	7A	8	10	12	13	Isolates	Races	Collections
Alabama	-	-	-	1	-	-	-	-	-	1	1	1
Colorado	-	-	-	1	-	-	-	-	-	1	1	1
Florida	1	-	-	1	1	1	1	-	-	5	5	5
Georgia	1	-	-	2	1	-	-	-	-	4	3	3
Illinois	-	-	-	20	-	3	-	1	-	24	3	23
Indiana	-	-	-	17	1	-	-	-	-	18	2	17
Iowa	-	-	-	19	-	1	-	-	-	20	2	20
Kansas	-	1	-	10	-	2	-	-	-	13	3	11
Kentucky	-	2	-	5	-	-	-	-	-	7	2	5
Louisiana	-	2	-	-	-	-	-	-	-	2	1	2
Maine	-	-	-	-	-	-	-	-	1	1	1	1
Michigan	1	-	-	28	-	7	-	1	-	37	4	32
Minnesota	2	1	-	37	2	16	1	1	-	60	7	54
Mississippi	2	1	-	2	-	-	-	-	-	5	3	4
Missouri	4	5	1	17	-	12	1	-	-	40	6	35
Montana	-	-	-	-	-	1	-	-	-	1	1	1
Nebraska	3	1	-	5	-	-	-	-	-	9	3	6
New York[a]	1	-	2	2	-	-	-	-	-	5	3	5
North Dakota	-	-	-	24	-	6	-	-	-	30	2	24
Ohio	-	-	-	11	-	-	-	-	-	11	1	11
Oklahoma	2	-	-	3	-	1	-	-	-	6	3	5
Oregon	1	-	-	-	-	-	-	-	-	1	1	1
Pennsylvania[a]	1	-	-	33	-	-	-	-	-	34	2	34
South Dakota	-	-	-	17	-	5	-	-	-	22	2	21
Tennessee	7	-	-	7	-	-	-	-	-	14	2	8
Texas	16	14	-	24	2	2	-	-	-	58	5	40
Virginia	7	3[b]	-	8[c]	-	-	-	-	-	18	3	13
Wisconsin	-	-	-	18	1	8	1	-	-	28	4	24
Wyoming	-	-	-	-	-	1	-	-	-	1	1	1
Totals	49	30	3	312	8	66	4	3	1	476	9	408
Percentage of isolates	10.4	6.3	0.5	65.7	1.7	13.9	0.8	0.5	0.2	100.0		

[a] Race 3 isolated from 1 aecial collection.
[b] Isolated also from 2 aecial collections.
[c] Isolated also from 1 aecial collection.

THE PLANT DISEASE REPORTER

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TEMPERATURE AS A FACTOR IN THE INFECTION OF COTTON SEEDLINGS BY TEN PATHOGENS

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The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Plant Disease Epidemics and Identification Section serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

THE PLANT DISEASE REPORTER

PLANT DISEASE EPIDEMICS AND IDENTIFICATION SECTION

Crops Research Division

Plant Industry Station, Beltsville, Maryland

TEMPERATURE AS A FACTOR IN THE INFECTION OF COTTON SEEDLINGS BY TEN PATHOGENS[1]

C.H. Arndt

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Abstract

Cotton seeds naturally infested by or artifically inoculated with ten fungi were grown in culture at 18°, 21°, 24°, 30°, 33°, and 36° C. The temperature range through which the several fungi infected the seedlings was as follows: Ascochyta gossypii, 18°-27°; Botryodiplodia phaseoli, 18°-36°; Colletotrichum gossypii, 18°-33°; Fusarium moniliforme, 18°-36°; Fusarium oxysporum f. vasinfectum, 18°-36°; Pythium ultimum, 18°-27°; Rhizoctonia solani, 18°-33°; Thielaviopsis basicola, 18°-30°; Verticillium albo-atrum, 18°-21°; and Xanthomonas malvacearum, 21°-36°. The latter produced lesions only on the cotyledons. Botryodiplodia phaseoli was a more aggressive parasite of the cotyledons than of the hypocotyls.

The characteristics of the lesions produced by the several fungi are described.

INTRODUCTION

A number of pathogens have been shown to infect cotton seedlings and cause damping-off (4, 37, 50, 62). The incidence of the diseases caused by each of these pathogens varies greatly from year to year, and they are not always controlled by the fungicides used for seed treatment. This is especially true when soil conditions are favorable for seedling infection by soil-inhabiting pathogens. The discovery of more effective fungicides for their control is dependent upon detailed information of the environmental conditions under which these pathogens infect cotton seedlings. Temperature was chosen for the environmental variable to be studied, since it is readily controlled and is known to be an important factor in determining the amount of seedling infection when soil moisture is adequate.

This paper presents data on the infection of cotton seedlings by 10 pathogens through a temperature range of 18°-36°C. Descriptions of the lesions caused by several pathogens are also included as an aid to identification of the causal pathogens under field conditions.

METHODS

The seedlings were grown in sand culture at controlled temperatures by essentially the same method as that described previously (8). Sufficient nutrient solution was added to the sand cultures to bring the amount of water to 80 percent of the field capacity. Additional water was added to maintain this moisture content when approximately 15 percent of the water had been lost by evaporation. The time required for this 15 percent reduction varied from 4 to 8 days, the shorter time being required at the higher temperatures. Since evaporation tended to lower the temperature of cultures below that of the air, the latter was maintained at a temper-

[1] Technical Contribution No. 271 of the South Carolina Agricultural Experiment Station, Clemson, South Carolina.

ature which would provide the desired culture temperature at seed depth, or 2.5 cm. The difference in the air and culture temperatures at 18°C was less than 0.25°; and this difference increased regularly at the higher temperatures to a maximum of 1.5° at 36°. After emergence the seedlings were irradiated for 16 hours each day with fluorescent lamps.

The pathogens used and their origin are indicated in Table 1. From one to three isolates of the several pathogens were used. When more than one isolate was used, the cultures of each were mixed in a mechanical blender, as indicated later. No attempt was made in these studies to assure that the isolates used were derived originally from a single spore or hypha. The use of mixed cultures of the same pathogen in these studies was considered advisable, since the main objective was to ascertain the temperature range over which strains of a given pathogen might infect seedlings and produce typical lesions for that pathogen.

Each isolate used in this study, except Verticillium albo-atrum, had been reisolated from an infected cotton seedling, although it may have been obtained originally from a host other than cotton. All isolates were obtained from sections of infected hypocotyls that were first immersed for 10 to 20 seconds in 95% ethanol and then for 1 to 3 minutes in a hypochlorite solution that contained 2%-3% free chlorine; after which they were cultured on non-nutrient agar. This same technique was used throughout the study to ascertain whether or not the fungus used for inoculation had infected the seedlings.

Five-day-old cultures of the pathogens grown on cornmeal-raisin agar slants at room temperature were used to inoculate the seeds. The inocula were prepared by scraping the mycelium from the surface of the agar and macerating in a blender for 20 seconds. The seeds were usually inoculated with this mycelial suspension by placing one drop on each seed after it had been placed in the sand culture. In some instances, as indicated, the seeds were soaked in the suspension immediately before the seed was placed in the sand culture. These methods of inoculation added only minute amounts of organic matter to the cultures.

Special care was taken to assure that the seeds used in these studies were not internally infected by fungi. Consequently, acid-delinted seed from which the floaters (7), about 30 percent, had been removed were used in the tests, except when otherwise indicated. Fuzzy seed naturally infested by the anthracnose fungus were used in one series of tests. In the first set of tests with each pathogen, a lot of Stoneville-2B seed of 95 percent viability was used. All results with this variety were verified by later tests in which seed of the variety Coker-100W was used. Since comparable results were usually obtained with both varieties, only occasional reference will be made to them. As will be noted later, seed of several other varieties were used in tests in which it was necessary to use a variety of known susceptibility to infection.

Generally, 5 sand cultures of 32 seeds each, as used in other studies (8), were used in a test of each pathogen at a given temperature. For convenience in making comparisons, all data have been adjusted to a 100-seed basis. Consequently, the numbers given are percentages. Over the temperature range in which infection was obtained, the tests were repeated two or three times. After 14 days, all cultures with more than 10 viable seedlings were thinned to that number by a systematic removal of plants so as to leave the remaining seedlings uniformly distributed throughout the culture. Sections of the hypocotyls of the removed seedlings were plated on a non-nutrient agar. All seedlings alive after 21 days were plated in the same manner to ascertain the absence or presence of infecting fungi. The numbers of healthy and infected seedlings after 21 days and the numbers of such seedlings removed previously were used to estimate the total numbers of healthy and infected seedlings after 21 days. In making these estimates it was assumed that the healthy seedlings removed after 14 days would have shown the same percentage of infection as the 10 or fewer healthy seedlings left in the individual culture from the 14th to the 21st day.

RESULTS

Rate of Seedling Emergence

The relative rate of emergence of uninoculated seeds at the several temperatures, as indicated by the coefficient of emergence (35)(Table 2) was not greatly different from that reported previously (6, Fig. 1.) At 18°C in the uninoculated cultures, the emerged cotyledons were still yellow or pale green after 14 days; and in the various cultures from 25 to 50 percent of them were still chlorotic after 21 days. At 21°, some cotyledons were chlorotic after 11 days, but there was no evident chlorosis after 14 days.

As in the earlier study of the temperature relations of cotton seedlings (6), the appearance

Table 1. Origin of pathogens used in studies of temperature relations.

Pathogen	Culture No.	Host	Locality	Supplier
Ascochyta gossypii Syd.				
	1	Cotton	S. C.	C. H. Arndt
	2	Cotton	N. C.	S. C. Lehman
	3	Okra	N. C.	S. C. Lehman
	4	Soybean	N. C.	S. C. Lehman
Botryodiplodia phaseoli (Maubl.) Thir.				
	5	Cowpea	Ga.	E. S. Luttrell
	6	Cowpea	S. C.	J. K. Armstrong
	7	Cotton	S. C.	C. H. Arndt
Colletotrichum gossypii Southworth[a]				
	8	Cotton	S. C.	C. H. Arndt
	9	Cotton	S. C.	C. H. Arndt
	10	Cotton	S. C.	C. H. Arndt
	11	Cotton	Miss.	C. H. Arndt
Fusarium moniliforme Sheldon				
	12	Crowder pea	S. C.	J. K. Armstrong
	13	Cotton boll	Okla.	W. W. Ray
	14	String bean	Idaho	W. W. Ray
	15	Corn	S. C.	C. H. Arndt
	16	Corn	Miss.	C. H. Arndt
	17	Cotton	S. C.	C. H. Arndt
Fusarium oxysporum f. *vasinfectum* (Atk.) Snyd. & Hans.				
	18	Cotton	S. C.	J. K. Armstrong
Pythium ultimum Trow				
	19	Pepper	S. C.	C. H. Arndt
	20	Cotton[b]	S. C.	C. H. Arndt
	21	Cotton[b]	S. C.	C. H. Arndt
	22	Guayule	Calif.	W. A. Campbell
Rhizoctonia solani Kuehn[c]				
	23	Cotton	Texas	C. H. Arndt
	24-	Cotton	S. C.	C. H. Arndt
	25	Cotton	S. C.	C. H. Arndt
Thielaviopsis basicola (Berk. & Br.) Ferr.				
	26	Tobacco	Canada	G. B. Lucas
	27	Tobacco	N. C.	G. B. Lucas
	28	Cotton	Miss.	J. T. Presley
Verticillium albo-atrum Reinke & Berth.				
	29	Cotton	Texas	P. J. Lyerly
	30	Cotton	N. C.	S. C. Lehman
	31-	Cotton	Miss.	J. T. Presley
Xanthomonas malvacearum (E. F. Sm.) Dowson				
	32	Cotton	Texas	L. S. Bird
	33	Cotton	Okla.	L. A. Brinkerhoff

[a] Cultures 8, 9, 10, and 11 were derived from lesions that developed on cotton seedlings grown in steamed sand cultures from seed that had been treated with Ceresan-M; hence, presumably derived from seeds internally infected by this fungus.

[b] Isolated from seedlings grown in river sand obtained near Clemson, S. C. (20); and from soil obtained near Charleston, S. C. (21)

[c] Isolated from seedlings grown from acid-delinted seed in soil received from Greenville, Texas (23), in river sand obtained near Clemson, S. C. (24), and in soil near Charleston, S. C. (25)

Table 2. Effect of indicated temperatures on the emergence of cotton seedlings in uninoculated cultures.

Temperature °C	Emergence: Total percent	Days required for: Initial	Days required for: Total	Coefficient of emergence[a]
18	64	7	14	11
21	88	5	8	18
24	89	4	5	23
27	85	3	4	32
30	90	2	3	40
33	90	2	3	40
36	86	2	3	42

[a] As calculated by Kotowski (35), or the coefficient of velocity of

$$\text{emergence} = \frac{\text{Total emergence at end of period}}{\text{Sum of (each daily emergence increase x days since planting)}} \times 100$$

of the seedlings indicated that a sustained temperature of 33°C was too high for best seedling development. At 27° and 30° after 17 days, the first foliage leaves had reached a length of 1 to 2 cm; while at 33°, they were still mere rudiments after 21 days. From 1 to 2 days longer were required for the cotyledons to expand fully at 33° than at 30°, although at both temperatures the seedlings emerged at about the same time. At 36°, the expansion of the cotyledons was still further delayed. Only 60 percent had emerged from the testas after 8 days, and 20 percent had not emerged after 14 days, but all were fully expanded after 21 days.

Ascochyta gossypii [2]

Acid delinted seed were inoculated by immersion for 5 minutes in a mycelial suspension of isolate #1 (Table 1) of Ascochyta gossypii. At 18°C there was no emergence, at 30° emergence was 97 percent and no seedlings were infected, Table 3. At 21°, 24°, and 27°, the first seedlings were killed after 9, 7, and 11 days, respectively; after 14 days the percentages of normal seedlings were 23, 16, and 35 respectively; and after 21 days, 2, 6, and 29, respect-

Table 3. Percent seedling emergence, number of seedlings alive after 14 and 21 days, and the day of culture on which the first of the emerged seedlings was killed for seeds inoculated with Ascochyta gossypii and cultured at the temperatures indicated.

Temperature °C	Percent seedling emergence	Number of seedlings alive after 14 days	Number of seedlings alive after 21 days	Number of days to death of first seedling
18	0	0	0	0
21	52	23	2	9
24	79	16	6	7
27	88	35	29	11
30	97	97	91	0
33	90	90	90	0
36	90	90	90	0

[2] The writer wishes to express his indebtedness to W. B. Boykin and Charles Brown for assistance in obtaining the data herein reported.

ively. Thus, the fungus may cause severe seedling loss at 21°, 24°, and 27°C. At 18° and 24°, other cultures were inoculated with an aqueous suspension of spores which were obtained from Petri-dish cultures on which pycnospores had been produced. When the latter were grown concurrently with cultures inoculated with the mycelial suspension, comparable results were obtained, except that 2 to 3 days longer were required for the death of the first seedling and there was a slightly greater number of surviving seedlings.

In a supplementary test, isolates of A. gossypii obtained from cotton, okra, and soybean in North Carolina were compared with the South Carolina isolate at 21°C. The North Carolina cotton isolates appeared slightly more virulent than the one from South Carolina. The okra and soybean isolates did not infect the cotton seedlings. More recently published results (17, 30, 61) would indicate that the lack of virulence of the latter two isolates may not be characteristic of all isolates from these hosts.

The first symptom of infection was the appearance of a reddish-brown lesion on the hypocotyl at or just below the surface of the soil. In 2 to 3 days this lesion enlarged to involve the entire circumference of the hypocotyl but with little or no extension of the lesion above the soil. Four to 5 days after the appearance of the lesion, the seedling would fall over but otherwise would appear healthy and unwilted. At this stage of infection, the cortex of the hypocotyl and root would be thoroughly rotted and would slough off readily. The seedlings did not wilt until 2 to 3 days later. Presumably, the cortex is seriously affected earlier than the stele.

Although Ascochyta gossypii is undoubtedly the cause of occasional severe injury to young cotton plants (2, 19, 29, 43, 56), the report by Smith (56) is the only one which indicates that it is a possible cause of seedling losses. It was not reported by Weindling et al. (62). It has not been isolated from diseased seedlings by the writer. The fungus may have infected a somewhat larger number of diseased seedlings than the reports indicate, since it grows more slowly on most culture media than most of the other fungi associated with hypocotyl lesions. Although this fungus may not be the primary cause of seedling losses, cotyledonary infection by it may predispose the seedlings to severe injury by other pathogens. In one season in which Ascochyta and thrips had injured the cotyledons, the writer observed an unexpected and widespread destruction of cotton seedlings by Rhizoctonia solani during a short period of relatively warm, rainy weather.

Botryodiplodia phaseoli

The isolate of Botryodiplodia phaseoli obtained from E. S. Luttrell (Table 1, No. 5) was unique in that it invariably developed pycnospores in the older lesions. The cultural characteristics and the lesions produced on cotton seedlings were identical with those of the other two isolates, which did not produce pycnospores. The pycnidia ranged in diameter from 0.09 to 0.14 mm, with a mean of about 0.1 mm. The sclerotia of the non-pycnidial isolates had a similar appearance microscopically, but were somewhat smaller and ranged from 0.07 to 0.09 mm in diameter. Since the pathogenicity of all three isolates was much the same in the preliminary tests, a mixed inoculum of the isolates, as with other pathogens, was used in the tests.

Table 4. Percent seedling emergence and the number of healthy seedlings per 100 seeds after the number of days indicated for seeds inoculated with Botryodiplodia phaseoli when cultured at 7 temperatures.

Temperature °C	Percent seedling emergence	Number of healthy seedlings per 100 seeds after days indicated: 6	8	10	14	21
18	64				64	54
21	74		74	74	70	60
24	76	76	72	71	65	46
27	80	80	80	78	63	47
30	89	86	84	83	72	63
33	83	80	76	73	68	61
36	83	80	74	60	41	18

Some seedlings were killed at all temperatures, as is shown in Table 4 by the reduction in the number of emerged seedlings. As found in previous studies (46), the fungus killed the seedlings most rapidly at relatively high temperatures; the lowest percentage of surviving seedlings occurred at 36°C. At 30°, 33°, and 36°, the first seedlings were killed after 6 days; at 21°, 24°, and 27° after 14, 7, and 9 days, respectively. At 18°, the first lesion became noticeable after 16 days, and the first dead seedlings were observed 2 days later. At 21°, 24°, and 27°, a few of the seedlings were killed before they emerged from the soil.

Botryodiplodia phaseoli did not always produce distinct lesions on the hypocotyl as did the other seedling pathogens included in this study. The first symptom of infection and injury at 30°, 33°, and 36°C was often the sudden falling over of the seedlings due to the destruction of the interior tissue of the hypocotyl at or near the surface of the soil. This region of the hypocotyl collapsed and became shrunken without the appearance of definite lesions on the surface. A similar effect has been reported for potato stems (57). B. phaseoli was readily isolated from the collapsed hypocotyls. There was no evidence of infection of the roots. As a result there was no evident stunting of the seedlings, even shortly before damping-off, as occurred with the pathogens Colletotrichum gossypii, Pythium ultimum, and Rhizoctonia solani.

In cultures inoculated with B. phaseoli, a large percentage of the seedlings that later showed lesions on the cotyledons did not have corresponding lesions on the hypocotyls. Except for the angular-leaf-spot bacterium, the other pathogens studied produced more abundant lesions on the hypocotyls than on the cotyledons. Cotyledonary infection was usually associated with the adherence of the testas to the cotyledons as they emerged from the soil. The first evidence of such infection was the appearance of small black spots which enlarged rapidly to involve the entire cotyledon. Usually both cotyledons were infected; but occasionally, at 36°C, only one cotyledon became infected. B. phaseoli apparently is not an important cause of losses of cotton seedlings in field plantings, regardless of its demonstrated pathogenicity in this study, since it has been obtained from very few of the diseased seedlings collected by the writer in South Carolina during the past 20 years.

Colletotrichum gossypii

The pathogenicity of Colletotrichum gossypii, the anthracnose fungus, to cotton seedlings is well known from many studies since 1892 (5, 11, 12, 18, 37, 41). Regardless of the relatively detailed information already available on the relation of temperature to infection by this fungus (5, 37), it was included in this study for comparative purposes.

Comparable results were obtained with naturally infested fuzzy seed and with inoculated acid-delinted seed (Table 5). These results approximate those published previously (5) the largest difference being in the greater pathogenicity at 30° and 33°C shown in the later tests. In the previous studies (5), this fungus killed fewer seedlings at 29° than at lower temperatures, and a much smaller proportion were killed at 33°. However, as in this study, lesions appeared sooner at 29° and 33° than at lower temperatures. Whether or not the difference between the cultural methods used in the two studies is sufficient to account for the difference in pathogenicity in the 29°to 30° range is uncertain.

As previously described, the anthracnose lesions first appeared as small, light brown, longitudinal lines (62). Since the lateral extension of the lesions was slow, one cotyledon frequently wilted and collapsed before the other cotyledon was affected. This one-sided character of the lesions produced by the anthracnose fungus usually permits them to be readily distinguished from those due to other pathogens, which generally produce lesions that tend to enlarge laterally as rapidly as they do longitudinally and which, consequently, tend to encircle the hypocotyl at or below the soil surface.

In spite of the large proportion of the seedlings killed at 33°C, typical one-sided lesions were not produced on the surface of the hypocotyl at this temperature. The internal tissues at the base of the hypocotyl were destroyed before definite lesions appeared on the surface. In this respect, the lesions were not greatly different from those produced by Botryodiplodia phaseoli at this temperature.

At 27°C and lower temperatures, the seedlings in the inoculated cultures were decidedly stunted, even in their early growth, as compared with those in the uninoculated. This stunting was only slightly evident at 30° and was not apparent at 33°. At these two temperatures, the seedlings at the time of damping-off were about the size of those in the control cultures. This feature had been noted in the previous studies (5). Lehman (37) found the maximum temperature for this fungus to be 34. 5°C, which explains the failure to infect the seedlings at 36°.

The cultures at 27°C which were planted with acid-delinted seed were the only cultures

Table 5. Percent seedling emergence and the number of healthy seedlings per 100 seeds after the number of days indicated for seed naturally infested by the anthracnose fungus, and also for acid-delinted seed inoculated with the same fungus when cultured at the temperatures indicated.

Temperature $0^{o}C$	Percent seedling emergence	Number of healthy seedlings per 100 seeds after days indicated 6	8	10	12	14	21
Fuzzy seed - naturally infested							
18	58					40	1
21	83		83	75	55	26	1
24	86	86	77	49	24	1	1
27	91	91	68	23	17	8	1
30	86	80	40	14	11	8	1
33	89	82	79	51	18	15	4
36	91	91	91	91	91	91	91
Acid delinted seed - inoculated							
18	39				58	28	3
21	36	No normal emergence, all dead 11 days					
24	84	84	33	10	4	0	0
27	88	88	85	21	4	0	0
30	86	86	23	0	0	0	0
33	87	87	80	52	46	20	6
36	84	84	84	84	84	84	84

in which a relatively large percentage of the cotyledons were infected by the anthracnose fungus. After 7 days, 30 percent of the seedlings had lesions on the cotyledons. Most of these infected cotyledons were completely rotted 3 to 5 days later.

Fusarium moniliforme

In preliminary tests with Fusarium moniliforme, no differences in pathogenicity were apparent among the six cultures derived from four different host plants (Table 1). Consequently, cultures 5, 6, and 8 were used in the tests from which the results reported with the seed of Coker-100W were obtained. Comparable results were also obtained with seed of the varieties of DPL-15a and Stoneville-2B.

Inoculation of the seeds with this fungus had little or no effect on seedling emergence. Emergence at the several temperatures ranged from 74 to 92 percent (Table 6), essentially the same as for the control cultures (Table 2). There were no evident differences in the size of the seedlings between the uninoculated and inoculated cultures after either the 14- or the 21-day culture period. Consequently, the stunting reported by Woodroof (65) was not noted. Such differences in results with this fungus may be expected, since great variation in pathogenicity seems to be a characteristic of this species (40, 59, 65), and infection of seedlings by it is greatly influenced by environmental conditions (50).

The lesions produced on the hypocotyls by this fungus at 18°, 21°, and 24°C were merely small brown spots on the cortex at or slightly above the collet. None of these lesions became sufficiently extensive to cause typical damping-off; although after 21 days at 18°, 21°, and 24°, the cortex near the base of the hypocotyl was well rotted in 10 percent, 6 percent and 2 percent, respectively, of the seedlings. At 24°, 6 percent of the lesions were the result of cotyledonary infection. F. moniliforme was isolated from them.

Although this fungus produced relatively few lesions and did not stunt the seedlings, the hypocotyls that were plated on agar after 14 days showed relatively large percentages of infection at all temperatures, except 18°C (Table 6). The explanation for the low percentage of seedlings from which the fungus was obtained at 18° is uncertain, since approximately half of the hypocotyls at 21° and 24° were infected after 14 days; and approximately all hypocotyls at

Table 6. Percent seedling emergence for seeds inoculated with Fusarium moniliforme and cultured at the temperatures indicated; and also the precentage of these seedlings from which the fungus was obtained (infected) and the percentage of seedlings that had visible lesions after 14 and 21 days of culture.

Temperature $0^{o}C$	Percent seedling emergence	Percentage of infected seedlings		Percentage of seedlings with lesions	
		14 days	21 days	14 days	21 days
18	74	17	22	16	22
21	84	55	100	16	16
24	92	45	88	8[a]	8[a]
27	91	60	16	0	0
30	90	35	18	0	0
33	85	36	43	0	0
36	90	51	72	0	0

[a] 2 percent of these seedlings had lesions on the hypocotyls; the other 6 percent had lesions only on the cotyledons.

these two temperatures were infected after 21 days. In contrast to the results at these two temperatures, after 21 days the percentages of hypocotyls at 27° and 30° from which the fungus was obtained were much smaller than the percentages after 14 days. The explanation for this reduction is again uncertain, unless the cortices of the 21-day-old hypocotyls were penetrated more readily by the hypochlorite solution used for surface sterilization than were those of the 14-day-old seedlings.

This fungus, when it grew from the surfaced-sterilized hypocotyls on water agar, first formed rounded masses of microconidia similar to those illustrated by Voorhees (59, Figs. 2, 8). Later, as the humidity within the dishes became less, the heads were replaced by typical long conidial chains. These frequently had small conidial masses at their bases.

Fusarium moniliforme is one of the more ubiquitous fungi associated with cotton culture in the southeastern portion of the Cotton Belt. It is frequently isolated from superficial reddish-brown lesions on the bases of hypocotyls of seedlings in the field (50). It is almost invariably obtained from the cortex at the base of the hypocotyl as it is being sloughed off with the formation of new cells by the subcortical cambium. The facts that this fungus, when isolated from lesions on the hypocotyl, is often associated with more virulent pathogens, and that it did not cause damping-off in this study, would indicate that it is generally a benign parasite on the cotton plant. One study (26) would indicate otherwise. The data given on the relation of temperature to infection by this fungus would indicate that 21° and 24°C are more favorable for the formation of the lesions on the hypocotyls than are higher temperatures, that 30° is the least favorable temperature for infection, and that after 21 days more seedlings are likely to be infected at 33° and 36° than at 30°.

Fusarium oxysporum f. vasinfectum

Although Fusarium oxysporum f. vasinfectum, the cotton-wilt fungus, is one of the more destructive pathogens of the cotton plant, there are few reports of it as a cause of seedling disease besides those of Elliott (20), Fahmy (22), and Rosen (54). These reports are substantiated by the results given in this paper which indicate that the wilt fungus may cause damping-off of cotton seedlings at relatively low temperatures. The data reported were derived from the inoculation of seeds of Coker-100W, a variety considered to be generally resistant to the wilt disease. The isolate of the fungus (Table 1) was obtained from a field of Coker-100W in which plants showed wilt symptoms.

The emergence of the seeds inoculated with the wilt fungus was about the same as that for uninoculated seeds (Tables 2 and 7), except for a smaller emergence at 21°C. Inoculation with this fungus produced most noticeable stunting of the infected seedlings at 18° and 21°. At the higher temperatures, the small light tan lesions did not have any apparent effect on seedling growth; and there was little stunting of the seedlings until the lesions involved the entire circumference of the hypocotyl, except for those seedlings with infected cotyledons at 33° and 36° (Table 7). Although the fungus was recovered from 13 percent of the hypocotyls at 36° after

Table 7. Percent seedling emergence for seed inoculated with Fusarium oxysporum f. vasinfectum and cultured at the temperatures indicated; and also the percentage of these seedlings from which the fungus was obtained (seedlings infected), the total percentage of seedlings with lesions, the percentage of the seedlings with extensive lesions, and the percentage of the seedlings killed after 14 and 21 days of culture.

Temperature ^0C	Percent seedling emergence	Percentage of seedlings after indicated number of days							
		Infected		With lesions		With extensive lesions[a]		Killed	
		14 and 21 days		14 and 21 days		14 and 21 days		14 and 21 days	
18	65	41	48	15	68	0	50	0	50
21	74	75	100	10	42	10	40	8	40
24	86	75	97	14	48	12	14	0	40
30	90	32	12	3	3	3	3	0	3
33	84	20	55	3[b]	41	3[b]	15	0	0
36	90	21	13	1[b]	1[b]	1[b]	1[b]	0	1

[a] Lesions which were extensive enough to preclude normal seedling growth.
[b] Lesions on cotyledons only.

21 days (Table 7) no lesions were produced on the hypocotyls at this temperature.

The hypocotyl lesions associated with infection first appeared as light tan, somewhat circular areas, 1 to 2 mm in diameter, that enlarged slowly. Initially they were confined to one side of the hypocotyl. Later they became dark brown in color and even blackish, coincidental with their invasion by bacteria. In some instances, the lesions increased in size and finally involved the entire circumference of the hypocotyl below the soil level. When this occurred, especially at the higher temperatures, 27° to 33°C, the infected area lost its turgidity and the seedlings showed the typical symptoms of damping-off. After 14 days, the highest percentage of seedlings (12 percent) with such lesions was at 24° (Table 7). After 21 days, these percentages at 18°, 21°, 24°, 27°, 30°, and 33° were 50, 40, 14, 6, 3, and 15, respectively, At 18° and 21°, these infected seedlings were dead. At the higher temperatures, 24°, 27°, and 30°, most seedlings with extensive lesions were still alive after 21 days, but it is doubtful whether they would have survived under field conditions. The only temperature at which the seedlings were killed (8 percent) before the 14th day was at 21° (Table 7). At 33° and 36° after 14 days a small percentage of the seedlings had their cotyledons destroyed by the fungus (Table 7).

When the seedlings were plated to ascertain the percentages infected, it was found that the percentages infected were much larger than the percentages with lesions, except at 18°C after 21 days. The differences were especially large at 21° and 24° after 14 and 21 days, and at 27° and 33° after 21 days. At 27° after 21 days, 24 seedlings with and without lesions were plated. The fungus was obtained from half of both groups of seedlings. It is apparent that this fungus may invade the tissues of a cotton seedling without causing visible lesions. The fungus obtained must also have been the same as that used to inoculate the seeds, since a similar fungus was not obtained from uninoculated cultures grown concurrently.

The data for the 21-day growth period indicate that the least favorable temperatures for the infection of the hypocotyl were 30° and 36°C; for the development of lesions, 30° and 36°; and for the production of severe lesions, 27°, 30°, and 36°. At 33° after 21 days higher percentages were infected and had lesions than at 30°. In this respect the results at 33° are more nearly comparable with those at 24° and 27° than at 30°. Thus, the cotton seedling appeared to have a maximal resistance to infection at 30°, and its susceptibility to infection and injury increased at lower and at higher temperatures.

