

BAYLETON EFFECTS ON PINE SEEDLING ECTOMYCORRHIZAL DEVELOPMENT

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Abstract.--The systemic fungicide triadimefon (Bayleton[®]) provides highly effective and practical control for fusiform rust in southern nurseries. However, results obtained from three southern nurseries in 1983 revealed that this fungicide had significant negative effects on both artificially inoculated Pisolithus tinctorius (Pt) and naturally occurring Thelephora terrestris ectomycorrhizae in these nurseries as well as on quality of loblolly pine seedlings in one nursery. Bayleton and its chemically converted isomer, Baytan, persisted in the seedling roots at levels detrimental to ectomycorrhizal production for extended periods. In laboratory studies with pure culture fungus, Baytan significantly reduced the mycelial growth of both Pt and T. terrestris to levels considerably lower than those detected in nursery seedling roots for extended periods following the last Bayleton spray treatments. Supplemental Bayleton-ectomycorrhizal nursery studies are being conducted in two southern nurseries in 1984.

Additional keywords: Baytan, Pisolithus tinctorius, Thelephora terrestris, bare-root nurseries, Pinus taeda, Pinus elliottii.

Since 1977, research concerning the development of a commercial source of vegetative inoculum of Pisolithus tinctorius (Pers.) Coker & Couch (Pt) has been underway between the USDA Forest Service and Abbott Laboratories. A functional inoculum, MycoRhiz[®], was formulated and thoroughly tested by the end of the 1980 nursery season (Marx and others 1982, 1984). In addition, a MycoRhiz inoculator - seed-sowing machine was developed to aid in the practical application of this inoculum in nurseries (Cordell and others 1981).

In the spring of 1982, 13 nurseries were involved in the operational (machine-applied inoculum) testing of MycoRhiz and the research inoculum of Pt produced by the Institute of Mycorrhizal Research and Development (IMRD). In September 1982, a midstudy assessment for ectomycorrhizae was made by IMRD and S&PF staff on the test seedlings. The results from the 10 southern nurseries were quite different from those obtained in past studies in these nurseries. Seedlings in 6 of the 10 nurseries had very little or no Pt ectomycorrhizal development even from IMRD inoculum. Results from past studies in five of these nurseries had been extremely good for Pt ectomycorrhizal development from

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IMRD inoculum. Seedlings in 4 of the 10 nurseries had erratic but acceptable quantities of Pt ectomycorrhizae from IMRD inoculum. The only cultural practice used in these 10 nurseries that was common to all but different from past years (when results from IMRD inoculum were good) was the use of 3 to 5 Bayleton® sprays instead of the usual 12 to 50 Ferbam® sprays used to control fusiform rust (Cronartium quercuum (Berk.) Miyabe ex. Shirai f. sp. fusiforme Burdsall & Snow). Some researchers have observed fewer naturally occurring ectomycorrhizae on pine seedlings in nurseries sprayed with Bayleton (Snow and others 1979, Kelley, 1980, 1982). Others have observed no appreciable change. Seedlings from nursery study plots receiving 2 or 4 times the recommended Bayleton rate were affected more than those receiving the recommended rate (6 oz a.i.). In 1982, certain nurseries--St. Regis in Florida (slash pine), Taylor in South Carolina (loblolly pine), and MacMillan-Blodel in Alabama (loblolly pine)--Ferbam versus Bayleton-sprayed (recommended rate) seedlings were made available for examination at the IMRD. The incidence of naturally occurring ectomycorrhizae (by Pt and by Thelephora terrestris (Ehrh.) Fr.) was 20 to 50% (as elsewhere) less on Bayleton-treated seedlings than on those sprayed with Ferbam. The majority of the seedling samples were obtained in October or November which is several months following the last Bayleton spray (June) and a few months from lifting date.

These results suggested that Bayleton applied between April and June is absorbed into the seedling tissues and not only protects the succulent foliage and stems of young pine seedlings from the rust fungus through July (fusiform rust infection period in the South), but also may be translocated to the feeder roots where, in some nurseries, it apparently inhibits normal ectomycorrhizal development (either from natural or introduced inoculum). Unfortunately, it is during this same period of Bayleton-induced "host resistance" that Pt vegetative inoculum must infect seedling feeder roots. If the roots are not susceptible to Pt infection until after the effects of Bayleton have passed--probably July or later--then this form of Pt inoculum (succulent vegetative mycelium in vermiculite) may not endure extended survival in the soil until roots are present. If this process takes place, this could explain the problems encountered in our 1982 inoculation tests with various Pt inocula.

In the 1982 MycoRhiz study, the Reidsville, GA, nursery had better Pt ectomycorrhizal development on loblolly and slash pine seedlings than other southern nurseries. These seedlings had been sprayed three times with Bayleton but had also been drenched three times with 2.24 kg a.i./ha (2 lb a.i./a) of benomyl (Benlate®) (another systemic fungicide). Earlier studies by Marx and Rowan (1981) showed that benomyl stimulated Pt ectomycorrhizal development on loblolly pine seedlings. Perhaps benomyl applied at sowing and again early in the growing season could enhance the survival of Pt inoculum which could then be functional after the effects of Bayleton have passed.

