THE STATUS AND PRACTICAL APPLICATION OF ECTOMYCORRHIZAE IN FOREST TREE NURSERIES AND FIELD FORESTATION

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Abstract.--Artificial nursery seedbed and container mix inoculations with the ectomycorrhizal fungus Pisolithus tinctorius (P.t.) have demonstrated significant increases in nursery seedling growth and quality on a variety of conifer and some hardwood seedling species in the United States and Canada. Results obtained from related field outplantings have also shown significant increases in tree survival and growth on a wide variety of conifer species and planting sites. A practical machine application technique along with several additional ectomycorrhizal inoculum application methods utilizing commercial inoculum produced by Abbott Laboratories are presented for bareroot nurseries.

Additional keywords: Pisolithus tinctorius, commercial inoculum, conifer species, nursery seedling growth and quality, field outplantings survival and growth, ectomycorrhizal inoculum applicator-nursery seeder, bareroot nursery seedbed inoculation techniques.

NURSERY AND FIELD OUTPLANTING STUDIES

During the past several years, researchers at the Institute for Mycorrhizal Research and Development (IMRD), Athens, Ga., and pest management specialists, Atlanta, Ga., both with the USDA, Forest Service, have been conducting extensive mycorrhizal research and field application studies with a number of cooperating forestry agencies. The practical application of one ectomycorrhizal fungus, Pisolithus tinctorius (P.t.), in forest tree nurseries and field forestation has been the major area of emphasis for this work.

Since 1977, a national evaluation to test the effectiveness of different formulations of P.t. inoculum produced by Abbott Laboratories, Chicago, Ill., and the IMRD on a variety of conifer and some hardwood seedling species has been underway. A progress report on this evaluation was presented at both the

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western and eastern sessions of the Southern Nurserymen's Conferences in 1978 (Cordell, et al., 1978). During the past 3 years, over 80 bareroot nursery tests have been conducted in 38 states. Eighteen container nursery tests have also been conducted in nine states (including Hawaii) and Canada. In addition, over 20 field outplantings have been established in 13 states involving a variety of conifer species and forestation sites. The objectives of these tests have been to compare the performance of seedlings inoculated with P.t. with that of seedlings with naturally occurring ectomycorrhizae (i.e., Thelephora terrestris) and to compare the effectiveness of the Abbott inoculum with the inoculum produced by the IMRD.

Study Trends

Despite the early problems encountered with the Abbott P.t., the majority of the nursery and field outplanting tests have been encouraging. Positive nursery benefits involving significant increases in seedling growth (fresh weights) and quality (cull reduction) have been obtained in most nurseries. Thus far, the P.t. inoculum produced by IMRD has been more consistent and effective than that produced by Abbott Laboratories. Preliminary results of the 1980 nursery tests, however, indicate that the quality of the Abbott inoculum has improved considerably, at least in certain batches.

In the outplanting tests, benefits from P.t. nursery inoculations have been consistently higher on poor quality planting sites. Results obtained from a 6-year-old outplanting study in Western North Carolina showed significant increases (25+%) in tree growth and survival on three pine species. The first outplantings of seedlings inoculated with Abbott P.t. were established in the spring of 1979. All outplantings are scheduled for a 10-year duration with annual measurements and progress reports.

ECTOMYCORRHIZAE INOCULUM APPLICATOR-NURSERY TREE SEEDER

Despite the experimentally proven benefits of P.t. to the nursery and field forestation, the operational use of P.t. in bareroot nursery seedlings production remains impractical. This is due, primarily, to projected seedbed inoculation costs. In an attempt to develop an effective and practical means of applying P.t. inoculum, a machine with the capability of simultaneous application of P.t. inoculum and nursery seedbed sowing was constructed by the U. S. Forest Service in 1979 (Figure 1).

The ectomycorrhizal inoculum applicator-nursery tree seeder was constructed through the modification of an Øyjard nursery seeder. By using this machine, a 2/3 (67%) reduction in ectomycorrhizal inoculum requirements can be realized as a result of the inoculum being applied in eight 2-inch width seedbed rows (bands) immediately followed by the seeding. Previous inoculation methods involved a broadcast inoculum application to the entire seedbed surface.

