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EFFECT OF METHYL BROMIDE ON MYCORRHIZAE AND GROWTH OF SWEETGUM SEEDLINGS

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Abstract

Fumigation of nursery beds with methyl bromide improved sweetgum growth by reducing the population of soil-inhabiting pathogens. Although mycorrhizal fungi were reduced, sufficient inoculum survived for rapid mycorrhizal development.

Many nurserymen have found through experience that they must fumigate the soil to grow healthy southern hardwood seedlings. The Mississippi State Forestry Commission nursery-

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man at Winona, Mississippi, for example, says that he cannot grow merchantable sweetgum seedlings unless he fumigates the nursery beds prior to sowing.

The study described in this paper was designed to determine the cause for the improved performance of sweetgum following bed fumigation with methyl bromide. Three possible causes were apparent: elimination of soil fungi, particularly those that are pathogenic (1, 3, 4), increased soil fertility (5, 6), or selective survival of mycorrhizal fungi.

MATERIALS AND METHODS

Forest soil was collected from the root zone around sweetgum trees on the Delta Experimental Forest near Stoneville, Mississippi, and on the Bluff Experimental Forest at Vicksburg, Mississippi. It was believed that these soils would contain many mycorrhizal fungi. Soil was also collected from a field near Stoneville that had been row-cropped for the past 50 years. It was assumed that this soil would contain few fungi that form mycorrhizae with sweetgum.

All soil samples were sifted through a 6-mm screen to remove debris and clods. No attempt was made to remove root fragments that passed through the screen. One part of perlite was mixed with four parts of soil as a conditioner. The soil-perlite mixture from each sampling location was placed in forty-eight 3- by 5-inch peat pots. Twenty-four pots were sterilized and twenty-four were not. Methyl bromide was applied at a rate of 2 lb/100 sq. ft under a plastic cover which was kept in place for 24 hours.

Surface-sterilized sweetgum seeds were germinated in a sand-peat mixture, and, after 1 month, one seedling was transplanted into each peat pot. The potted seedlings were kept in a greenhouse throughout the study. Seedlings were watered as necessary during the growing season.

At the end of the growing season (after 6 months), seedling height and diameter at the root collar were measured, and roots were examined for mycorrhizae. Later, microtome sections were made of root samples from each soil and treatment.

RESULTS AND DISCUSSION

As expected, treatment with methyl bromide increased height growth of sweetgum on the forest soils. On the agricultural soil, however, treatment reduced height growth -- an indication that a change in soil fertility is not the probable cause of increased growth on forest soil. Sizes of seedlings at the end of the growing season are given in Table 1.

Microscopic examinations of roots showed that all seedlings had some mycorrhizae (Fig. 1). The presence of sweetgum mycorrhizae in agricultural soil that had been devoid of sweetgum for 50 years indicates that agronomic species have some of the same mycorrhizal partners as sweetgum. The vesicles and arbuscles on the sweetgum roots were similar to *Endogone* species reported by Gerdemann (2) on corn, red clover, onion, strawberry, and soybean.

The fewest mycorrhizae were found on roots in treated agricultural soil. The much larger numbers on untreated agricultural soil probably explain the decrease in growth caused by fumigation

On forest soil, fumigation did not greatly reduce numbers of mycorrhizae. Sufficient inoculum survived the treatment -- probably in root fragments -- for rapid mycorrhizal development. Fumigating the forest soil apparently greatly reduced the population of pathogenic fungi living outside of root fragments while leaving the mycorrhizal fungi inside the fragments relatively undisturbed. Increased growth is attributed, therefore, to selective survival of beneficial fungi.

Table 1. Size of 6-month-old seedlings, by treatment and soil.

Source of soil and treatment	Height of seedlings (in cm)		Root length (in cm)		Root collar diameter (in mm)	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
DEF[a] treated	39.37	4.62	16.69	4.55	6.79	1.10
DEF untreated	34.34	12.57	17.25	3.94	5.62	0.81
BEF[b] treated	38.68	1.55	16.28	3.78	6.29	0.31
BEF untreated	28.12	4.45	16.18	4.22	4.62	0.76
Field treated	25.58	9.25	19.51	5.28	5.29	1.23
Field untreated	33.53	7.65	17.12	4.19	5.87	1.29

[a]Delta Experimental Forest. [b]Bluff Experimental Forest.

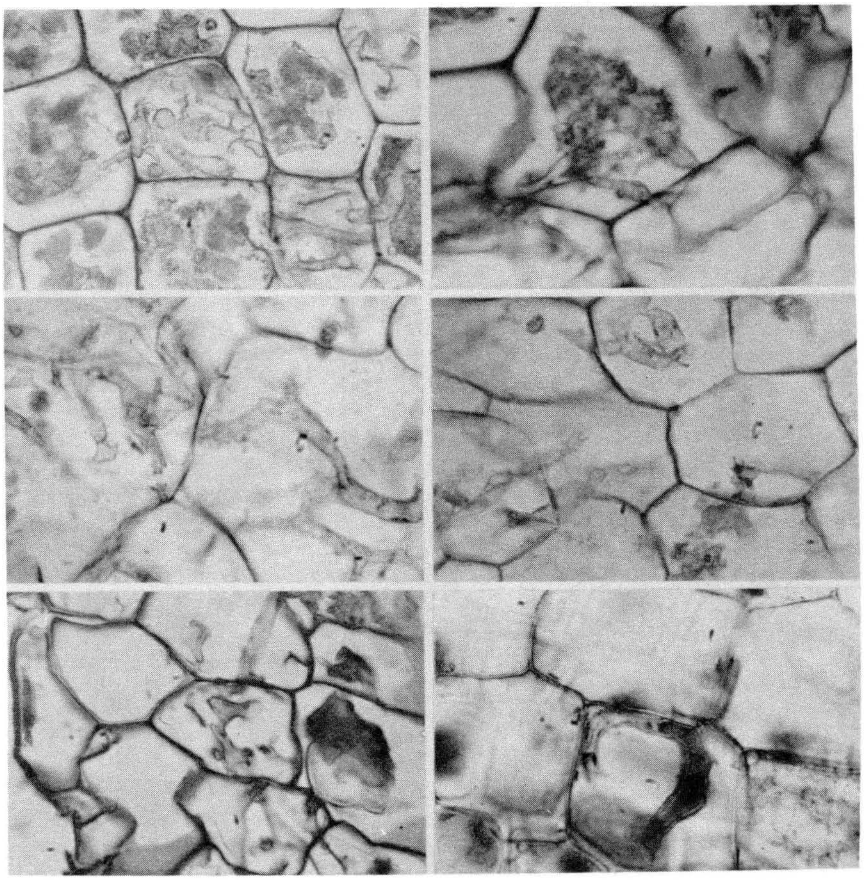

FIGURE 1. Photomicrographs of sweetgum mycorrhizal roots: Untreated soil (left); treated soil (right); Bluff Experimental Forest soil (top); Delta Experimental Forest soil (middle); bean field soil (bottom).

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