Based on these observations, a study was designed in 1983 to determine (1) the possible combined effects of Bayleton and benomyl on Pt ectomycorrhizal development from vegetative inoculum applied at sowing, (2) the feasibility of inoculating seedlings with Pt spores after spraying with Bayleton, and (3) the correlation of Bayleton residues in tops and roots of seedlings with ectomycorrhizal development.

MATERIALS AND METHODS

The following treatments were applied at the Buckeye Cellulose Corp. Nursery, Perry, FL (slash pine), Taylor Nursery, Trenton, SC (loblolly pine), and International Paper Co. Nursery, Bluff City, AR (loblolly pine):

1. IMRD vegetative inoculum (1 liter/2.3 m (1 liter/7.5 ft) of bed, machine applied).
2. IMRD vegetative inoculum + benomyl at 2.24 kg a.i./ha (2 lb a.i./a) applied at sowing date and at 3 and 6 weeks following sowing.
3. IMRD vegetative inoculum + reinoculation with Pt spore pellets (13 g/3.7 m - 13 gm/40 ft') applied 3 weeks after the last Bayleton spray.
4. IMRD inoculum + benomyl + Pt pellets.
5. No inoculum.
6. No inoculum + benomyl.
7. No inoculum + Pt pellets.
8. No inoculum + benomyl + Pt pellets.

These eight treatments were applied at random in five nursery beds each for Ferbam and Bayleton sprays. Each treatment plot was 3 meters long (10 ft); each plot was separated by a 1.5-meter (5-linear-ft), seedling-free buffer strip. Seed were sown in April following standard nursery procedures, and treatments were applied according to schedule. Bayleton .56 kg a.i./ha (8 oz a.i./a) was applied three times (April 28, May 23, and June 21) at the Buckeye Cellulose Corp. Nursery, three times (April 28, May 23, and June 28) at the Taylor Nursery, and four times (May 5, May 25, June 8, and June 22) at the International Paper Co. Nursery. Ferbam plots were sprayed 17 to 41 times during the rust hazard period as needed in these nurseries.

Ten seedlings/plot/nursery were assessed for growth and ectomycorrhizal development in July, August, September, and November. At lifting date, 20 seedlings/plot/nursery were assessed. Seedlings for Bayleton residue analysis were collected from 1 to 116 days after the last Bayleton spray. Laboratory studies on the effects of Bayleton and Baytan on pure culture fungus growth of Pt and *T. terrestris* were also conducted.

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RESULTS AND DISCUSSION

Neither the benomyl nor the Pt spore pellet treatments significantly affected either seedling growth or ectomycorrhizal development; thus, data from these treatments will not be presented. The results, by nursery, are briefly summarized as follows:

Buckeye Cellulose Corp. Nursery, Perry, FL (slash pine)

1. Seedling growth was not significantly affected by either Bayleton or Pt ectomycorrhizae.
2. Natural ectomycorrhizal development (formed by *T. terrestris* and *Rhizopogon nigrescens* N. sp.) was significantly reduced by Bayleton through the growing season. At lifting date (December 1983), Ferbam- and Bayleton-sprayed seedlings had 52 and 22% natural ectomycorrhizae, respectively.
3. Bayleton-sprayed and Pt-inoculated seedlings had a Pt index <1; those sprayed with Ferbam had a Pt index 54. Abundant Pt ectomycorrhizae were detected as early as July in the Ferbam-treated plots.
4. Over 20 times more Pt, 3 times more *T. terrestris*, and 4 times more *R. nigrescens* fruiting bodies were produced in Ferbam-sprayed plots than in Bayleton-sprayed plots.
5. Less than 0.1% of the seedlings had fusiform rust in either Ferbam- or Bayleton-sprayed plots (nonsprayed seedlings in a nearby nursery section had 22.5% rust).

Taylor Nursery, Trenton, SC (loblolly pine)

1. Seedling growth was significantly reduced by Bayleton throughout the growing season. At lifting date, seedling fresh weights were 9.2 g for the Bayleton treatments and 11.9 g for the Ferbam treatments.
2. Pt ectomycorrhizae in the Ferbam treatments significantly increased seedling growth. Fresh weights of seedlings with Pt ectomycorrhizae and natural ectomycorrhizae was 13.0 and 10.8 g, respectively, in the Ferbam treatment.
3. Natural ectomycorrhizal development (formed by *T. terrestris*) was significantly reduced by Bayleton during the growing season. At lifting date (December 1983), Ferbam-sprayed and Bayleton-sprayed seedlings had 63 and 24% natural ectomycorrhizae, respectively.
4. Bayleton-sprayed, Pt-inoculated seedlings had a Pt index 4; those sprayed with Ferbam had a Pt index 83. Abundant Pt ectomycorrhizae were detected as early as July in Ferbam-sprayed plots.
5. Over 6 times more Pt and 10 times more *T. terrestris* fruiting bodies were produced in Ferbam-sprayed plots than in Bayleton-sprayed plots.

