Improving Outplanting Survival of Stored Southern Pine Seedlings by Addition of Benomyl to the Packing Medium[1]

James P. Barnett and John C. Brissette[2]

Barnett, James P.; Brissette, John C. 1987. Improving outplanting survival of stored southern pine seedlings by addition of Benomyl to the packing medium. In: Landis, T.D., technical coordinator. Proceedings, Intermountain Forest Nursery Association; 1987 August 10-14; Oklahoma City, OK. General Technical Report RM-151. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 43-45. Available at: http://www.fcnanet.org/proceedings/1987/barnett.pdf

Abstract.-- Field survival of longleaf, shortleaf, slash, and loblolly pine seedlings planted with benomyl incorporated in the packing medium was markedly improved over that of controls with clay-slurry packing medium. Longleaf pine (*Pinus palustris* Mill.) and shortleaf pine (*P. elliottii* Englem.) seedlings, which are more difficult to store, had greater magnitudes of response than the more easily stored loblolly and slash pine seedlings.

INTRODUCTION

Clay-benomyl (Benlate®)3 mixture used as a root dip treatment at the time of planting provides systemic protection of longleaf pine (*Pinus palustris* Mill.) seedlings from brown-spot disease (*Scirrhia acicola* (Dearn.) Siggers). Protection should last for at least one year in the field (Kais and Barnett 1984; Cordell et al. 1984; Kais et al. 1986a, 1986b). This treatment has resulted in improved survival and early height growth (Kais 1985; Kais and Barnett 1984; Kais et al. 1986b). Benomyl is a very effective fungicide that is recommended for a number of other uses in container and bare-root nursery seedling production (Barnett and Brissette 1986; Sutherland 1984).It also has the advantage of having no phytotoxic effect on mycorrhizal development; in fact, seedling development is enhanced by benomyl use (Pawuk and Barnett 1981).

Recent tests have shown that longleaf pine seedling storage may be dramatically improved by the incorporation of benomyl into the clay slurry used for seedling packing (Barnett and Kais 1987). Early results have stimulated additional testing and extension of the technique to other species.

METHODS

Three studies are underway by the Southern Forest Experiment Station to evaluate the effect of fungicides on storage of southern pine seedlings. In study 1, 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 two sublots for two 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 a benomyl dip added 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 as a 10-percent mixture of Benlate® WP50 with 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 study 2, 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 three sublots for three 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) 10-percent Benlate® WP50 and clay slurry mixture.

In study 3, two seedlots (Florida and Mississippi) of slash pine (*P. elliotti* Engelm.) and three (Alabama, Louisiana, and north Mississippi) of loblolly pine were lifted at the Ashe Nursery late in the season (March 9, 1987) and subdivided for two treatments (0 and 6 weeks) The dosage rate was reduced to one-fourth the rate of the earlier test, i.e., a 2.5-percent mixture of Benlate® WP50 and kaolinate clay. The control was a clay slurry.

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[1]Paper presented at the Intermountain Nursery Association Meeting, Oklahoma City, Oklahoma, August 10-14 1987.

[2]Principal silviculturist and silviculturist, respectively, USDA-Forest Service, Southern Forest Experiment Station, Pineville, LA 71360.

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

In all tests, seedlings were packed in Kraft polyethylene bags (350 per bag) and stored at 35°F. Seedlings of the 0 week treatment were planted within 3 or 4 days, while the other plantings were made after 3 or 6 weeks of storage. Seedlings were machine planted at 5- by 5-foot spacings in 2 rows of 50 seedlings; there were 4 replications. Study 1 was outplanted on two different sites in central Louisiana. Only one site was used for the other two studies. Seedling survival was measured in June and December of the same year following planting. Study 1 was also measured for survival and height 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.--The outplanting site had a considerable influence 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. Both length of seedling storage and packing-medium treatments significantly affected seedling performance. Survival of seedlings that had undergone 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.

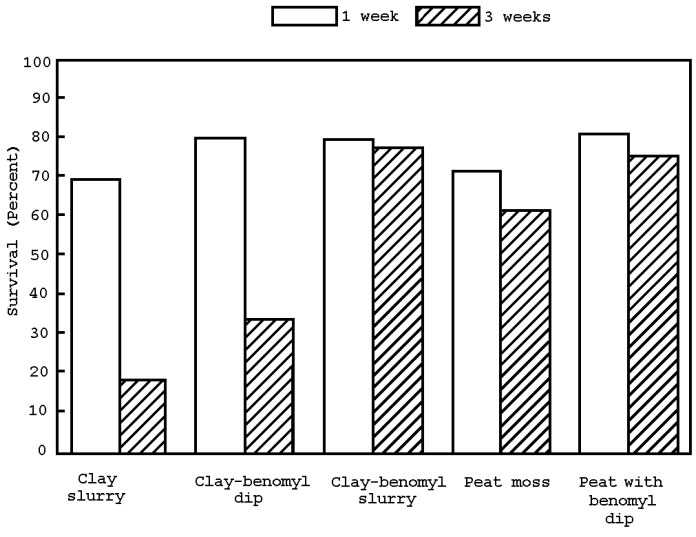

Figure 1.--Survival of longleaf pine seedlings stored 1 and 3 weeks with various root packings 2 years after outplanting (Study 1.)

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 difference 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 by 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 seedlings was almost 100 percent regardless of treatment or storage. 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).