The data in Table 7 show three anomalies which are difficult to explain and which did not appear to a comparable extent in all tests with this fungus. They are 1) the failure to obtain a fungus from all seedlings with lesions at 18°C after 21 days, and 2) the lower percentages of infected seedlings at 30° and 36° after 21 days than after 14 days. As indicated previously, in the Fusarium moniliforme cultures also a lower percentage were infected after 21 days than after 14 days at 27° and 30°.

Similar results were obtained in another test with a Fusarium-wilt isolate, in which the seedlings were grown in controlled temperature tanks in the glasshouse and at soil temperatures of 18°, 21°, 24°, 27°, and 30°C. The mean glasshouse temperature was about 25°, with a daily range of 15° to 30°. The test was terminated after 3 weeks when the check plants at 27° had a mean height of 45 cm. The percentages of plants with lesions at or just below the surface of the soil were much the same as in the laboratory tests, being 100, 30, 35, 41, 2, and 2, respectively, for 18°, 21°, 24°, 27°, 30°, and 33°. All but 3 percent of the seedlings were killed at 18°. The only plants to show discoloration of the stele were those grown at 27°, 30°, and 33°.

As previously described by Rosen (54), the color and nature of lesions produced by the Fusarium oxysporum isolates may not be greatly different from those produced by Rhizoctonia solani, except that in these studies they enlarged less rapidly than Rhizoctonia lesions and were mostly confined to one side of the hypocotyl. The superficial lesions at first were a light tan in color, gradually becoming deeper and browner. Later, coincidental with invasion by bacteria, they became dark and black.

Since it has been shown that isolates of Fusarium oxysporum from the sweetpotato, Ipomoea batatas, may infect cotton without necessarily producing symptoms of wilt (3), an isolate highly pathogenic to sweetpotato was compared at 21°C with that from cotton. The percentage of emerged seedlings for the sweetpotato and cotton isolates were 82 and 74, respectively. The differences in the percentages of seedlings from which the respective fungi were obtained were slightly greater. Thus, after 14 days the percentage for the sweetpotato isolate was 50, for the cotton isolate 75; after 21 days, the percentages were 87 and 100 respectively. The sweetpotato isolate, however, produced fewer lesions on the hypocotyls than the cotton isolate. The former had produced lesions on only 2 percent of the hypocotyls after 14 days and no additional lesions appeared. In contrast, the cotton isolate had produced lesions on 10 percent of the hypocotyls after 14 days, and 42 percent after 21 days. Thus, the two isolates were not very different in respect to infection of hypocotyls, but were greatly different in respect to capacity to produce lesions.

Over a period of 20 years in which the writer had examined and plated large numbers of seedlings, Fusarium oxysporum f. vasinfectum was found definitely associated with seedling losses in only one field. These losses occurred after a period of relatively heavy rainfall and low temperatures. This field was known to have a high inoculum potential for this fungus. The seedlings examined were also abundantly infested by several species of nematodes.

The data which indicate a greater infection of cotton seedlings by the wilt fungus at relatively low temperatures, 18° to 24°C, compare with those obtained by Porter and Melhus (47) and Walker (60) for Citrullus spp. Other studies with cotton and other plants agree that the optimum temperature for the expression of wilt symptoms is 27° or slightly higher (15, 20, 47, 66). Similarly, during the studies reported in this paper, the dark discoloration of the stele that is typical of wilt symptoms was observed only at the temperatures of 27°, 30°, and 33°, but not at lower temperatures; thus, it would appear that the optimum temperature for infection by the wilt-producing Fusaria may be lower than that for the appearance of internal discoloration.

A culture of Fusarium solani (Mart.) Appel & Wr. obtained from a diseased cotton seedling in a field in which a large proportion of the seedlings were dying as the result of infection by various pathogens was used in a similar study. At soil temperatures of 20° and 25°C, it produced larger lesions and more extensive damping-off than the wilt isolates. The cultural conditions were such that the results cannot be compared with those reported in this paper; but the results supplied unquestionable proof that F. solani could cause extensive damping-off at a soil temperature of 20°, and at 25° could produce lesions on the hypocotyl and cause discoloration of the stele in a small proportion of the seedlings. Fusarium roseum (Lk.) emend. Snyd. & Hans. has also been obtained from infected cotton seedlings (10).

Pythium ultimum

Published data on Pythium ultimum as a parasite of cotton seedlings (4) indicate that it is a highly virulent pathogen at soil temperatures of 18°, 21°, 24°, and 27°C. Few seedlings were infected at 30°, and seedlings grown at this temperature for 12 days and then grown at a lower soil temperature were no longer severely injured. In the present study, in which both air and soil temperatures were approximately the same, no seedlings emerged at 18° and 21°; this demonstrates a more rapid destruction of the seeds and seedlings by this pathogen than by any of the others studied. At 24° (Table 8) emergence was only 34 percent, and the number of seedlings gradually decreased until only 23 percent were alive after 14 days, and 21 percent after 21 days. The first seedlings damped-off on the eighth day. The 23 seedlings alive after

Table 8. Percent seedling emergence for seeds inoculated with Pythium ultimum and cultured at the temperatures indicated, and also the number of surviving seedlings per 100 seeds after 14 and 21 days of culture.

	Temperature $0^{o}C$						
Days	18	21	24	27	30	33	36
Percent seedling emergence							
21	0	0	34	71	90	88	88
Surviving seedlings per 100 seeds							
14	0	0	23[a]	52	90	88	88
21	0	0	21[b]	47	90	88	88

[a] All stunted.

[b] Only one seedling was without a lesion; the other 20 were infected by P. ultimum, and the seedlings were 25 to 40 percent the size of those in controls.

14 days were only 60 percent to 80 percent as large as those in checks. Twenty of these were alive after 21 days, and only one of these seedlings was of approximately normal size. The others were 25 to 40 percent as large as the checks. P. ultimum was isolated from all the seedlings with lesions.

At $27^{o}C$, the percentage of emerged seedlings was 19 percent less than in the controls; the first seedling damped-off on the eighth day; and there was a further reduction to 52 percent of living seedlings after 14 days. A further reduction of 5 percent occurred before the 21st day. Of the 24 seedlings removed after 14 days, 18 were not infected and 6 had lesions on the hypocotyls from which the pathogen was recovered. Four of the surviving seedlings removed after 21 days had relatively large lesions on the hypocotyls from which the fungus was recovered. About 10 percent of the seedlings had small 1-2 mm lesions on cotyledons, but no fungi were obtained when they were plated. At 30^{o}, 33^{o}, and 36^{o}, no seedlings were infected. Harter and Whitney (27) found a somewhat similar relation of temperature to the decay of sweetpotatoes when infected by this fungus, although their data indicate a growth optimum for the fungus at 32^{o}. The latter is somewhat higher than the optimum found by Halpin et al. (25).

The nature of the injuries to the hypocotyl and roots of the cotton plant is very similar to that of injuries produced on red clover seedlings by P. ultimum and other Pythium spp. (25). Thus, after the infection of cotton seedlings by P. ultimum, the cortex of the root or hypocotyl appears as if infiltrated with water and the cortical tissues quickly collapse. The lesions tend to remain tan or light brown in color until invaded by other microorganisms, when they change to dark brown or black. The initial lesions generally appeared on the hypocotyl just above the collet. However, lesions were often present on the tap and secondary roots. If infection of the hypocotyl occurred 2 to 3 weeks after emergence, only small cortical lesions were formed. Most of the seedlings that emerged at 24^{o} and $27^{o}C$ formed secondary roots and the latter were also infected, as was indicated by small, dark lesions. This infection of the roots apparently accounted for the noticeable stunting of the surviving seedlings after 21 days at 24^{o} and 27^{o}.

P. ultimum causes a relatively small proportion of the losses of cotton seedlings in the field (62), even though it is a virulent pathogen. It is usually very destructive in small, sharply delineated areas in which few seedlings may survive. The erratic distribution of such areas makes it difficult to incriminate any particular soil condition as a predisposing factor to seedling infection, except that infections are invariably associated with periods of relatively high soil moisture. It is also possible that this fungus may have been present in more instances of seedling losses than reports would indicate, since on non-nutrient agar it forms relatively inconspicuous mycelium which may be readily overlooked because of the usual presence of fungi with more conspicuous growth.

Rhizoctonia solani

Rhizoctonia solani is generally considered to be the cause of greater losses of cotton seedlings than any other pathogen when likelihood of infection by the anthracnose fungus is eliminated by seed treatment. This is largely due to its widespread geographical distribution and the severity of the sporadic losses of stand which occur when conditions are favorable for seedling infection. The fact that seed treatments are only partially effective in preventing seedling infection by R. solani (38) is one of the reasons for the intensive study of its parasitism on the seedlings. It was described by Atkinson in 1892 (11) as a pathogen which causes damping-off of cotton. A study of the temperature relations of its parasitism on cotton was made by Walker (60), who also reviewed the pertinent, available literature.

As indicated in Table 1, three isolates from cotton seedlings were used in these tests. In the preliminary tests, three additional isolates were found to be equally pathogenic at 24°C. They were supplied by W. W. Ray, who isolated them from snap bean (Idaho), soybean (Oklahoma), and cotton boll (Oklahoma). Culture No. 23, Table 1, invariably formed basidiospores when infected seedlings were plated on non-nutrient agar. The length of sterigmata approximated that described for flax strains (26 microns) by Vanterpool (58). Basidiospores were not found on seedlings from cultures inoculated with the other two isolates. All isolates tested were similar in cultural characteristics to type A of Houston (31).

Table 9. Percent seedling emergence for seeds inoculated with Rhizoctonia solani and cultured at the temperatures indicated, and also the number of surviving seedlings per 100 seeds after 14 and 21 days of culture.

	Temperature 0°C						
Days	18	21	24	27	30	33	36
Percent seedling emergence							
21	25	5	65	78	69	81	83
Surviving seedlings per 100 seeds							
14	0	0	5	13	30	49	86
21	0	0	0	0	16	19	86

This fungus was most destructive at 21°C, at which temperature only 5 seedlings emerged (Table 9); and lesions were visible on the hypocotyls when they emerged. All of these seedlings had died before the 14th day. At 18° it was only slightly less virulent, and after 11 days there were 25 percent emerged seedlings. None of these survived to the 14th day. At 24°, 27°, 30°, and 33°, the percentage of emergence varied from 65 to 81. The emerged seedlings, however, quickly succumbed to infection and after 14 days the number of seedlings was greatly reduced. At the several temperatures, 18°, 21°, 24°, 27°, 30°, and 33°, the first seedlings were killed after 11, 10, 7, 5, 6, and 6 days, respectively. At 30° and 33° after 21 days, the living seedlings were stunted and had small lesions which had destroyed most of the cortex over a small area below the soil surface; but they were then forming new roots below the lesion and would likely have survived. These were the only temperatures at which all infected seedlings were not killed.

The first symptom of infection of the hypocotyl was the appearance of a small, light brown or tan lesion on its base, which enlarged rapidly to girdle the hypocotyl. This was accompanied by a soft rot and disintegration of the cells in the affected area. Seedlings were killed within 48 hours of the appearance of the initial lesion. The cotyledons frequently did not wilt until the seedlings had damped-off. This fungus may also infect and kill the roots (9). This type of infection resulted in the stunting of the seedlings, as was evident in the 18° to 27°C range. After 11 days the seedlings in the inoculated cultures at 27° were only 1/3 as large as those in the check cultures.

The cortex of seedlings is sometimes infected above the soil level. In such cases conspicuous sunken, dark brown lesions with sharply delineated margins may be formed. Such lesions may enlarge and girdle the stem. This fungus may also infect the foliage of cotton plants (44).

Infection of the seedlings by this pathogen is generally described as being associated with relatively cool, rainy weather; but in this study it was still an active parasite at 30° and 33°C, which temperatures are close to and slightly above the optimum for growth of typical isolates (13). Walker (60) obtained comparable results with cotton seedlings in the 19° to 34.5° soil temperature range. Its virulence over a wide range of temperatures would seem to indicate that it should be almost impossible to obtain a stand of cotton seedlings in fields in which this fungus is well distributed, except that its parasitism in the field is greatly influenced by environmental factors other than temperature (13, 21, 33, 36, 51, 52, 55).

Thielaviopsis basicola

The three isolates of Thielaviopsis basicola used (Table 1) were obtained from two hosts, cotton and tobacco, and from three geographical locations, Mississippi, North Carolina, and Canada. Preliminary tests at 24°C showed no apparent differences in pathogenicity among them. Consequently, the three isolates were combined for the inoculation of the cultures on which the accompanying data are based.

Table 10. Percent emerged seedlings for seeds inoculated with Thielaviopsis basicola and cultured at the temperatures indicated; and also the day of culture on which the first seedling was killed by the fungus, and the number of living and normal seedlings per 100 seeds after 14 and 21 days of culture.

Temperature 0°C	Percent seedling emergence	Day on which first seedling was killed	Seedlings per 100 seeds after 14 days		21 days	
			Alive	Normal	Alive	Normal
18	64	18	64	23	27	0
21	85	10	49	0	31	0
24	88	14	87	2	52	0
27	92	18	92	3	55	0
30	95	14	95	3	55	2
33	92		92	92	92	92

This fungus infected the seedlings through a temperature range of 18° to 30°C (Table 10). After 14 days, the lowest percentage of surviving seedlings was at 21° (49 percent). The taproot, or hypocotyl, of essentially every seedling was infected through the range of 21° to 30°. The lesions appeared somewhat later at 18° than at 21°, but after 21 days practically all seedlings at this temperature were also infected. An unique feature of infection by this fungus was the sharp delineation of the temperature at which seedlings were infected. As indicated above, the fungus was a virulent parasite at 30°, yet at 33° no lesions were produced. This observation agrees with that of Johnson and Hartman (32), who found that the upper limit for infection of tobacco was below 32°. Most of the other pathogens used in this test showed a more gradual change in the percentage of infected seedlings as the temperature at which the plants were grown was raised.

In these studies the first evidence of infection was the falling over of the seedlings -- the hypocotyl bending sharply at the surface of the sand. The cotyledons of the prostrate seedlings generally remained unwilted for several days. Lesions appeared initially on the proximal portion of the taproot immediately adjacent to the original position of the seed, and such lesions constituted most of those that were present on the seedlings after 14 days. Necrosis of the hypocotyl became evident only after the cortex of the taproot was well blackened and necrotic. The failure of the prostrate seedlings to wilt appeared to be associated with the decay of the cortex before the stele was seriously affected. Frequently, the cortex of the proximal part of the taproot was completely rotted and sloughed off; yet the stele was normal in color and the seedling was unwilted and was making some growth. Death of the seedlings was usually associated with discoloration of the stele. If this did not occur before the seedlings reached a certain size -- equivalent to growth for 3 weeks at 27°C -- the seedlings formed new roots both above and below the lesion and seemed capable of forming normal plants. These observations are somewhat at variance with those reported for older plants by King and Presley (34), whose description of the disease would indicate that the stele is blackened before there is extensive damage to other tissues.

After 3 weeks at 18°, 21°, and 24°C, it was still uncertain as to what percentage of the surviving seedlings would have been able to make further growth. The tops were mostly prostrate, but the cotyledons had not wilted. If these seedlings had recovered, they might have remained stunted as suggested by Blank (14). In contrast to the severe injury to the seedlings in these tests after 21 days at 18° to 30°, Blank (14) states that the first above-the-ground symptoms appeared after 4 to 5 weeks of culture. Whether or not the difference in the time required for the symptoms of infection to appear in these two studies is explicable on the basis of a difference between the varieties of cotton or the techniques used is uncertain.

One of the characteristic features of infection by this fungus was an evident stunting of plants long before they became prostrate or before lesions were apparent on the hypocotyl above the surface of the soil. Weights of the surviving seedlings were recorded for the several temperatures after 21 days; at this time the mean seedling weights in the inoculated cultures relative to the controls were: 18°C, 90 percent; 24°, 75 percent; and 27°, 84 percent. At 30° there was no evident stunting and about 50 percent of the surviving plants were forming abundant secondary roots. This fungus did not produce lesions on the cotyledons.

As indicated by previous papers (14, 34), this fungus has rarely been reported as a cause of seedling losses in cotton. It is not listed as a fungus infecting cotton seedlings in the Southeast (50, 62), nor has it been isolated by the writer. The high pathogenicity herein reported and the effects noted previously (14, 34) indicate that it may be a destructive pathogen when present in the soil. Thus, these data would seem to indicate that cotton plants would be likely to be infected by this fungus if grown in a field in which black root-rot of tobacco had been prevalent.

Verticillium albo-atrum

Since Presley (48) discussed the distribution of the Verticillium wilt of cotton, there has been one report of a seasonal, but widespread occurrence of this disease in North Carolina (39). Presley (48) states that seedling infection by Verticillium albo-atrum results in yellowish cotyledons, desiccation, and usually the death of the seedling. Otherwise, there is little in the literature to indicate that this fungus may be the cause of a disease of cotton seedlings.

Three isolates from cotton (Table 1) were used in the tests. The germination percentages in the inoculated cultures were the same as in the checks. No seedlings showed infection at any temperature after 14 days. After 21 days at 24°C and at higher temperatures, there were no lesions on the hypocotyls or roots, while at 18° and 21° there were small black lesions, 1 to 3 mm in diameter, on 6 percent and 2 percent respectively of the hypocotyls. No fungi were obtained when these hypocotyls were surface sterilized and plated.

Since the parasitism of the fungus on the cotton plant is well substantiated, other cultures were inoculated with the same three isolates and grown in a glasshouse with a maximal daily range in temperature of 15° to 28°C. The first wilted seedlings were observed after 24 days in cultures that had been adjusted to pH 7.5 by the addition of $CaCO_3$. Yellowish-brown areas, 1 to 3 mm in diameter, were present on the hypocotyls of the wilted seedlings. The adjacent stele was discolored for 1 to 2 cm beyond the lesion. The fungus was recovered from these hypocotyls. No infection was observed in the more acid cultures. These observations indicate that a somewhat longer culture period than 21 days is needed to produce appreciable injury to the seedlings, and also that the parasitism of this fungus, as previously reported (24), is greatly influenced by soil conditions.

Xanthomonas malvacearum

Xanthomonas malvacearum is recognized as a common cause of seedling blight on susceptible varieties of cotton (23, 42, 53) when seed either infested and/or infected by this bacterium are planted. Massey (42) has indicated a temperature range for severe infection of 21° to 28°C, with no infection at 28° and higher.

Two cultures (Table 1), derived from infected plants in Texas and Oklahoma, were used in the study. Cultures on raisin-oats agar were used to make bacterial suspensions in which the seed were immersed for 4 hours. No infection was obtained when seed of the Stoneville-2B and Coker-100W varieties were thus inoculated. A lot of seed of the susceptible variety Acala was then obtained and used for the studies reported here. In preliminary tests, the lesions produced were confined to the cotyledons. No hypocotyls were infected. Consequently, an attempt was made to maintain the cotyledons at a given temperature. To accomplish this the air temperature was lowered immediately after cotyledonary emergence so that the cotyledons would be subjected to the same temperature as before emergence. As indicated previously, this involved reducing the air temperature from 37.5° to 36°C at the highest temperature, from 18.5° to 18° at the lowest temperature, and intermediate amounts at the other temperatures.

Lesions were not produced on the hypocotyls at any of the temperatures. The first lesions on the cotyledons became evident in from 5 to 10 days at 21°C and higher temperatures (Table 11). No lesions were produced at 18°. The number of cotyledons with lesions was less at 21° than through the higher temperature range of 24° to 36°, and there was little difference after 14 days in the number of lesions and the severity of the injury to the cotyledons in this temperature range. At 36°, the lesions were mostly confined to the margin of the cotyledons.

Table 11. Percent seedling emergence for Acala cotton seed inoculated with Xanthomonas malvacearum and cultured at the temperatures indicated; and also the day of culture on which lesions were first observed on the cotyledons, and the number of seedlings per 100 seeds on which cotyledonary lesions were present after 14 days of culture.

Temperature 0°C	Percent seedling emergence	Days of culture to appearance of first lesion	Seedlings per 100 seeds with cotyledonary lesions on 14th day of culture
18	63	0	0
21	86	10	25
24	86	8	44
27	84	7	43
30	81	5	36
33	76	5	33
36	83	6	50

Except at 30° and 33°C after 14 days, there was no further increase in the number of lesions and little increase in the degree of injury to the cotyledons. At 30° the cotyledons of 26 of the seedlings (100-seed basis) that did not have infected cotyledons after 14 days had extensive cotyledonary lesions after 21 days. The corresponding number at 33° was 20. Consequently, the total numbers of seedlings with infected cotyledons at these two temperatures after 21 days were 62 and 53, respectively. In view of the conditions necessary for infection (64), there is no certain explanation for the increase in the number of lesions after 14 days.

After 21 days, the stunting effect of cotyledonary infection was more noticeable in the 24° to 33°C range than at 21° and 36°. At 33°, the mean weight of the seedlings in the inoculated cultures was only 77 percent of the weight of seedlings in the uninoculated cultures. At 30° the stunting was only slightly less, and the relative weight of the seedlings in the inoculated cultures was 83 percent. At this temperature, the lesions were slightly more numerous than at 33°, but the lesions tended to be somewhat smaller. At 21° there was no evident stunting and the largest lesions were not greater than 2 mm in diameter. Through the range 24° to 33°, some cotyledons were completely destroyed. It is rather difficult to reconcile these results with Massey's statement (42) to the effect that little infection is to be expected above 28°C.

It should be evident from the small effect that infection of cotton seedling cotyledons by X. malvacearum does not result in typical damping-off. Under certain conditions, however, the injury to cotyledons can be sufficiently severe to stunt and to retard the growth of seedlings, and thus predispose seedlings to infection and injury by the more virulent soil-inhabiting pathogens.

DISCUSSION

The first protective structure of the taproot and lower hypocotyl, the epidermis, is not highly effective as a barrier to infection by fungi. This epidermal barrier becomes ineffective when the epidermis and cortex are ruptured by the development of a sub-endodermal cambium and periderm in the initiation of secondary growth and by the development of secondary roots.

The periderm develops irregularly, and it may not form a complete, protective cylinder for some time after the cortex is ruptured. It is at this phase of development that the hypocotyl is especially susceptible to invasion by pathogens and nematodes; and any environmental condition which delays the formation of a complete periderm greatly predisposes the seedling to infection by fungi and invasion by nematodes. Consequently, this is a very critical period in the life cycle of the cotton seedling; and its survival and future normal growth are often dependent on the rapid development of a complete periderm after the epidermis has been ruptured. The cortex, after initiation of secondary growth, assumes a yellow to yellowish-brown color which closely simulates the color of the lesions produced by certain fungi. Fusarium spp., bacteria, and nematodes are usually present in the cells of the cortex at this time. After the periderm has become well developed, usually in 2 to 4 weeks, the hypocotyl region is no longer susceptible to infection by some pathogens. This applies especially to Colletotrichum gossypii and Pythium ultimum, and to a lesser degree to Rhizoctonia solani.

Table 12. The pathogens infecting cotton seedlings, the temperature range through which they infect seedlings, and primary source of inoculum.

Pathogen	Temperature range (°C)		Primary source of inoculum in field
	For infection	For severe damage	
Ascochyta gossypii	18°-27°	18°-27°	Seed, hosts other than cotton
Botryodiplodia phaseoli	18°-36°	36°	Soil[a]
Colletotrichum gossypii	18°-33°	18°-33°	Seed, soil occasionally
Fusarium moniliforme	18°-36°	None	Seed and soil
F. oxysporum f. vasinfectum	18°-36°	18°-24°	Soil, seed rarely[b]
Pythium ultimum	18°-27°	18°-24°	Soil
Rhizoctonia solani	18°-33°	18°-33°	Soil, seed occasionally
Thielaviopsis basicola	18°-30°	18°-21°	Soil
Verticillium albo-atrum	18°-21°	?	Soil, seed rarely
Xanthomonas malvacearum	21°-36° [c]	24°-36° [c]	Seed and soil

[a] The term soil is used to include inoculum which may have survived on plants and plant debris on or in the soil.

[b] Elliott (19) has shown that this fungus may be carried in a small percentage of the seeds derived from infected plants. Other Fusarium spp. have been frequently isolated from cotton seeds. The writer, however, has germinated numerous seeds produced by severely wilted plants without finding a single seed that was infected by the wilt fungus.

[c] On cotyledons only.

In these studies most of the pathogens were destructive over a wider temperature range than they are ordinarily under field conditions (Table 12). The innoculum potential should probably be placed first among the factors that affected pathogenicity, since relatively large amounts of the mycelium of the pathogens were placed on the seeds. The soil moisture conditions and the relatively high humidity also should have been favorable for a high incidence of infection. In these tests the pathogen under study also had little competition with other fungi, since autoclaved sand was used as the culture medium. Under field conditions, there is competition among the numerous soil microorganisms, some of which are antagonists of the pathogens (1, 52, 63).

The mixed-isolate cultures of the several pathogens used in this study may also have extended the range of pathogenicity of a given species somewhat further than that which would have been obtained for a single isolate. However, the studies carried out initially with the separate isolates at several temperatures did not show significant differences in pathogenicity among the isolates of a given species. Since the primary objective of this study was to ascertain the range of temperature over which a given pathogen would infect cotton seedlings and to obtain information on the nature of lesions produced, the use of mixed cultures appears to have been the most convenient method of obtaining this information.

Since the data in Table 12 show that the pathogenicity of the pathogens must be influenced by soil temperature, a résumé of soil temperatures after the usual time that cotton seed is planted should indicate the manner in which these temperatures influence the incidence of the diseases of the cotton seedling. Soil temperatures taken in South Carolina over a period of years (16, Fig. 5) show that the maximum daily soil temperatures after cotton has been planted may frequently exceed 35°C on clear days. Temperatures as high as 42° have been recorded within 3 weeks after planting. On cloudy days and those with rainfall, soil temperatures are lower and approximate temperature of the air. Thus, for some days during rainy weather, the maximum daily temperature may not exceed 20° (16, Fig. 5, A). As soon as the soil loses its high moisture content the soil temperature at 5 cm may exceed that of the air temperature by 5° to 10°. Nearer the soil surface the temperatures must be even higher. Although these high temperatures may not kill the pathogens, they are undoubtedly high enough to inhibit their growth temporarily; and the capacity of the pathogens to injure the seedlings severely should be reduced in the following order as the temperature becomes higher: Verticillium albo-atrum, Thielaviopsis basicola, Fusarium oxysporum f. vasinfectum, Ascochyta gossypii, Colletotrichum gossypii, Rhizoctonia solani, Botryodiplodia phaseoli, and Xanthomonas malvacearum.

SUMMARY

Ascochyta gossypii is not known to be a frequent cause of the damping-off of cotton seedlings, regardless of its proven pathogenicity and the number of other hosts. However, infection of the cotyledons and leaves after seedling emergence may retard seedling growth and predispose the seedlings to infection and severe injury by soil-inhabiting pathogens. Infections of the hypocotyl at or below the soil level by this fungus in these tests resulted in the formation of reddish-brown to blackish lesions which enlarged rapidly to involve the entire circumference of the hypocotyl. Several days later the seedlings broke over at the soil level, but did not wilt until after several more days. The stele was not destroyed until after the cortex was well rotted. This fungus may infect and kill seedlings at 27°C and lower temperatures. Infection did not occur at 30°.

Botryodiplodia phaseoli was the only fungus tested which showed a high pathogenicity at 36°C. It was weakly parasitic at lower temperatures as compared with Colletotrichum gossypii and Rhizoctonia solani. At 30°, 33°, and 36°, when infection did occur, the fungus often invaded the internal tissues at the soil level and caused the collapse of the hypocotyl before there were external symptoms of infection. A small percentage of the cotyledons were also infected at these temperatures. In some instances, small dark lesions just below the surface of the soil enlarged to involve the entire cortex and stele. This fungus has been isolated only occasionally from diseased seedlings.

Colletotrichum gossypii -- The typical lesion that results from infection by this fungus is marked by the appearance on the base of the hypocotyl of a longitudinally elongated tan area, which becomes darker brown and forms a depressed area in the cortex. A distinguishing characteristic of the lesions produced by this fungus is that they enlarge more rapidly longitudinally than transversely. Consequently, one side of a hypocotyl may be rotted and its corresponding cotyledon wilted, while the opposite cotyledon remains turgid for several days longer. Cotyledons may be infected at 27°C and lower temperatures. These infections first result in small black spots which under appropriate temperature and humidity conditions may enlarge to involve the entire cotyledon. In contrast to most of the other pathogens studied, this fungus does not invade the taproot until after the hypocotyl has been severely injured.

Since this fungus is usually dispersed by mycelium carried in or on the seed (internally infected seed rarely form seedlings), the infection is generally uniform throughout the field when untreated infested seed are planted. Seedling losses are generally greatest on sandy soils. This is not related to the degree of infection, but to the rapidity with which the soils dry out after relatively high soil moisture has predisposed the seedlings to infection. The enlargement of lesions at the base of the hypocotyl may be inhibited by hot, dry weather. When this occurs, the seedlings may develop new secondary roots, frequently on the hypocotyl. Whether or not the seedling survives depends upon the capacity of the injured hypocotyl to supply sufficient water to the seedling until the new roots are developed. The hypocotyl is not susceptible to infection by this fungus after a continuous cylinder of periderm has been formed. This fungus killed the seedlings most quickly at 27° and 30°C, but there were few surviv-

ing seedlings in these studies in the range of 18° to 33°.

Fusarium moniliforme, when isolated from lesions on cotton hypocotyls, is usually associated with more aggressive parasites. The results reported indicate that it may produce lesions on a small percentage of cotyledons and hypocotyls at 18° to 24°C. It is also often the only fungus isolated from reddish-brown superficial cortical lesions below the soil surface at about the time that secondary growth is initiated. Probably the most striking feature of the results with F. moniliforme was the large proportion of the seedlings from which the fungus was recovered but which had no apparent lesions. Further study will be necessary to ascertain whether the fungus had penetrated beyond the cortex. All results with this species must be interpreted on the basis of its known variation in pathogenicity.

Fusarium oxysporum f. vasinfectum produced lesions on the hypocotyls of cotton seedlings through a temperature range of 18° to 33°C. Cotyledons were also infected. The lesions produced on the hypocotyl were not greatly different initially from those produced by Rhizoctonia solani, except that they enlarged less rapidly, tended to be confined to one side of the stem, and finally became blackish rather than reddish-brown. Only at 18° and 21° did these lesions become extensive enough to kill the seedlings; and after a 21-day period of culture at temperatures of 21° and higher, the number of seedlings from which the fungus was reisolated was much greater than the number with lesions. Other Fusarium species, as F. solani, may produce similar lesions on the hypocotyl. The Fusarium spp. were aggressive pathogens only at relatively low temperatures, 21° and lower. Thus, the temperature that is favorable for seedling infection by Fusarium oxysporum f. vasinfectum is lower than that which is favorable for the expression of wilt symptoms in older plants.

Pythium ultimum -- The lesions produced on the base of the hypocotyls and the roots of cotton seedlings by Pythium ultimum initially are not greatly different from those resulting from infection by Rhizoctonia solani. P. ultimum tends to initiate a soft, watery rot of the cortex of the roots and hypocotyl that remains light-brown in color until the lesion is invaded by other fungi. These lesions rarely assume the reddish-brown characteristic of older R. solani lesions. As with the latter fungus, the lesions tend to girdle the hypocotyl rather than to extend longitudinally. P. ultimum does not infect the aerial parts of the plant. Infection in the field is usually associated with several days of rainy weather, and the data given indicate that it is an aggressive parasite only at relatively low temperatures. The maximum temperature for infection is approximately 27°C.

The geographic distribution of the areas in which seedlings are infected is even more erratic than for R. solani. The areas are generally relatively small, and the disease has a tendency to appear each year in the same areas when they are planted to cotton. Thus, infection by this pathogen, because of its association with certain limited soil areas, causes much less extensive losses than R. solani.

