MICRO-ORGANISMS IN NURSERY SEEDBED SOILS

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One phase of the forest-tree seedling research program at the Alabama Station is a study of some of the soil micro-organisms. The preliminary work was primarily concerned with identification of fungi associated with damping-off and with nematodes associated with root rot. Sawdust and cover crops are extensively used as sources of soil organic matter; therefore the study was expanded to include them.

Rotations being studied at the Auburn Nursery include the following: (1) Sawdust, mineral fertilizers, and continuous seedling production; (2) cover crops, with and without sawdust, and mineral fertilizers; and (3) intermittent seedling production. Some rotations receive a soil chemical treatment prior to seedling production; other rotations do not.

Important questions that may influence a soil management program include the following: (1) What species of organisms are associated with the breakdown of different types of organic matter? (2) When are these organisms most active ? (3) What is the relationship between these organisms and availability of nutrients, especially nitrogen? (4) Which of these organisms attack the roots and stems of forest tree seedlings ? (5) Under what conditions may a nurseryman expect a heavy seedling loss due to action of soil micro-organisms ? Answers to these questions may greatly influence nursery management practices.

Many kinds of organisms, including bacteria, actinomycetes, fungi, and nematodes, are responsible for the disintegration of cellulose and related compounds in the soil. However, bacteria and actinomycetes are not known to be causes of important diseases of tree seedlings. Therefore, in 1953, the study was limited to soil fungi. Soil samples collected from seedbeds receiving different treatments were cultured on a medium of potato dextrose agar. As colonies of fungi developed, they were examined under the microscope and classified by genera. The colonies in each genus were counted and calculated as a percentage of the total fungus population that developed. The fungi found are listed in table 1. In table 2 they are grouped according to their probable relationship to plants, as follows: (1) Cellulose destroyers, (2) antagonists,

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(3) pathogens, and (4) sporodics.

Addition of cellulose to the soil results in extensive development of fungi that possess very strong cellulose-decomposing power. The' first five genera in table 1, namely, Chaetomium_, Thielavia, Aspergillus, Penicillium, and Trichoderma, are potent cellulose destroyers.

An antagonist may be defined as an organism that inhibits the growth of other nearby organisms. A single organism may be classified into two or more groups. For example, Aspergillus, Penicillium and Trichoderma must be classified as antagonists as well as cellulose destroyers The influence of organic materials in controlling the development of disease-producing fungi in the soil is due to the effect of antagonistic organisms favored by some forms of organic matter. These play an inportant role in suppressing the growth of plant parasites.

The last four genera listed in table 1, Curvularia, Pythium, Phytophthora, and Fusarium, are root pathogens. These genera include many of the root rot and damping-off organisms.

The fungi classified represent only a fraction of the total fungus population, and they are largely spore formers. This means a disproportionate representation, percentage wise, for these spore formers. However, tentative conclusions have been made, as follows: (1) Many of the active fungi in seedbeds were beneficial rather than harmful. (2) Incidence of cellulose-decomposing and antagonistic fungi increased sharply with rising temperatures. (3) The increase of antagonists with rising temperatures is accompanied by a sharp decrease of root pathogens. (4) The cellulose-destroying community remained in a definite balance. Disappearing genera were replaced by genera of the same physiological type. Penicillium apparently replaced Trichoderma and, in turn, Aspergillus replaced Penicillium and Thielavia. (5) The pathogens did not maintain a balance, but rather were replaced by genera that were both cellulose destroying and antagonistic.

Table 1.--Fungi isolated from sawdust-mulched pine nursery seedbeds, Auburn, Ala., in 1953.

Fungi isolated (genus)	Percentage of total isolations				
	May 13	June 6	June 29	July 25	Aug. 25
Chaetomium	12	11	2	0	0
Thielavia	9	12	37	4	3
Aspergillus	0	17	18	26	55
Penicillium	0	0	28	61	27
Trichoderma	38	33	14	8	2
Curvularia	0	0	0	0	10
Pythium or Phytophthora 1/	19	20	0	0	0
Fusarium	22	7	0	0	0

1/ Most investigators are unable to distinguish *Pythium* from *Phytophthora* in culture. Some of these colonies had the appearance of *Phytophthora cinnamomi*. If the latter organism was obtained by these methods, it was purely accidental.

Table 2.--Type classification of fungi isolated from sawdust-mulched pine nursery seedbeds at Auburn, Ala., in 1953

Fungus type	Percentage of total isolations 1/				
	May 13	June 6	June 29	July 25	Aug. 25
Cellulose destroyers	21	40	85	91	85
Antagonists	38	40	60	95	82
Pathogens	41	27	0	0	0
Sporodics	0	0	1	1	13

1/ Since some genera in table 1 are both cellulose destroyers and antagonists, percentages here usually total more than 100.