

IMPROVING LONGLEAF PINE SEEDLING PRODUCTION BY CONTROLLING SEED AND SEEDLING PATHOGENS

James P. Barnett and John M. McGilvray¹

Abstract—The demand for container longleaf pine (*Pinus palustris* Mill.) planting stock is increasing across the Lower Gulf Coastal Plain. Poor-quality seeds and seedling losses during nursery culture further constrain a limited seed supply. Improved seed efficiency will be necessary to meet the need for increased seedling production. Seed presowing treatments and seedling fungicidal applications were evaluated in container longleaf pine seedling operations to determine if efficiency of seedling production could be improved. Application of treatments to reduce pathogenic fungi on seed and in seedling culture significantly increased plantable container stock.

INTRODUCTION

With a tenfold increase in seedling production occurring in the last few years, interest in the production and planting of longleaf pine (*Pinus palustris* Mill.) seedlings has reached an all time high. A limitation in producing even more seedlings is lack of high-quality seeds that not only germinate well, but result in plantable stock. Earlier results have shown that longleaf seed coats carry pathogenic fungi that not only reduce germination, but also result in significant seedling mortality (Barnett and others 1999). Pawuk (1978) and Fraedrich and Dwinell (1996) found that *Fusarium* spp. are commonly found on longleaf pine seeds and cause longleaf seedling mortality. Tests have shown that treating longleaf seeds with a sterilant or fungicide prior to sowing can improve both germination and seedling establishment (Barnett 1976, Barnett and Pesacreta 1993, Litke and others 1997). However, the effects of using both seed pretreatments to control seed-coat pathogens and fungicides to minimize seedling losses during the cultural period have not been reported. Our objectives were to develop recommendations for presowing treatments and fungicidal applications that will improve the efficiency of seedling production.

METHODS

The seeds used originated from bulked seed orchard lots of longleaf pine adapted to the Western Gulf Coastal Region. Seedlings were grown at the Southern Research Station's facility at Pineville, LA, following guidelines for producing longleaf pine container stock (Barnett and McGilvray 1997).

All seedlings were grown in Multipot 3-96ä containers, and both seed presowing treatments and seedling fungicidal applications were evaluated. The presowing treatments were a control and a hydrogen peroxide application—1-hour soak in 30-percent hydrogen peroxide (Barnett 1976, Barnett and McGilvray 1997). The seedling fungicide treatments included: (1) a control, and applications of

(2) Benlate®, (3) Fungo-flo®, and (4) Fungo-flo® plus Subdue®. The fungicides were applied biweekly after seed germination was complete. The recommended concentrations of the fungicides used are: Benlate® 50WP (benomyl)—1 rounded teaspoon per gallon of water; Fungo-flo® (46.2 percent a.i. thiophanate-methyl)—0.2 fluid ounce per gallon of water; Fungo-flo® plus Subdue® 2E (metalaxyl) at 10 ppm active ingredient (0.15 ml per gallon of water).

The study was a randomized experiment with three replications of three trays each for each treatment replication. A total of 72 trays of 96 seedlings each was included in the study. The seeds were sown in late April 1999; seedling counts were made in December 1999 to determine the percentage of plantable seedlings (number of cavities with a plantable seedling divided by number of cavities with a germinant). Plantable seedling percentages differ from germination percentages in that losses of germinants due to disease are taken into consideration.

RESULTS

Both the seed and seedling treatments had a significant effect on plantable seedling percentages at the end of the study, and there were no statistical interactions between the presowing and fungicidal treatments (table 1). The hydrogen peroxide treatment of seed increased plantable seedlings from 85 to 93 percent; fungicide treatment of controls increased plantable seedlings from 78 to 92 percent. When the hydrogen peroxide seed treatment was used, 92 percent of the seedlings that did not receive fungicides were plantable. Fungicide applications to seedlings only improved average plantable stock by 2 percent.

Seedlings grown from seed that did not receive the hydrogen peroxide presowing treatment had a plantable seedling percentage of only 78, compared to 88 for those treated with fungicides during culture. There were no significant differences in the effectiveness of fungicides.

