USING BENOMYL TO IMPROVE PERFORMANCE OF STORED SOUTHERN PINE SEEDLINGS

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Abstract. Survival of longleaf, shortleaf, slash, and loblolly pine seedlings planted in the field with benomyl incorporated in the packing medium was markedly improved over that of controls with clay-slurry packing medium. Longleaf and shortleaf pine seedlings, which are more difficult to store, had greater magnitudes of response than more easily stored loblolly and slash pines.

Studies have shown that a clay-benomyl (Benlate® WP50)[1/] mixture used as a root dip at the time of planting provides systemic protection of longleaf pine *(Pinus palustris* Mill.) seedlings from brown-spot disease *(Scirrhis acicola [Dearn.]* Siggers) for at least one year in the field (Kais and Barnett 1984, Cordell et al. 1984, Kais et al. 1986a and 1986b). This treatment resulted in improved survival and earlier initiation of height growth (Kais 1985, Kais and Barnett 1984). These data provided incentive to determine if incorporation of fungicides in the clay slurry packing medium could improve the storage of southern pine seedlings, particularly those species more difficult to store. A series of tests of clay-benomyl mixtures applied at time of seedling lifting were installed to evaluate field performance of stored seedlings.

METHODS

Several tests are underway to evaluate the effect of fungicides on storage of southern pine seedlings. In the first of three studies in this report, longleaf pine seedlings from a single seed lot were lifted in January 1985 from beds at the Ashe Nursery in Mississippi. Seedlings were divided into sublots for 2 storage periods (1 and 3 weeks), and five root packing material treatments were applied for each storage period: 1) clay slurry control, 2) clay slurry, with benomyl applied at the time of planting, 3) clay slurry with benomyl added at the time of packing, 4) peat-moss control, and 5) peat moss combined with a benomyl dip treatment. Benomyl was applied in a 10 percent mixture of Benlate® WP50 and kaolinate clay. This resulted in an approximate 5-percent a.i. of benomyl in the clay slurry or dip. A 10 percent dilution of benomyl in water was used as a dip prior to packing with peat moss for treatment 5.

In a second test, longleaf pine, loblolly pine *(P. taeda* L.) and shortleaf pine *(P. echinata* Mill.) seedlings from the Ashe Nursery were lifted in January 1986 and divided into sublots for 3 storage periods (0, 3, and 6 weeks). Two root packing treatments were applied to each of the three sublots: 1) clay slurry control, and 2) a 10 percent Benlate® WP50 and clay slurry mixture.

[1/] Mention of trade names is for information only and does not constitute endorsement by the USDA Forest Service.

In test three, two seedlots (from Florida and Mississippi) of slash pine (*P. elliotti* Engelm.) and three (from Alabama, Louisiana, and north Mississippi) of loblolly pine were lifted late in the season (March 9, 1986) and subdivided for two treatments (0 and 6 weeks). The dosage rate was reduced to about 1/4 of that of the earlier test, i.e., 2.5 percent mixture of Benlate° WP50 and kaolinate clay. The control was a clay slurry.

In all tests, seedlings were packed in Kraft-polyethylene bags (350 seedlings per bag) and stored at 35°F. Seedlings of the 0 week treatment were planted within 1 week, while the other plantings were made after 3 or 6 weeks of storage. Seedlings were machine planted at a 5x5-foot spacing in 2 rows of 50 seedlings; there were 4 replications of 100 seedlings. Study one was outplanted on two different sites in central Louisiana. The other two studies were planted on only one site. Seedling survival was measured in June and December in the same year following planting. Test one was also measured after 2 years in the field.

Differences in survival were tested for significance at the 0.05 level by analyses of variance. Duncan's multiple range test was used to evaluate treatment means.

RESULTS

Study 1.--Outplanting site had considerable effect on longleaf pine seedling survival after two growing seasons. Heavier grass and woody competition as well as greater brown-spot incidence occurred on site 1. Nevertheless, treatment effects followed the same trends on both sites. For example, both length of seedling storage and packing-medium treatments significantly affected seedling performance. Survival after 3 weeks of storage was markedly lower than for the 1 week storage period (fig. 1). The effect of storage varied greatly, depending on packing-medium treatments, and for both sites there was a storage x packing treatment interaction.