Rhizoctonia solani -- In contrast to the usual uniform incidence throughout the field of the anthracnose disease, infection by this fungus is likely to be more severe in certain areas of a field, usually those with heavier soil or more poorly drained. All parts of the seedling may by infected -- root, hypocotyl, and cotyledon. Usually the initial infection occurs just below the level of the soil. Under favorable conditions for the fungus, the infected, light brown, water-soaked area will rapidly enlarge to encircle the hypocotyl and kill the seedling in 1 to 2 days. The enlargement of the lesion may be stopped quickly by dry, warm weather, If infection of the cortex occurs after secondary growth has been initiated, the lesions are generally confined to the cortex. In these instances, a reddish-brown to dark-brown sunken area is produced. R. solani killed most of the seedlings through the range of 18° to 33°. No seedlings were infected at 36°C.

Thielaviopsis basicola -- The initial lesions that are produced by this fungus enlarge more slowly than those produced by Colletotrichum gossypii, Rhizoctonia solani, or Pythium ultimum. Roots and hypocotyls are about equally susceptible, although in these studies the lesions first appeared on the upper portion of the taproot. The cortex may be completely destroyed before the stele is sufficiently affected to result in wilting of the seedling. The blackish color of the lesions produced by this fungus is another diagnostic feature. The writer has not observed this fungus as a cause of the damping-off of cotton seedlings in the field. This fungus was an active parasite through the range 18° to 30°C; no seedlings were infected at 33°.

Verticillium albo-atrum -- Although this fungus is a well known parasite of the cotton plant, the three isolates of the fungus used in this study did not produce lesions on the seedlings at 24°C and higher temperatures; and at lower temperatures produced small lesions on only a small percentage of the seedlings. Infection did occur and wilted seedlings were obtained when cultures adjusted to pH 7.5 were grown in a greenhouse for 24 days. Small black lesions on the surface of the hypocotyls were associated with a more extensive discoloration of the stele.

Xanthomonas malvacearum did not infect the hypocotyls, but it did produce lesions on the cotyledons of susceptible varieties of cotton at 21° to 36°C. The lesions were somewhat more extensive in the 24° to 33° range than at 21° and 36°, although they were slightly more numerous at 36° than at the lower temperatures. Although this bacterium may not be a direct cause of damping-off, the lesions which it produces may retard the development of the seedlings; and thus may predispose the seedlings to infection by pathogens which may cause seedling losses.

Literature Cited

1. ALLEN, M.C., and C.M.HAENSELER. 1935. Antagonistic action of Trichoderma on Rhizoctonia and other soil fungi. Phytopathology 25: 244-252.
2. ARMSTRONG, G.M. 1938. Ascochyta blight on cotton in South Carolina. Plant Dis. Reptr. 22: 324-325.
3. ARMSTRONG, G.M., and J.K. ARMSTRONG, 1948. Nonsusceptible hosts as carriers of wilt Fusaria. Phytopathology 38: 808-826.
4. ARNDT, C.H. 1943. Pythium ultimum and the damping-off of cotton seedlings. Phytopathology 33: 607-611.
5. ARNDT, C.H. 1944. Infection of cotton seedlings by Colletotrichum gossypii as affected by temperature. Phytopathology 34: 861-869.
6. ARNDT, C.H. 1945. Temperature-growth relations of the roots and hypocotyls of cotton seedlings. Plant Physiol. 20: 200-220.
7. ARNDT, C.H. 1945. Viability and infection of light and heavy cotton seeds. Phytopathology 35: 747-753.
8. ARNDT, C.H. 1948. An evaluation of certain substituted phenol esters for the treatment of cotton seed. Phytopathology 38: 978-987.
9. ARNDT, C.H. 1953. Evaluation of fungicides as protectants of cotton seedlings from infection by Rhizoctonia solani. Plant Dis.Reptr. 37: 397-400.
10. ARNDT, C.H. 1956. Cotton seed produced in South Carolina in 1954 and 1955, its viability and infestation by fungi. Plant Dis. Reptr. 40: 1001-1004.
11. ATKINSON, G.F. 1892. Some disease of cotton. Alabama Agr. Expt. Sta. Bul. 164.
12. BARRE, H.W. 1912. Cotton anthracnose. South Carolina Agr. Expt. Sta. Bul. 164.
13. BEACH, W.S. 1949. The effects of excess solutes, temperature, and moisture upon damping-off. Pennsylvania Agr. Expt. Sta. Bul. 509.
14. BLANK, L.M. 1953. Observations on black root rot symptoms on cotton seedlings at different soil temperatures. Plant Dis. Reptr. 37: 473-476.
15. CLAYTON, E.E. 1923. The relation of soil moisture to the Fusarium wilt of the tomato. Amer. Jour. Bot. 10: 133-147.
16. COMMITTEE on cotton seedling diseases of the cotton disease council. 1950. Cotton seed treatment: its effect on seedling emergence, seedling survival, plant stands,

and yields. U.S. Dept. Agr. Tech. Bul. 1025.

17. CROSSAN, D.F. 1953. Comparative studies on species of Ascochyta from okra, bean, and cotton in North Carolina. (Abst.) Phytopathology 43: 469.
18. EDGERTON, C.W. 1912. The rots of the cotton boll. Louisiana Agr. Expt. Sta. Bul. 137.
19. ELLIOTT, J.A. 1922. A new Ascochyta disease of cotton. Arkansas Agr. Expt. Sta. Bul. 178.
20. ELLIOTT, J.A. 1923. Cotton wilt, a seed-borne disease. Jour. Agr. Res. (U.S.) 23: 387-393.
21. ELMER, O.H. 1942. Effect of environment on the prevalence of soil-borne Rhizoctonia. Phytopathology 32: 972-977.
22. FAHMY, T. 1927. The Fusarium disease (wilt) of cotton and its control. Phytopathology 17: 749-767.
23. FAULWETTER, R.C. 1919. The angular leaf spot of cotton. South Carolina Agr. Expt. Sta. Bul. 198.
24. GARRETT, S.O. 1944. Root disease fungi. Chronica Botanica, Waltham, Mass.
25. HALPIN, J.E., E.W. HANSON, and J.G. DICKSON. 1952. Studies on the pathogenicity of seven species of Pythium on red clover seedlings. Phytopathology 42: 245-249.
26. HARROLD, T.J. 1943. Histological studies of infections of the cotton hypocotyl by Glomerella gossypii and Fusarium moniliforme. Phytopathology 33: 666-673.
27. HARTER, L.L., and W.A. WHITNEY. 1927. Mottle necrosis of sweet potatoes. Jour. Agr. Res. (U.S.) 34: 893-914.
28. HAWKINS, B.S., and B.B. HIGGINS. 1949. Verticillium wilt of cotton found in Georgia. Plant Dis. Reptr. 33: 77-78.
29. HIGGINS, B.B. 1947. Outbreak of Ascochyta canker of cotton in Georgia. Plant Dis. Reptr. 31: 299-300.
30. HOLDEMAN, Q.L., and T.W. GRAHAM. 1952. Ascochyta leaf spot in tobacco plant beds in South Carolina. Plant Dis. Reptr. 36: 8.
31. HOUSTON, B.R. 1945. Culture types and pathogenicity of isolates of Corticium solani. Phytopathology 35: 371-393.
32. JOHNSON, J., and R.E. HARTMAN. 1919. Influence of soil environment on the root-rot of tobacco. Jour. Agr. Res. (U.S.) 17: 41-86.
33. KENDRICK, J.B., JR. 1951. The influence of temperature upon the incidence of Rhizoctonia root rot of Lima beans. (Abst.) Phytopathology 41: 20.
34. KING, C.J., and J.T. PRESLEY. 1942. A root rot of cotton caused by Thielaviopsis basicola. Phytopathology 32: 752-761.
35. KOTOWSKI, F. 1927. Temperature relations to germination of vegetable seed. Amer. Soc. Hort. Sci. Proc. 23: 176-184.
36. LEACH, L.D. 1947. Growth rates of host and pathogen as factors determining the severity of pre-emergence damping-off. Jour. Agr. Res. (U.S.) 75: 161-181.
37. LEHMAN, S.G. 1925. Studies on treatment of cotton seed. North Carolina Agr. Expt. Sta. Tech. Bul. 26.
38. LEHMAN, S.G. 1940. Cotton seed dusting in relation to control of seedling infection by Rhizoctonia in the soil. Phytopathology 30: 847-853.
39. LEHMAN, S.G., and HOWARD GARRISS. 1948. Verticillium wilt of cotton discovered in North Carolina. Plant Dis. Reptr. 32: 88-91.

40. LEONIAN, L.H. 1932. The pathogenicity and variability of Fusarium moniliforme from corn. West Virginia Agr. Expt. Sta. Bul. 248.
41. LUDWIG, C.A. 1925. Studies with an anthracnose infection in cotton seed. South Carolina Agr. Expt. Sta. Bul. 222.
42. MASSEY, R.E. 1927. On the relation of soil temperature to angular leaf-spot of cotton. Ann. Bot. 41: 497-507.
43. MILLER, J.H. 1947. An unusual disease of cotton in Georgia. Plant Dis. Reptr. 31: 300.
44. NEAL, D.C. 1944. Rhizoctonia leaf spot of cotton. Phytopathology 34: 599-602.
45. NEAL, D.C. 1927. Cotton wilt: A pathological and physiological investigation. Ann. Missouri Bot. Gard. 14: 359.
46. NORTON, D.C. 1953. Linear growth of Sclerotium bataticola through soil. Phytopathology 43: 633-636.
47. PORTER, D.R., and I.E. MELHUS. 1932. The pathogenicity of Fusarium niveum(EFS) and the development of wilt resistant strains of Citrullus vulgaris. Iowa Agr. Expt. Sta. Res. Bul. 149: 123-184.
48. PRESLEY, J.T. 1950. Verticillium wilt of cotton with particular emphasis on variation of the causal organism. Phytopathology 40: 497-511.
49. RAY, W.W. 1946. Cotton boll rots in Oklahoma. Oklahoma Agr. Expt. Sta. Bul. B-300.
50. RAY, W.W., and J.G. McLAUGHLIN. 1942. Isolation and infection tests with seed- and soil-borne cotton pathogens. Phytopathology 32: 233-238.
51. RICHARDS, B.L. 1923. Soil temperature as a factor affecting the pathogenicity of Corticium vagum on the pea and the bean. Jour. Agr. Res. (U.S.) 25: 431-449.
52. RICHARDSON, L.T. 1954. The persistence of thiram in soil and its relationship to the microbiological balance and damping-off control. Canadian Jour. Bot. 32: 335-346.
53. ROLFS, F.M. 1915. Angular leaf spot of cotton. South Carolina Agr. Expt. Sta. Bul. 184.
54. ROSEN, H.R. 1925. Fusarium vasinfectum and the damping-off of cotton seedlings. Phytopathology 15: 486-488.
55. SCHWEGMANN, J.C. 1953. Temperature-pathogenicity relationships in Rhizoctonia solani on cotton. Plant Dis. Reptr. 37: 178.
56. SMITH, A.L. 1950. Ascochyta seedling blight of cotton in Alabama in 1950. Plant Dis. Reptr. 34: 233.
57. THIRUMALACHAR, M.J. 1953. Pycnidial stage of charcoal rot inciting fungus with a discussion on its nomenclature. Phytopathology 43: 608-610.
58. VANTERPOOL, T.C. 1953. Corticium practicola and the Rhizoctonia solani problem. (Abst.) Phytopathology 43: 488.
59. VOORHEES, R.K. 1933. Gibberella moniliformis on corn. Phytopathology 23: 368.
60. WALKER, M.N. 1928. Soil temperature studies with cotton. III. Relation of soil temperature and soil moisture to the soreshin disease of cot-

ton. Florida Agr. Expt. Sta. Bul. 197: 343-371.

61. WEIMER, J. L. 1951. Ascochyta canker of blue lupine. Plant Dis. Reptr. 35: 81-82.
62. WEINDLING, R., P.R. MILLER, and A. J. ULLSTRUP. 1941. Fungi associated with diseases of cotton seedlings and bolls, with special consideration of Glomerella gossypii. Phytopathology 31: 158-167.
63. WEINDLING, R. 1946. Microbial antagonism and disease control. Soil Sci. 1: 23-30.
64. WEINDLING, R. 1948. Bacterial blight of cotton under conditions of artificial inoculation. U.S. Dept. Agr. Tech. Bul. 956.
65. WOODROOF, N.C. 1927. A disease of cotton roots produced by Fusarium moniliforme Sheld. Phytopathology 17: 227-238.
66. YOUNG, V.H. 1928. Relation of soil temperatures to the development of cotton wilt. Arkansas Agr. Expt. Sta. Bul. 226.

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PLANT DISEASE EPIDEMICS
and
IDENTIFICATION SECTION

AGRICULTURAL RESEARCH SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE

A FOREST DISEASE SURVEY OF ALASKA

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THE PLANT DISEASE REPORTER

PLANT DISEASE EPIDEMICS AND IDENTIFICATION SECTION

Crops Protection Research Branch Plant Industry Station, Beltsville, Maryland

A FOREST DISEASE SURVEY OF ALASKA

James W. Kimmey[1] and John A. Stevenson[2]

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In the summers of 1952 through 1954 an extensive forest disease survey was made throughout Alaska, and 250 fungus collections were made. The purpose of the survey was primarily to observe the general health of the native forest trees and to determine whether any epidemic disease conditions existed there. Much of the survey was by observations from the air, although brief observations were frequently made on the ground. As a part of the survey, the cull in commercially important forest trees was studied in Southeast Alaska[3].

This report is a brief summary of the general disease conditions found and a listing of the fungi collected during the survey.

GENERAL DISEASE CONDITIONS

No foreign or introduced diseases were found in the survey. No epidemic disease condition was found, but some of the native diseases were abundant and widespread.

Dwarfmistletoe, Arceuthobium campylopodum forma tsugensis, is abundant on western hemlock in Alaska. In dense young sapling stands the more heavily infected trees are so stunted that they are soon suppressed by their more vigorous neighbors. In old-growth hemlock stands the more heavily infected trees are so weakened that they eventually succumb to the infections, or they become easy prey for other disease-producing agents and insects.

The rust fungus Peridermium coloradense commonly causes large witches'-brooms in both white and black spruce throughout the range of these spruces in Alaska. The growth of infected trees is retarded, and many treetops and occasionally entire trees are killed by the disease.

General observations of conks and other indicators of cull give the impression that cull in Southeast Alaska forests becomes greater toward the northern limits of each tree's range. Detailed study of cull in Sitka spruce, western hemlock, and western redcedar substantiated these observations.

Fomes pinicola, which occurs almost entirely as a scavenger fungus on dead host plants in Oregon and Washington, is the principal cause of heartrot in living Sitka spruce and causes most of the brown rot in western hemlock in Alaska. One of the principal means of entrance for this fungus is through frost cracks in the bole of the trees. The prevalence of frost cracks increases in both spruce and hemlock toward the northern limits of their ranges. Also, the amount of cull caused by shake, which is often associated with frost cracks, becomes progressively greater toward the North.

Fomes pini, which causes the most common heartrot in Sitka spruce and western hemlock in the Pacific Northwest States and British Columbia, accounts for only 9 percent of the total cull in Sitka spruce and 1 percent of the total cull in western hemlock in Alaska[3]. The cull resulting from this fungus becomes less and less prevalent toward the northern and western limits of the ranges of these two host trees. However, at these limits F. pini is abundant in associated mountain hemlock and white spruce. Here mountain hemlock occurs at sea level and does

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3 Kimmey, James W. 1956. Cull factors for Sitka spruce, western hemlock, and western redcedar in Southeast Alaska. Alaska Forest Research Center, Station Paper No. 6. 31 pp., 24 illus.

not extend appreciably farther north. In contrast, white spruce extends much farther north, where F. pini remains as one of the more common fungi, if not the principal fungus, causing heartrot of the main bole.

Most white spruce stands are relatively young because of repeated forest fires in the Interior, and the percentage of cull is not great. Nevertheless, considerable loss occurs through windthrow of trees weakened by the common butt and root rot from the fungus Coniophora puteana. White spruce trees injured by fire are readily infected by Stereum sanguinolentum, which enters through dead areas on the tree boles, and windthrown trees soon deteriorate from the action of Fomes pinicola, Trametes heteromorpha, and other fungi.

In spite of the many large fires in the Interior, some stands of the short-lived birch reach an age when they are highly defective. The most common heartrot of birch, aspen, and willow is caused by Fomes igniarius. As the old birch stands break up, a large number of fungi cause decay of dead and down trees. One of the more conspicuous fungi found on dead birch is Polyporus betulinus.

FUNGI COLLECTED

During the course of the Alaska survey, specimens of forest fungi were collected at every opportunity. They were placed in a forest-fungus collection at the Forest Research Center at Juneau. Duplicate specimens were sent to Beltsville, Maryland, to be added to the National Fungus Collections there.

There follow lists for each of the various forest host plants showing each fungus collected, the nature of the decay or diseases it causes, and its general prevalence as determined from the survey. A supplementary list of fungi found growing on humus and soil and on plants other than trees is appended. Determinations of Thelephoraceae were made by Paul L. Lentz and of Poria by Dow V. Baxter.

ALNUS RUBRA Bong. -- RED ALDER

Fomes applanatus (Pers. ex S. F. Gray) Gill.
Causes a white rot of dead trees. Uncommon.

Kuehneomyces mutabilis (Fr.) Singer & A. H. Sm.
Causes a white rot of slash. Uncommon.

Polyporus versicolor L. ex Fr.
Causes a white spongy rot of dead wood. Common.

ALNUS SINUATA (Reg.) Rydb. -- SITKA ALDER

Hypoxylon fragiforme (Pers. ex Fr.) Petr.
Causes a white rot of dead stems. Common.

Peniophora sheari Burt
Causes a white rot of dead stems and branches. Common.

Polyporus albellus Pk.
Causes decay of dead stems. Only specimen found on Sitka alder.

Stereum gausapatum Fr.
Causes a white rot of dead stems. Common.

Stereum purpureum (Pers. ex Fr.) Fr.
Causes a white rot of dead stems. Common.

ALNUS TENUIFOLIA Nutt. -- THINLEAF ALDER

Fomes igniarius (L. ex Fr.) Kickx
Causes a white rot of the heartwood of living trees. Common.

Hericium laciniatum Leers ex Banker
Causes a white rot of logs. Uncommon.

<u>Hymenochaete</u> <u>tabacina</u> Lév.
Causes a white rot of dead trees. Uncommon.

<u>Polyporus</u> <u>radiatus</u> Sow. ex Fr.
Causes a white rot in old logs. Common.

<u>Steccherinum</u> <u>ochraceum</u> (Fr.) S. F. Gray
Causes white rot of sapwood in dead, down trees. Uncommon.

<u>Stereum</u> <u>hirsutum</u> (Willd. ex Fr.) S. F. Gray
Causes white rot of sapwood of dead trees and slash. Uncommon on thinleaf alder.

<u>Stereum</u> <u>purpureum</u> (Pers. ex Fr.) Fr.
Causes decay of logs. Uncommon on this host.

<u>Trametes</u> <u>mollis</u> (Sommerf.) Fr.
Causes white rot of sapwood in dead down trees. Uncommon.

BETULA GLANDULOSA Michx. -- RESIN BIRCH

<u>Melampsoridium</u> <u>betulinum</u> (Pers.) Kleb.
Causes rust on leaves of living plants. Found at only one location.

BETULA PAPYRIFERA Marsh. -- PAPER BIRCH

<u>Daedalea</u> <u>unicolor</u> Bull. ex Fr.
White rot of sapwood in dead trees and slash. Abundant.

<u>Daldinia</u> <u>occidentalis</u> Child
White rot of outer sapwood in fire-killed trees. Common in burns.

<u>Fomes</u> <u>applanatus</u> (Pers. ex S. F. Gray) Gill.
White rot in sapwood and heartwood of logs and stumps. Common.

<u>Fomes</u> <u>fomentarium</u> (L. ex Fr.) Kickx
White rot in heartwood of living trees, and both sapwood and heartwood of dead trees.

Common on dead trees. Uncommon in heartwood and rare in sapwood of living trees.

<u>Fomes</u> <u>igniarius</u> (L. ex Fr.) Kickx
White rot of heartwood. Principal decay of living birch in Alaska. Abundant.

<u>Hericium</u> <u>laciniatum</u> Leers ex Banker
White rot in wood of down dead trees. Uncommon.

<u>Lenzites</u> <u>betulina</u> L. ex Fr.
Causes a white rot in dead trees. Occasional.

<u>Panus</u> <u>rudis</u> Fr.
Causes decay of dead wood. Uncommon.

<u>Pholiota</u> <u>squarrosoides</u> Pk.
White rot of heartwood in living trees, and of sapwood and heartwood of dead and down trees. Uncommon.

<u>Pleurotus</u> <u>ostreatus</u> Fr.
White rot of heartwood in living trees. Uncommon.

<u>Polyporus</u> <u>albellus</u> Pk.
Causes a white rot of old logs, and slash. Uncommon.

Polyporus betulinus Bull. ex Fr.
Brown rot of dead sapwood. Abundant throughout the birch range in Alaska.

Polyporus dichrous Fr.
White rot in stump. Rare.

Polyporus hirsutus Wulf. ex Fr.
Causes a white rot of dead sapwood. Uncommon on this host.

Polyporus pargamenus Fr.
White rot in sapwood of logs. Rare on paper birch.

Polyporus resinosus Schrad. ex Fr.
Causes a white rot of heartwood in living trees.
Sporophores rare.

Polyporus versicolor L. ex Fr.
White rot of sapwood in dead down tree. Found at only one locaction.

Stereum hirsutum (Willd. ex Fr.) S. F. Gray
White rot of logs and slash. Common.

Stereum purpureum (Pers. ex Fr.) Fr.
White rot of sapwood in logs and slash. Common.

Trogia crispa Pers. ex Fr.
Causes a white rot of sapwood in logs. Occasional.

LARIX LARICINA (Du Roi) K. Koch -- TAMARACK

Durella sp.
Found on drouth-killed branches and tops as a secondary organism. Occasional.

Lenzites saepiaria Wulf. ex Fr.
Brown rot in sapwood and heartwood of dead standing trees. Common.

Polyporus abietinus Dicks. ex Fr.
White rot of sapwood in dead trees and logs. Common.

Trametes tenuis Karst. (Trametes setosus Weir)
Causes a brown rot in old logs. Uncommon.

PICEA GLAUCA (Moench) Voss -- WHITE SPRUCE

Chrysomyxa ledicola (Pk.) Lagh.
Causes a cast of current year's needles of living trees. At times causes serious retardation of growth, and occasionally kills small trees.
Widespread, and abundant in some areas.

Chrysomyxa pyrolae (DC.) Rostr.
A rust of new cones. Infected cones develop no seed. Occasional.

Coniophora puteana Schum. ex Fr.
Causes a brown cubical butt rot of living trees. Economically important because of extensive losses of mature trees through windthrow.
Common.

Fomes pini (Thore ex Fr.) Karst.
A white rot of heartwood in living trees. Probably the principal cause of volume loss through decay in white spruce.
Common.

Fomes pinicola (Sw. ex Fr.) Cke.
Produces a brown rot of sapwood and heartwood of dead trees and logs. Common.

Fomes roseus (Alb. & Schw. ex Fr.) Cke.
Causes a brown rot of heartwood in living and dead trees. Uncommon.

Lenzites saepiaria Wulf. ex Fr.
Produces a brown cubical rot of sapwood and heartwood of dead trees and slash. Most prevalent in drier locations.
Common.

Lophodermium filiforme Darker
Causes a cast of previous year's needles from living trees. Common.

Peridermium coloradense (Diet.) Arth. & Kern
A rust of needles and branchlets on living trees. Produces witches'-brooms, kills treetops, and occasionally entire trees.
Common to abundant throughout range of white spruce in Alaska.

Polyporus abietinus Dicks. ex Fr.
White rot of dead sapwood. Usually on logs and slash. Common.

Polyporus fibrillosus Karst.
Causes a brown rot of logs and dead down trees. Uncommon.

Polyporus pargamenus Fr.
Produces a white rot of sapwood in dead and down trees. Common on drier sites.

Polyporus tomentosus Fr.
Decays dead roots of stumps or snags. Rare.

Poria crustulina Bres.
White rot of dead sapwood. Rare.

Stereum sanguinolentum Fr.
Causes a white rot of dead sapwood on living or dead trees. Common.

Trametes heteromorpha (Fr.) Bres.
A brown rot of sapwood in down timber and slash. Common.

Trametes serialis Fr.
Causes a brown rot of heartwood in old logs on the ground.
Rot common, sporophores uncommon.

PICEA MARIANA (Mill.) B. S. P. -- BLACK SPRUCE

Chrysomyxa ledicola (Pk.) Lagh.
Causes cast of current year's needles from living trees. Retards tree growth but rarely kills trees.
Abundant.

Chrysomyxa pyrolae (DC.) Rostr.
A rust on new cones on living trees. Prevents seed development in affected cones.
Uncommon.

Lophodermium filiforme Darker
Causes cast of previous year's needles. Common.

Peridermium coloradense (Diet.) Arth. & Kern

Rust of needles and branchlets. Produces large witches'-brooms, kills treetops, and occasionally entire tree.

Common to abundant throughout the host range of black spruce in Alaska.

PICEA SITCHENSIS (Bong.) Carr. -- SITKA SPRUCE

Chrysomyxa ledicola (Pk.) Lagh.

Causes cast of current year's needles. Retards tree growth, and rarely kills small trees.

Abundant some years, common other years.

Chrysomyxa pyrolae (DC.) Rostr.

A rust on new cones. Prevents seed development. Uncommon.

Fomes applanatus (Pers. ex S. F. Gray) Gill.

Produces a white spongy rot of both sapwood and heartwood in down timber and old logs in moist places.

Uncommon on this host.

Fomes nigrolimitatus (Rom.) Egelund

Causes a white rot of heartwood in living trees, and both heartwood and sapwood of dead down trees.

Uncommon.

Fomes pini (Thore ex Fr.) Karst.

Produces a white rot of heartwood in living trees. One of the most important decays of Sitka spruce.

Common in southern end of Southeast Alaska, becoming progressively less common northward. Rare in this host at northern limits of the tree's range.

Fomes pinicola (Sw. ex Fr.) Cke.

A brown rot of heartwood in living trees, and both sapwood and heartwood of dead trees and slash. The principal cause of decay of both living and dead Sitka spruce in Alaska.

Abundant.

Ganoderma oregonense Murr.

Causes a white spongy rot in old logs in wet places. Uncommon.

Lenzites saepiaria Wulf. ex Fr.

Produces a brown rot of sapwood and heartwood of logs and slash in dry situations. Common.

Lophodermium filiforme Darker

Kills needles of previous two years. Common.

Lophodermium piceae (Fckl.) Hoehn.

Kills needles of upper crown in large trees, and needles of previous year in small trees. At times causes serious defoliation.

Common.

Paxillus panuoides Fr.

Causes a brown rot of sapwood and heartwood at base of dead trees. Rare.

Polyporus abietinus Dicks. ex Fr.

Produces a white rot of sapwood in dead trees, logs, and slash; and also of dead sapwood in living trees.

Common on drier sites.

Polyporus borealis Fr.

Causes extensive heartrot in old-growth living trees. Common.

Polyporus fibrillosus Karst.
A brown rot of sapwood in old logs. Occasional.

Polyporus schweinitzii Fr.
Causes a brown rot of heartwood in butts and roots of living trees. One of the important heartwood decayers in Sitka spruce.
Common.

Polyporus serialis Fr. f. alaskanus Baxter
Produces a white rot in the sapwood of old snags. Uncommon.

Polyporus sulphureus Bull. ex Fr.
Brown rot of heartwood, principally in the lower bole, of living trees. One of the more important heartrots in Sitka spruce.
Common.

Poria albobrunnea (Romell) Baxter
Brown rot in dead branch stub of large living trees. No cull in tree bole.
One specimen found.

Poria sitchensis Baxter
Produces a brown rot of sapwood in old logs and stumps. Uncommon.

Stereum sanguinolentum Fr.
Causes a white rot of dead sapwood in living trees and less frequently in sapwood of dead trees and logs.
Abundant.

Trametes heteromorpha (Fr.) Bres.
Produces a brown rot of logs and slash, and occasionally of heartwood in dead branch stubs of live trees.
Common.

POPULUS BALSAMIFERA L. -- BALSAM POPLAR

Eichleriella spinulosa (Berk. & Curt.) Burt
Causes a white rot of logs and slash. Common.

Polyporus pargamenus Fr.
Produces a white rot of logs and slash. Uncommon.

Trametes suaveolens (L. ex Fr.) Fr.
Produces a white rot in dead and down trees. Uncommon.

POPULUS TREMULOIDES Michx. -- QUAKING ASPEN

Cryptochaete (Corticium) polygonia (Fr.) Karst.
Produces a superficial sapwood rot in small dead trees. Common.

Fomes applanatus (Pers. ex S. F. Gray) Gill.
Causes a stringy white rot of sapwood and heartwood of old logs in wet places. Common.

Fomes igniarius (L. ex Fr.) Kickx
Causes a white rot of heartwood in living trees. Most common heartrot in quaking aspen.
Common.

Fomes tenuis Karst.
Produces a white rot in old logs. Common.

Lenzites betulina (L. ex Fr.) Fr.
White rot of old stumps. Common.

Melampsora albertensis Arth.
A rust on leaves of live trees. This is the alternate host for a rust on conifers.
Occasional.

Pleurotus ostreatus Jacq. ex Fr.
Causes a white rot of sapwood and heartwood of both dead and living trees. Abundant in some locations.

Polyporus adustus Willd. ex Fr.
Causes a white rot in dead trees and slash. Uncommon.

Polyporus albellus Pk.
A white rot in old logs. Uncommon.

Polyporus hirsutus Wulf. ex Fr.
Produces a white rot of dead trees and slash. Uncommon.

Polyporus pargamenus Fr.
Causes a white rot in logs. Uncommon.

Polyporus pubescens Schum. ex Fr.
Produces a white rot in logs. Rare.

Polyporus zonatus Fr.
Causes a white rot of dead sapwood and heartwood. Common.

Stereum hirsutum (Willd. ex Fr.) S. F. Gray
Causes a white rot of old logs. Common.

Stereum rufum Fr.
Causes a superficial rot of small dead trees. Common.

Trametes suaveolens (L. ex Fr.) Fr.
Produces a white rot in logs. Uncommon.

POPULUS TRICHOCARPA Torr. & Gray -- BLACK COTTONWOOD

Fomes applanatus (Pers. ex S. F. Gray) Gill.
Produces a white spongy rot in logs in wet places. Common.

Hericium laciniatum Leers ex Banker
Causes a white rot of dead sapwood and heartwood. Rare.

Polyporus picipes Fr.
Causes a white rot of sapwood in old logs. Rare.

Polyporus versicolor L. ex Fr.
White rot of logs and slash. Uncommon.

Stereum purpureum (Pers. ex Fr.) Fr.
Decays sapwood of dead trees. Uncommon.

Trametes variiformis Pk.
Decays old logs. Rare on black cottonwood.

SALIX ALAXENSIS (Anderss.) Cov. -- FELTLEAF WILLOW

Daedalea confragosa Bolt. ex Fr.
Causes a white rot of sapwood in dead standing trees. Uncommon.

Fomes igniarius (L. ex Fr.) Kickx
Produces a white rot of the heartwood of living trees. Probably the most

prevalent rot in living trees.
Common.

Hymenochaete tabacina Lév.
Produces a white rot in dead trees, logs, and slash. Common.

Melampsora ribesii-purpureae Kleb.
A rust on the underside of leaves of living trees. At times causes some defoliation. The alternate host plants are Ribes spp.
Common.