¹Chief Silviculturist, Biological Technician, USDA Forest Service, Southern Research Station, Pineville, LA 71360, respectively.

Table 1—Longleaf pine plantable seedling percentages resulting from seed and seedling treatments^a

Seedling treatment	Seed treatment		
	Hydrogen peroxide		Average
	Control		
	----- <i>Percent</i> -----		
Control	78	92	85a
Benlate®	85	93	89b
Fungo-flo®	88	94	91b
Fungo-flo® plus Subdue®	90	94	92b
Average	85a	93b	

^a Plantable seedling percentages (numbers plantable in November divided by numbers with an initial germinant) are averages for 288 seedling cavities for each of 3 replications. Averages within columns and across rows followed by the same letter are not significantly different at the 0.05 level.

DISCUSSION

Results from this study demonstrate the effectiveness of reducing fungal populations on longleaf pine seed coats before they are sown in containers. Elimination of pathogenic fungi from seed coats increases seedling establishment and reduces sources of disease infestation later in the nursery cultural period. Although 30-percent hydrogen peroxide was used in this study and is labelled as a stimulant of pine seed germination, earlier research has shown that a 10-minute Benlate® seed drench was equally effective and is a safer means of reducing seed coat pathogens (Barnett and others 1999). Benlate® has been labelled for conifer seed treatment in most of the southern States. Other fungicidal chemicals or methodologies also may be effective if they are not phytotoxic to seed germination.

There were no statistical differences among the fungicides used to reduce seedling losses during the nursery growing period. Because a great deal of research has

demonstrated its effectiveness in controlling *Fusaria*, Benlate® was used as a kind of fungicidal standard. However, the label for this fungicide has been withdrawn for conifer nursery use. Fungo-flo®, a labelled replacement for Benlate®, is equally effective in controlling pathogens of longleaf seed and seedlings. Subdue® is normally added to the fungicidal application because it broadens the spectrum of disease protection to include other pathogens such as *Pythium* and *Rhizoctonia*.

Combing presowing seed treatments to reduce pathogenic fungi on the seed coats with the application of appropriate fungicides to seedlings during the growing season to control pathogenic fungi greatly increases the efficiency of container seedling production.

LITERATURE CITED

Barnett, J.P. 1976. Sterilizing southern pine seeds with hydrogen peroxide. *Tree Planters' Notes*. 27(3): 17-19, 24.

Barnett, J.P.; McGilvray, J.M. 1997. Practical guidelines for producing longleaf pine seedlings in containers. General Tech. Report SRS-14. Asheville, NC: USDA Forest Service, Southern Research Station. 28 p.

Barnett, J.P.; Pesacreta, T. C. 1993. Handling longleaf pine seeds for optimal nursery performance. *Southern Journal of Applied Forestry*. 17: 180-187.

Barnett, J.P.; Pickens, B.; Karrfalt, R. 1999. Longleaf pine seed presowing treatments: effects on germination and nursery establishment. In: Landis, T.D.; Barnett, J.P., tech. coords. National proceedings: forest and conservation nursery associations—1998. General Tech. Report SRS-25. Asheville, NC: USDA Forest Service, Southern Research Station: 43-46.

Fraedrich, S.W.; Dwinell, L.D. 1996. Mortality of longleaf pine seedlings caused by *Fusarium subglutinans* and an evaluation of potential inoculum services. In: Proceedings of the 3rd meeting of IUFRO Working Party 57.03.04; 1996 May 19-24; Orlando-Gainesville, FL: 48-54.

Litke, W.; Miller, H.; Milican, D. [and others]. 1997. The efficacy of Benlate seed-dip treatments to control seedborne *Fusarium* disease in containerized longleaf pine (*Pinus palustris*). Weyerhaeuser Research and Development Rep. 050-1422-97.1. Centralia, WA: Weyerhaeuser Forestry Laboratory. 22 p.

Pawuk, W.H. 1978. Damping-off of container-grown longleaf pine seedlings by seedborne *Fusaria*. *Plant Disease Reporter*. 62: 82-84.