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# ORGANIC MATTER MAINTENANCE IN FORESTRY NURSERIES

BY

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## INTRODUCTION

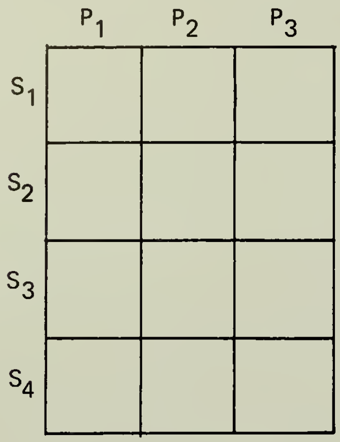
Pine and other tree seedlings are raised by the Georgia Forestry Commission at a number of nurseries throughout the state. In order to produce marketable trees throughout the season it is necessary for the soil in the nursery beds to have a good tilth so that root pruning may be practiced in order to maintain the seedlings at heights convenient for packing and shipping.

Soil tilth is determined in large measure by the organic matter content of the soil. Prior to this investigation organic matter was added to the soil in the form of sawdust in order to maintain a suitable tilth. However sawdust is no longer available for this purpose necessitating research to determine whether or not it would be possible to maintain and/or build up the organic matter content of the soil by other means. Observations made by the staff of the Georgia Forestry Commission at a number of nurseries indicated that the organic matter content of the soil had fallen from values of about 1.8-2.0% when sawdust was being used to 1.0-1.2% a few years later.

The results reported here arise from a research project funded by the Georgia Forestry Commission to investigate the possibility of rotating agronomic crops with pine seedlings in order to build up soil organic matter. The research was conducted at the Morgan Nursery near Byron over a two year period.

## THE EXPERIMENT

A Faceville fine sandy loam soil which is typical of the Morgan Nursery was selected for the experimental site. A two way strip experimental design in three replications was used as illustrated below.




Summer crops of corn (Funks G4507), forage sorghum (Funks G996) and pearl millet (Gahi 3) were planted in Spring 1979 in strips labelled $P_1$, $P_2$ and $P_3$ after plowing and disking. These crops were planted in 3 ft. rows using 16 lbs. and 20 lbs. of seed per acre for sorghum and millet respectively. The corn population after germination was 15,000/ac. Planting dates were March 20 for corn and May 29 for millet and sorghum. Prior to planting a fertilizer mixture was applied to give 30 lbs. N, 60 lbs. $P_2O_5$, 90 lbs. $K_2O$ and 80 lbs. Mg per acre with sidedressing of 60 lbs. N/acre applied approximately 25 days after germination.

In the fall of 1979 crimson clover, ryegrass and a mixture of the two were planted in strips labeled $S_2$, $S_3$ and $S_4$ respectively with strip $S_1$ being left fallow. There was no land preparation, the seed were overseeded with a cyclone seeder. Also, the fodder from the preceding crop was mulched into the land three months prior to overseeding.

The following summer grain sorghum (Funks 522D2) was substituted for corn, the other two crops being the same. Due to weather conditions the crops could not be planted until June 5. No fertilizer was applied except for a sidedressing of 60 lbs. N/ac 25 days after germination. In order to evaluate how the organic matter content would vary under fallow conditions, an additional strip adjacent to treatment area was kept clean of plants throughout the experiment.

Soil samples were taken before and after fertilization in the spring of 1979 (Table 1) for soil fertility evaluation.

TABLE 1

Average soil test values on summer crop plots before and after fertilization.

| Crop | | pH | P | K | Ca | Mg |
|---|---|---|---|---|---|---|
| | | Soil Test Value | | | | |
| | | ---- | ---- | -lb/ac- | ---- | ---- |
| Corn | Before | 5.2 | 92 | 223 | 641 | 33 |
| | After | 5.4 | 126 | 370 | 600 | 100 |
| Sorghum | Before | 5.2 | 92 | 223 | 704 | 34 |
| | After | 5.4 | 134 | 384 | 598 | 99 |
| Millet | Before | 5.2 | 98 | 225 | 669 | 33 |
| | After | 5.4 | 125 | 386 | 645 | 94 |

The results in Table 1 show that the experimental site was uniform and had adequate levels of all major nutrients prior to planting the summer crops in 1979.

Soil samples (30 cores per plot) were also taken before crops were planted in 1979, at the end of 1979, in spring 1980, at the end of 1980. These samples were analyzed for organic matter, organic carbon and nitrogen.

## RESULTS

Summer crop yields are presented in Table 2 for 1979.

TABLE 2

Yield of Summer Crops

| Crop | Stover Weight tons/ac | Grain Yield bu/ac |
|---|---|---|
| Sorghum | 5.9 | -- |
| Millet | 5.4 | -- |
| Corn | 2.5 | 35.4 |

Corn yield was disappointing due to the poor stand achieved. However, sorghum and millet yielded well. The effect of these crops on soil organic matter content is presented in Table 3.