Study 3.--The loblolly and slash pine seedlings 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 one-fourth 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.

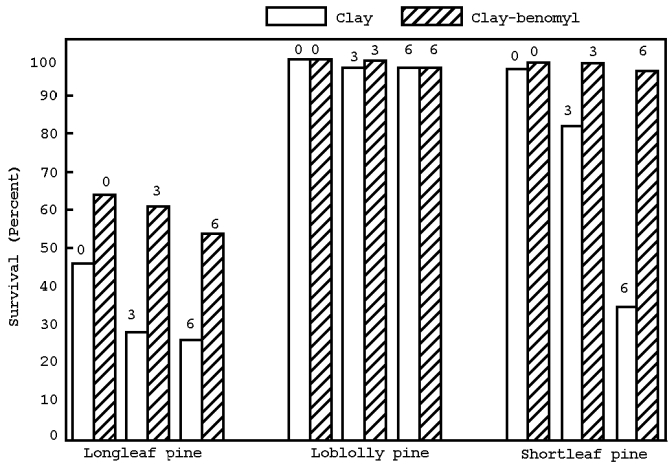

Figure 2.--Survival of longleaf, loblolly, and shortleaf pine seedlings stored for 0, 3, and 6 weeks with two root packings 1 year after outplanting (Study 2). Numerals above bars represent number of weeks stored.

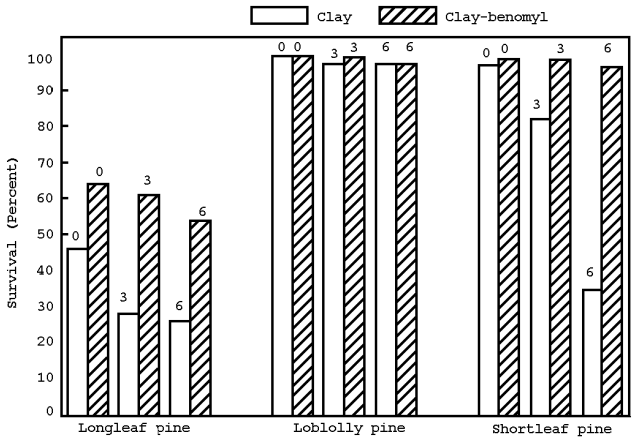

Figure 3.--Survival of loblolly and slash pine seedlings stored for 0 and 6 weeks with two root packings 3 months after outplanting (Study 3). Numerals above bars represent number of weeks stored.

DISCUSSION

Results of all three tests showed a very positive response from the incorporation of benomyl into the clay slurry used for seedling packing. The root dip in benomyl followed by seedling storage in peat moss followed the same 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, is improved by benomyl treatment even when the seedlings are outplanted within 1 week. The second greatest response was with shortleaf pine. Major improvements in shortleaf pine survival occurred with 3 to 6 weeks of storage.

Loblolly pine seedlings lifted in early January survived well without benomyl treatment. However, when loblolly and slash seedlings were lifted in March and stored for 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 underway to determine the effect of date of lifting on seedling storage.

LITERATURE CITED

Barnett, James P.; Brissette, John C. 1986. Producing southern pine seedlings in containers. Gen. Tech. Report SO-59. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. 71 p.

Barnett, James P.; Kais, Albert G. 1987. Longleaf pine seedling storability and resistance to brown-spot disease improved by adding benomyl to the packing medium. In: Proc. Fourth Biennial Southern Silviculturall Research Conference, November 4-6, 1986, Atlanta, GA. Gen. Tech. Report SE-24. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. P. 222-224.

Cordell, C. E.; Kais, A. G.; Barnett, J. P.; Affeltranger C. E., 1984. Effects of benomyl root storage treatments on longleaf pine seedling survival and brown-spot disease incidence. In: Proc. 1984 Southern Nursery Conference. Western Session: Alexandria, LA. June 11-14. Eastern Session: Asheville, NC, July 24-27, 1984. U.S. Forest Service, Southern Region, Atlanta, GA. p. 84-88.

Kais, A. G. 1985. Recent advances in control of brown spot in longleaf pine. Proc. 34th Annual Forestry Symposium, March 26-27, 1985. Louisiana State Univ.: 83-90.

Kais, A. G.; Barnett, J. P. 1984. Longleaf pine grown following storage and benomyl root-dip treatment. Tree Planters' Notes 35(1):30-3

Kais, A. G.; Cordell, C. E.; Affeltranger, C. E. 1986a. Benomyl root treatment controls brown-spot disease on longleaf pine in the Southern United States. Forest Science 32:506-511.

Kais, A. G.; Cordell, E.; Affeltranger, C. E. 1986b. Nursery application of benomyl fungicide for field control of brown-spot needle blight (*Scirrhia acicola* (Dearn.) Siggers.) on longleaf pine (*Pinus palustris* Mill.). Tree Planters' Notes 37(1):5.

Pawuk, William H.; Barnett, James P. 1981. Benomyl stimulates ectomycorrhizal development by *Pisolithus tinctorius* on shortleaf pine grown in containers. Res. Note SO-267. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. ,3 p.

Sutherland, J. R. 1984. Pest management in Northwest bareroot nurseries. Chapter 19 in Forest Nursery Manual: Production of Bareroot Seedlings. Duryea, Mary R.; Landis, Thomas D.; editors. Martinus Nijhoff/Dr. W. Junk Publishers, The Hague. p. 203-210.