SALIX BEBBIANA var. PERROSTRATA (Rydb.) Schneid. -- BEBB WILLOW
Uncinula salicis (Merat) Wint.
Produces mildew on leaves of living trees. Common.

SALIX FUSCESCENS Anderson
Melampsora ribesii-purpureae Kleb.
Rust on leaves of living trees. Common.

SALIX PADOPHYLLA Rydb. -- SERVICEBERRY WILLOW
Melampsora ribesii-purpureae Kleb.
Forms rust spots on leaves of living host plants. Common.

SALIX SCOULERIANA Barratt -- SCOULER WILLOW
Melampsora ribesii-purpureae Kleb.
Rust spots on underside of leaves of living trees.

SALIX SP. -- WILLOW
Melampsora biglowii Thuem.
A rust on the leaves of living willows. The alternate stage occurs on the leaves of tamarack trees.
Common.

Uncinula salicis (Merat) Wint.
A powdery mildew of leaves on living host plants. At times kills new shoots on young plants.
Common.

THUJA PLICATA Donn -- WESTERN REDCEDAR
Polyporus cuneatus (Murr.) Zeller
Causes a white rot of sapwood in logs and windfalls with bark on. Found only in wet locations.
Uncommon.

Poria ferrugineofusca Karst.
Causes extensive white rot in the heartwood of living trees.
Rot abundant, sporophores rare.

TSUGA HETEROPHYLLA (Raf.) Sarg. -- WESTERN HEMLOCK
Fomes annosus (Fr.) Cke.
Causes a white rot and hollows in the heartwood of living trees. One of the more common heartrots of western hemlock, and the most common rot originating in old logging wounds.
Rot common. Sporophores rare.

Fomes applanatus (Pers. ex S. F. Gray) Gill.
Causes a white rot of the heartwood and sapwood of old logs and occasionally heartrot of living trees. Common.

Fomes pini (Thore ex Fr.) Karst.
Produces a white rot in the heartwood of living trees. One of the more

common heartrots in western hemlock in the southern end of Southeast Alaska, becoming less common farther north.

Common.

Fomes pinicola (Sw. ex Fr.) Cke.

A brown rot of heartwood in living trees, and heartwood and sapwood of dead trees and logs. Causes about 60 percent of the cull from brown rots in western hemlock in Alaska.

Abundant.

Fomes robustus Karst.

Causes a white rot in sapwood and heartwood of living trees. Kills the cambium in decayed areas, and occasionally entire trees. A common cause of wind-breakage in living trees.

Common.

Lenzites saepiaria Wulf. ex Fr.

Produces a brown rot in logs and slash in dry locations. Common.

Pholiota adiposa (Batsch. ex Fr.) Kummer

Causes a white rot of heartwood in living trees and sapwood and heartwood of dead trees and logs.

Rot common, sporophores rare.

Polyporus abietinus Dicks. ex Fr.

Produces a white rot of sapwood in limbs of dead and down trees. Uncommon.

Polyporus elegans Fr.

Causes a brown rot of sapwood in old logs. Rare.

Polyporus fibrillosus Karst.

Causes a brown rot in dead trees and slash. Common.

Polyporus resinosus Fr.

Causes a white rot of sapwood and heartwood in dead trees and old logs. Uncommon.

Polyporus schweinitzii Fr.

Produces a brown rot in the heartwood of the butts of living trees. One of the more common butt rots of western hemlock.

Common.

Polyporus sulphureus (Bull.) Fr.

Produces a brown rot in the heartwood of living trees. This heartrot occurs extensively in the butt and trunk of trees of western hemlock.

Common.

Poria subacida (Pk.) Sacc.

Causes a white rot in sapwood and heartwood of old snags. Uncommon.

Stereum sanguinolentum (Alb. & Schw. ex Fr.) Fr.

A white rot of sapwood in logs. Common.

Trametes heteromorpha (Fr.) Bres.

Produces a brown rot in logs and slash. Common.

Uraecium holwayi Arth. (Uredo holwayi Arth.)

Kills needles of young trees. Some years causes serious defoliation. Common.

TSUGA MERTENSIANA (Bong.) Carr. -- MOUNTAIN HEMLOCK

Fomes pini (Thore ex Fr.) Karst.

Produces a white rot in the heartwood of living trees. Probably the most common heartrot in mountain hemlock in Alaska.

Fomes pinicola (Sw. ex Fr.) Cke.

A brown rot of sapwood and heartwood in dead trees, and logs. Probably occurs as a heartrot in living trees. Common.

Fomes robustus Karst.

Causes a white rot of heartwood and sapwood of living trees. May kill trees by killing cambium. One of the more common heartrots in mountain hemlock.

Polyporus resinosus Schrad. ex Fr.

Causes a white rot of sapwood and heartwood in stumps and slash. Uncommon.

Poria crassa (Karst.) Sacc.

Produces a brown rot of sapwood and heartwood in old logs. Rare.

SUPPLEMENTARY LIST

DUFF -- Rotten wood, moss, and soil.

Cantharellus floccosus Schw.

Breaks down components of duff. Uncommon.

Polyporus cristatus Pers. ex Fr.

On ground at base of living western redcedar trees. Rare.

Polyporus perennis L. ex Fr.

Decay of duff components. Abundant.

EPILOBIUM ANGUSTIFOLIUM L.

Pucciniastrum pustulatum (Pers.) Diet.

Rust on leaves of living plants. Uncommon.

LEDUM PALUSTRE b. s. sp. groenlandicum (Retz.) Hulten

Chrysomyxa ledicola (Pk.) Lagh.

Alternate stage of a serious rust on spruces. On leaves of living plants. Causes defoliation. Abundant.

MENZIESIA FERRUGINEA J. E. Sm.

Melasmia menziesii Dearn. & Barth.

Causes a tar spot on leaves of living plants. Common.

PETASITES SAGITTATUS (Banks) Gray

Puccinia poarum Niels.

A rust on leaves of living plants. Abundant.

RIBES BRACTEOSUM Dougl.

Puccinia caricis grossulariata Arth.

A rust on leaves. Common.

RIBES TRISTE Pall.

Puccinia ribis DC.

A rust on leaves. Common.

ROSA ACICULARIS Lindl.

Phragmidium rosae-acicularis Liro
Causes defoliation of living plants. Common.

RUBUS IDAEUS L.
Phragmidium rubi-idaei (DC.) Karst.
Causes withering of leaves on cultivated raspberry bushes. Common.

RUBUS SPECTABILIS Pursh
Nidula candida (Pk.) White
Birds'-nest fungus on dead stems of salmonberry. Common.

Polyporus varius Pers. ex Fr.
Causes a white rot of dead stems. Rare.

CALIFORNIA FOREST AND RANGE EXPERIMENT STATION, FOREST SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE, IN COOPERATION WITH THE UNIVERSITY OF CALIFORNIA; AND CROPS PROTECTION RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE

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SOME NEW AND IMPORTANT PLANT DISEASE OCCURRENCES AND DEVELOPMENTS IN THE UNITED STATES IN 1956

Supplement 248 November 15, 1957

The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Plant Disease Epidemics and Identification Section serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

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Crops Protection Research Branch   Plant Industry Station, Beltsville, Maryland

SOME NEW AND IMPORTANT PLANT DISEASE OCCURRENCES AND DEVELOPMENTS IN THE UNITED STATES IN 1956

Compiled by Nellie W. Nance

Plant Disease Reporter
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This summary of some new and important plant disease occurrences and developments has been compiled for the most part from reports to the Mycology and Plant Disease Reporting Section and from articles in Phytopathology. Reports listed in the tables are not usually noted again in the text.

In general drought and below normal temperatures were responsible for reduced prevalence of diseases in 1956. The persistence of below-normal temperature in the Great Lakes and Northeast was considered the outstanding feature of the spring season. Crop damage from record-low May temperatures in the Northeast was estimated at millions of dollars.

WEATHER OF 1956. General Summary. - - Subnormal precipitation which prolonged and intensified the drought in the central and lower Great Plains and Far Southwest to disastrous proportions was the greatest weather news item of 1956. Of far greater importance to the Nation, however, was the combination of weather conditions in most of the remainder of the country, particularly east of the Mississippi River, which favored one of the highest total crop productions on record.

Other major weather highlights of the year included heavy snowfall in the central and northern mountains of the Far West which helped furnish ample irrigation water during the growing season, a cold, wet spring in the northeastern quarter of the Nation which threw agricultural activities 2 or 3 weeks behind schedule, a cool summer and fall in the Great Basin of the Far West, a cold winter in the northern Great Plains, subnormal rainfall in Florida and adjacent areas of adjoining states, and an unusually warm December east of the Continental Divide.

Total storm losses were less than in recent years due mainly to relatively light hurricane damage, although a near-record outbreak of tornadoes caused heavy property losses and frequent hail caused heavy crop losses in north-central areas.

TEMPERATURE. - - Temperatures for the year averaged below normal in the Florida Peninsula, New Jersey, New York, New England, from the upper half of Michigan through the Dakotas, in most sections of the Pacific States, most of Idaho, western Wyoming and northwestern Colorado; but departures were small, exceeding 1° only at a few scattered northern stations. In the remainder of the country averages were above normal with greatest departures occurring in the lower Great Plains where they exceeded 2° at a few stations.

The January temperature pattern showed well above-normal values west of the Continental Divide with greatest departures from normal centered over the lower Rocky Mountain region where the warmest January in nearly 100 years occurred at Tucson, Ariz. The month was also unusually warm in the extreme Northeast and a little warmer than normal in the Great Lakes region, but in other areas east of the Continental Divide temperatures averaged below normal with greatest departures in the extreme Southeast where Miami, Fla., experienced its second coldest January on record. The pattern was reversed in February -- very cold in the western two-thirds of the country and unusually mild in the eastern third. The year's coldest weather occurred in the northern Rockies on February 1-3, when West Yellowstone, Mont., recorded the year's lowest temperature, -52°, on the 1st and a freeze in Arizona caused some crop damage. Average temperatures for the winter of 1956-1957, however, showed no unusual departures from normal.

Spring (March-April-May) temperature averages were relatively high in the lower Great Plains, abnormally low from the Dakotas eastward and near normal elsewhere. The persistence of below-normal temperatures in the Great Lakes and Northeast may be considered the outstanding temperature feature of the season. March freezes were responsible for crop damage locally in western Colorado and from Texas to the Atlantic coast. April freezes damaged some fruit in Idaho and western Colorado on the 6th and in the Middle Atlantic States and Southeast during the third decade. Crop damage from record-low May temperatures in the Northeast was estimated at millions of dollars, far exceeding the total losses for both March and April. Many stations in the lower great Plains reported their warmest May on record for another temperature feature of the month.

The summer was unusually warm in the Great Plains with temperatures averaging 2° or more above normal in large areas from South Dakota southward through Texas. Above-normal temperatures were unusually persistent in the lower Great Plains, particularly Oklahoma and Texas, where temperatures remained almost continuously above normal except during a sharp, cool snap from August 19 through the 23d. In the upper Great Plains summer temperatures averaged above normal only because of an unusually hot June, as both July and August were relatively cool. The summer was also 2° or more warmer than normal along the California coast. Notable hot periods occurred in the northern Plains from June 8 to 13, and in the lower Great Plains and lower Mississippi Valley during the first half of August. During the latter period maximum temperatures at Shreveport, La., equaled or exceeded 100° on 15 consecutive days (Aug. 4-18), a new record there.

The summer was abnormally cool in the upper Great Lakes region and Northeast, and in most of the area west of the Rocky Mountains, particularly the Great Basin. In the Northeast June was about normal or a little above, while July and August were both unusually cool, particularly July which was 4° or more cooler than normal in some areas. The water temperature in Lake Erie at Buffalo, N. Y., averaged 66°, the lowest in 29 years of record. The year's highest temperature, 125°, was recorded at Cow Creek, Calif., on June 25.

Fall (September-October-November) was unusually warm in the Great Plains but was on the cool side in the East and Pacific Northwest. September average temperatures were above normal in the lower Great Plains and Far West and below in the northern Great Plains and East. This pattern was reversed in October except that departures were rather high in the middle Mississippi Basin. November temperatures averaged well below normal except in California and along the Canadian Border east of the Continental Divide where they were a few degrees above. Temperatures in Florida averaged below normal for each of the 3 months. In the Northeast September 1956 was among the coldest on record and in the Far Southwest it was one of the warmest, with Prescott, Ariz., reporting the highest average temperature (72.3°) since 1865. October temperatures were featured by extreme warmth in the mid-Mississippi Valley where Peoria, Ill., experienced its second warmest October in the past 101 years. November temperatures were featured by one of the earliest freezes on record in the Far Southwest during the first few days of the month, followed by the next few days with record-breaking heat in the same region when a late-season high of 96° for San Diego, Calif., was recorded on the 9th.

December was somewhat on the cool side in the central Great Basin and on the Pacific coast above Santa Maria, Calif., but abnormally warm elsewhere. The month was unusually warm in the East where monthly departures ranged up to 10° and a number of stations reported the warmest December since 1889 and a number of others reported new December highs.

PRECIPITATION. - - The year's precipitation was above normal only in the Pacific Northwest, the eastern Dakotas and central Minnesota, the Appalachian region, parts of Alabama, and in scattered northern sections of the area east of the Appalachians. Precipitation was below normal in the remainder of the country. It was less than 50 percent of normal in central and western Texas, western Kansas, eastern New Mexico and in some sections of the Far Southwest, and less than 75 percent in nearly all of the Far Southwest, the central and lower Great Plains, Iowa, northern portions of Missouri and Illinois, and some sections of the central Rocky Mountain region.

In a large area extending from Iowa and northern portions of Illinois and Missouri into the Far Southwest many stations recorded their least annual precipitation totals on record. Some of these stations with long-term records and their 1956 annual totals with departures from normal are listed below:

Chicago, Ill.	22.23 inches	-10.49 inches
Des Moines, Iowa	17.07 "	-13.82 "
Concordia, Kansas	13.73 "	-11.67 "
Dodge City, Kansas	9.97 "	-10.61 "
Tulsa, Okla.	23.24 "	-14.44 "
Amarillo, Tex.	9.94 "	-11.18 "
Dallas, Tex.	21.75 "	-12.67 "
Del Rio, Tex.	4.34 "	-14.24 "
Roswell, N. Mex.	4.35 "	-7.72 "
Phoenix, Ariz.	2.82 "	-4.34 "
Yuma, Ariz.	0.30 "	-3.09 "

In Florida, where the year was also exceptionally dry, Tampa and Key West reported their driest year on record, 28.89 and 20.46 inches, respectively.

Drought threatened in several other sections outside of Florida and the main drought areas in midcountry and the Far Southwest in the course of the year, but failed to become serious due to timely rains.

Record-breaking rains in southern California during January caused damaging floods in the Los Angeles area. Heavy precipitation fell in the Pacific Northwest during both January and February and during the latter month frequent rains from Kentucky and Tennessee eastward accumulated to 9.74 inches at Greenville, S. C., for its wettest February on record.

The spring season was extremely dry in central and south-central Texas, in an area extending from the central Great Plains through the Far Southwest and in some sections of the northern Great Basin area and the Pacific Northwest. March, dry over most of the country, was extremely dry from the middle Mississippi Basin westward. Sacramento, Calif., recorded its lowest March total, 0.03 inch, in the past 107 years. Mid-April rains of 2 to 4 inches brought much relief from the prolonged dry spell in the Florida Peninsula and generous rains in California during both April and May were very beneficial in that state. Rain was needed badly in the State of Washington by the end of May.

During the summer season rainfall was seriously deficient in most of the southwestern quarter of the country and generally ample to abundant in the North and East. June rains brought relief from the dry spell in the State of Washington. Both July and August were extremely rainy and cloudy in northern areas east of the Great Plains; totals for both months set new records at a number of stations, and at Buffalo, N. Y., not one clear day occurred during the entire month of July. A notable rainfall occurred at Unionville, Md., on July 4 when 1.23 inches was recorded in 1 minute (3:23 p.m. - 3:24 p.m.) or less, setting a new world's record for rainfall intensity. The degree of instrumental accuracy in measuring such high rates of rainfall has never been fully determined; still, the above record exceeds all others by a considerable margin.

The fall season was extremely dry from the lower Great Lakes to the Far Southwest, and precipitation was generally below normal elsewhere except along the north Pacific coast and east of the Appalachians. In the latter area totals generally exceeded 8 inches and ranged up to more than 20 inches in the east Gulf coastal area, the major portion of which fell during the passage of hurricane Flossy, September 24-28. Most of the north Pacific coastal rains fell in October although generous amounts also fell west of the Cascades in November.

During December the only significant above-normal amounts fell in the Appalachian region, the Northeast and a few other small widely scattered areas. At the end of the year, although surface moisture conditions had been replenished in the southeastern Great Plains, drought continued in most of the large area from the lower Great Lakes to the Far Southwest. Drought also persisted in Florida where December was the driest on record in some sections.

DROUGHT. - - The 1956 drought in the central and lower Great Plains and Far Southwest, measured on the basis of subnormal rainfall, was the culmination of a series of dry years (50 to 75 percent of normal rainfall) which began in parts of the Far Southwest in the 1940's and spread into the Great Plains in 1952, and into parts of Iowa and Missouri in 1953. In 1954 the drought was greatly intensified in the central and lower Great Plains during one of the hottest and driest summers on record there. At the end of another dry year in 1955 both in the central and lower Great Plains and Far Southwest, ground water had fallen to record-low levels and water supplies in streams, lakes and storage reservoirs had become extremely low.

The first 3 months of 1956 were unusually dry. Rains brought some relief to the eastern portions of the drought area in April and to scattered sections in May and June. July rains brought further relief to the eastern Great Plains and some relief to other sections of the drought area except Texas and southeastern New Mexico; but in all sections, even where generous rains fell, benefits were of short duration due to dry, powdery surface soil and high temperatures. Extremely dry weather in the drought area continued through August, September and most of October.

The disastrous effects of the drought continued to mount throughout the growing season. Dryland crops were a total failure in many sections of the southwestern Great Plains and crop production was reduced greatly throughout the drought area. Particularly serious was the failure of pasture and feed crops which forced liquidation of livestock. A large number of counties were declared disaster areas and received Federal Aid. Thousands of farmers were without means of livelihood and sought work in cities. Businessmen in small towns, a large part of their sales being to farmers, were also hit hard. Water supplies in several large cities became a serious problem.

General rains in late October and early November and again in mid-December in the southeastern Great Plains brought renewed hopes for fall crops although subsoil moisture remained low and more rain was badly needed there at the end of the year.

SNOWFALL. - - During 1956 snowfall in the Cascade Mountains was outstanding. In January, February and March heavy falls boosted depths to near or above previous records, and at Paradise Ranger Station, Wash., the seasonal fall (July 1955 - June 1956) of 1,000.3 inches set a new record for the United States. The previous seasonal record fall was 884 inches at Tamarack, Calif., in 1906-07. Snowfall during the first 3 months was also very heavy in the Sierra Nevada and central and northern Rocky Mountains. These heavy snows helped furnish adequate irrigation water during the growing season. Snowfall was very light in the Far West during the closing months of the year and the mountain pack was much below normal.

The year's snowfall was also heavy in New York and New England and occurred unusually late in the spring and unusually early in the fall. Many stations reported twice their average annual amounts. The highest annual total in this area was 211.4 inches at Boonville, N. Y.

Outstanding snowstorms during the year occurred in the southwestern Plains on February 1-3 and in the Northeast on March 16-19.

DESTRUCTIVE STORMS. - - January's most destructive storms occurred on the 8th when glaze covered a large area of the Northeast causing damage estimated at $1,000,000 in Pennsylvania alone. The worst snowstorm in 50 years in sections of the southwestern Plains on February 1-3 paralyzed transportation, damaged power and communication lines, caused some loss of livestock, and on the 24th and 25th high winds caused severe duststorms in the Great Plains and millions of dollars property damage in the Northeast. On March 16-17 New England's worst late-season snowstorm in a generation paralyzed transportation and caused some damage to power and communication lines. Another snowstorm in central and upper New England on April 7-8 was described as the worst April snowstorm there in 23 years.

An outbreak of tornadoes in central areas on April 7-8 caused heavy damage in parts of Kansas, Tennessee, Wisconsin and Michigan, and on the 15th a very severe tornado hit the outskirts of Birmingham, Ala. Another outbreak of these storms occurred in Ohio and Michigan on May 12. On October 29 tornadoes took a heavy toll of farm property in Kansas and Nebraska. Tornadoes were reported in New England on November 21-22 during the passage of a cold front. In December these storms caused some damage in Missouri and Kansas on the 4th and additional damage estimated at many thousands of dollars in Alabama and Georgia during the night of the 22d-23d.

During the summer months numerous thunderstorms with damaging wind and hail occurred in the northcentral border region.

A glaze storm, one of the most destructive storms of the entire year, caused damage in Macoupin, Madison and Jersey Counties, Illinois, estimated at $50,000,000 on December 8, the worst such storm in west-central Illinois since 1924. In southern California high winds on December 24 - 28 were blamed for spreading brush fires which were responsible for losses estimated at many millions of dollars.

Flossy, the year's only hurricane to enter the United States mainland, on September 24-28, followed a path from the southeastern tip of Louisiana to extreme southeastern Virginia causing several millions of dollars damage; but she also brought beneficial moisture to a wide belt extending from the Gulf to southern New England. (From Climatological Data. National Summary, Annual 1956, Vol. 7. No. 13.

The maps on pages 106, 107, 108, 109, show the temperature and precipitation for the winter 1955-56, spring, summer and fall, of 1956.

GENERAL

K. Maramorosch collated and summarized the information accrued during the past 20 years concerning the transmission of plant viruses by insect vectors, the mechanism of their multiplication in the vector, in which they must be regarded as parasites, and the bearing of this upon the relationship between animal and plant viruses. (Bull. Torrey Bot. Club 83(3): 234-237).

Carlton F. Taylor described a device which records with high accuracy the starting time and the duration of dew deposits. Dew deposition on it is comparable to that on foliage under similar placement. This instrument has proved to be dependable and rugged under field conditions. Knowledge of the period during which dew is present on plants is of prime importance in studies on the epiphytology of plant diseases (PDR 40: 1025).

R. D. Schein and others have given directions for construction of a portable thermistor-equipped psychrometer, suitable for use in field study of atmospheric temperature and moisture in relation to disease development (PDR 40: 929).

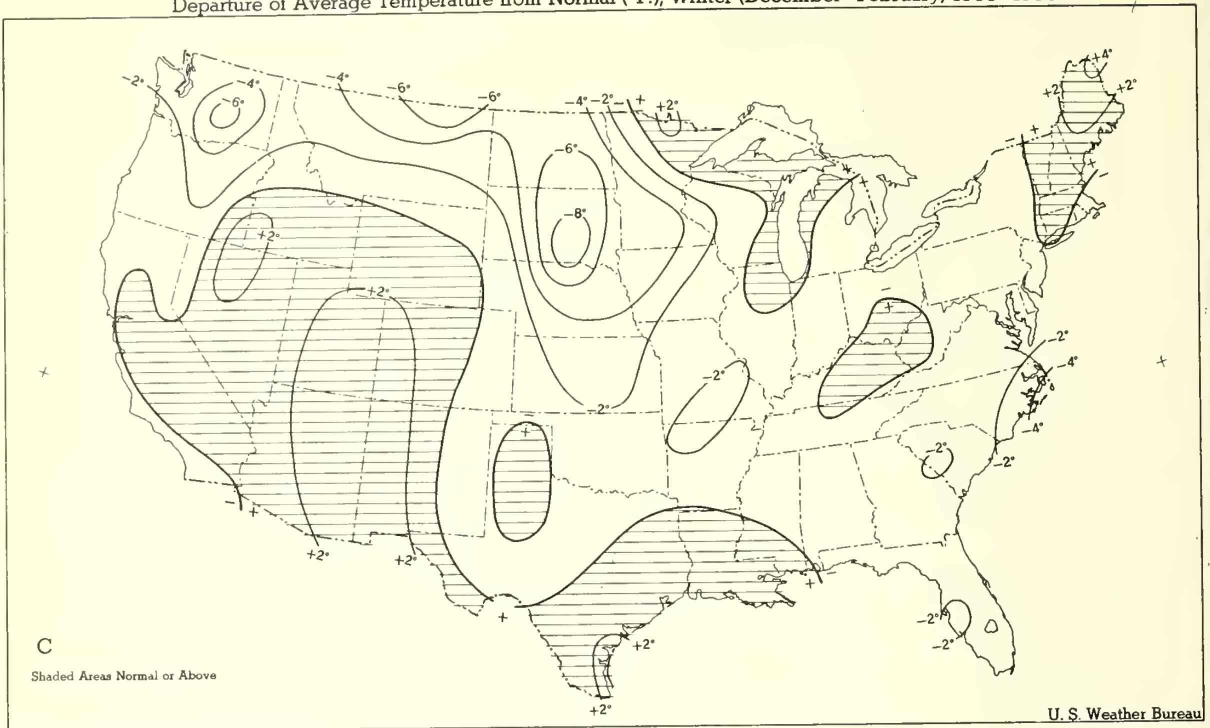
In California, a small, inexpensive, multipurpose unit for steaming soil has been developed and reported by Chester N. Roistacher and Kenneth F. Baker. Units of this type have been extensively and satisfactorily used over a 7-year period to free soil of a wide range of fungi, bacteria, nematodes and viruses (Phytopath. 46: 329).

In Ohio, Wm. Bridge Cooke reported fungi of interest to the plant pathologist isolated from polluted water and sewage. He pointed out that in these days of increased supplemental irrigation by use of sewage or polluted water the plant pathologist is presented with additional problems of disease control. Unfortunately, to control one fungus chemically may inhibit the work of many beneficial organisms, so that control measures necessary for irrigation waters should be applied to effluents rather than to influents of the sewage treatment plant. Adequate control of plant pathogens may also result in adequate control of human pathogens, so that a wider use could be made of sewage effluents than is being made today. (PDR 40: 681).

P. L. Leyendecker and R. M. Nakayama in reporting the 1956 plant disease summary for New Mexico stated that drought was responsible for reduced prevalence of diseases in that State (PDR 41: 53).

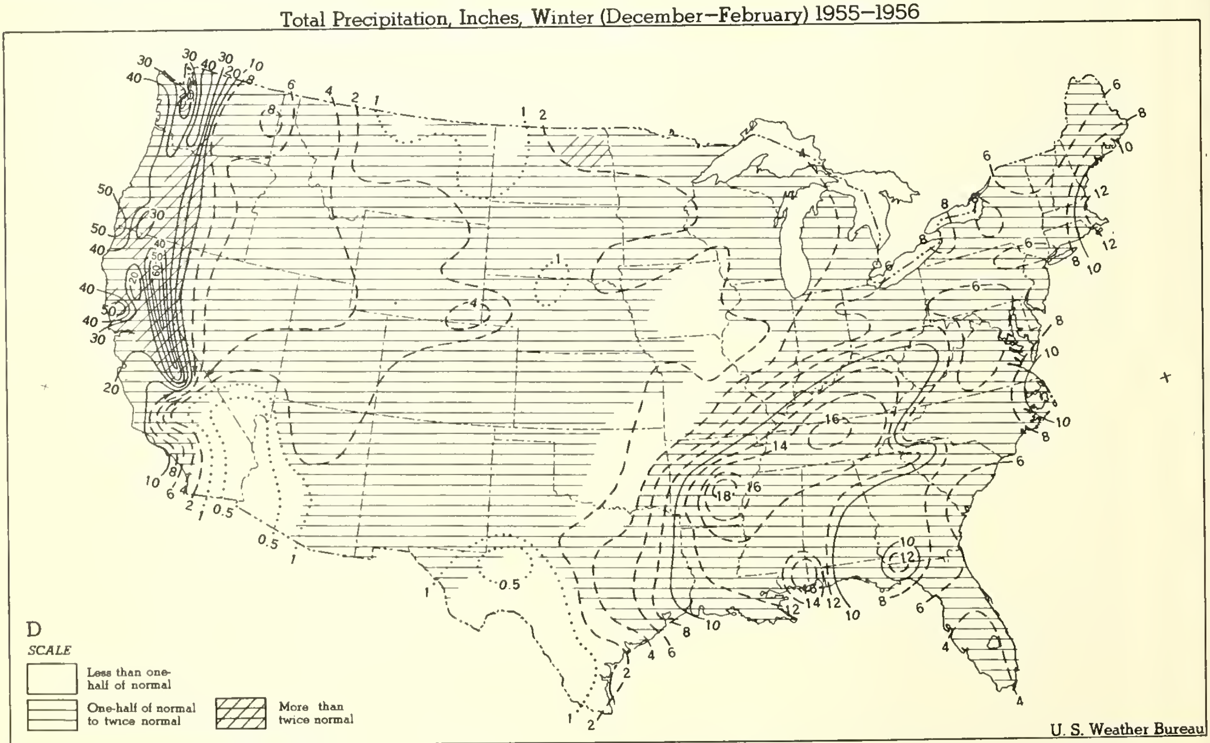
TEMPERATURE AND PRECIPITATION

Departure of Average Temperature from Normal (°F.), Winter (December–February) 1955–1956



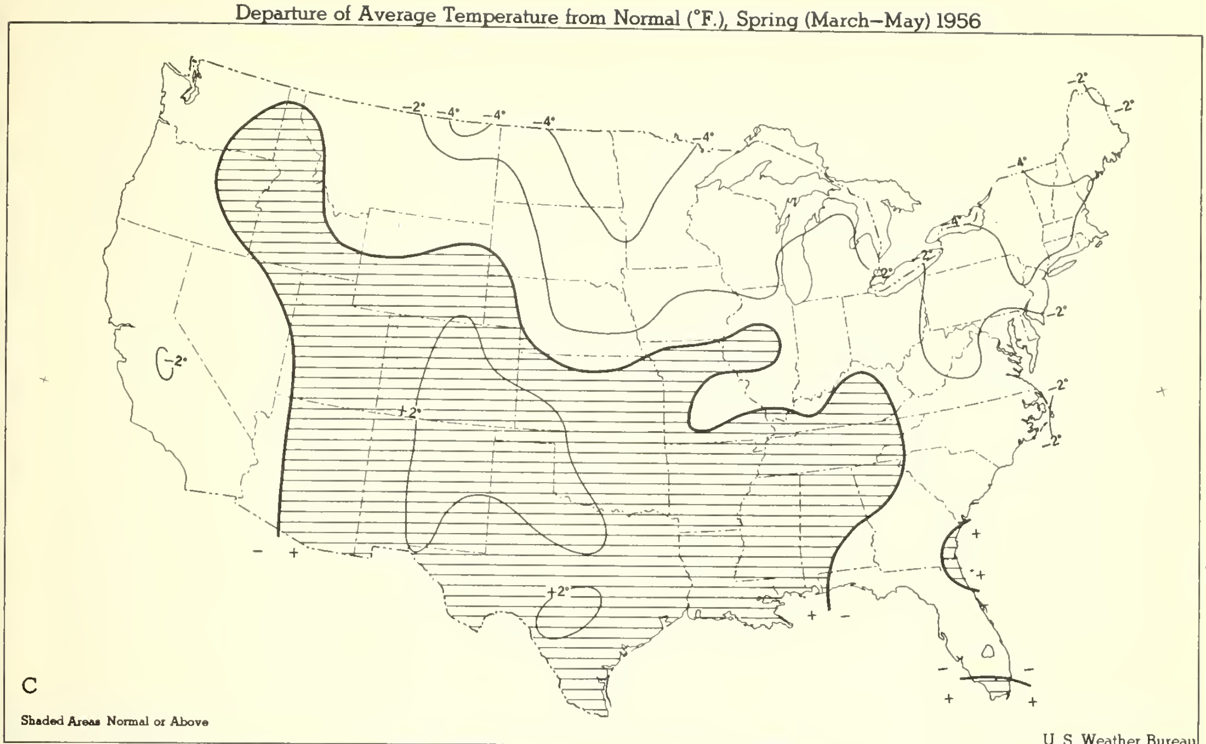
Based on preliminary telegraphic reports