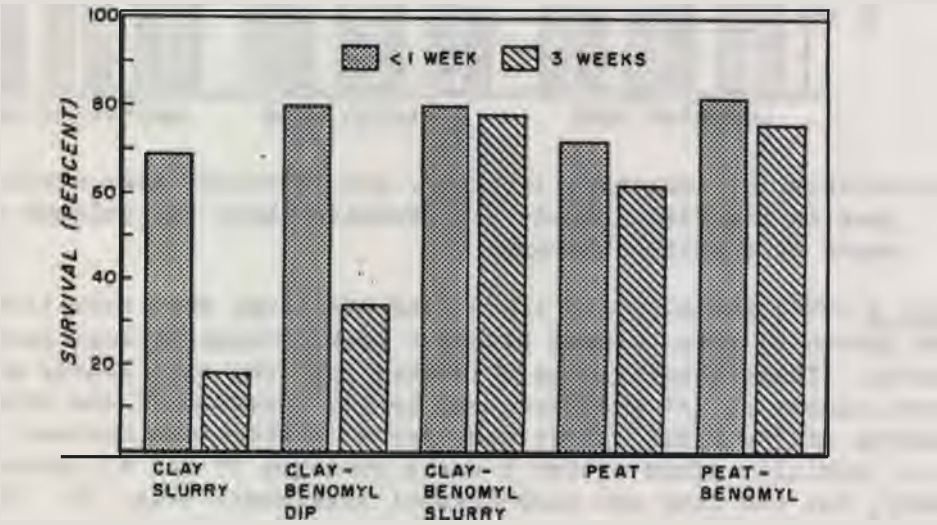

Figure 1.--Survival of longleaf pine seedlings stored less than 1 week and 3 weeks with various root packings 2 years after outplanting (Study 1).

The clay-slurry and peat-moss controls had consistently lower survival than any of the benomyl treatments when stored 1 week (fig. 1). The magnitude of treatment differences was much greater for the 3-week storage treatment. The clay-slurry treatments averaged 19, 33, and 79 percent survival for the control, benomyl dip at planting, and the clay-benomyl slurry, respectively. The peat-moss control averaged 64 percent, three times that of the clay-slurry control. The addition of benomyl to the peat-moss treatment improved survival 13 percentage points.

Study 2.—Longleaf, loblolly and shortleaf pine seedlings receiving clay-slurry control and clay-benomyl treatments were planted after storage periods of 0, 3, and 6 weeks. Response after 1 year varied by species. Longleaf pine seedlings had the lowest survival regardless of treatment, and benomyl improved survival after all lengths of storage (fig. 2). In contrast, survival of loblolly pine seedling was nearly 100 percent regardless of treatment. Survival of shortleaf pine seedlings without storage (0 week storage period) averaged 99 percent, but after being stored for 3 and 6 weeks, survival of the controls dropped to 83 and 36 percent, respectively. Benomyl-treated shortleaf seedlings maintained the same level of survival even after storage (fig. 2).

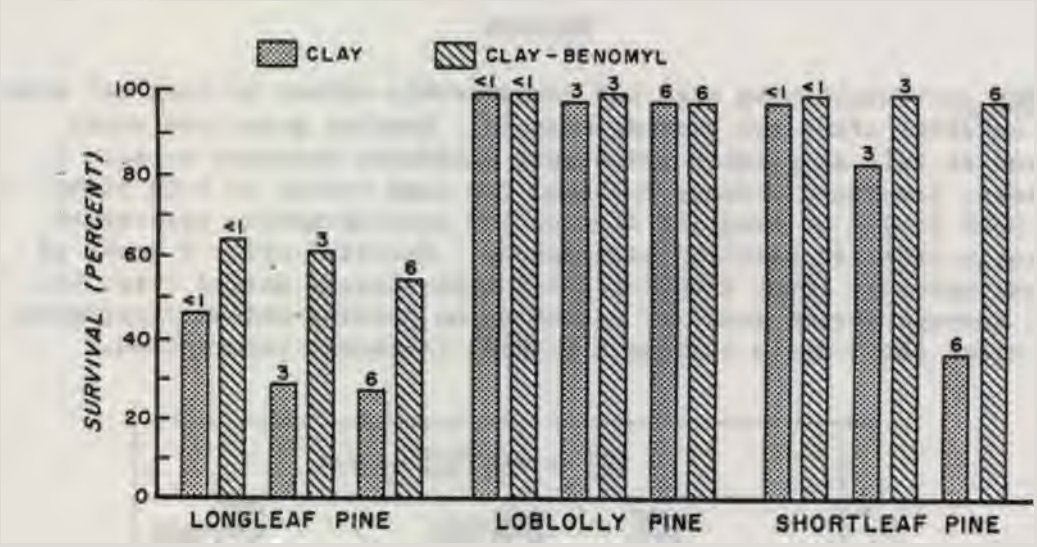

Figure 2.--Survival of longleaf, loblolly, and shortleaf pine seedlings after 1 year in the field (study 2). Numbers above the columns represent weeks of seedling storage.