TABLE 3

Effect of summer crops on soil organic matter, carbon and nitrogen.

| Crop | Before Planting | | | | End of 1979 | | | |
|---|---|---|---|---|---|---|---|---|
| | OM % | C % | N % | C/N | OM % | C % | N % | C/N |
| Corn | 1.10 | 0.64 | 0.062 | 10.3 | 1.45 | 0.84 | 0.060 | 14.0 |
| Forage sorghum | 1.12 | 0.65 | 0.066 | 9.8 | 1.64 | 0.95 | 0.066 | 14.4 |
| Pearl Millet | 1.13 | 0.66 | 0.066 | 10.0 | 1.30 | 0.75 | 0.052 | 14.4 |
| Fallow | 1.10 | 0.64 | 0.048 | 13.3 | 1.10 | 0.64 | 0.049 | 13.1 |

The three summer crops significantly increased the organic matter content of the soil with the greatest increase being caused by forage sorghum. The organic carbon content and the C/N ratio were also increased indicating that the material incorporated had wider C/N ratios than the organic matter originally present. This suggests that with time the organic matter will be decomposed until an equilibrium C/N ratio of about 10 is reached. It is therefore unlikely that the higher organic matter content can be expected to persist without further additions.

Yields of the winter crops are presented in Table 4.

TABLE 4

Yield of Winter Crops Following Summer Crops

| Preceding Summer Crop | Yield of winter crops: Crimson clover | Ryegrass | Ryegrass-crimson clover |
|---|---|---|---|
| | --------tons/ac-------- | | |
| Corn | 4.3 | 0.7 | 5.2 |
| Forage Sorghum | 2.4 | 0.6 | 2.0 |
| Pearl Millet | 3.9 | 1.5 | 3.9 |
| Average | 3.5 | 0.9 | 3.7 |

If a winter crop is to be oversown, crimson clover with or without grass would be the obvious choice. The preceding summer crop had a marked effect on the production of the winter crop, more or less in inverse proportion to the amount of summer production which determined the amount of surface mulch at overseeding and thereby stand of the winter crops. The winter crops had no significant effect on organic matter content as shown in Table 5.

TABLE 5

Effect of sampling time on organic matter content and C/N ratio of summer crop plots averaged over winter crops.

| Crop | Initially | | After 1st summer crop | | After 1st winter crop | | After 2nd summer crop | |
|---|---|---|---|---|---|---|---|---|
| | OM % | C/N | OM % | C/N | OM % | C/N | OM % | C/N |
| Corn | 1.10 | 10.3 | 1.45 | 14.0 | 1.40 | 11.8 | 1.42* | 10.2* |
| Forage Sorghum | 1.12 | 9.8 | 1.64 | 14.4 | 1.49 | 11.8 | 1.46 | 9.9 |
| Pearl Millet | 1.13 | 10.0 | 1.30 | 14.4 | 1.32 | 12.2 | 1.36 | 9.8 |
| Fallow | 1.10 | 13.3 | 1.10 | 13.1 | 1.08 | 13.0 | 0.90 | 12.9 |

*In the second summer season grain sorghum replaced corn.

This was also true of the second summer crops which merely maintained the organic matter level originally established by the first summer crop. However there was a consistent pattern of changes in C/N ratio. This was increased by the first summer crop and then reduced subsequently as the wider C/N ratio material was decomposed. At the end of the experiment the C/N ratio was about the same level observed before planting.

The yields of the second summer crops are presented in Table 6.

Again the preceding crop has had a pronounced effect on the production of the succeeding crop. These results together with those in Table 5 suggest that there is little benefit to be gained in terms of biomass production and hence increased organic matter content of soil from winter cropping.

TABLE 6

Yield of Second Summer Crops

| Preceding Winter Crop | Forage sorghum | Pearl millet | Grain sorghum | Sorghum grain yield |
|---|---|---|---|---|
| | -------- | tons/ac | -------- | (bu/ac) |
| Fallow | 5.4 | 4.6 | 8.0 | 21 |
| Crimson clover | 5.4 | 4.3 | 2.8 | 10 |
| Ryegrass | 3.4 | 3.9 | 2.3 | 5 |
| Crimson clover-ryegrass | 3.7 | 4.2 | 0.9 | 6 |

# CONCLUSION

1. It is possible to build up the organic matter content of nursery soils by cropping with agronomic crops. However it is not possible to build the organic matter content above a level of 1.4 to 1.6% even if a rotation involving two years of cropping is practiced.
2. If an economic return from the agronomic cropping is required a grain crop such as corn or grain sorghum could be used in rotation with forage sorghum in a two year system with no winter cropping.
3. Whether or not the increase in organic matter content effected by the agronomic crops will be large enough to improve soil structure sufficiently to prevent compaction and to facilitate root proliferation of the seedlings in a rotation with agronomic crops remains largely unanswered. However there is no doubt that the organic matter content of the soil can be increased by agronomic cropping to about the same level as was obtained in the past by adding organic materials. Therefore, it seems reasonable to expect little or no decline in seedling production and quality as a result of changing the strategy for organic matterrmaintenance.

GEORGIA FORESTRY COMMISSION

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Cost $605
Quantity 5,000