Total Precipitation, Inches, Winter (December–February) 1955–1956



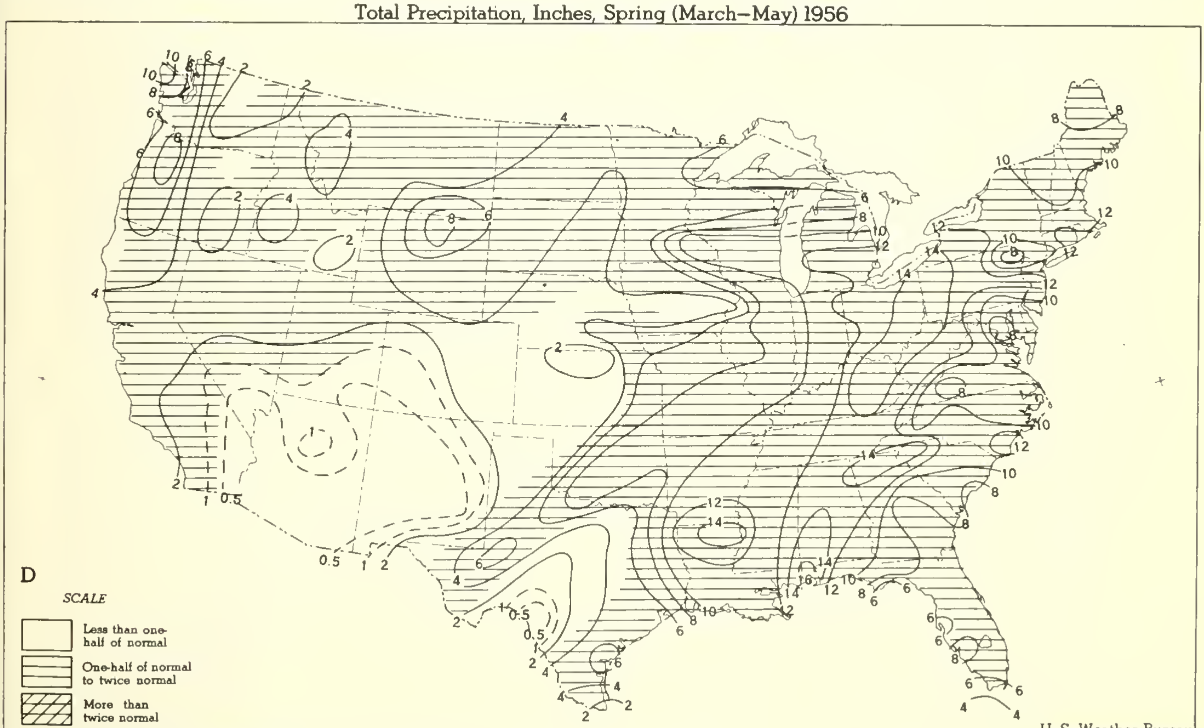
Based on preliminary telegraphic reports

Departure of Average Temperature from Normal (°F.), Spring (March–May) 1956



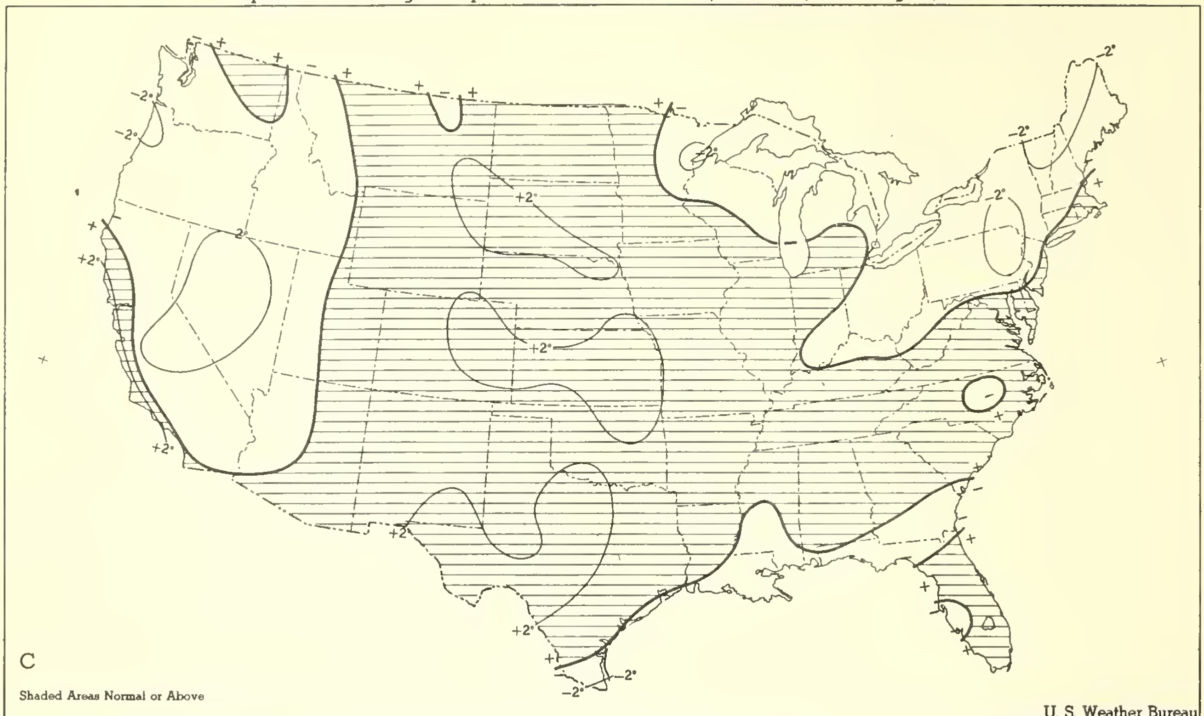
Based on preliminary telegraphic reports

Total Precipitation, Inches, Spring (March–May) 1956



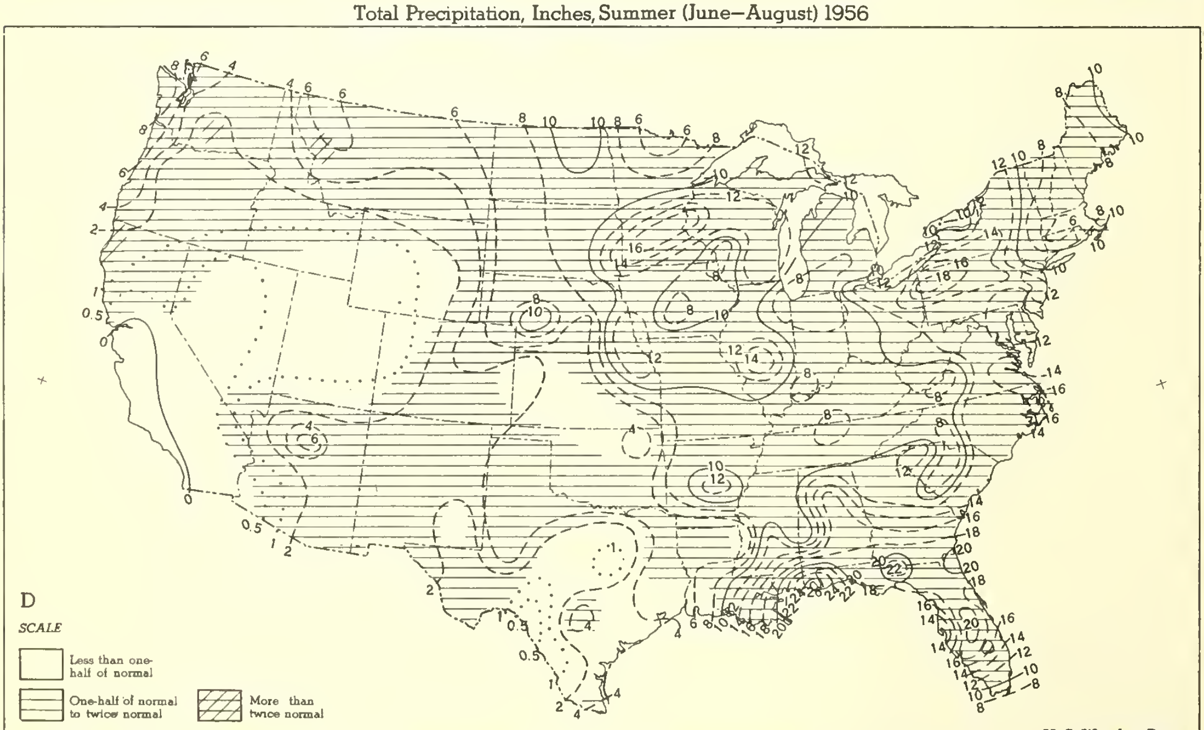
Based on preliminary telegraphic reports

Departure of Average Temperature from Normal (°F.), Summer (June—August) 1956



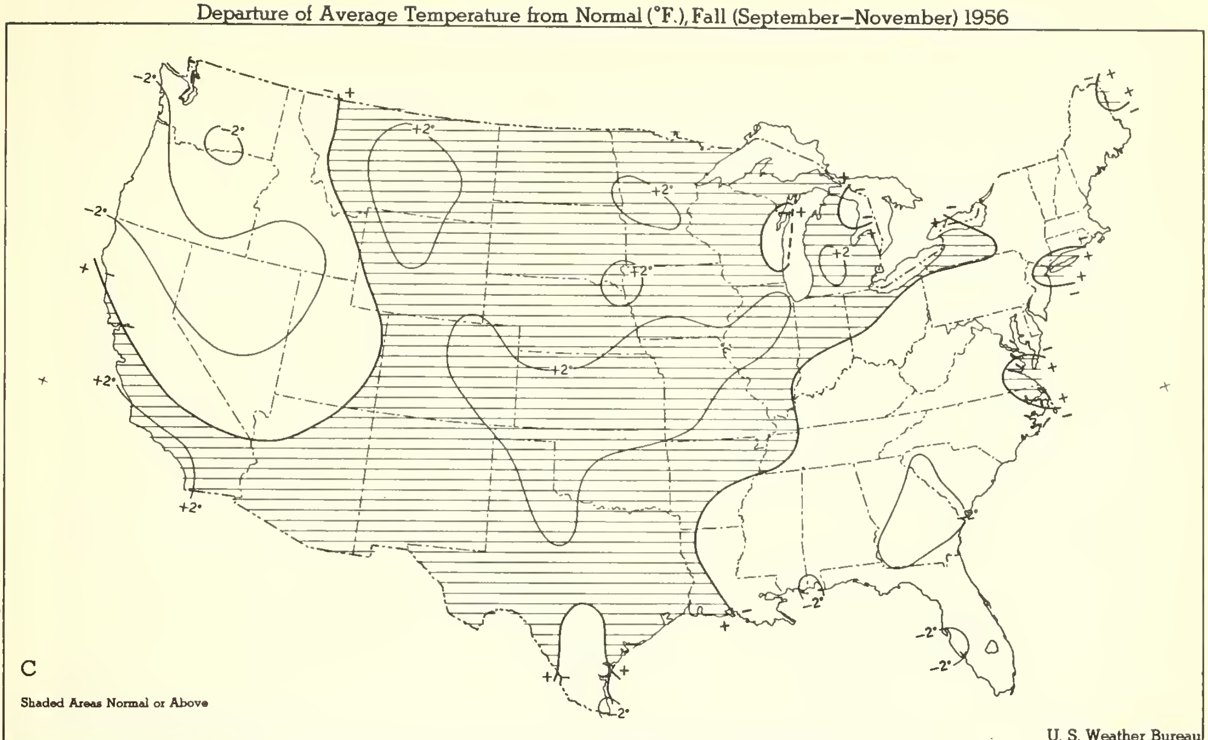
Based on preliminary telegraphic reports

Total Precipitation, Inches, Summer (June—August) 1956



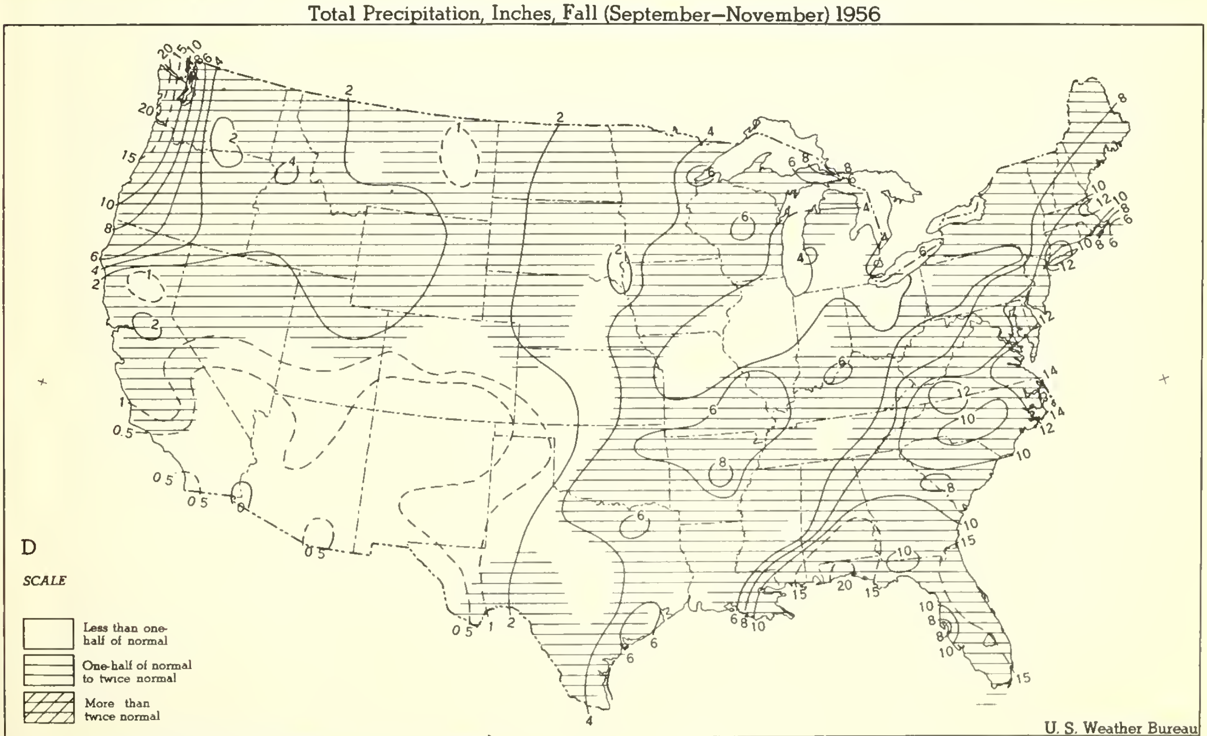
Based on preliminary telegraphic reports

Departure of Average Temperature from Normal (°F.), Fall (September—November) 1956



Based on preliminary telegraphic reports

Total Precipitation, Inches, Fall (September—November) 1956



Based on preliminary telegraphic reports

(From Weekly Weather and Crop Bulletin National Summary, Volume 43, 1956)

Table 1. Diseases reported in States where they had not been found or reported on a particular host until 1956.

Host Disease (Cause)	Where found	Remarks
CORN (ZEA MAYS) Sting nematode (*Belonolaimus gracilis*)	New Jersey	Previously published records of this nematode have indicated that it did not occur north of Virginia, except for one occurrence in a greenhouse in Connecticut (PDR 40: 1049).
CORN (ZEA MAYS) Witchweed (*Striga* sp.)	South Carolina	Found adjacent to the affected portion of North Carolina (PDR 41: 133).
WHEAT (TRITICUM AESTIVUM) Leaf stripe (*Cephalosporium gramineum*)	New York	The pathogen has been observed in all of the important soft white winter wheat growing counties of central and western New York (PDR 41: 384).
CAMELLIA spp. Flower blight (*Sclerotinia camelliae*)	South Carolina	The disease has been found in three counties, Sumter, Dorchester and Florence (PDR 40: 831).
SMARTWEED (POLYGONUM PUNCTATUM) *Ustilago utriculosa*	Pennsylvania	Dotted smartweed seed is an important waterfowl food. All the ovaries of the spike were killed and the tissue was replaced by fungus spores (PDR 40: 1017).

Table 2. Diseases found or reported in this country for the first time in 1956=*; diseases found on new hosts=**, 1, 2, 3, 4.

ZEA MAYS (CORN)		
Witchweed *Striga* sp.	North Carolina	Found in several fields in Columbus and Robeson Counties. First report in the Western Hemisphere. Associated with poor growth and dying of corn (PDR 40: 837).
ALFALFA (MEDICAGO SATIVA)		
Bacterial leaf spot* (*Xanthomonas alfalfae*)	Iowa	The disease occurred chiefly on a clonal selection from Cossack alfalfa, which was seriously infected (PDR 40: 830).
ALTA FESCUE (FESTUCA ELATIOR var. ARUNDINACEA)		
Crazy top** (*Sclerophthora macrospora*)	Indiana	The infected plants were found in a low wet part of the field (PDR 40: 830).
BERMUDA GRASS (CYNODON DACTYLON)		
Leaf spot (*Helminthosporium stenospilum*)	Florida	A new disease on this host, symptoms described (PDR 41: 389).
BLUEGRASS (POA spp.)		
Stripe rust** (*Puccinia striiformis*)	California	Reaction of species of *Poa* and other grasses to this rust. 1st rept. on this host (PDR 40: 644).
BLUE LUPIN (LUPINUS ANGUSTIFOLIUS)		
Gray leaf spot**) (*Stemphylium solani*)	Florida Georgia	Observed near Albany in 1956 and later in other localities in Georgia, and at Gainesville and Quincy, Florida (PDR 40: 803).
Little leaf spot** (*Stemphylium botryosum*)	Florida Georgia	Reported and described as a hitherto unrecognized disease of blue lupines in the United States (PDR 40: 803).

[1] Birchfield, Wray. New and suspected host plants of the burrowing nematode, *Radopholus similis* (Cobb) Thorne. PDR 40: 866. Thirty-one plants are reported as new hosts. Twenty-four additional plants are indicated as suspected hosts. In all 36 plant families are represented.

[2] Hardison, J. R. and J. P. Meiners. New host records for dwarf bunt in the Pacific Northwest. PDR 40: 1058.

[3] Feder, William A. and Julius Feldmesser. Additions to the host list of *Radopholus similis*, the burrowing nematode. PDR 41: 33. The hosts include many tropical and subtropical weeds and ornamental plants grown in Florida.

[4] Ellett, C. W., Diseases not previously reported in Ohio. (PDR 41: 369). The records are based upon collections and identifications of the author for the most part.

Table 2. (Continued)

Host Disease (Cause)	Where found	Remarks
LADINO WHITE CLOVER (TRIFOLIUM REPENS var. LADINO) Stemphylium trifolii** J. H. Graham	Pennsylvania	A previously unreported disease on this host has been observed in central Pennsylvania for 3 years. The disease has been described as a new species and the name Stemphylium trifolii was proposed (Phytopath. 47: 13).
SWITCHGRASS (PANICUM VIRGATUM) Panicum mosaic (Panicum mosaic virus)	Kansas	A new virus disease due to a new manually-transmissible virus. A potentially serious disease (PDR 41: 241).
WHITE CLOVER (TRIFOLIUM REPENS) Bacterial leaf spot ** (Pseudomonas stizolobii)	New York	During the summer of 1954 numerous areas were observed in the lawn of the Cornell University campus where the leaves of white clover were spotted and dying. An occasional plant was found in 1955 (Phytopath. 47: 48).
ADDER'S-TONGUE FERN (OPHIOGLOSSUM VULGATUM) Blight* ** (Curvularia crepini)	Ohio	Diseased plants were found frequently during May and June 1956 in University woods, Franklin County. This is the first report of this fungus in North America and apparently the first report of any disease on the host in this country (PDR 40: 756).
ENGLISH HOLLY (ILEX AQUIFOLIUM) Leaf and twig disease (Phytophthora ilicis n. sp.) I. W. Buddenhagen and R. A. Young	Oregon Washington	Previously ascribed to two different organisms, Boydia insculpta and Phomopsis crustosa. The disease developed during cool moist periods (Phytopath. 47: 95).
GOMPHRENA GLOBOSA Tomato ringspot virus**	Maryland	It was found that the tomato ringspot virus produced symptoms on G. globosa while using it as an index for detection of hydrangea viruses (PDR 40: 667).

Table 2. (Continued)

Host Disease (Cause)	Where found	Remarks
GREENE'S BUR-REED (SPARGANIUM GREENEI) *Radopholus gracilis** **	California	Soil from around the roots of this plant had a light population of this nematode together with various other forms (PDR 41: 91).
ICELAND POPPY (PAPAVER NUDICAULE) Powdery mildew** (*Erysiphe polygoni*)	California	In the summer of 1956 a planting of Iceland poppy on the Berkeley campus of the University of California was found to be heavily infected with the conidial stage of a powdery mildew. As the season progressed, the perithecial stage of the fungus was produced in abundance on the infected leaves (PDR 41: 694).
SYRINGA VULGARIS (LILAC) VITIS VINIFERA var. EMPEROR (GRAPE) Citrus nematode** (*Tylenchulus semipenetrans*)	California	Found on the Citrus Experiment Station, Riverside (PDR 40: 1047).
PEPPERMINT (MENTHA PIPERITA) (*Sclerotinia sclerotiorum*)**	Washington	Extremely heavy mint growth favored the development of *Sclerotinia.* Abundant formation of sclerotia was found in the stem (PDR 41: 493).
CANISTEL TREE (POUTERIA CAMPECHIANA) Scab** (*Elsinoë lepagei*)	Florida	Found on small trees in cans in a nursery at Hialeah, Florida (PDR 41: 540).
COTINUS COGGYGRIA (SMOKE-TREE) Rust**	Georgia	First observation and collections of a rust new to North America on this host were made on June 25, 1956 (PDR 40: 1015).

Table 2. (Continued)

Host Disease (Cause)	Where found	Remarks
FEIJOA SELLOWIANA Sphaceloma psidii*	Florida	Found on leaves in April 1956. First rept. in this country (PDR 40: 655).
LEUCOTHOE POPULIFOLIA Elsinoë ledi**	Florida	Found on leaves in January 1956 (PDR 40: 655).
TERNSTROEMIA GYMNANTHERA Elsinoë leucospila**	Florida	Found on leaves in March 1956 (PDR 40: 655).
BEAN (PHASEOLUS VULGARIS) Bean wilt Corynebacterium flaccumfaciens var. aurantiacum n. var.)	Nebraska	Presence of an orange-colored bacterium under the seed coat of beans was manifested by a similar coloration of the seed (Phytopath. 47: 51).
BEAN (PHASEOLUS VULGARIS) Victoria blight** (Helminthosporium victoriae)	North Carolina	The disease was observed in the field only when beans were grown adjacent to fields of oats heavily infected with the disease (Phytopath. 46: 229).
CARROT (DAUCUS CAROTA) Motley dwarf* (Virus)	California	Found in several areas. In a seed field crop at Davis less than 50 percent of plants were infected. As the insect vector Cavariella aegopodii was present the disease continued to spread. This disease previously known to occur only in Australia (PDR 40: 763).
PEPPER (CAPSICUM FRUTESCENS) Powdery mildew (Erysiphe cichoracearum)	Florida	Observed in spring of 1955 on small planting of pepper. At about the same time in 1956 it was again found on the same farm and also on several adjacent farms. First outbreak on pepper in U. S. (PDR 40: 756).

DISEASES OF CEREAL CROPS

R. A. Cappellini and S. Lund reported diseases of small grains observed in New Jersey in the 1955-56 season. Grain yields were relatively high and disease losses low. (PDR 41: 117).

M. C. Futrell and I. M. Atkins reported trends in diseases of cereal crops in Texas in recent years. They included some diseases not previously observed in the area (PDR 41: 42).

In Utah M. Treshow reported evidence that suggested occurrence of terminal bleach of cereals may be associated with sudden advent of hot dry weather accompanied by high winds (PDR 41: 118).

H. H. McKinney concludes that protection and synergy tests with cereal mosaic viruses aid in determining relationships between viruses (PDR 40: 898).

H. H. McKinney reported that Atsel barley is an effective test plant for wheat streak mosaic virus but not for brome grass mosaic or barley stripe-mosaic viruses (PDR 40: 1102).

R. W. Leukel and R. W. Earhart reported results of seed treatment tests for control of oat smuts and wheat bunt (PDR 40: 785).

AVENA SATIVA. OATS: Erysiphe graminis avenae, powdery mildew. H. R. Rosen reported that 1956 marks the first epidemic of powdery mildew ever observed on oats in the field in Arkansas. Among the well known varieties Victorgrain 48-93 and the Red Rustproof strains showed a high degree of resistance, as did numerous breeding numbers. Similar epidemics also occurred on barley and wheat (PDR 41: 330).

Helminthosporium avenae, leaf blotch, according to H. H. Luke and others, is generally considered as a minor disease but it occurred in epiphytotic proportions throughout Florida and south Georgia during the spring of 1956. A black stem symptom not previously associated with the organism was reported (PDR 41: 69).

Helminthosporium victoriae, Helminthosporium blight. In New York, R. B. Pringle and A. C. Braun reported the isolation of the toxin of H. victoriae. The purified toxin shows the same specificity as does the causal fungus and produces symptoms in susceptible oat plants that are indistinguishable from those produced by the fungus (Phytopath. 47: 369). Experiments at State College, Texas, during 1956, resulted in the discovery of an improved technique for inoculating oat plants in their seedling stage to determine reaction to H. victoriae, according to G. W. Rivers and others (Jour. Agron. 48 (9): 428).

Leptosphaeria avenaria, black stem and leaf blotch phases of Septoria. R. L. Kiesling and J. E. Grafius reported that 40 oat varieties were selected from a total of 5343 lines of the World Oat Collection for their resistance to this fungus under Michigan conditions. During 3 years of tests those selections retained resistance to natural infection, whereas the susceptible check became highly infected. The resistant varieties included a range of maturity dates and agronomic types. Resistance to stem and leaf blotch functioned independently in certain varieties. Some varieties showed slight difference in different years and parts of the State, but varietal reaction was mostly highly consistent (Phytopath. 46: 305).

Puccinia graminis and P. coronata var. avenae, stem rust and crown rust. S. M. Pady and C. O. Johnston reported that on oats stem rust was only a trace and crown rust was difficult to find, in Kansas (PDR 40: 1061).

Septoria avenae, speckled blotch. A. L. Hooker reported that the reactions of 257 oat varieties or selections to artificial inoculations with S. avenae were determined at Madison, Wisconsin in 1956. Several oat strains showed little disease while others were highly susceptible (PDR 41: 385).

HORDEUM VULGARE. BARLEY: Erysiphe graminis f. sp. hordei, powdery mildew. At the North Carolina Agricultural Experiment Station six new physiologic races of Erysiphe graminis, numbered 14 to 19, and nine reported previously were isolated from mildewed barley plants collected in Canada and the United States from 1950 to 1954. Most of the cultures were obtained from the southeastern United States where race 9 and 6 predominated; 3, 13, 18 were isolated in California, while the following were found in one State only: race 4 in Texas, 14 and 16 in Virginia, and 15 in North Carolina (J. G. Moseman, Phytopath. 46: 318).

Helminthosporium sativum, leaf blotch. The relation of temperature to disease development by H. sativum on barley was discussed by R. V. Clark and J. G. Dickson (Phytopath. 47: 6).

Puccinia graminis f. sp. tritici, stem rust. The seedling reactions of 52 barley varieties to 3 races of P. graminis f. sp. tritici were determined at temperatures of 16°, 20°, 24°, and 28° C during and following inoculation. A combination of number and type of pustules was the best measure of differences among varieties. Temperature influenced the frequency of pustules, pustule size, and reaction type. Differences among races were small. For most varieties and hybrids, there was close agreement between seedling reactions at 28° C and the adult-plant reactions in field or greenhouse. (F. L. Patterson, and others, Phytopath. 47: 395).

Richard D. Schein and J. W. Kerelo described an effective technique for isolating and growing Rhynchosporium secalis (PDR 40: 814).

Ustilago nuda, loose smut. According to I. N. Tandon and E. D. Hansing the anaerobic treatment was more satisfactory than the water-soak in controlling loose smut of barley because it controlled smut and only slightly reduced emergence (PDR 41: 202).

Mosaic (virus). Barley stripe mosaic has been recognized as a serious disease of barley, according to P. J. Fitzgerald and others. The nature of the disease suggests that it may be a potentially serious threat to winter wheat (PDR 41: 393). Evaluation of results so far obtained from the barley seed-testing program for stripe mosaic in Montana for two years, reported by H. S. MacWithey and others, suggested that it may not be possible to eliminate stripe mosaic entirely but that spread and increase of the virus may be reduced (PDR 41: 514).

LINUM USITATISSIMUM. FLAX: Colletotrichum linicola, anthracnose, occurs in most of the major flax-growing areas of the world. Its prevalence and destructiveness depend on extensive culture of a susceptible flax variety and on humid growing seasons, according to E. A. Schwinghamer. Except for Crystal, flax varieties grown commercially in the United States were unsatisfactory for differentiating pathogenic races. Six varieties were selected as differentials in a screening test of 650 entries of the world collection. By their use 42 monoconidial isolates of C. linicola were identified as 5 distinct pathogenic races. On the basis of minor differences, these races were further separable into subraces (Phytopath. 46: 300).

ORYZA SATIVA. RICE: Results of the uniform rice seed treatment tests in Arkansas, Louisiana, and Texas in 1955-1956 have been analyzed by J. G. Atkins and others (PDR 41: 105).

In 1956 several chelated compounds together with a soil amendment material called Feralum were applied to a straighthead-susceptible variety of rice grown under conditions favorable for disease development on sandy loam near Eagle Lake, Texas. No benefits from the chelated materials were noted, but highly significant yield differences obtained from Feralum were attributed to differences in severity of straighthead. (N. S. Evatt and J. G. Atkins, PDR 41: 103).

According to E. M. Cralley experiments were conducted during 1954-56 on the effects of seeding methods on the severity of the foliar nematode disease of rice known as white tip (Aphelenchoides oryzae). It was concluded that water seeding of rice offers a simple and practical method for the control of white tip. Since the organism is seed borne and not soil borne, it would not be necessary to seed in water every year in order to maintain satisfactory control of the disease (Phytopath. 47: 7).

SORGHUM spp. SORGHUM: C. H. Hsi reported that eighteen varieties of sorghum were tested for reaction to the phytotoxic action of a liquid mercury fungicide (Panogen 15) applied at several dosages to the seed (PDR 41: 312).

R. W. Leukel and others summarized the results of the 1956 seed-treatment tests for control of sorghum covered kernel smut (Sphacelotheca sorghi) (PDR 40: 1071). Preliminary studies with the complex F-17 for control of sorghum covered kernel smut was reported by R. W. Leukel and J. W. Mitchell. They concluded that a practical method of dusting seeds with F-17 for smut control could possibly be developed (PDR 40: 1073).

Sphacelotheca reiliana, head smut. Some factors that might contribute to the incidence of sorghum head smut in the Mid-West were discussed by R. W. Leukel (PDR 40: 737).

TRITICUM AESTIVUM. WHEAT: C. H. Hsi concluded that both stand reduction and seedling injury must be considered in studies on toxicity of mercurial seed disinfectants to wheat (PDR 40: 1065).

Puccinia spp. An unusual combination of circumstances in 1956 resulted in one of the lightest rust years ever experienced in Kansas, according to S. M. Pady and C. O. Johnston

(PDR 40: 1061).