Study 3.--The loblolly and slash pine seedlings that were lifted later in the season (March 9) were planted within 1 week (0-week storage period) and after 6 weeks. These seedlings were treated with the clay slurry and a clay-benomyl slurry at 1/4 the rate used in the slurries of the other studies. After 3 months in the field, there were marked differences between packing treatments. Loblolly pines stored 6 weeks averaged 23 and 87 percent, respectively, for the clay and clay-benomyl treatments (fig. 3). Comparative treatments for slash pine averaged 9- and 88-percent survival.

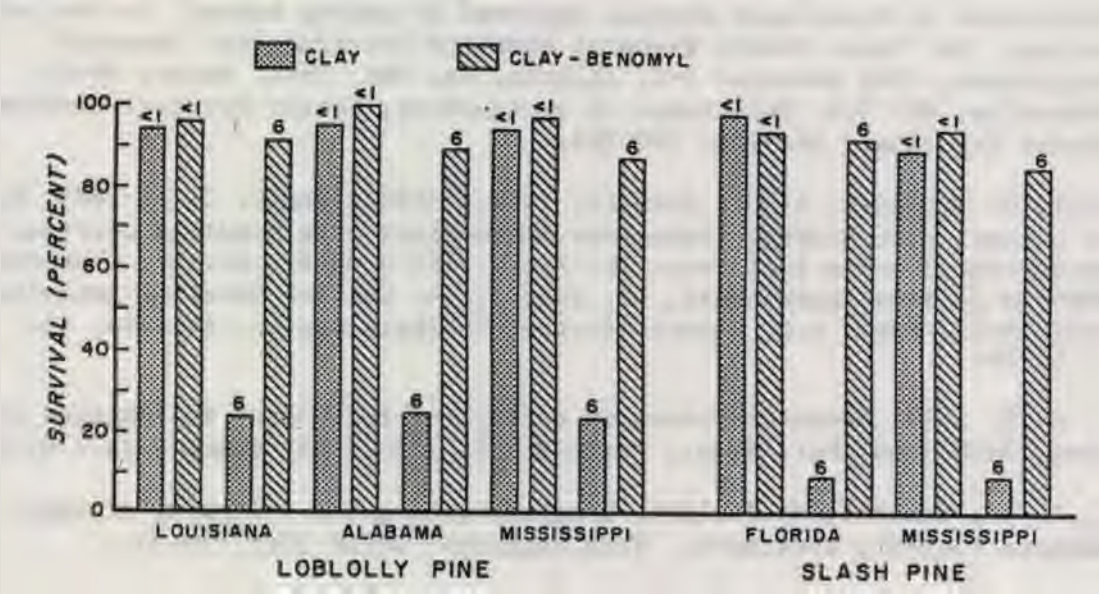

Figure 3.--Survival of loblolly and slash pine seedlings after 3 months in the field (study 3). Numbers above the columns represent weeks of seedling storage.

DISCUSSION

Results of all three tests showed a very positive response to the incorporation of benomyl into the clay slurry used for seedling packing. The root—dip treatment in benomyl prior to seedling storage in peat moss followed a similar trend. Preliminary pathological evaluations indicate that benomyl is controlling pathogenic microorganisms that reduce seedling quality after storage of 3 or 6 weeks. Survival of longleaf pine seedlings, which are the most difficult of the southern pines to store, benefited from benomyl treatment even when the seedlings are outplanted within 1 week. The second greatest response among species was with shortleaf pine. Major improvements in survival of shortleaf pine seedlings occurred with storage for 3 to 6 weeks.

Loblolly pine seedlings lifted in early January survived well without benomyl treatment. However, when loblolly and slash seedlings were lifted in March and stored 6 weeks, seedlings that received benomyl treatment were able to be stored satisfactorily. Those without such treatment showed a large decrease in survival. Additional studies are underway to evaluate the mechanisms involved in deterioration of seedlings during storage; other studies are being conducted to determine the effect of date of lifting on seedling storage.

LITERATURE CITED

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