EFFECTS OF BENOMYL ROOT STORAGE TREATMENTS ON LONGLEAF PINE SEEDLING SURVIVAL AND BROWN-SPOT DISEASE INCIDENCE

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Abstract.--A benomyl (Benlate®) fungicide treatment applied to seedling roots at the nursery during the packing operation generally promoted field survival of seedlings stored in four packing materials for different storage periods. Seedlings stored in clay slurry and peat moss had the best field survival, seedlings stored in Terrasorb® (a water-absorbent material) had intermediate survival, while seedlings stored in hydromulch (a by-product material of paper-production) had the lowest field survival. Best field survival occurred on seedlings stored for a period of 6 weeks or less.

Benomyl applied to seedling roots either prior to nursery storage or at the outplanting site prior to planting significantly reduced brown-spot needle blight on longleaf pine during the first year in the field. Benlate is currently being registered for use as a root treatment either at the nursery or field planting site by E. I. Dupont De Nemours and Company.

Additional keywords: *Pinus palustris* Mill., *Scirrhia acicola* Dearn. Siggers, nursery fungicide treatment, nursery packing materials.

Brown-spot needle blight, caused by the fungus *Scirrhia acicola* Dearn. Siggers, is the most serious disease of longleaf pine (*Pinus palustris* Mill.) in forest tree nurseries and young plantations. This disease causes significant growth and mortality losses. Severe infection on young trees can extend the characteristic "grass" stage for several to many years, thus delaying early height growth. Mortality of 50 percent or more has been routinely observed in young longleaf pine stands throughout the range of this pine species. The endemic occurrence of brown-spot over the longleaf pine range has drastically limited the use of this species in southern pine forestation. An effective, practical control of brown-spot needle blight is urgently needed for the successful regeneration of longleaf pine in the South.

OBJECTIVES

The objectives of the present study are to evaluate the effects of:

1. Benomyl (Benlate®) fungicide root treatments applied at the nursery on field survival and growth.
2. Four seedling packing and storage materials on field survival.
3. Seedling storage on field survival.
4. Packing and storage of benomyl-treated seedlings at the nursery on brown-spot disease development in field plantings.

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METHODS

One-year-old longleaf pine seedlings were lifted at the W. W. Ashe Nursery (USDA Forest Service), Brooklyn, Mississippi in January 1983, utilizing routine nursery seedling lifting practices. The seedlings were bundled in groups of 25, packed with one of four storage materials in kraft-polyethylene (K-P) bags, and placed in cold storage at 2°C (35°F). The four packing materials were: 1) clay slurry, 2) hydromulch, 3) peat moss, and 4) Terrasorb®. A total of 6,000 seedlings were placed in cold storage. The following 12 treatments were applied to the seedlings:

Nursery Treatment	Planting Site Treatment
1. Seedlings root-treated in clay slurry	No treatment
2. Seedlings root-treated in clay slurry	Benomyl + clay root treatment [1/]
3. Benomyl + clay root treatment [1/]	No treatment
4. Seedlings packed in hydromulch	No treatment
5. Seedlings packed in hydromulch	Benomyl + clay root treatment
6. Benomyl + clay root treatment followed by packing in hydromulch	No treatment
7. Seedlings packed in peat moss	No treatment
8. Seedlings packed in peat moss	Benomyl + clay root treatment
9. Benomyl + clay root treatment followed by packing in peat moss	No treatment
10. Seedlings treated with Terrasorb	No treatment
11. Seedlings treated with Terrasorb	Benomyl + clay root treatment
12. Benomyl + Terrasorb root treatment	No treatment

1/ Both the nursery and field planting site benomyl + clay treatments were prepared by using a dry mixture of 10% a.i. benomyl (20% Benlate-50 WP) + 80% kaolinite clay.