A vacuum drying process for preservation of spores of Puccinia graminis was reported by D. M. Stewart in Minnesota. In all tests spores survived best in a mixture of hemin. Results of this preliminary study indicated that urediospores of P. graminis can be preserved longer when certain additives, especially hemin, are mixed with the spores prior to vacuum drying. It appeared that hemin may also stimulate spore germination (Phytopath. 46: 234).

Puccinia graminis f. sp. tritici, stem rust. Pre-infection applications of the semicarbazone of cycloheximide controlled black stem rust on a highly susceptible spring wheat variety; its effect persisted for a long period of time after application; and phytotoxicity was negligible since there was no adverse effect on yield or germination (R. G. Hacker and J. R. Vaughn. PDR 41: 442).

An automatic syringe "Vipol Vaccinator" for injecting liquids into plants was reported by C. W. Boothroyd. Wheat plants inoculated in the young boot stage with Puccinia graminis f. sp. tritici were heavily rusted about two weeks after inoculation. The technique might be used for inoculations with other pathogens as well as for the injection into plants of solutions or suspensions of such materials as dyes, pesticides, and radioactive substances (Phytopath. 47: 244).

Puccinia rubigo-vera (P. recondita), leaf rust. S. M. Pady and C. O. Johnston in Kansas reported that in general, the amount of rust was much less in 1956, both in the air and in the field, than in previous years, and 1956 was one of the lightest, and at the same time, one of the most unusual leaf rust years experienced in the State (PDR 40: 1061).

Tilletia spp., bunt. Laurence H. Purdy summarized results of the 1956 regional seed treatment tests for wheat smut control in the Pacific Northwest (PDR 40: 996).

Tilletia caries, bunt. At the University of California, F. P. Zscheile reported a search for chlamydospores in wheat seeds grown under conditions favorable to bunt. It was concluded that hidden chlamydospores do not occur frequently in either Baart or Baart 38 under any conditions studied to date, even though adjacent seeds in the head are bunted. Artificial inoculation of flowers or heads was ineffective in producing chlamydospores. No bunted plant was produced from any seed that showed no external evidence of chlamydospore sorus formation, even though the seed may have come from a bunted plant or bunted head. If chlamydospores were present within the seed, they were neither viable nor able to produce infection (Phytopath. 46: 182).

F. P. Zscheile and M. Anken reported limited development of Tilletia chlamydospores within wheat kernels (Phytopath. 46: 182).

Typhula spp., and associated Fusarium nivale, were severe on fall-seeded winter wheat in Douglas County, Washington, during the past winter. A combination of poor dry seeding conditions in the fall, a long winter with continuously deep snow, and some severe freezes in February resulted in almost complete elimination of the fall seedings in this county. (R. Sprague, PDR 40: 640).

Urocystis spp., and Ustilago spp., smuts. In Washington, Laurence H. Purdy summarized data showing that good control of smut was obtained with all four materials tested and that post-treatment storage caused little or no significant increase in the effectiveness of the fungicides. Furthermore, there was no differential effectiveness of the materials, whether the seed was stored in paper or cloth bags. (PDR 40: 878).

Urocystis agropyri, flag smut. In greenhouse tests, hexachlorobenzene applied as a seed treatment gave good control of flag smut, according to results reported by Laurence H. Purdy (PDR 41: 558).

In Montana, F. H. McNeal and M. M. Afanasiev reported barley stripe mosaic virus in different parts of the head in Rescue and Onas spring wheat (PDR 40: 407).

ZEA MAYS. CORN: Data on the value of corn cold testing were obtained at Madison, Wisconsin, in 1956. Paul E. Hoppe showed evidence that cold testing and retreatment of old corn seed are definitely advantageous (PDR 40: 887).

In Ohio, L. E. Williams and S. K. Menon described their cork borer technique for inoculating corn plants with stalk-rot organisms. This method was selected for large-scale field inoculations because of the ease of preparation of inoculum and rapidity of procedures (PDR 41: 111).

A. L. Hooker reported association of resistance to several seedling, root, stalk, and ear diseases in corn. The disease reactions of 25 dent corn inbred lines to artificial inoculations that resulted in basal stalk rot caused by Diplodia zeae, by Gibberella zeae, and by both D. zeae and G. zeae were measured in 1953 and 1954. Seedling reactions to artificial inoculations with Pythium debaryanum, with P. graminicola, with D. zeae, and with G. zeae were determined in the greenhouse. Differences among corn strains in all evaluations were statistically significant (Phytopath. 46: 379).

Diplodia zeae and Gibberella zeae, stalk rots, were consistently determined to be the most prevalent and important causes of corn stalk rot in Illinois during the period 1945-56 (B. Koehler and G. H. Boewe, PDR 41: 501).

In the 1956 surveys in Minnesota, stalk rots were found to be the most important corn diseases and Gibberella spp. and Fusarium spp. the most important stalk rot pathogens, according to J. E. DeVay and others (PDR 41: 505).

Helminthosporium spp. A. J. Ullstrup and S. R. Miles reported the effects on grain yields of artificially induced epiphytotics of northern corn leaf blight, H. turcicum, southern corn leaf blight, H. maydis, and Helminthosporium leaf spot, H. carbonum, in the field. The severity of the 3 diseases appeared to be determined not by the primary infection induced by artificial inoculation but rather by the development of secondary infection, which was influenced by weather conditions. Early onset of the northern corn leaf blight, 2 to 3 weeks after silking, may be expected to cause severe losses in grain yield. If the disease does not become conspicuous until mid-September or 6 to 8 weeks after silking, no appreciable reduction in yield is apt to occur. With southern corn leaf blight, the same general trends were observed (Phytopath. 47: 331).

Striga asiatica, a flowering plant (witchweed), causes severe damage to the roots of many species of cultivated and wild grasses in tropical and subtropical countries of the Eastern Hemisphere. Its recent discovery on corn in North Carolina is the first known report of its presence in the Western Hemisphere. The parasite was found on corn and crabgrass in widely scattered areas in 4 counties in southeastern North Carolina and in several adjoining counties in South Carolina. Studies indicate that the parasite attacks a variety of economic and wild hosts that occur commonly in the sandy soils of the Coastal Plain. Striga seed germinated when kept in the presence of corn roots or in corn root leachates. Seed also germinated in the absence of host stimuli when subjected to either scarification or alternate freezing and thawing (R. R. Nelson and H. R. Garriss, Phytopath. 47: 313). R. R. Nelson summarized results of preliminary studies on S. asiatica found in corn fields in North and South Carolina, including host range, factors affecting development and parasitism, and control (PDR 41: 377).

ZEA MAYS var. SACCHARATA. SWEET CORN: Bacterium stewartii, bacterial wilt. In Michigan, L. E. Williams and J. L. Lockwood reported that 4 antibiotics and 9 surface-active agents were tested for control of bacterial wilt of sweet corn seedlings in the greenhouse. Wilt control was increased by placing plants in a moist chamber for 24 hours after spraying with streptomycin or Terramycin (Phytopath. 47: 44).

Helminthosporium maydis, leaf blight, was reported by Alice L. Robert to be the cause of the blackening of the silks of sweet corn ears in Florida. This symptom had not previously been associated with this pathogen (PDR 40: 991).

DISEASES OF FRUIT CROPS

W. F. Mai and others reported nematode genera found in New York State orchards (PDR 41: 402).

CITRUS spp. CITRUS: Lemon tree collapse as related to sodium in roots was reported by D. R. Rodney and others. They concluded that a high sodium content was the result and not the cause of this condition (Calif. Citrogr. 41: 313).

J. F. L. Childs reported a new disease of citrus trees in Florida in four widely separated locations. The disease has been found attacking the below-ground parts of 2- to 5-year old citrus trees on well drained sandy land recently cleared of turkey oak (Quercus laevis). The disease is characterized by the formation of soil and mycelium incrustations up to 1/4 inch thick and of rhizomorphs on the below-ground parts of the citrus trees and on oak roots occasionally found in contact with them (Phytopath. 47: 6).

L. J. Klotz and others reported leaf drop and copper spray damage to citrus. During the 1955-56 season copper damage caused considerable defoliation of citrus in some parts of

California. Bordeaux and other copper sprays cause damage by release of an excess of soluble copper, and also by increasing transpiration and thus accelerating wilting. Reduction of photosynthesis in dull weather results in the accumulation of carbon dioxide, which in turn causes an increase of soluble copper, and this damages leaf surfaces moistened by dew or fog with no run off, the effect being increased with low temperatures and inadequate soil moisture (Calif. Citrogr. 41: 147, 188, 1956).

Russet of citrus fruits, long combatted by sulfur on the theory that it was caused by the russet mite Phyllocoptruta oleivora, was controlled effectively in Florida by a single application of zineb during July and August, according to Fran. E. Fisher. Zineb depressed the population of rust mites, but some evidence suggested that the cause of the russet may not be mites but a fungus, possibly Cladosporium brunneo-atrum (Phytopath. 47 433).

F. E. Fisher reported results of Florida tests to determine effectiveness of non-copper-containing fungicides for control of anthracnose (Colletotrichum gloeosporioides) on rough lemon seedlings (PDR 41: 77).

Harry W. Ford reported that a total of 133 chemicals were screened for systemic effects against spreading decline (Radopholus similis). So far none has shown promise (PDR 40: 861).

R. C. Baines and others reported results of trials of various methods of applying Vapam for the control of the citrus nematode (Tylenchulus semipenetrans) and brown rot (Phytophthora spp.) in California (PDR 41: 405).

Tristeza (virus), mild and severe strains were reported in Texas citrus by Edward O. Olson (Phytopath. 46: 336).

Chronic decline, a bud-union disorder of sweet orange trees on sour orange rootstock, causes trees to decline in various degrees, according to Henry Schneider. The disease has been discovered as a result of intensive research on tristeza disease. Tristeza is caused by an aphid-transmitted virus. In both tristeza and chronic decline, a necrosis of sieve tubes occurs below the bud union, and the resulting girdling causes trees to deteriorate. In most trees additional anatomical abnormalities that are distinctly different from those of tristeza accompany the necrosis. A positive correlation was found between the amount of functioning phloem and the amount of starch in roots (Phytopath. 47: 279).

H. Schneider also reported a new disease of Eureka lemon trees on sweet orange root stocks, characterized by extensive necrosis of the sieve-tubes of the stock. Affected trees were stunted, new growth suppressed, the foliage yellow, and the branches partly defoliated. This disease may be of importance as sweet orange is the most successful citrus rootstock for lemons (Calif. Citrogr. 41: 387).

Flying aphid populations in southern California citrus groves and their relation to the transmission of the tristeza virus was reported by R. C. Dickson and others. Populations of flying aphids in southern California citrus groves from 1951 to 1954 were determined by trapping with sticky boards. The green citrus or spirea aphid, Aphis spiraecola, made up about 85 percent of the catch. The melon or cotton aphid, Aphis gossypii, constituted only 3 percent of the catch, but the 35,000 of these aphids recorded as flying to each citrus tree each year in the area of the most rapid spread of the tristeza (quick decline) virus were more than enough to account for the spread even though the transfer of an average of 5600 melon aphids was required to produce each infection in the experimental work. The spread of tristeza in the groves seldom exceeded the rate of 2 new infections each year from each diseased tree present. The tristeza virus was shown to be nonpersistent in its vector and to be carried only by the melon aphid in this area (Phytopath. 46: 204). In Florida, T. J. Grant and R. P. Higgins reported occurrence of mixtures of tristeza virus strains in Citrus (Phytopath. 47: 272).

FRAGARIA spp. STRAWBERRY: Botrytis cinerea, gray mold. P. M. Miller and E. M. Stoddard reported that in field trials, three applications of thiram, dichlone, or captan, starting at bloom and spaced 10 to 14 days apart, reduced the number of berries affected by gray mold. Thiram and dichlone reduced the number of affected berries to less than one-third that of the control, while captan plots had two-thirds as many as the control.. Dichlone and thiram gave about equal control, and both showed long residual action (PDR 40: 788).

Botrytis and Rhizopus rots. In New Jersey, G. H. DiMarco and B. H. Davis tested several chemicals for effectiveness as post-harvest treatments to prevent decay of strawberries (PDR 41: 496).

In California, Idriella lunata was found to be pathogenic to strawberry. The fungus caused rootlet degeneration and tip killing of the large adventitious roots. Under field conditions, I. lunata has been isolated only from roots of strawberry plants in areas where root deterioration was extensive. Under greenhouse conditions the fungus did not cause pre-emergence or post-emergence damping-off of strawberry seedlings. Under conditions favorable for the development of strawberry leaf spot caused by Mycosphaerella fragariae, I. lunata did not attack the foliage of strawberry (Paul E. Nelson, Phytopath. 47: 438).

Phytophthora fragariae, red stele. A method for the propagation of strawberry stocks which ensures the elimination of P. fragariae has been used successfully at the Oregon Agricultural Experiment Station. It is based on the established principles that the fungus does not invade the crowns or stolons even of susceptible varieties, that it grows poorly at soil temperatures above 65° F, and that it does not flourish in well-drained soil (E. K. Vaughan, Phytopath. 46: 235).

Pratylenchus penetrans, root lesion nematode. Observations reported by D. J. Raski indicated that P. penetrans was only one of the factors associated with black root rot in a California strawberry planting (PDR 40: 690).

Sphaerotheca macularis, powdery mildew. The relative resistance of some strawberry varieties and selections to powdery mildew at Corvallis, Oregon was reported by P. W. Miller and G. F. Waldo (PDR 41: 23).

Stephen Wilhelm reported that chloropicrin gave promising control of Verticillium wilt (Verticillium albo-atrum) of strawberry. Small-scale and commercial field-machine-applied tests at 480 pounds per acre achieved outstanding control of wilt and gave exceptionally vigorous plants. The control effect lasted through 2 years. Reinvasion of the fumigated soil by Pythium ultimum with attendant killing of feeder rootlets appeared to be a primary factor causing decline in plant vigor in fumigated fields (Phytopath. 47: 37).

Viruses. R. S. Bringhurst and Victor Voth in California reported that strawberry viruses are readily transmitted by cleft grafting excised terminal leaflets from test plants in place of the terminal leaflets of indicator plants. Successful graft unions can be quickly detected and virus symptoms develop in from 2 to 5 weeks on alpine vesca. Leaves can be collected from the field and grafted immediately or stored in polyethylene for a month or more at 36° F before grafting (PDR 40: 596).

MALUS SYLVESTRIS. APPLE: Gymnosporangium juniperi-virginianae, cedar apple rust, see under Venturia inaequalis.

Nectria galligena, European canker, has caused considerable damage to apple trees in Sonoma County, California in the past 2 years, according to C. W. Nichols and E. E. Wilson (PDR 40: 952).

Neofabraea malicorticis or N. perennans, bull's-eye rot, often causes serious losses on apple and pear fruits in cold storage, according to J. R. Kienholz. The study of weather relations and latent infection has led to more effective control of this disease in the Pacific Northwest (PDR 40: 872).

Physalospora obtusa, frog-eye leaf spot, appeared more widely in Connecticut in May and June of 1956. P. M. Miller recommended use of aluminum foil to increase success of inoculation in studies with the fungus (PDR 40: 1117).

Venturia inaequalis, scab. P. W. Miller described experimental methods for testing effectiveness of apple scab control under conditions favoring severe infection (PDR 40: 1118). J. M. Hamilton and Michael Szkolnik in New York reported the performance of Omadine, AC 5223, and other promising fungicides in the control of apple scab and cedar-apple rust (Gymnosporangium juniperi-virginianae) (PDR 41: 293).

Stem pitting. In Missouri, H. W. Guengerich and D. F. Millikan reported that the stem pitting factor has been experimentally transmitted by buds and bits of bark from pitted to non-pitted apple trees. This confirms the virus nature of this disorder, suggested previously in transmission studies involving hosts other than apple (PDR 40: 934).

PRUNUS spp. At the New York Agricultural Experiment Station, six Prunus species were compared as indexing hosts for stone fruit viruses by budding with 126 individual isolates, each containing one or more viruses (R. M. Gilmer and K. D. Brase, PDR 40: 767).

PRUNUS spp. CHERRY: Lambert mottle (virus). M. M. Afanasiev and I. K. Mills reported observations on the spread of Lambert mottle in Lambert and Peerless varieties of sweet cherries in Montana (PDR 41: 517).

Twisted leaf virus. E. L. Reeves and P. W. Cheney reported a new form of the twisted leaf virus of cherries, found on an old Lambert tree in Stevens County, Washington, producing a variety of symptoms on a number of cherry varieties that are unaffected, or only mildly affected, by the normal form (Phytopath. 46: 639).

PRUNUS AVIUM. MAZZARD CHERRY: Agrobacterium tumefaciens, crown gall. Ira W. Deep reported the effectiveness of preplanting treatments with antibiotics in preventing crown gall of Mazzard cherry (Phytopath. 46: 635).

PRUNUS CERASUS. SOUR CHERRY: Stereum purpureum, silver leaf, though present in Oregon for some 40 years, had not been observed in commercial orchards nor reported as affecting Montmorency sour cherry trees until 1954, when 14 percent of a block of 448 trees showed symptoms. In 1955 incidence seemed to be increasing, but by 1956 many trees had recovered, apparently as a result of the high summer temperatures (H. E. Williams and H. R. Cameron, PDR 40: 954).

PRUNUS DOMESTICA. ITALIAN PRUNE: Prune crinkle leaf. E. C. Blodgett reported that observations and transmission tests over a period of many years have shown that prune crinkle leaf, common on Italian Prune, is bud-perpetuated but is not caused by an agent transmissible by budding. It was concluded that this disorder is due to genetic instability (Phytopath. 47: 418).

M. J. Ceponis and B. A. Friedman reported the effect of bruising injury and storage temperature upon decay and discoloration of fresh, Idaho-grown Italian prunes on the New York City market. Penicillium, the blue mold fungus, accounted for 52.6 percent of the decay (PDR 41: 491).

PRUNUS PERSICA. PEACH: Monilinia fructicola, brown rot. In New Jersey, G. R. DiMarco and B. H. Davis reported that a series of tests were conducted during 1955 and 1956 peach seasons, using chemical dips for the control of decay of harvested fruit. Mycostatin and Dowicide A-M245 gave the best results (PDR 41: 284). In New York, M. Szkolnik and J. M. Hamilton reported brown rot control with Omadine and certain antibiotics (PDR 41: 289).

W. L. Smith and others stated that during a 4-year period 67 chemicals were tested as post harvest treatments for reduction of decay of peaches inoculated with M. fructicola and Rhizopus stolonifer. Several chemicals were effective in reducing the two types of decay. Sprays of Orthocide 50 Wettable and Isothan Q15 were equal to or better than sulfur dust in reducing brown rot; but like sulfur dust, they were ineffective against Rhizopus rot. Dowicide A spray and a combination treatment of sulfur dust followed by fumigation with tetrachloroethylene effectively reduced both brown rot and Rhizopus rot. It is not known whether these chemicals would leave toxic residues when used as indicated (Phytopath. 46: 261).

M. A. Smith and G. B. Ramsey of the Agricultural Marketing Service reported that during holding tests of South Carolina Elberta peaches in August 1953 and 1956, a type of decay on fruit that did not resemble brown rot or Rhizopus rot was observed. Inoculation tests and morphological studies of the fungus indicated that it is the species of Phomopsis that causes the constriction disease of peach trees. The fungus is referred to in current literature as Phoma persicae Sacc., but presumably it should be transferred to Phomopsis (Phytopath. 47: 446).

Taphrina deformans, leaf curl. Control in New York with Omadine was reported by M. Szkolnik and J. M. Hamilton (PDR 41: 289).

Peach yellow bud mosaic virus. At the University of California five of eight potted peach trees treated in water at different temperatures prior to inoculation with the peach yellow bud mosaic virus by rubbing with sap from infected cowpea became infected. This is believed to be the first case of sap transmission of a virus infection to fruit trees (C. E. Yarwood, PDR 40: 299).

PYRUS COMMUNIS. PEAR: Erwinia amylovora, blossom blight. Greenhouse tests on cut branches and potted pear trees for the control of blossom blight indicated that the sodium and zinc salts of 2 pyridinethione 1-oxide provide for more effective control than do bordeaux mixture and the antibiotics streptomycin, Malucidin, and griseofulvin (J. M. Hamilton and M. Szkolnik, PDR 41: 301).

Protective spraying with various formulations of streptomycin gave good control of fire blight in Bosc pears in Connecticut, according to P. M. Miller (PDR 41: 19).

Neofabraea malicorticis or N. perennans, bull's-eye rot, see under Malus sylvestris.

Pear decline. In Washington and British Columbia a problem in pear culture of considerable economic importance is referred to as pear decline. According to C. G. Woodbridge and others there are two types designated as "quick decline" and "slow decline". The cause of pear decline is unknown (PDR 41: 569). Roderick Sprague listed the fungi obtained from pear trees during studies to determine the cause of pear decline in north-central Washington (PDR 41: 74).

RIBES spp. CURRANTS AND GOOSEBERRIES. On Ribes plants, the uredial and telial stages of the white pine blister rust (Cronartium ribicola) are so similar morphologically to those of the pinyon pine blister rust fungus (C. occidentale) that, according to D. H. Ford and T. E. Rawlins, it is impractical to distinguish them routinely by their morphology. Two cytochemical methods were developed that distinguish between the telia of C. ribicola and those of C. occidentale on Ribes (Phytopath. 46: 667).

VACCINIUM spp. BLUEBERRY: Agrobacterium tumefaciens, crown gall. Bert M. Zuckerman reported that five different antibiotics tested did not suppress crown gall formation on cultivated highbush blueberry in Massachusetts (PDR 41: 674).

Mosaic and shoestring (virus diseases). Mosaic and shoestring have been observed for a number of years in various blueberry plantings in New Jersey. Shoestring was thought to be a virus disease, but mosaic referred to locally as "variegation" was thought to be a generic disorder. E. H. Varney described the symptoms of the two diseases and gave evidence, based on transmission experiments, that both were of virus origin. Both diseases are considered of minor importance at present; however, they are a potential threat to industry (Phytopath. 47: 309).

VACCINIUM MACROCARPON, CRANBERRY: According to results of preliminary tests reported by P. R. Harding, Jr., ammonia pellets do not give satisfactory control of fungal decay in packaged cranberries (PDR 41: 564).

Rots. In Massachusetts, Bert M. Zuckerman reported that over a 2-year test period fungicides applied by helicopter at concentrations of 33X and 23X gave control of cranberry rots comparable with that from fungicides applied by ground equipment at standard concentrations (PDR 41: 278).

VITIS spp. GRAPE: Botrytis cinerea, Botrytis rot, according to K. E. Nelson has been considered to be the most important form of decay of Tokay grapes in the Lodi area of California, destroying a high percentage of the crop in some years when early fall rains wet the mature unharvested fruit. The severity of the disease could not be predicted, even at the time of the rain, and control was ineffective. The histological aspects of the disease were studied to obtain better understanding of mode of infection and its effect on the host tissues. Such information should be valuable in planning control measures (Phytopath. 46: 223).

Plasmopara viticola, downy mildew. A physiological form of P. viticola was found for the first time, according to Vincent Santilli. The grape downy mildew fungus was found to occur in California only on the wild grape (Vitis californica). No authentic record of its existence on the cultivated grape (V. vinifera) was found. By means of artificial inoculations and by comparison with P. viticola from the eastern United States, it was discovered that the California fungus was a strain of P. viticola, the first so characterized, and was incapable of completing its life cycle on V. vinifera and other species of Vitis that serve as hosts of this fungus outside California. Only four species of Vitis were found susceptible to the California strain (Phytopath. 47: 30).

Boron deficiency. In San Bernardino County, California, abnormalities in the early growth of vines after midwinter pruning gave rise to a bushy habit attributable to boron deficiency, according to M. M. Barnes and W. W. Jones. One application of borax at 1 ounce per vine in January 1952 and another in November 1955, effected a complete cure (Calif. Agr. 10 (8): 12, 1956).

DISEASES OF FORAGE AND COVER CROPS

D. A. Roberts and C. H. Ward reported results of the fifth consecutive survey of diseases of forage crops in New York. Total hay losses brought about by diseases were lower in 1956 than in any previous year in which forage crop disease surveys were made in the State (PDR 40: 807).

R. A. Cappellini reported forage crop diseases in New Jersey in 1956. Only a few of the observed diseases were widespread (PDR 41: 123).

R. A. Kilpatrick reported diseases of forage crops in New England and New York in 1956 (PDR 40: 1054).

GRASSES

C. J. Gould reported results of a turf disease survey in Western Washington in 1955 and 1956. Fusarium patch (F. nivale) was the most important disease on golf greens (PDR 41: 344).

BROMUS spp. BROMEGRASS: Ustilago bullata, head smut. Jack P. Meiners reported that artificial inoculation of mountain brome seed may result in failure of otherwise effective seed treatments to control head smut (PDR 40: 734).

BROMUS CATHARTICUS. RESCUEGRASS: Ustilago bullata, head smut. Howard W. Johnson reported Lamont, a new variety of rescuegrass resistant to head smut (Phytopath. 47: 409).

ELYMUS VIRGINICUS var. GLABRIFLORUS. VIRGINIA WILD RYE: Occurrence of the nematode Radopholus gracilis in a distinctly drier environment than it is usually associated with is reported by Don C. Norton in Texas (PDR 41: 599).

FESTUCA sp., ILLAHEE FESCUE, see under Poa pratensis.

LOLIUM PERENNE. PERENNIAL RYEGRASS: Gloeotinia temulenta, blind seed disease. John R. Hardison has given a record of the very successful program for control of the blind seed disease in Oregon. In late years losses have been negligible (PDR 41: 34).

POA PRATENSIS. KENTUCKY BLUEGRASS: H. B. Couch and Herbert Cole, Jr. reported that melting-out of Kentucky bluegrass and Helminthosporium blight of Illahee fescue, caused by Helminthosporium vagans and H. dictyoides respectively, were epiphytotic in Pennsylvania during the 1956 growing season. Complete loss of stands was common, and in many areas, plantings were rendered so undesirable it was necessary that they be re-established. In replicated field tests, Acti-dione, Kromad, Omadine, Captan 50-W, and Terramycin gave highly significant reductions in intensity of the leaf spot phase of the Kentucky bluegrass disease. Yield tests showed Anti-dione to cause a temporary reduction in growth of Kentucky bluegrass, while Omadine, Kromad, and Captan 50-W brought significant increases in yield per plot. None of the materials tested gave satisfactory control of Helminthosporium blight of Illahee fescue. Terraclor was extremely phytotoxic on this species, killing approximately 50 percent of the plants in the test areas (PDR 41: 205).

LEGUMES

In greenhouse pot studies, the relative increases of populations of Belonalaimus gracilis on six different winter legumes were determined and reported by J. M. Good and G. D. Thornton in Florida (PDR 40: 1050).

GLYCINE MAX. SOYBEAN: Cercospora kikuchii. Soybean stems heavily infected with the fungus were collected from field plots at the Mississippi Experiment Station in October 1951, tied in a bundle, and hung outside the laboratory window. At 6-month intervals portions were examined for sporulation of the fungus. Conidia were abundant during the first 18 months, though generally decreasing at each successive examination. After 3 1/2 years the pathogen could still be isolated (R. A. Kilpatrick, Phytopath. 46: 58). R. A. Kilpatrick reported that studies of the fungi associated with the flowers, pods and seeds of soybeans were made at the Delta Branch Experiment Station, Stoneville, Mississippi, from 1951 to 1955. The kinds of fungi and their relative prevalence varied with season, with location within the plant, and with varieties. Cercospora kikuchii comprised the highest percentage of isolates from seed within pods. Alternaria spp. were isolated most frequently from the pistils and stamens of unopened and opened flowers. It was suggested that fungi gain entrance to soybean seed within unopened pods by the following means: 1) cracking of pod walls; 2) insect injuries, and 3) systemic infection (Phytopath. 47: 131).

Kirk L. Athow reported that observations on time and place of natural infection by the soybean stem canker fungus, Diaporthe phaseolorum var. caulivora, have been made for 8 years (Phytopath. 47: 2). Stem canker is considered one of the most destructive diseases on soybean in the north central States. F. I. Frosheiser reported studies on its etiology and epidemiology. The only known method of survival of the pathogen is in overwintered plant parts and seed. It is possible that the pathogen lives saprophytically in the soil or survives in plant material other than soybean (Phytopath. 47: 87).

Helicotylenchus nannus, spiral nematode. N. A. Minton and E. J. Cairns reported suitability of the soybean variety Ogden and twelve other plants as hosts of the spiral nematode. Various crop plants and weeds frequently found in Alabama where this nematode occurs were tested in the greenhouse as hosts (Phytopath. 47: 313).

Heterodera glycines, the soybean cyst nematode, has been found in soybean fields in Lake County, Western Tennessee. The extent of the infestation has not been determined. Investigations as to extent and area of damage are being continued (J. M. Epps, PDR 41: 33). A. H. Hegge reported that on December 5, 1956, soil collections for soybean cyst nematodes were taken from six fields in Pemiscott County, Missouri. Soil was collected from six soybean stubble fields located across the Mississippi River from the Lake County, Tennessee infestation. Examination revealed the presence of the soybean cyst nematode. During the week of December 17, soil collections were taken from 41 other fields planted to soybeans in 1956 in Pemiscott County. The soybean cyst nematode was found in eight of these fields, bringing the known total infested locations in Missouri to nine (PDR 41: 201). J. F. Spears and others reported the soybean cyst nematode found in a new area near Burgaw, North Carolina. There are now three centers of infestation in the State, comprising 79 properties and 1,687 acres (PDR 40: 830).

Meloidogyne incognita acrita. In Delaware, experiments reported by H. W. Crittenden indicated that rotation with a resistant cash crop such as resistant soybeans should be a successful and economical means of controlling this nematode (PDR 40: 977).

Rhizoctonia solani. The influence of certain plant nutrients on infection of soybeans by R. solani was reported by J. J. Castano and M. F. Kernkamp. Soybeans were inoculated with R. solani and grown in sand culture with deficiencies of calcium, magnesium, iron, sulfur, nitrogen, phosphorus, or potassium. A deficiency of any of these elements except potassium increased the severity of infection. In tests under other than deficiency conditions, the degree of infection was not influenced by the different levels of calcium and magnesium used (Phytopath. 46: 326).

At Camp Detrick, Maryland, Robert P. Kahn reported seed transmission of the tomato-ringspot virus in the Lincoln variety of soybeans. The results of his experiments confirm a previous finding of seed transmission of the tobacco-ringspot virus and represent the first report of seed transmission of the tomato-ringspot virus (Phytopath. 46: 295).

Chlorosis. In Maryland a chlorosis of the Lee soybean variety described by L. W. Erdman appeared to be associated with certain rhizobial inoculants (PDR 40: 646).

LESPEDEZA spp. BUSH CLOVER: Fusarium roseum, Rhizoctonia solani, and Pythium debaryanum, damping-off, see under Trifolium repens var. Ladino.

LESPEDEZA STIPULACEA. KOREAN LESPEDEZA: In North Carolina, annual Korean lespedeza was infected and severely defoliated by the tar spot fungus, Phyllachora lespedezae. In southeastern United States native species of lespedeza are known to be susceptible, but this is the first report of its occurrence on introduced Korean lespedeza, which is grown extensively as a hay and seed crop in this region. Damage has been most severe in breeding nurseries at Raleigh, but the disease is prevalent on Korean lespedeza throughout the State (J. L. Allison, Phytopath. 47: 2).

MEDICAGO SATIVA. ALFALFA: R. K. Stivers and others reported the relationships of varieties and fertilization to observed symptoms of root rots (Ascochyta imperfecta and Fusarium spp.) and bacterial wilt (Corynebacterium insidiosum) of alfalfa in Indiana

(Agronomy Jour. (48 (2): 71-73, 1956).

