ENDOMYCORRHIZAE IN SOME NURSERY-PRODUCED TREES AND SHRUBS ON A SURFACE-MINED AREA

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Adequate sources of vesicular-arbuscular mycorrhizal inoculum were still present in a TVA nursery after repeated soil fumigations and with high soil phosphorous levels. Tree seedlings planted on surface-mined sites were colonized with VAM after 1 year.

The beneficial effects of vesicular-arbuscular mycorrhizae (VAM) in plant growth and nutrition have been extensively documented, and recent studies have suggested that endomycorrhizal associations may aid in the establishment and growth of plants on disturbed sites (*1, 2, 3, 5*). At the Tennessee Valley Authority's Norris Nursery, several woody plant species are propagated for use in surface mine reclamation programs. We considered it important to know whether these species were colonized with VAM prior to outplanting on surface mine sites. The present study was designed to determine whether plants propagated under present nursery practices (i.e., high nitrogen and phosphorus fertilization and frequent fumigation) were colonized with indigenous VAM and, if so, whether the mycorrhizal associations survived under the relatively infertile mine spoil conditions.

Table 1.—*Average percent of 1-centimeter root segments infected with endomycorrhizae*

Species	Hyphae		Vesicles	
	Norris Nursery	Ollis Creek	Norris Nursery	Ollis Creek
Lespedeza bicolor Turcz.	75.5	85.6	70.6	79.3
Malus seiboldi (Reg.) Rehd.	90.4	81.4	88.7	76.6
Pnunus besseyi Bailey	92.4	77.3	88.5	68.0
Cornus amomum Mill.	99.1	72.7	72.4	67.4
Elaeagnus umbellata Thunb.	94.6	64.7	83.4	55.2
Robinia fertilis L.	79.4	3.2	69.0	1.6
Robinia pseudoacacia L.	—	5.85	—	4.86
Corpus stolonifera Michx.	99.6	—	93.3	—
Cornusforida L.	96.8	—	69.6	—
Liriodendron tulipifera L.	94.0	—	53.8	—
Cercis canadensis L.	87.1	—	71.9	—
Prunus munsoniana Bailey	79.6	—	69.3	—

Methods

Root systems of seven randomly selected 1-year-old plants from each of 11 species (table 1) were collected from the Norris Nursery in March 1978. The nursery soil is a silty loam, and production practices include summer cover cropping (rye or soybeans), application of fertilizer (100 kg/ha of ammonium nitrate and 800 kg/ha of 6-12-12) in the fall, and fumigation of the beds with methyl bromide prior to fall seeding. In addition to the nursery collection, seven plants each of seven species produced in the nursery in 1977 and used in the Ollis Creek reclamation program were collected in June 1978 after one season's growth on a surface-mined site.

The Ollis Creek surface mine is located in Campbell County, Tennessee, and is characterized by low nutrient levels, a pH ranging from 4.3 to 5.9, and steep barren outslopes (*7*). Surface mining began in 1958, after which the area was abandoned without reclamation. The area was mined once again from 1970 to 1972, with only partial revegetation success; and 1977 plantings were made to complete revegetation.

Current-year roots of plants collected from both the nursery and mined area were cleaned, fixed in FAA, and stained using the method of Phillips and Hayman (8). A minimum of 36 1-centimeter-long root segments from each plant were evaluated microscopically for the presence or absence of endomycorrhizal stuctures, and the degree of infection was assessed using the method of Nicolson (*6*).

Results

Microscopic evaluation of root segments from the Norris Nursery showed that VAM in-

fection was of general occurrence in all genera examined (table 1). However, there were significant (0.5 level) differences among species in percentages of infected segments and in the intensity of infection within roots. The highest levels of infection were observed in *Corpus amomum, C. stolonifera,* and *C. florida.* Greater than 90 percent hyphal infection was scored in *briodendron tulipifera, Elaeagnus umbellata, Malus seiboldi,* and *Prunus besseyi.* In *Cercis canadensis, Prunus munsoniana, Robinia fertilis,* and *Lespedeza bicolor,* hyphal infection varied from 68.6 to 87.1 percent. Arbuscules, another parameter of infection, were noted in a significant percentage of the root segments of *C. amomum* (72.4 percent), *C. stolonifera* (34.3 percent), and *P. munsoniana* (16.7 percent). In all other species, less than 10 percent of the roots were infected with arbuscules. The proportion of roots containing vesicles varied among species, both in terms of intensity and percentage of segments infected. In C. *stolonifera, M. seiboldi, P. besseyi,* and *E. umbellata,* vesicles were observed in greater than 80 percent of the root segments scored.

Endomycorrhizal colonization was less extensive in roots of plants collected at the Ollis Creek mine site than in plants of the same species collected from the nursery (table 1). Of the seven species examined, the highest levels of hyphal infection were observed in roots of *Lespedeza bicolor* (79.3 percent) and *Malus seiboldi* (76.6 percent). Hyphal infection in *Prunus besseyi, Cornus amomum,* and *Elaeagnus umbellata* was lower; and there was a large amount of variation in degree of infection among plants within the species. The least hyphal infection occurred in *Robinia fertilis* and *R. pseudoacacia.* Arbuscules were absent in roots of virtually all plants from the Ollis Creek site, while the prevalence of vesicles paralleled that of the hyphal infection.

Discussion

VAM were generally present in greater than 70 percent of the root segments of plants of 11 species propagated at the Norris Nursery. This finding indicates that even after frequent fumigation of the nursery soil, adequate sources of inoculum (i.e., mycorrhizal root fragments, spores, or extramatrical mycelium) were present. It also appears that the high phosphorus level of the soil did not inhibit mycorrhizal infection in these plants. This observation is similar to the findings of Hayman et al. (*4*) of extensive endomycorrhizal infection in crops planted in soils of both high and low fertility. Since this study was not designed to assess the degree of colonization of plants produced under specific nursery management practices, it is not known whether these species would have exhibited more extensive infection under different nursery conditions. Nevertheless, the data do provide a quantitative estimate of the degree of indigenous infection in these nursery-produced plants prior to their use in revegetation programs.

The study further verified that roots of most species on the surface mine sites were colonized with VAM after 1 year's growth there, though to a lesser degree than the nursery plants. Presumably the source of inoculum for these plants was the nursery soil. Since plants on the mine site were from a different nursery crop (that is, 1977), no conclusion can be made on the cause of this difference in degree of infection. However, it is likely that the decrease is related to planting site since nursery conditions are fairly uniform from year to year.

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