One hundred seedlings of each of the 12 treatments were outplanted at the Harrison Experimental Forest near Gulfport, Mississippi, following four different periods of storage (3, 6, 9, and 12 weeks). Seedlings were machine planted at a .9 m x 2.7 m (3 ft. x 9 ft.) spacing on .9 m (3 ft.) wide scalped rows. The treatments were randomly located in each of five blocks. First-year measurements of tree survival and brown-spot disease incidence were made in November 1983. The incidence of brown-spot was determined by visually estimating the amount of individual seedling foliage expressing disease symptoms. Treatment means were analyzed statistically for significant differences (P = 0.05) by Duncan's multiple range test.

Annual measurements will be made of tree survival, brown-spot disease incidence, height, and percent of seedlings out of the "grass" stage (height > 10 cm) for 2 more years.

RESULTS

Longleaf seedling field survival was significantly affected by benomyl treatment, packing material, and storage time (Fig. 1 A-D). Seedlings treated with benomyl at the time of outplanting had the best survival (61.0%) of the stored seedling treatments. Survival was less on both the nonbenomyl-treated seedlings (53.8%) and the seedlings treated with benomyl prior to storage (54.4%). Good survival occurred on seedlings packed in either clay (61.7-77.0%) or peat moss (63.6-74.4%). Relatively poor survival occurred on seedlings packed in either hydromulch (27.0-45.9%) or Terrasorb (41.0-54.3%). In general, seedling survival decreased with increasing storage time. In comparison, the clay-treated and clay + benomyl-treated seedlings planted immediately after nursery lifting without a storage period had 80.0 percent and 73.0 percent survival, respectively.

Brown-spot disease incidence was significantly affected by benomyl treatment and seedling storage factors (Fig. 1 A-D). Benomyl applied either prior to nursery storage or at time of outplanting significantly reduced brown-spot disease incidence during the first year in the field. The interaction of benomyl and packing material also significantly affected the disease occurrence. Seedlings not treated with benomyl and packed in either clay or peat moss at the nursery had significantly more brown-spot disease (22.1 and 25.7%, respectively) than the untreated seedlings packed in either hydromulch or Terrasorb (18.2 and 16.2%, respectively). Increasing the length of storage resulted in a decrease in disease occurrence. In comparison, the clay-treated and clay + benomyl-treated seedlings planted immediately after lifting without a storage period had 34.6 percent and 6.0 percent brown-spot disease incidence, respectively.

DISCUSSION AND CONCLUSIONS

The best survival of stored longleaf pine seedlings occurred with seedlings treated with benomyl and then packed in clay slurry or peat moss prior to shipment. This benomyl treatment applied during the packing operation at the nursery apparently provided some beneficial fungicidal effect on the seedlings during storage. This was an additional benefit of the benomyl root treatment and may be important for reducing seedling diseases. The occurrence of seedling diseases in storage could he partially responsible for the past field survival problems associated with longleaf pine.

The hydromulch and Terrasorb packing materials provided relatively poor longleaf pine field survival results, even after only three weeks of storage. Similar results have been reported for these two packing materials for slash pine seedlings in Florida nurseries (Barnard, 1982). Starch content and/or the amount of water associated with these two packing materials may have affected seedling quality and subsequent field survival. These factors could also alter the fungicidal action of benomyl in the storage bags. Additional studies are planned with starch-free, water-absorbent materials. The results also suggested that longleaf pine seedlings should not be stored more than 6 weeks for acceptable field survival and agrees with previous nursery storage results (White, 1981; Kais and Barnett, 1984). The application of the benomyl treatment at the nursery effectively reduced brown-spot needle blight incidence on longleaf pine seedlings during the first year in field plantings. Two of the most popular packing materials used by nurseries, clay slurry and peat moss (Williston, 1974), were successfully combined with benomyl for effective control of brown-spot in field plantings.

Benomyl treatment of longleaf pine by nursery personnel during packing could stimulate the future expansion of longleaf pine production by: 1) effectively controlling brown-spot needle blight, 2) increasing field survival and early height growth, and 3) stimulating interest in growing longleaf pines. Plans are in progress to promote the operational use of the benomyl treatment in southern nurseries producing longleaf pine. The Dupont Chemical Company (benomyl manufacturer) has recently applied for an expanded Environmental Protection Agency (EPA) registration for this fungicide treatment.