Cercospora medicaginis, black stem, is an important disease of alfalfa in Iowa according to J. W. Baxter. The fungus overwinters chiefly as mycelium in plant debris. The incidence of seed infection in alfalfa appeared to be low. In greenhouse inoculations with conidia of C. medicaginis, the fungus proved to be pathogenic to species of Medicago but failed to infect species of Melilotus and Trifolium (Phytopath 46: 398).

Corynebacterium insidiosum, bacterial wilt. The occurrence of this organism in alfalfa seed was reported by M. W. Cormack and J. E. Moffatt. It has become prevalent in many of the alfalfa-growing regions of North America during the past 25 years, and has spead erratically, as shown by its frequent appearance in areas far from any known source of infection. Seed transmission was thought to be a possible explanation, but has not been previously proved (Phytopath. 46: 407).

Xanthomonas alfalfae, bacterial leaf spot, was observed in Iowa on June 19, 1956. At first found only in experimental plots, by September the disease was observed to be present in many fields of alfalfa in the central part of the State. Damage was generally light, possibly because of the appearance of the disease late in the growing season. Stem lesions also occurred under field conditions. This is believed to be the first reported outbreak of the disease in commercial fields, and the first reported occurrence of stem lesions under field conditions (R. D. Brigham, Phytopath. 47: 309).

TRIFOLIUM PRATENSE. RED CLOVER: Viruses. N. Oshima and M. F. Kernkamp concluded that the short life of red clover plantings in Minnesota is largely due to virus infection (PDR 41: 10).

C. H. Graves, Jr and D. J. Hagedorn, reporting on the red clover vein-mosaic virus in Wisconsin, stated that the virus was endemic among leguminous weeds along roadsides and in waste places, suggesting that such plants are important in perpetuation of the virus. The virus was found in leaves and stems, in crowns, and in roots of red clover and sweet clover. Indirect evidence of overwintering of the virus in red clover, sweet clover, and alsike clover plants was obtained (Phytopath. 46: 257).

TRIFOLIUM REPENS. WHITE CLOVER: Populations of nematodes in white clover were studied during 1955-56 in field-plot fumigation experiments in Louisiana. Maximal plant growth of white clover occurred from January to June of 1956 and nematode populations likewise were highest during this period. The general trend of populations of Pratylenchus sp. and Tylenchorhynchus sp. varied with the period of maximal growth of white clover (E. J. Wehunt, Phytopath. 47: 36).

TRIFOLIUM REPENS var. LADINO, LADINO CLOVER: Fusarium roseum, Rhizoctonia solani, and Pythium debaryanum, damping off.

J. H. Graham and others reported that a series of experiments were conducted to determine the pre-emergence and postemergence damping-off of Ladino clover and of common Lespedeza by the above fungi at constant temperatures from 52° to 94° F at 7° intervals, and at three levels of soil moisture. The temperatures most favorable for radial mycelial growth of Fusarium and Rhizoctonia were near 80° and of Pythium near 87° F. Temperatures most favorable for seedling emergence of Ladino clover were 66° and 73° and for Lespedeza near 87° F. High temperatures favored the pre-emergence damping-off of Ladino clover by three fungi, and low temperatures favored pre-emergence damping-off of Lespedeza by Fusarium and Phthium. Rhizoctonia reduced the emergence of Lespedeza very little (Phytopath. 47: 182).

Viruses. K. W. Kreitlow and others reported the effect of virus infection on yield and chemical composition of Ladino white clover. From the greenhouse and field data presented it was apparent that virus infection can reduce the yielding ability of Ladino clover from 23 to 55 percent. The widespread occurrence of virus infection among the plants in the field and the substantial reduction in yielding ability that results emphasize the need for obtaining resistant plants (Phytopath. 47: 394).

VIGNA SINENSIS. COWPEA: Fusarium oxysporum f. tracheiphilum, wilt. In field and greenhouse tests of the new Giant variety of blackeye cowpea at the University of California, Riverside, D. C. Erwin and I. J. Thomason found promising resistance to F. oxysporum f.

tracheiphilum. In field tests Grant remained green, while two other varieties were dying from wilt. The variety was, however, found susceptible to nematode injury (Calif. Agri. 10 (5): 6, 1956).

DISEASES OF NUT CROPS

P. W. Miller reported the incidence of nut diseases in Oregon and Washington in 1956 (PDR 40: 965).

CARYA ILLINOENSIS. PECAN: Cladosporium effusum, scab. In Oklahoma, R. H. Converse reported that certain contact fungicides effectively prevented sporulation of the scab fungus in holdover stromata on dormant pecan nursery trees (PDR 40: 870). In 1956, J. R. Cole and A. C. Gossard reported increased virulence of scab on Stewart pecan in Mississippi, and its presence in Louisiana (PDR 40: 1120).

JUGLANS REGIA. PERSIAN WALNUT (ENGLISH WALNUT): P. W. Miller and L. F. Roth reported that the most important rootstock species in Oregon are J. hindsii and J. regia. In recent years some interest has developed in the Chinese wingnut (Pterocarya stenoptera) as a rootstock for Persian walnut. In two different greenhouse experiments inoculated potted seedlings of these two species of Juglans were found to be susceptible to Phytophthora cinnamomi. Inoculated potted seedlings of P. stenoptera did not become infected (PDR 40: 538).

B. F. Lownsbery reported the results of experiments which showed that Pratylenchus vulnus is the primary cause of the root-lesion disease of walnuts. It has been estimated that approximately 50,000 acres of Persian walnuts, in all important walnut-growing areas in California, are infested with this nematode (Phytopath. 46: 376).

Xanthomonas juglandis, walnut blight. Experiments in San Joaquin County, California, have shown that whereas control of walnut blight was poor following only one pre-bloom or post-bloom spray, good control was obtainable with one at mid-bloom, and especially with an additional post-bloom spray. Both copper A and streptomycin were effective. The former gave 92 to 95 percent control; the latter 89 percent. Dusts were less effective because of wind. No phytotoxic effects were observed on the blossom. (P. A. Ark and F. M. Charles, Calif. Agr. 10 (3): 8, 1956).

DISEASES OF ORNAMENTALS

ALOE VARIEGATA. ALOE: Pythium ultimum, root rot, described by K. F. Baker and R. D. Durbin, was responsible for a loss of several thousand seedlings in a nursery in Los Angeles, California. The disease starts at the root tips and spreads rapidly back to the stem. Infected plants which would normally be discarded may be treated by total immersion in hot water at 115° F for 30 minutes. They are then placed in or sprayed with cold water, dried, and replanted. Even large seed-bearing specimens may be saved by this method, and in such cases the treatment time may be safely extended to 40 minutes (Cactus and Succ. Jour., Los Angeles, 28(2): 45, 1956).

CHRYSANTHEMUM spp. CHRYSANTHEMUM: Itersonilia perplexans, petal blight, of chrysanthemum was reported by Louise T. Dosdall. In 1951 the fungus was isolated from blighted pompom type Chrysanthemum blossoms growing in a greenhouse in Minnesota. I. perplexans and/or its variants seem to be widely distributed, having been isolated from a wide variety of plants in the Philippines, Japan, Washington, Louisiana, New York, Minnesota, and probably England (Phytopath. 46: 231). Philip Brierley and Floyd F. Smith reported symptoms of chrysanthemum flower distortion, transmission of the virus by dodder, and heat cure of infected plants (Phytopath. 47: 448).

DIANTHUS CARYOPHYLLUS. CARNATION: E. C. Gasiorkiewicz reported that phytotoxic effects were obtained on carnation cuttings following dip treatments with Terramycin and Streptomycin S. It was surmised that the phytotoxic dosages affected the hormonal balance, influencing callus tissue and subsequent root formation (PDR 40: 421).

Alternaria dianthi, Alternaria blight. R. E. Skiver reported the use of antibiotics and fungicides in mist propagation of carnation cuttings. The system provided for introduction of antibiotics and fungicides into the mist stream. The effects of the introduced chemicals on Alternaria blight and rust (Uromyces caryophyllinus) were studied. The results showed that 1) Captan, Tomatine, Omadine 1456, Omadine 1564, and Omadine 1483 significantly reduced the incidence of Alternaria blight. 2) Carnation rust seemed to be of little importance. 3) Rooting was usually reduced in cuttings infected with A. dianthi. 4) Miller's Yellow variety tended to develop a better root system than Red Sim variety regardless of treatment when rooted under mist (PDR 40: 1074).

A. F. Schindler and R. N. Stewart reported that Fusarium wilt, F. oxysporum f. dianthi, of carnations was retarded by fungus-eating nematodes, Ditylenchus spp. (PDR 46: 469).

Pseudomonas caryophylli, bacterial wilt. R. N. Stewart and A. F. Schindler reported that carnation cuttings were inoculated with P. caryophylli after they had been inoculated with root-knot nematodes Meloidogyne hapla, M. javanica, M. incognita acrita, M. arenaria, and M. incognita, and the ectoparasitic nematodes Helicotylenchus nannus, Xiphinema diversicaudatum, and Ditylenchus sp. From the results they concluded that the significant role of the nematodes in the complex is apparently only to provide wounds for entry of the bacterial pathogen (Phytopath. 46: 219).

Uromyces caryophyllinus, rust, see under Alternaria dianthi.

GLADIOLUS spp. GLADIOLUS: Results of tests of gladiolus varieties for susceptibility to Botrytis gladiolorum, Fusarium oxysporum f., gladioli, and Curvularia trifolii were reported by W. D. McClellan and R. L. Pryor (PDR 41: 47).

Rhizopus arrhizus, soft rot. W. D. McClellan reported that soft rot may occur when freshly harvested corms are heat-cured at 85° or 95° F; the greatest amount of rot occurred at 95° F. Losses were greatest when corms were stored under humid conditions and when corms were injured. The five tested varieties of gladiolus were found to be susceptible (Phytopath. 46: 687).

Recent advances in controlling diseases of gladiolus were reported by R. O. Magie at the Gulf Coast Experiment Station, in Florida. Further studies on Stromatinia root rot of gladiolus showed that the disease was economically important only on well drained land. Plantings made early or late escaped the effects of the disease almost completely, but the production of sclerotia in the soil usually occurred whatever the time the corms were planted. Fungicidal treatment of the soil made it possible to produce flowers in heavily infested land. In one test root rot was largely controlled when Terraclor was broadcast at the rate of 200 pounds per acre and disked 6 inches deep 75 days before planting. Crag 974 and Vapam were also effective (Florida Hort Soc. Proc. 68: 373-376).

Cucumber mosaic virus. By 1955 this disease had practically disappeared from the hundreds of acres of gladiolus grown in the Portland, Oregon area. F. P. McWhorter reported a recurrence in unprecedented severity in 1956. Evidence indicates that the role of clovers and grasses as possible sources of the virus should be investigated (PDR 41: 141).

HYDRANGEA MACROPHYLLA. FLORISTS' HYDRANGEA: Ringspot (virus). According to Philip Brierley and Paul Lorentz hydrangea ringspot virus was found to be transmitted by mechanical methods and by the cutting knife, but not through seed. It produced distinctive local lesions in Gomphrena globosa after 5 to 6 days. Other local-lesion hosts were mentioned. Hydrangea ringspot was present in all commercial varieties tested. The majority of varieties were tolerant to this virus, and only Charm and Sainte Speer are known to be unsalable when infected. Tomato ringspot virus also was found to be transmitted from hydrangea to Gomphrena. No evidence was found that tomato ringspot virus is carried on the cutting knife or through seed of florists' hydrangea (Phytopath. 47: 39).

IRIS spp. IRIS: Puccinia iridis, rust. Varietal reaction suggested the possibility that a new race of P. iridis may have been concerned in an outbreak of rust observed in a Dutch iris variety test in North Carolina in 1954 (N. N. Winstead and others, PDR 40: 1112).

PAEONIA sp. PEONY: Leaf curl (virus) see under Wisteria.

PELARGONIUM spp. GERANIUM: In Connecticut, E. M. Stoddard described a Fusarium black rot of geranium cuttings and reported that both it and the bacterial black leg with which it has apparently been confused can be controlled by a mixture of oxyquinoline sulfate and streptomycin applied as a soil drench (PDR 41: 536).

Virus diseases. F. P. McWhorter reported virus diseases of geranium in the Pacific Northwest (PDR 41: 83).

PELARGONIUM HORTORUM. GERANIUM: Alternaria tenuis, leaf spot. According to D. E. Munnecke, geraniums growing in southern California fields during the winter are often severely affected with this leaf spot. The symptoms produced in artificial and natural infections are described and compared with those produced by Xanthomonas pelargonii (PDR 40: 452).

PHILODENDRON HASTATUM. PHILODENDRON: Leaf spot (physiological disorder). Leaves of Philodendron growing in the Los Angeles area often have exuding spots, frequently with necrotic centers. The spots and the sooty molds growing on the exudate often make plants unsalable, according to D. E. Munnecke and P. A. Chandler. Controlled laboratory and commercial greenhouse experiments indicated that the disease is due to stimulation by high temperatures of exudation from secretory cells located beneath the stomates. The saprophytic bacteria associated with the spots may be responsible for the necrosis. It is thought that the disease may be partially controlled by preventing extreme temperature rises during growth, and by application of fungicides to control the sooty molds that grow on the exudate (Phytopath. 47: 299).

POLYPODIACEAE. COMMON-FERN FAMILY: Smog damage to ferns in the Los Angeles area was reported by Ruth Ann Bobrov Glater. Studies to date indicated that Los Angeles smog is a complex of liquids, solids, and gases, comprising more than 50 chemical elements and compounds. Plant damage was considered to be due to certain intermediate peroxidic products resulting from the chemical combination of unsaturated hydrocarbons with ozone in the atmosphere. In the field, as well as under lath, fern leaves showed characteristic markings following a period of high smog intensity (Phytopath.46: 696).

RHODODENDRON spp. AZALEA: Paul E. Nelson and others reported occurrence of Ovulinia flower spot (Ovulinia azaleae) on Long Island, New York. According to one of the growers the disease is important at temperatures of 60° to 70° F, but the greatest loss occurred when the temperature was dropped to 50° to 60° to prevent the flowers from opening too soon (PDR 40: 1115).

ROSA spp. ROSE: Agrobacterium tumefaciens, crown gall, according to P. A. Ark and W. S. Sibray in California, causes significant losses in rose cuttings planted in soils heavily infested with the organism. Paul's Scarlet was found to be the most susceptible and Burr Multiflora the most resistant of the varieties used in experiments on control. Some control was obtained in the Manetti and Dr. Huey cuttings with streptomycin dips, but streptomycin dusts were not satisfactory. Tetracycline dips showed 67 percent control in Manetti and only 40 percent control in Paul's Scarlet (PDR 41: 451).

Diplocarpon rosae, blackspot. W. D. McClellan and others reported the relation of fungicide and miticide treatments to winter injury and spring blackspot development on roses (Phytopath. 47: 357).

Sphaerotheca spp., powdery mildew. R. S. Kirby compared results of Systox-lead arsenate, antibiotics, and sulfur for the control of powdery mildew of roses in Pennsylvania. The Systox-lead arsenate combination gave outstanding control throughout the season. (PDR 41: 534).

SAINTPAULIA IONANTHA. AFRICAN VIOLET: Botrytis cinerea, leaf rot. E. S. McDonough and R. J. McGray reported that during the course of a number of experiments designed to perfect a control of mites (apparently Tarsonemus pallidus), it was observed that elimination of mites also reduced growth of B. cinerea on African violet. Various conditions other than that caused by mite infestation would seem to favor growth of Botrytis on Saintpaulia. (Phytopath. 47: 109).

SOLANUM SARACHOIDES. HAIRY NIGHTSHADE: A sand-culture technique for the isolation of fungi associated with roots was reported by Stephen Wilhelm. After incubation in moist sterile sand, washed surface-disinfected roots were examined for resting or reproductive structures of fungi, which were then dissected or trapped out for further culturing or study. The most typical root fungus flora on the hairy nightshade, growing as a weed in strawberry fields of central coastal California, consisted of a number of pathogens better known on other hosts. Among these were Verticillium albo-atrum, pathogenic to strawberry; Colletotrichum atramentarium and Pyrenochaeta terrestris, pathogenic to onion and strawberry; Pythium ultimum, pathogenic to tomato; Macrophomina phaseoli; Fusarium roseum; a species of Phoma; and a sterile fungus pathogenic to strawberry (Phytopath. 46: 293).

STRELITZIA REGINAE. BIRD OF PARADISE: R. D. Durbin reported that hot-water seed treatment was effective for control of a troublesome root rot complex of bird-of-paradise plants. Control of the disease was not adequate at temperatures of 125° F and below. The best results were obtained using 135° for 30 minutes (PDR 40: 1116).

THALICTRUM DIOICUM. MEADOW RUE: Puccinia rubigo-vera var. tritici, (Puccinia recondita), leaf rust. In Minnesota, M. N. Levine and R. C. Hildreth reported a natural occurrence of the aecial stage of this fungus on T. dioicum, but stated that the significance of this discovery was entirely problematical (Phytopath. 47: 110).

WISTERIA sp. WISTERIA: Viruses. Wisteria mosaic and peony leaf curl are both caused by viruses that are transmissible by grafting but not by sap inoculation, according to Philip Brierley and Paul Lorentz (PDR 41: 691).

DISEASES OF SHRUBS AND TREES

G. G. Hahn reported results of investigations in this country on the life cycle and control of Phacidiopycnis pseudotsugae (Phomopsis pseudotsugae), a canker-dieback disease of conifers. Procedures to be followed in effecting control in the Northeast were outlined (PDR 41: 623).

ALBIZZIA JULIBRISSIN. MIMOSA: O. D. Morgan reported spread of mimosa wilt (Fusarium oxysporum f. perniciosum) in southern Maryland (PDR 41: 51).

CELTIS OCCIDENTALIS. HACKBERRY: Association of an eriophyid mite and a powdery mildew fungus with witches'-broom of hackberry in Illinois substantiates Kellerman and Swingle's early work but further study is needed to determine the exact cause of the disease, according to Robert Snetsinger and E. B. Himelick (PDR 41: 540).

CHAMAECYPARIS LAWSONIANA. PORT ORFORD CEDAR OR LAWSON CYPRESS: Phytophthora lateralis, root rot, has increased greatly along the southwest coast of Oregon in recent years and is now epiphytotic, according to E. J. Trione and L. F. Roth. In the summer of 1954 and in subsequent seasons aerial infections caused by Phytophthora were found on the foliage, branches and main stems of the cypress. Previously only root infection had been observed (PDR 41: 211).

FRAXINUS spp. ASH: Puccinia peridermiospora, ash rust, according to A. D. Partridge and A. E. Rich, has been reported as increasingly severe in the New England area. Greenhouse and field tests have indicated that 3 to 4 hours of high moisture conditions initiate basidiospore production, but that 6 to 8 hours of moist air and gentle air movement are necessary for infection of ash trees. The optimum temperature for basidiospore formation was found to be 54° to 70° F. Bordeaux mixture, dichlone, griseofulvin, Mycostatin, and ziram each partially controlled the disease (Phytopath. 47: 246).

JUNIPERUS COMMUNIS. COMMON JUNIPER: Phomopsis juniperovora, juniper blight, has been long recognized as a serious disease of 1- and 2-year-old junipers, as pointed out by N. E. Caroselli of the Rhode Island Agricultural Experiment Station. All chemicals tested afforded some control but those which consistently gave best results under the conditions of experiments in 1955 and 1956 were Kromad, Merbam, and WK-34 (PDR 41: 216).

LIQUIDAMBAR STYRACIFLUA. SWEETGUM: Leader dieback of sweetgum may result from infection by Diplodia theobromae under certain predisposing environmental conditions, according to successful inoculations reported by K. H. Garren (PDR 40: 1132).

LITCHI CHINENSIS. LITCHI TREES: M. Cohen reported that the most important disease of litchi trees in Florida is mushroom root rot, Clitocybe tabescens, which is present on both the east and west coasts. It has killed 25 trees in one grove on Merritt Island and destroyed many in the Sarasota area. It is also present in Pinellas County and has been reported from others. The planting on Merritt Island, consisting of 325 trees planted in 1947, was established on land from which oaks and pines had recently been cleared. The fungus had completely girdled the base of every dead litchi tree found and had spread along all the branch roots to a distance of 3 1/2 to 7 feet. The author recommended that sites for new litchi plantings should be selected in areas where oaks and other woody plants have been present for many years, or that all oak stumps and roots should be completely removed before planting. Fumigation of the soil was being tried (Florida Hort. Soc. Proc. 68: 329-332).

PINUS spp. PINE: E. Hacskaylo and J. C. Palmer reported studies on the effects of chemical soil treatments on mycorrhizal fungi and on growth of pine seedlings (PDR 41: 354). A. A. Foster reported a pathological survey of pine seedling nurseries in Georgia. Fusiform rust (Cronartium fusiforme) can be effectively controlled by spraying. Damping-off has been virtually absent in recent years, probably because of the use of a sawdust and pine straw cover. Cone rust (C. strobilinum) sometimes eliminates more than 60 percent of the slash pine (Pinus elliottii) cone crop and limits seed production. Practical control is not possible at present. The economic importance of Phomopsis juniperovora on Arizona cypress (Cupressus arizonica) has been recognized since this species is increasingly being used for Christmas trees. Both seed and soil were suspected of being sources of inoculum in the nursery. The rapid expansion of the pulp and paper industry in the Southeast has given new emphasis to the production of pine seedlings (PDR 40: 69).

Cronartium ribicola, white pine blister rust. E. P. Van Arsdel and others report studies on the effects of temperature and moisture on the spread of white pine blister rust, with particular attention to the production and germinability of spores of C. ribicola. The spread of blister rust in Wisconsin was limited principally by the lack of sufficient moisture for sporidial formation and germination. When periods of saturated air occurred, a prior period of 2 weeks with no 3 consecutive days over 28° C became important to provide production of fertile teliospores. For subsequent infection on pine, the period of 48 hours of saturated air required temperatures under 20° (Phytopath. 46: 307). The history of the white pine blister rust development in Northeastern America during the past 50 years has been traced by R. R. Hirt (Jour. For. 54 (7), 435-438, 1956).

Cronartium strobilinum, cone rust. F. F. Jewell reported the prevention of cone rust on slash pine, P. elliottii, by pollination techniques used in breeding programs. His data suggested that infection of slash pine cones by this fungus occurs during the pollinating period and that the standard practice of bagging cone flowers protects them from infection (Phytopath. 47: 242).

B. T. Chitwood and others described a new genus, Meloidodera, with the type species M. floridensis, parasitic on roots of the southern slash pine in Florida. They considered the nematode to be a link between Heterodera and Meloidogyne (Phytopath. 46: 264). Reproduction and increase of this nematode in slash pine seedlings apparently did not injure the host, according to pathogenicity tests reported by B. G. Chitwood and R. P. Esser in Florida (PDR 41:603).

Charles L. Fergus described an extreme fasciculation of pine cones. The cause of the hypertrophy was unknown (PDR 40: 752).

PLATANUS spp. SYCAMORE, PLANE TREE: Gnomonia veneta, anthracnose. H. D. Snyder reported single-spray control for G. veneta on Platanus occidentalis and P. acerifolia. Favorable results were obtained in 1955. In 1956, 31 American sycamore and 118 London plane trees were sprayed with a "delayed dormant" application of PMAS. Complete defoliation of sycamore trees was uncommon in New Jersey in 1956. Only three sprayed specimens, 75 to 100 feet in height, were moderately affected (Phytopath. 47: 246).

POPULUS TREMULOIDES. ASPEN: Hypoxylon canker of aspen. R. L. Anderson gives a popular account of the symptoms, life-cycle, distribution and control of Hypoxylon canker (H. pruinatum) of aspens. The disease is particularly common in Michigan, Wisconsin, and Minnesota (For. Pest Leaflet U. S. Dept. Agri. 6, 33 pp. 1956).

QUERCUS spp. OAK: Ceratocystis fagacearum (Endoconidiophora fagacearum), oak wilt. T. W. Bretz and T. W. Jones reported that inoculation of oak flowers with the oak wilt fungus resulted in infection of the trees (PDR 41: 545). On the other hand the wilt fungus was not found in acorns from a wilt-infected oak tree according to Bretz and W. D. Buchanan. To check if the activity shown by cultured embryos was a response to injury, acorns from a disease free black oak were plated in culture dishes. These embryos remained dormant and no "scar" tissue developed on the injured cotyledons (PDR 41: 546). Evidence of autumn infection by the oak wilt fungus in Pennsylvania was presented by W. J. Stambaugh and J. C. Nelson (PDR 40: 750).

Wilt development, host-parasite relationships, and symptom expression in bur oak (Q. macrocarpa) inoculated with C. fagacearum were studied and compared with those in infected pin oaks (Q. palustris). Major differences were attributed to the more rapid spread and corresponding general distribution of the fungus through pin oak trees as compared with generally slow spread and corresponding limited distribution of the fungus through bur oaks (J. R. Parmeter and others, Phytopath. 46: 423).

W. D. Buchanan reported evidence suggesting that the Brentid, Arrhenodes minuta, may have a role in the spread of the oak wilt disease (PDR 41: 707). Experiments made during 1953 and 1954 demonstrated that artificially contaminated nitidulids caged on suitable wounds are capable of bringing about infection of healthy oaks. Species of Nitidulidae used in successful inoculations are listed. All positive cases of insect transmission resulted from inoculations made in May and early June. Many species of insects present on the mats were the same as those found in fresh wounds. Apparently a symbiotic relationship existed between Nitidulidae and Graphium rigidum and Ophiostoma pluriannulata; the fungi are disseminated by the nitidulids, which in turn receive nutritional benefits from the two fungi. It is suggested that these two fungi are the original fungus members of the symbiotic relationship and that the oak wilt fungus is a relatively recent member. If this theory is correct, the association with C. fagacearum can be expected to become more general as time passes, with a corresponding increase in rate of spread of oak wilt. This probable increase in the association of C. fagacearum with the Nitidulidae further justifies efforts now being made to bring the disease under control as promptly as possible (Frederick F. Jewell, Phytopath. 46: 244). W. J. Stambaugh and C. L. Fergus concluded from their studies that conidial inoculum picked up by insects from mycelial mats produced in the fall fails to survive the winter on hibernating insects, whereas ascospore inoculum remains viable (PDR 40: 919).

Bert M. Zuckerman reported effects of X-rays on the germination of conidia of the oak wilt fungus (Phytopath. 47: 361). John S. Boyce, Jr. pointed out that sampling of suspected oak wilt trees by means of the increment hammer is easier and more rapid than by the usual pruning or chopping methods (PDR 40: 822). W. H. Gillespie and others reported that fall examination of 117 oaks which had shown symptoms during the summer of 1956 and from which C. fagacearum had been isolated gave further proof of the effectiveness of the deep-girdle method of controlling overland spread of oak wilt (PDR 41: 362).

E. R. Toole reported the amount of infection in bottomland red oak trees (Q. phellos and Q. nuttallii) observed two years after inoculation with Fomes phellos, Polyporus fissilis, and P. hispidus (PDR 40: 823).

C. L. Fergus reported that oak trees with roots decayed by Polyporus dryadeus may be more susceptible than unaffected trees to unfavorable environmental conditions (PDR 40: 827).

C. L. Fergus and J. E. Ibberson reported that some unknown factor was causing extensive dying of oak trees in Pennsylvania (PDR 40: 749). In August 1953, according to W. H. Gillespie reports were received of an unexplained dying of scarlet oak (Q. coccinea) in parts of West Virginia. Symptoms suggested drought injury. A similar condition had been reported in Pennsylvania, New Jersey, and New York and also was observed in parts of western Virginia during the summers of 1953, 1954, and 1956. The cause of the disease has not been determined. The author presented information related particularly to the symptoms and distribution of the disease (PDR 40: 1121).

Frost cracks, the radial splitting of tree trunks caused by sudden pronounced temperature drops, are commonly found in the northern hardwood forests, according to Charles L. Fergus. Little specific information on their importance is available. To obtain information as to their importance, about which little is known, observations were made in a central Pennsylvania woodlot. Cracks were more frequent on large trees than on smaller ones. A rather large proportion of the dominant trees had frost cracks. Many cracks heal over but the defects in the logs remain. Furthermore, healed cracks may reopen thus providing avenues of entrance for fungi that cause wood decay, wilt, or cankers (Phytopath. 46: 297).

ULMUS spp. ELM: Ceratocystis ulmi, Dutch elm disease. I. R. Schneider reported that addition of streptomycin sulfate and cycloheximide to the culture medium inhibited growth of contaminants and aided identification of the Dutch elm disease organism (PDR 40: 816). In experiments reported by A. W. Englehard common salt did not control the Dutch elm disease (PDR 40: 1005). Spread of the Dutch elm disease in North America during 1956 was reported by Francis W. Holmes. New locations were found in Delaware, Maryland, West Virginia, and Kentucky. For the first time cultures of the fungus were obtained from elms in Wisconsin (PDR 41: 634). According to R. J. Campana and J. C. Carter Dutch elm disease continued to spread into new areas of northern and western Illinois during 1955 and 1956, and increased in areas previously affected. Observations suggested that where Dutch elm disease follows the virus disease phloem necrosis, it not only exceeds the latter in the rate of increase, but obscures the presence of phloem necrosis (PDR 41: 636). H. E. Reed and H. L. Bruner reported widespread occurrence of the disease in Knox County, Tennessee (PDR 40: 756).

DISEASES OF SPECIAL CROPS

AGARICUS CAMPESTRIS. MUSHROOM: Dactylium dendroides, mildew. R. N. Goodman reported results from organic fungicides Terraclor and Dowicide A, and antifungal antibiotics Actidione, Anisomycin, Griseofulvin, Rimocidin, and Oligomycin applied as drenches to mushroom beds for control of "mildew". Terraclor at either 500 or 1000 ppm proved highly effective in controlling the disease. In addition this material was found to be equally effective against "lipstick" mold, Geotrichum sp. (PDR 40: 714).

E. B. Lambert and T. T. Ayers reported that most mushroom pests were killed by exposure to a moist heat of 130° F for 16 hours, 140° for 6 hours, or 150° for 4 hours. Exceptions were Papulaspora byssina, Chaetomium spp., and Diehliomyces microspora. The thermal death times reported did not apply to pests under dry conditions, since several of the organisms were more easily killed with heat under moist conditions than when dry (PDR 41: 348).

ARACHIS HYPOGAEA, PEANUT: K. H. Garren and G. B. Duke reported studies showing that weed-control methods affect yield of peanuts as well as incidence of stem rot (Sclerotium rolfsii) in Virginia (PDR 41: 424).

BETA VULGARIS. SUGAR BEET: Yellow vein disease (? virus). According to C. W. Bennett a disease of sugar beet characterized by yellowing of veins of the leaves, dwarfing of one side of the plant in early stages of infection, and stunting of the entire plant in later stages of development, has been reported in Arizona, California, Colorado, Kansas and New Mexico. Infected plants are damaged severely but the incidence of infection has been low, so far as reported. The causal agent is graft-transmissible in sugar beet and apparently is a virus. It was not transmitted by juice inoculation and no transmission was obtained with the common insects (PDR 40: 611).

DIOSCOREA FLORIBUNDA. YAM: Meloidogyne spp. Preliminary experiments reported by W. O. Hawley at Glenn Dale, Maryland indicated that the hot-water treatment will eliminate root knot nematodes from infected dioscorea roots. In the process of developing a crop for the production of cortisone in the United States, a large number of species of Dioscorea are cultivated at Glenn Dale (PDR 40: 1045).

GOSSYPIUM spp. COTTON: The fifth report of the Committee on Cotton Disease Losses, of the Cotton Disease Council, lists the estimated losses to the cotton crop from diseases in 1956 (PDR 41: 124).