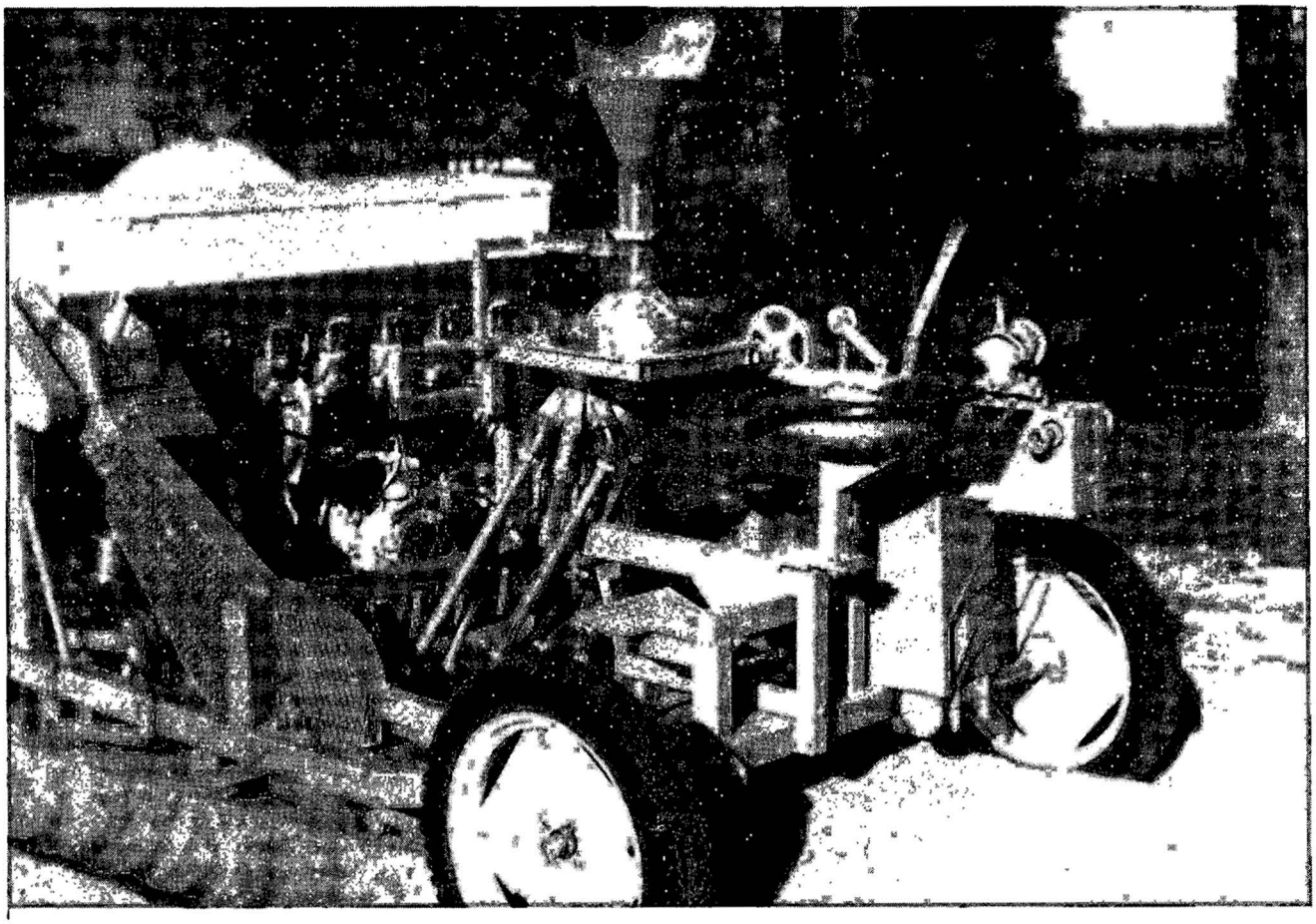

Figure 1.--Ectomycorrhizal inoculum applicator-nursery tree seeder.

The prototype ectomycorrhizal inoculum applicator-tree seeder has three separate methods of inoculum application. The inoculum can be injected at a desired soil depth, injected at a desired soil depth and plowed to mix the inoculum into the upper soil layers, and dropped on the seedbed surface and tilled in by means of a rototiller attachment.

In the spring of 1980, the effectiveness and practicality of the ectomycorrhizal inoculum applicator-nursery seeder were evaluated in four southern nurseries. The results of these nursery evaluations will be available in the spring of 1981. Field outplantings involving selected nursery treatments displaying effective P.t. ectomycorrhizal development are also planned.

ADDITIONAL ECTOMYCORRHIZAL INOCULUM APPLICATION TECHNIQUES

Other ectomycorrhizal inoculum application methods which may be considered for the practical and effective application of inoculum in bareroot nurseries are as follows:

1. Broadcasting the vegetative mycelium-vermiculite-peat inoculum on the seedbed surface with a conventional nursery fertilizer spreader and rototilling it into the soil with a bed shaper just before seeding. Although having a major advantage of simplicity in operating this method also has a major disadvantage of requiring large volumes of expensive inoculum.

2. Spores of ectomycorrhizal fungi such as P.t. may be used as inoculum either by mixing with the hydromulch and applying immediately following seeding or by encapsulating tree seed with a coating of spores. Nursery tests evaluating the relative effectiveness of the spore and mycelium inoculum techniques have shown the mycelium inoculum to be consistently more effective in promoting P.t. ectomycorrhizae than the spore inoculum. While offering primary advantages of simplicity and reduced cost, the spore inoculation methods require large volumes of spores with unknown viability and purity.

P. t. INOCULUM AVAILABILITY

Abbott Laboratories, Chicago, Ill., has developed techniques for the commercial production of P.t. mycelium-vermiculite-peat inoculum. However, the future commercial production of P.t. inoculum by Abbott, or any other producer, will depend primarily on consumer demand (forest tree nurseries) and prevailing economic conditions. The present indicated nursery demand for P.t. inoculum and current economic conditions are not favorable for the wholesale commercial production of this product. Any P.t. inoculum production by Abbott Laboratories in the near future will most likely be arranged through special agreements for custom P.t. inoculum orders between various nurseries and Abbott.

LITERATURE CITED

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