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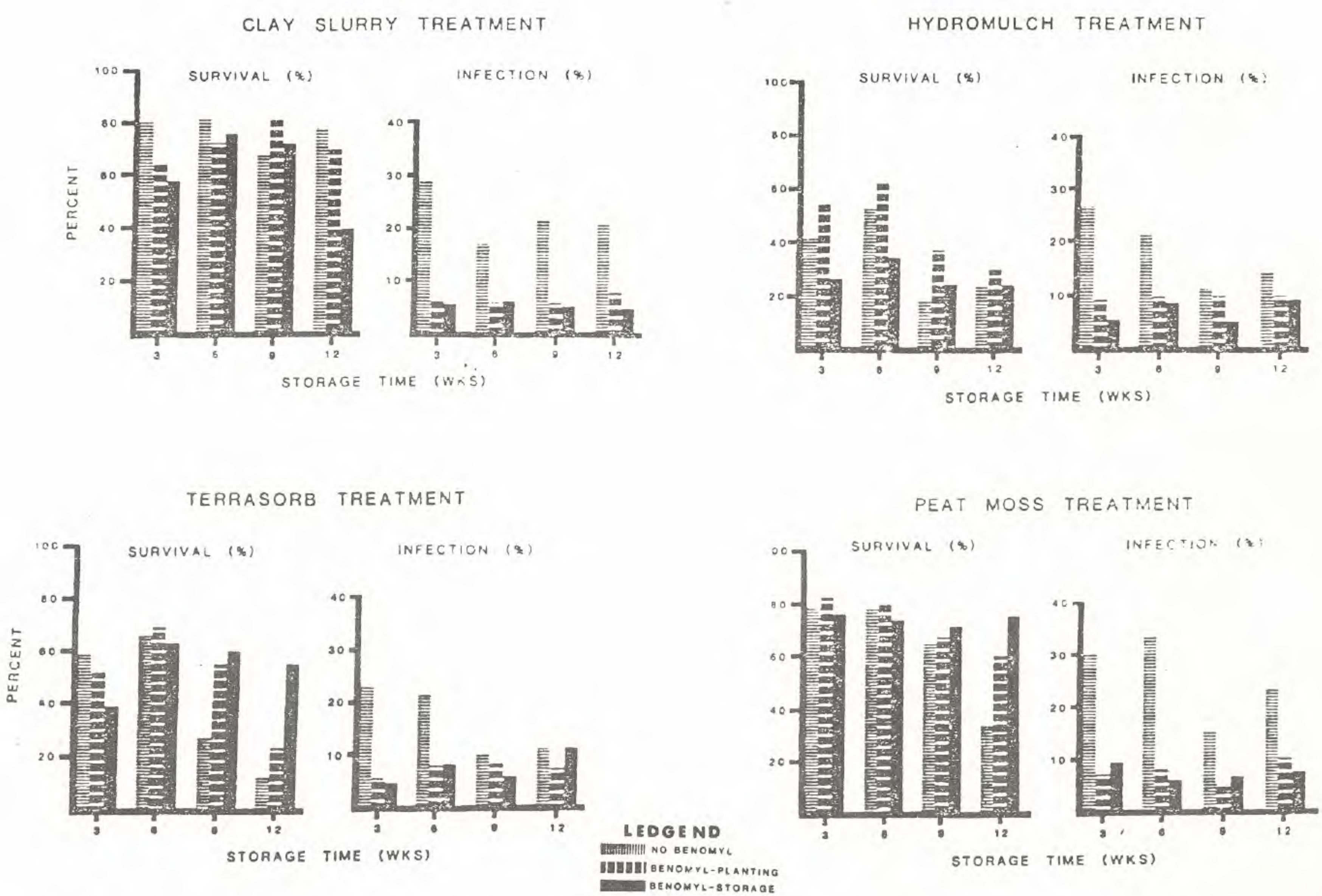

Figure 1.-- The effects of four packing materials and storage time at the nursery on longleaf pine seedling survival and brown-spot disease incidence after one year in the field.