Marvin D. Whitehead and Norman E. Brown reported results obtained from in-the-furrow application of fungicides to control the cotton seedling disease complex, damping-off and nub-root in Missouri (PDR 41: 419).

D. C. Erwin and others reported the effect of some fungicides on seedling diseases of cotton in the irrigated desert valleys of Southern California (PDR 41: 324).

L. S. Bird and others discussed some of the difficulties involved in controlling the cotton seedling-disease complex by mixing fungicides with the covering soil at planting time. Tests were made on sandy and clay soil types in Texas in 1955 and 1956 (PDR 41: 165).

In Louisiana, Fusarium oxysporum f. vasinfectum, wilt, development was studied in cotton growing in steam-sterilized soil artificially infested with populations of nematodes alone, with the fungus alone, and with combinations of nematodes and Fusarium. Pure populations of Meloidogyne incognita, M. incognita acrita, Trichodorus sp., Tylenchorhynchus sp. and Helicotylenchus sp. were used. The nematodes reproduced abundantly on cotton varieties Deltapine 15 (wilt-susceptible) and Coker 100 Wilt (wilt-resistant). Of the five nematodes used in the tests, only Meloidogyne incognita and M. incognita acrita significantly increased incidence of wilt in the two varieties. Severe injury to the cotton was recorded as a result of infestations of Meloidogyne only. Little or no injury was caused by the other three genera (W. L. Martin, L. D. Newsom, and J. E. Jones, Phytopath. 46: 285).

Host-parasite relationships of the lance nematode (Hoplolaimus coronatus) in cotton roots were investigated by L. R. Krusberg and J. N. Sasser. Under low moisture conditions cotton plants in the field were severely stunted, yellowed, and almost completely defoliated in heavily infested areas. Populations of the nematode increased on cotton in the greenhouse, with little stunting of the plants. Seed germination was not affected by the nematode. In the absence of a host plant the nematode did not reproduce. Apparently it cannot live as a saprophyte (Phytopath. 46: 505).

Rhizoctonia solani, damping-off. Field surveys to determine the cause of a cotton seedling disease in Arizona indicated that the presence of the cotton root-knot nematode, Meloidogyne incognita acrita, affects the incidence of post-emergence damping-off of cotton, primarily caused by the fungus R. solani. Field surveys and experiments showed that an increase in Rhizoctonia disease was associated with an increase in the incidence of root-knot nematodes (H. W. Reynolds and R. G. Hanson, Phytopath. 47: 256).

Leaf scald. Conditions under which cotton leaf scald occurs indicated that the injury is associated with midday rain showers followed by bright sunshine. The relation of wind to scald was also clearly indicated (PDR 40: 802).

Seedling necrosis. In Texas, C. D. Ranney and L. S. Bird reported that different combinations and rates of five fungicides were tested at two soil temperatures as possible control measures for cotton seedling necrosis. Evidence indicated that temperature does not affect the fungicidal materials directly but rather that the effect is to change the soil microflora. Pre-emergence damping-off was more severe at 70° than at 80° F, while post-emergence necrosis was higher at 80° than at 70° (PDR 40: 1032).

MENTHA PIPERITA. PEPPERMINT: According to C. A. Thomas and R. E. Webb Verticillium albo-atrum is considered to be the most serious disease of peppermint in Indiana and Michigan. They reported peppermint wilt induced by a Verticillium isolate from potato. So far as known this is the first report of a Verticillium isolate capable of inducing wilt symptoms in peppermint as well as in potato and tomato. This work and previous reports indicated that such strains of V. albo-atrum are not common (Phytopath. 46: 238).

NICOTIANA spp. TOBACCO: The Colletotrichum sp. associated with tobacco anthracnose has a wide host range, according to results of cross inoculations reported by O. D. Morgan, Jr. (PDR 40: 908).

Fusarium oxysporum var. nicotianae, Fusarium wilt. O. D. Morgan found that when rootknot nematodes (Meloidogyne spp.) and Fusarium wilt were both present, control of the nematode by soil fumigation was a definite factor in control of the wilt also (PDR 41: 27). At the Pee Dee Experiment Station in South Carolina, Q. L. Holdeman reported that the incidence of infection by F. oxysporum var. nicotianae in the susceptible Oxford 1-181 tobacco variety was increased by joint inoculation with the fungus and the tobacco stunt nematode, Tylenchorhynchus claytoni, as compared with the fungus alone. He pointed out that the presence or absence of the nematode in the soil may be one of the factors involved in the erratic development of the fungus in the field (Phytopath. 46: 129).

Meloidogyne spp. In South Carolina, T. W. Graham reported that surface drench applications with Vapam, Mylone, and N521 used alone and in combination with calcium cyanamid gave effective weed and nematode control in tobacco plant beds in 1955 and 1956 tests (PDR 40: 1041).

Peronospora tabacina, blue mold. According to reports to the Plant Disease Warning Service, blue mold of tobacco was reported present in Connecticut, Florida, Georgia, Kentucky, Maryland, Massachusetts, North Carolina, South Carolina, Tennessee, and Virginia. Damage from blue mold in 1956 was for the most part very light owing to either one or a combination of factors: 1) late appearance of initial outbreak; 2) unfavorable weather conditions for development after first appearance; 3) general and widespread use of fungicides. Ferbam and zineb gave good control, and in some areas maneb. The use of streptomycin was recorded in Massachusetts. Saul Rich and G. S. Taylor concluded that cottonseed oil may be safely mixed with certain organic fungicides for spraying tobacco foliage. It is possible that these formulations may be used successfully on other crops (PDR 41: 465). P. J. Anderson reported that on replicated, inoculated plots in tobacco beds, both streptomycin and Dithane Z-78 sprays gave good control of blue mold. The results suggested that both of these materials are fungistatic rather than fungicidal (Phytopath. 46: 240).

Results of the studies of resistance to black shank (Phytophthora parasitaca var. nicotianae) within the genus Nicotiana are reported by William Lautz (PDR 41: 95).

Pseudomonas tabaci, wildfire. In North Carolina spraying with streptomycin nitrate effectively controlled wildfire in tobacco plant beds in trials reported by Luther Shaw and others in 1956 (PDR 41: 99).

Thielaviopsis basicola, black root rot. William Lautz reported that treatment of black root rot-infested soil with Vapam, chlorobromopropene, and allyl bromide effectively controlled the disease (PDR 41: 174).

Viruses. In Wisconsin Carlos Garces-Orejuela and G. S. Pound reported the multiplication of tobacco mosaic virus in the presence of cucumber mosaic virus or tobacco ringspot virus in tobacco (Phytopath. 47: 232).

RICINUS COMMUNIS. CASTORBEAN: Tobacco ring spot virus. Castorbean was found to be susceptible to tobacco ring spot virus but not to nine other viruses with which it was inoculated. This virus was not transmitted with seed from infected plants. There were three distinct types of reaction. In varieties such as Cimarron leaf symptoms were accompanied by only slight necrosis of the epicotyl in a few plants and recovery was general; in the group represented by U. S. 49 there was extensive internal necrosis of the hypocotyl followed by death of the plants; in other varieties, such as Conner, reaction was intermediate, characterized by early killing of the growing plant (A. A. Cook, PDR 40: 606).

SACCHARUM OFFICINARUM. SUGARCANE: According to Wray Birchfield and W. J. Martin, an ectoparasitic nematode of the genus Tylenchorhynchus was found associated with diseased sugarcane roots in Louisiana. The nematode was found to reproduce on two varieties of soybean which are used in the sugarcane crop-rotation program, and on Johnson grass, which is a noxious weed in sugarcane fields of Louisiana. Other hosts included rice and sweetpotato (Phytopath. 46: 277).

DISEASES OF VEGETABLE CROPS

ALLIUM CEPA. ONION: Recent outbreaks of onion bloat, caused by Ditylenchus dipsaci, in southern New York were attributed to the planting of infected onion sets produced in the Midwest. No infestations due to infected sets occurred in 1955, presumably because of cooperation with the distributors of sets and the inspection of sets shipped to southern New York (G. D. Lewis. PDR 40: 271).

Peronospora destructor, downy mildew. S. Z. Berry and G. N. Davis reported observations on the production and germination of the downy mildew fungus which may explain occurrence of the disease in the absence of other known sources of primary inoculum (PDR 41: 3).

BRASSICA OLERACEA var. BOTRYTIS. BROCCOLI: Peronospora parasitica, downy mildew. The influence of insecticide and fungicide sprays on downy mildew of broccoli was reported by J. J. Natti and G. E. R. Hervey. Control of broccoli downy mildew in their own tests with Agri-mycin,together with the reported control of blue mold of tobacco with streptomycin,suggests that streptomycin is effective against the Peronosporaceae (Phytopath. 46: 242).

BRASSICA OLERACEA var. CAPITATA. CABBAGE: Fusarium oxysporum f. conglutinans, yellows. J. C. Walker and others reported Badger Ballhead, a new cabbage variety resistant to yellows and mosaic, derived from a cross between Wisconsin Ballhead and Wisconsin Hollander (Phytopath. 47: 269).

Pseudomonas cichorii, bacterial zonate spot, according to M. A. Smith and G. B. Ramsey, is unlike any bacterial disease previously seen on the Chicago market. The organism proved pathogenic to certain members of the Cruciferae and the Cucurbitaceae as well as to potato, tomato, pepper, bean (green), pea, beet, onion, head lettuce, and witloof chicory (Phytopath. 46: 210).

CAPSICUM FRUTESCENS. PEPPER: Meloidogyne incognita acrita, root knot. A collection of 162 varieties or strains of pepper was tested for reaction to the root-knot nematode, according to W. W. Hare. Tests were conducted in infested soil in a greenhouse bench. No variety was found to be immune, four were grouped as resistant, 14 as moderately resistant, and 135 as susceptible. Nine were not rated. In large scale tests, commercial bell varieties did not differ in degree of susceptibility. Apparently resistant individuals in susceptible lots were demonstrated to be primarily escapes (Phytopath. 46: 98).

In Mississippi, W. W. Hare reported the comparative resistance of seven pepper varieties to five root-knot nematodes, Meloidogyne incognita, M. incognita acrita, M. javanica, M. arenaria, and M. hapla (Phytopath. 46: 669).

Cucumber mosaic virus. John N. Simons reported that at least three strains of this virus were present in California Wonder pepper (C. frutescens) in the Everglades area of southern Florida. Southern cucumber mosaic virus was most prevalent. A second strain caused necrotic oak-leaf patterns on older pepper foliage and at times induced a reddish or yellowish fruit blistering. The third, least common, strain produced a calico-like foliage mottle with no apparent fruit symptoms. All three strains apparently were transmitted in a nonpersistent manner by the cotton aphid, Aphis gossypii, and the green peach aphid, Myzus persicae (Phytopath. 47: 145).

CUCURBITS. CUCUMBER, MELON, SQUASH: Occurrence and fungicidal control of watermelon foliage diseases in Florida were reported by J. M. Crall and N. C. Schenck (Phytopath. 47: 312).

Reports received by the Plant Disease Warning Service stated that in South Carolina Alternaria was present in severe form on cantaloupes and caused serious economic damage.

The cucumber anthracnose (Colletotrichum lagenarium) can be transmitted by the spotted cucumber beetle (Diabrotica undecimpunctata howardi) and occasionally with seeds, but soil infestation apparently is not a factor in initial infection, according to Louisiana experiments reported by N. L. Horn and others (PDR 41: 69).

Erysiphe cichoracearum, powdery mildew, of cucumbers is seldom of any importance in the Southeastern States, according to W. C. Barnes and W. M. Epps. South Carolina introductions and numerous breeding lines of cucumbers possess a high degree of resistance to powdery mildew (PDR 40: 1093).

Fusarium oxysporum f. cucumerinum n. f. The results of cross-inoculation tests at the University of Florida, with the Fusarium spp. causing wilt of cucumber, watermelon, and muskmelon, have been published (Phytopath. 45: 435). Since the form from cucumber differed in pathogenicity from those on watermelon and muskmelon, it has been described as a new form (Phytopath. 46: 153).

S. D. Van Gundy and J. C. Walker reported studies on the transmission, overwintering, and host range of the cucurbit angular leaf spot (Pseudomonas lachrymans). The fungus infected all species of cucurbits tested but symptoms were most severe in field and greenhouse on cucumber and Cucumis anguria (PDR 41: 137).

The susceptibility of cucumber as a host of Pseudomonas lachrymans was found to be in part dependent upon the relative level of amino nitrogen in the leaves, according to S. D. Van Gundy and J. C. Walker. Mature leaves were most resistant; leaves approaching maturity were most susceptible (Phytopath. 47: 35).

N. N. Winstead and others reported reactions of some 300 watermelon plant introductions and certain other varieties and breeding lines to downy mildew (Pseudoperonospora cubensis) in North Carolina (PDR 41: 620).

The Plant Disease Warning Service reported that in 1956 downy mildew of cucurbits occurred in the Atlantic Coast Seaboard States as far north as Massachusetts, and was also found in Kentucky. In Delaware downy mildew and anthracnose were severe on watermelon. In North Carolina downy mildew reduced yields of poor quality melons in the Castle Hayne area.

Ringspot virus. A mechanically transmitted virus was found constantly associated with pimples disease of watermelons in Oklahoma, according to R. J. Shepherd and F. B. Struble. This virus was identified as a yellow strain of the tobacco ringspot virus. It was transmitted from watermelon to watermelon in 1 of 48 trials by the differential grasshopper (Melonaplus differentialis) but not in any of 45 trials with melon aphids (Aphis gossypii). There was no evidence of transmission of this virus by watermelon seed (Phytopath. 46: 358).

In New York, R. M. Gilmer and K. D. Brase reported that the cucumber proved superior to several Prunus spp. tested as indexing hosts for stone fruit viruses (PDR 40: 767).

Western aster yellows (virus). J. H. Freitag reported that the high incidence of the disease on cucurbits prompted the study of the cause. The explanation for this high incidence and for the apparent sudden appearance of aster yellows virus on cucurbits and certain other host plants not previously recognized to be hosts of the virus is not known. The author suggests that perhaps a new strain of virus has developed; however, the virus recovered from naturally infected cucurbits does not appear to differ from western aster yellows virus as known for over 25 years in California. The most likely explanation is that during previous years environmental conditions resulted in such a low incidence of the disease that it has been unnoticed. During the past three years the high incidence might possibly be explained by environmental conditions favorable to high leafhopper populations, although no data were collected on insect numbers during the years in question (Phytopath. 46: 323).

IPOMOEA BATATAS. SWEETPOTATO: Internal cork (virus) was discovered in 1944 in South Carolina and has since spread to all the sweetpotato growing States and Territories of the United States. Recently developed indexing methods should make the investigation of this disease much easier (E. M. Hildebrand, PDR 40: 289). In 1955-56 the United States Department of Agriculture directed a survey study on the incidence, severity, and extent of dissemination of sweetpotato internal cork virosis in the 1955 crop in 21 States. E. M. Hildebrand and others analyzed the findings of this survey (PDR 40: 1097). E. M. Hildebrand reported that mechanical transmission of sweetpotato internal cork virus was aided by cysteine (Phytopath. 46: 233).

Ceratocystis fimbriata, black rot. E. M. Hildebrand described the procedure used to evaluate resistance of sweetpotato varieties and selections to black root rot, which is still one of the most destructive and widespread diseases of sweetpotatoes in the United States (PDR 41: 661).

IPOMOEA BONA-NOX x I. HEDERACEA. SCARLETT O'HARA MORNING GLORY: In extensive tests since 1954 at the Plant Industry Station, Beltsville, Maryland, E. M. Hildebrand reported that the Scarlett O'Hara morning glory was demonstrated to be a remarkably good indexing host for the sweetpotato internal cork virus (Science 123: 506, 3195, 1956).

LACTUCA SATIVA. LETTUCE: Bremia lactucae, downy mildew. R. S. Cox reported that excellent control was obtained over a two-year period with zineb and during one year with maneb. Other materials were either less effective or were objectionable because of phytotoxicity. He suggested that in disease control investigations more attention should be given to the effects of phytotoxicity on yield and quality (PDR 41: 455).

Fertilizer injury and its relationship to several previously described diseases of lettuce was reported by R. G. Grogan and F. W. Zink (Phytopath. 46: 416).

Rib discoloration, or rib blight. R. B. Marlatt and others in Arizona reported that when rib-discolored head lettuce was stored at 37°, 47°, and 50° F, the lesions became dark brown and then black at all storage temperatures. Neither the size nor the number of lesions increased significantly during storage. They pointed out that lettuce with rib discoloration was more susceptible to decay than was normal lettuce and also had a greater tendency to develop symptoms of pink rib (Phytopath. 47: 231).

LYCOPERSICON ESCULENTUM. TOMATO: A. J. Lemin and W. E. Magee reported that antifungal properties detected in leaves of tomato plants treated with cycloheximide acetate absorbed through roots are probably due to formation of free cycloheximide in the leaves (PDR 41: 449).

Alternaria solani, early blight. Curt Leben and others described a small-scale field test for the evaluation of fungicides in the control of tomato early blight. A high level of artificial inoculum was maintained by weekly applications. Bimonthly applications were less effective. Four proprietary fungicides were tested for two seasons, and the antibiotic oligomycin for one. It was pointed out that the method has merit in that land, labor, equipment, and chemical test requirements are small (Phytopath. 46: 333).

Botrytis cinerea, gray mold. In experiments reported by R. S. Cox and N. C. Hayslip several materials gave effective control. Evidence showed that repeated spraying with nabam (plus metal salts), and possibly other materials, resulted in increased gray mold incidence on stems, leaves and fruit. The high yield in the thiram-sprayed plots was attributed to control of gray mold and Rhizoctonia fruit rot without phytotoxicity (PDR 40: 718).

Cladosporium fulvum, leaf mold. In Massachusetts, E. F. Guba reported success in breeding red forcing tomatoes for resistance to this mold. The work on this project has brought advantage and security to the tomato forcing industry in New England (PDR 40: 647).

The relationship between overhead irrigation and the incidence, severity, and control of certain tomato diseases was investigated in field plot experiments. Maneb and zineb gave significant control of anthracnose (Colletotrichum phomoides) under both irrigated and non-irrigated conditions, but maneb was more satisfactory than zineb under irrigation. Both materials appeared to decrease the severity of blossom-end rot in non-irrigated plots, but neither material gave control of fruit rot (Rhizoctonia solani) (D. F. Crossan and P. J. Lloyd, PDR 40: 314).

Fusarium oxysporum f. lycopersici, wilt. W. R. Jenkins and B. W. Coursen reported experimental evidence suggesting that root-knot nematodes increase the incidence of Fusarium wilt in wilt-resistant varieties such as Rutgers and Chesapeake. In varieties lacking resistance, such as Red Beefsteak, wilting is not more severe or more rapid in the presence of these nematodes (PDR 41: 185). Glenn E. Smith reported inhibition of F. oxysporum f. lycopersici by a species of Micromonospora isolated from tomato, in Ohio (Phytopath. 47: 429).

Meloidogyne spp. I. J. Thomason and P. G. Smith discussed inheritance in a tomato line (HES 4857) of resistance to M. javanica and M. incognita var. acrita (PDR 41: 180).

Phytophthora spp., buckeye rot. Comparative control of buckeye rot of tomato by various fungicides was reported by J. D. Wilson. This disease has occurred only sporadically in Ohio. In an experimental planting sprayed for the control of anthracnose fruit rot at Wooster in 1955, the best control of buckeye rot was furnished by captan, followed by maneb. Ziram gave very poor control, but when half of it was replaced with a fixed copper in a tank-mix formulation markedly increased control of the disease resulted (Phytopath. 46: 511).

Phytophthora infestans, late blight. In the 1956 season, late blight of potato and tomato was reported to the Plant Disease Warning Service from many States and from Canada. Severity depended upon local conditions. No blight was found in either green-wrap or transplant tomato areas in Georgia where disease incidence as a whole was very light. Revocation of certification was generally due to the physical condition of the plants and to nematode infestation. Poor weather and bad growing conditions throughout the season brought about a shortage of tomato transplants. Experimental forecasting attained a wider scope this year with the addition of forecasts for the Hendersonville Mountain area of North Carolina and for East Tennessee.

In a plastic greenhouse near Blacksburg, Virginia, excessive moisture during cold weather resulted in an outbreak of tomato late blight, described by C. W. Roane, and P. H. Massey, Jr. The bottled gas heating units now being used in plastic houses do not have the capacity to permit proper ventilation during sub-freezing weather (PDR 40: 313).

Rhizopus nigricans, rot. E. E. Butler reported that in three tests copper-treated fruit wraps failed to reduce the spread of R. nigricans from fruit to fruit in green-wrap tomatoes significantly (PDR 41: 474).

Blossom-end rot. A new method of controlling blossom-end rot of tomatoes, developed at the Gulf Coast Experiment Station, Bradenton, Florida, has proved completely successful in field and greenhouse trials, according to C. M. Geraldson. It is based on the concept that the primary cause of the condition is calcium deficiency. The principal objective is maintenance of the calcium level in the soil solution at over 20 percent of the total soluble salts during the entire growing season. To do this ability to recognize the factors tending to depress calcium content is necessary, so that cultural practices can be adjusted as required (Florida Hort Soc. Proc. 68: 197-202, 1955).

Internal browning. In Pennsylvania, D. C. Wharton and J. S. Boyle reported on the pathological histology of the internal browning disease of the tomato. Abnormalities of field-grown tomato fruits affected with internal browning were studied histologically by means of unstained hand sections and stained microtome sections (Phytopath. 47: 208).

Rosette (virus complex). G. R. Doering and others have recorded the observation that tomato rosette disease is caused by a mixture of two distinct viruses, rather than by a single strain of tobacco mosaic virus as originally supposed. The disease was first observed in tomato fields in southwestern Virginia. The two viruses that in combination cause rosette are the tomato rosette strain of tobacco mosaic virus and the highly instable virus, referred to as shoestring virus, not identifiable with any heretofore described (Phytopath. 47: 310).

PHASEOLUS spp. BEAN: A. D. Davison and J. R. Vaughn reported results of screening tests with various established and experimental organic chemicals, including antibiotics, against isolates of bean root rot fungi (PDR 41: 432).

Corynebacterium flaccumfaciens, bacterial wilt. D. W. Burke and C. E. Seliskar reported that cultivator damage increased incidence of some stem and root diseases of bean in Colorado (PDR 41: 483). A study was conducted by D. W. Burke to determine the influence of soil type and cropping history on the incidence of bacterial wilt in pinto bean fields. The disease is usually found in beans grown in coarse-textured, sandy soil (PDR 41: 671).

Pellicularia filamentosa, root and stem rot. D. W. Burke reported for the first time the basidial stage of Pellicularia filamentosa on bean plants in the usually dry climate of the Rocky Mountain region. The fungus was found on many plants in fields near Greeley, Colorado, and in an experimental bean plot at Cheyenne, Wyoming, in September 1956 (PDR 41: 533).

C. M. Leach and Merle Pierpont reported seed transmission of Rhizoctonia solani in bean seed (PDR 40: 907).

Sclerotinia sclerotiorum, Sclerotinia wilt or white mold. Aerial spread by ascospores was mainly responsible for the increased prevalence of Sclerotinia wilt in bean fields in northeastern Colorado in 1956, according to D. W. Burke and others (PDR 41: 72).

PHASEOLUS LIMENSIS. LIMA BEAN: Phytophthora phaseoli, downy mildew. R. A. Hyre reported that a method has been developed for forecasting downy mildew of lima bean from rainfall and temperature data (PDR 41: 7). In greenhouse experiments streptomycin in various formulations gave good control of lima bean downy mildew; better protection resulted from a spray containing equal parts of Agri-mycin 500 and neutral copper than from either component alone (W. J. Zaumeyer and R. E. Wester, PDR 40: 776). Maneb gave best results of several materials tested for control of downy mildew in trials reported by D. F. Crossan and others (PDR 41: 156). According to reports of the Plant Disease Warning Service extremely accurate forecasting of the appearance and spread of downy mildew of lima bean in Delaware and the Eastern Shore of Maryland was obtained with the use of the mildew forecasting scheme devised by R. A. Hyre. Excellent control was obtained this year when infected lima beans were sprayed twice with tribasic copper sulfate.

Pseudomonas syringae, bacterial blight. Studies on this disease of lima bean were made by Maung M. Thaung and J. C. Walker in Wisconsin. The organism was shown to be present commonly on lima bean seed grown in the United States west of the Continental Divide. It survived in the soil during a Wisconsin winter and throughout the growing season (Phytopath. 47: 413).

PISUM SATIVUM. PEA: J. L. Lockwood and others summarized surveys that were made in 1955 and 1956 to determine the causes, prevalence, and severity of pea diseases in Michigan. Root rots proved to be by far the most important group of diseases in both years (PDR 41: 478).

Pea enation mosaic virus. F. L. McEwen and W. T. Schroeder reported experiments in which the host range of pea enation mosaic virus was studied to determine possible overwintering hosts for the virus in New York. The pea aphid (Macrosiphum pisi) was used as a vector and 14 species of the family Leguminosae were tested. Plants found susceptible included alfalfa, clover, vetch, broad bean, rough peavine, and garden pea (PDR 40: 11).

D. J. Hagedorn reported a previously undescribed nonparasitic disease of canning peas, due to water congestion, which occurred in Wisconsin. Controlled experiments indicated that the disease developed most rapidly and severely under conditions of high temperature, high soil moisture, and high relative humidity (Phytopath. 47: 14).

SOLANUM spp. Heterodera rostochiensis, golden nematode. Effects of seasonal variation in soil temperature and moisture on reproduction of the golden nematode were studied by J. M. Ferris and W. F. Mai (PDR 40: 966). In New York, J. M. Ferris reported the effect of soil temperature on the life cycle of the golden nematode in host and nonhost species. Soil temperature had a marked effect on the life cycle in the three host species of Solanum studied; in the single nonhost species of Solanum studied, temperature had only a slight effect (Phytopath. 47: 221).

SOLANUM TUBEROSUM. POTATO: J. F. Malcolmson and R. Bonde reported further tests with antibiotics and fungicides for control of bacterial and fungous decay of potato seed pieces. Tests with different antibiotics did not show any to be effective against both bacterial and fungous decay. Good control of the fungous rots were obtained with Rimocidin sulfate alone and in combination with Agrimycin 100 (PDR 40: 708).

R. D. Shealy reported that in 1955, a stem rot disease of Irish potato was severe in Ohio. Apparently, aboveground plant parts were invaded by the pathogen, but decay might extend into the roots. A bacterium that was isolated repeatedly, in 1955 and 1956, from diseased tissue incited the disease on plants in the field and greenhouse. Tubers were planted in soil collected in early March 1956, from fields in which the disease had been severe in 1955. Symptoms of the disease developed on plants growing in this soil in the greenhouse. No resistant potato varieties have been found (Phytopath. 47: 31).

Alternaria solani, early blight. In Colorado, N. R. Gerhold described a successful field technique for artificial inoculation of potato with A. solani (PDR 41: 135).

Erwinia atroseptica, black leg. Working at the Science Service Laboratory at Charlottetown, Maine, D. B. Robinson and R. R. Hurst studied the use of antibiotic treatments against black leg of potatoes. Severe attacks usually result from seed infection in Maine. With Agristrep and AS-15 agricultural streptomycin as an instant dip for seed pieces, infection was reduced from 28.5 percent in the untreated to 1 percent or nothing. Semesan Bel was less effective and neomycin sulfate of no use (Amer. Potato Jour. 33: 56). In South Carolina, under stringent experimental conditions described by W. M. Epps, bacterial decay (E. atroseptica and E. carotovora) of potato seed pieces was best controlled by streptomycin treatments (PDR 41: 148).

Phytophthora infestans, late blight (see also under tomato). In Aroostook County, Maine, there was little late blight on potato foliage in 1956, according to R. A. Hyre and R. Bonde. The estimated mean foliage blight was 2.5 percent. The rainfall-temperature method of forecasting blight was quite accurate when modified to allow for the unusually cool season (PDR 40: 1087). The influence of time and temperature on sporulation of P. infestans on potato leaves was reported by J. R. Wallin, and D. N. Polhemus (Phytopath. 47: 36). J. R. Wallin and Dale N. Polhemus reported observations on the growth and development of the late blight fungus from infected tubers in steamed soil (PDR 40: 534). In Iowa, J. R. Wallin reported results of pathogenicity studies with monozoospore lines of the potato late blight fungus and described a technique for isolating single zoospores

(PDR 41: 612). R. A. Hyre and J. D. Wilson analyzed the relation of rainfall, temperature, and late blight occurrence records for northern Ohio, as a basis for forecasting occurrence of the disease in that area (PDR 41: 616).

F. J. Stevenson and others have given details of the potato variety, Plymouth, released in April 1955, by the United States Department of Agriculture and the University of North Carolina. It is immune from P. infestans and has shown moderate resistance to Streptomyces scabies in tests in Maine, Michigan, Minnesota, Wisconsin and Wyoming. It seems superior to Irish Cobbler. They recommend that this variety should largely replace the Irish Cobbler in eastern North Carolina, where it is classified as early-maturing (Amer. Potato Jour. 33: 296-299, 1956).

H. D. Thurston and others reported the effect of location and races on the epidemiology of P. infestans (Phytopath. 47: 35).

H. C. Fink reported potato late blight control in Pennsylvania in 1956. Ten fungicides were tested as dilute sprays, 100 gallons per acre, against the fungus on Katahdin potatoes (Phytopath. 47: 244).

Stemphylium solani, gray leaf spot. According to D. M. Coe and R. A. Conover, B-622 gave outstanding control of gray leaf spot in limited trials at two locations in Florida. No phytotoxicity was observed (PDR 40: 1084).

Streptomyces scabies, scab. T. Dykstra reported that, using the vermiculite method of Houghland and Cash in a modified form, he obtained very satisfactory results in testing first-year potato seedlings for resistance to scab at the Louisiana Agricultural Experiment Station, Baton Rouge. A few months after sowing the true seed, definite information on the reactions of individual seedlings could be obtained, the first symptoms being detectible on tubers the size of a pea (Phytopath. 46: 57).

In Oregon, the early maturity disease of potato attributed principally to Verticillium albo-atrum was effectively controlled by injection of Vapam into the soil with a blade applicator ten days before planting (R. A. Young, PDR 40: 781).

Stem rot (a bacterium) was noted in Ohio in August 1955 by R. D. Shealy. Tubers were planted in soil collected in early March 1956 from fields in which the disease had been severe in 1955. The bacterium was pathogenic to many members of the Solanaceae. This appears to be a different stem rot from any described on potato (PDR 40: 667).

C. W. McAnelly and others reported the detection of potato leaf roll (virus) by paper chromatography and electrophoresis (Amer. Potato Jour. 33: 134).

SPINACIA OLERACEA. SPINACH: Peronospora effusa, downy mildew. P. G. Smith and M. B. Zahara reported the development at the University of California of a new variety of spinach immune from downy mildew. The variety, named Califlay, is a cross of the variety Viroflay with a resistant wild spinach from Iran, backcrossed to Viroflay, and is intended for use in conditions to which the latter is adapted (Calif. Agric. 10(7): 15, 1956).

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The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Crops Research Division serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

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MYCOLOGY AND PLANT DISEASE REPORTING SECTION

INDEX TO PLANT DISEASE REPORTER SUPPLEMENTS 243-248, 1957

Compiled by Nellie W. Nance

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Index to Supplements, 1957

LIST OF SUPPLEMENTS

SUBJECT INDEX

ERRATA

On page 8, 2nd line read Erysiphe cichoracearum instead of Erysiphe cichorocearum.

On page 17, 10th line from top read Sphacelotheca sorghi instead of Spacelotheca sorghi.

On page 123, under LEGUMES read Belonolaimus gracilis instead of Belonalaimus gracilis.

MYCOLOGY AND PLANT DISEASE REPORTING SECTION