The Effects of Presoaking Longleaf Pine Seeds in Sterilants on Direct Seeding

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Sterilizing longleaf pine seedcoats before applying repellant coatings was evaluated for germination effects in two laboratory and three nursery tests. The only significant improvements in germination were to seedlots with viability levels below minimums recommended for direct seeding. Highly viable seeds were adversely affected by some treatments.

Southern pine seedcoats are infested with fungal microorganisms, which cause reduced germination, root rot, and damping-off in greenhouse production of containerized seedlings (3). Barnett (1) found that soaking seeds for 30 minutes or more in 30-percent hydrogen peroxide sterilized the seedcoats and effectively eliminated the source of infection.

If fungi are inherent in the seedcoats rather than being greenhouse-induced, they could also account for frequent poor germination in nursery-sowing and direct-seeding operations. But seeds sown directly on a forest site must be coated with a thiram-endrin-latex repellant to protect them from predators, and no tests exist to document the effects of sterilization on germination of repellant-treated seeds. The purpose of this study was to determine whether sterilizing seeds before overcoating with repellants improves germination of longleaf pine (*Pinus palustris* Mill.) seed.

Methods

Six sterilization treatments followed by application of the standard repellant coating were compared with the repellant coating only treatment (S) to evaluate their effects on germination. The six treatments were:

- P1S—1-hour soak of untreated seeds in 30-percent hydrogen peroxide; seeds air dried and then repellant coated.
- P1WS—1-hour peroxide soak; seeds washed under fast-flowing tapwater for 10 minutes to remove excess peroxide, air dried, and then repellant coated.
- P3S—3-hour peroxide soak; seeds air dried and then repellant coated.
- P3WS—3-hour peroxide soak; seeds washed, air dried, and then repellant coated.
- C4S—4-hour soak in 9.1 percent Clorox (1 part commercial laundry product to 10 parts water); seeds air dried, and then repellant coated.
- C4WS—4-hour Clorox soak; seeds washed, air dried, and then repellant coated.

Three separate tests evaluated total germination of seeds with each of the seven treatments. The first was a laboratory trial with three different seedlots—A, B, and C—purpose selected from several long-term storage lots that had shown wide variations in viability. The second and third test were run concurrently in the laboratory and in the nursery with three similar seedlots—D, E, and F. The study design was a randomized split plot complete block with five replications. Differences between seedlots, treatments, and seedlot by treatment interactions were tested for significance at the 5-percent level by analyses of variance. Duncan's Multiple Range Test was used to locate differences.

Laboratory treatment plots were standard germinating trays sown with 100 seeds each. A laboratory rack was a block in the experimental design; seedlots were major plots and were placed on separate rack shelves; treatments for each seedlot were shelved at random. Standard laboratory pro-

cedures were followed. Nursery treatment plots were single rows across a bed sown with 50 uniformly spaced seeds. Rows were 6 inches apart with physical barriers between them to prevent mixing of seeds by water movement. Separate nurserybeds were blocks, and seedlots were assigned a section of bed; treatments for each seedlot were placed at random in that compartment. Standard nursery procedures were followed. The principal measurement response in each test was normal germination percent.

Table 1.—*Laboratory germination percentages—first test*[1]

Seedlot A							
Treatments	S	C4WS	P1WS	C4S	P3WS	P3S	P1S
Treatment means	84	83	78	75	53	37	36
Seedlot B							
Treatments	S	C4S	C4WS	P1WS	P3WS	P3S	P1S
Treatment means	84	79	79	64	60	53	52
Seedlot C							
Treatments	P1S	P1WS	P3WS	C4S	C4WS	P3S	S
Treatment means	70	61	60	52	51	51	44
Combined seedlots							
Treatments	C4WS	S	C4S	P1WS	P3WS	P1S	P3S
Treatment means	71	70	69	67	57	52	47

[1]Treatment means not underscored by the same line are significantly different at the 0.05 level.

Results and Discussion

Since the purpose of this study was to compare normal germination percentages of sterilized and repellant-coated seeds with seeds that were only coated, the following discussion is confined to that comparison, and individual sterilization treatments are not compared.

***Laboratory* germination.** In the first test, sterilizing the seeds had no beneficial effect on germination of seedlots A or B, whether or not the excess sterilant was washed off. P1WS and C4WS with lot A and C4S and C4WS with lot B were not significantly different from the repellant alone, but all other treatments were detrimental (table 1). However, germination in lot C was improved by P1S, P1WS, and P3WS. While only 44 percent of the coated-only seeds germinated, the three sterilization treatments increased germination from 16 to 26 percent.

The most obvious of the significant interactions between seedlots and treatments was the reduction in germination by P1S and P3WS in lots A and B; both enhanced germination in lot C. Barnett (1) found a similar interaction. He reported that seedlots of low viability apparently benefited greatly from seed sterilization, although germinability of highly viable seeds may be decreased. When the three seedlots were combined into one composite lot, the advantage of sterilizing low-quality seeds was nullified; and there was no significant increase over the repellant treatment alone.

In the second test as in the first test, sterilizing good seeds was not beneficial, but some enhancement from soaking poor-quality seeds resulted. Lot D germinated 86 percent with the repellant treatment only and was not different from C4S, C4WS, and P1WS. However, P1S and both P3 treatments significantly decreased germination (table 2). Lots E and F were of low quality, but were improved

Table 2.—*Laboratory germination percentages-second test*[1]

	Seedlot D						
Treatments	S	C4S	C4WS	P1WS	P3S	P1S	P3WS
Treatment means	86	86	78	76	47	46	33
	Seedlot E						
Treatments	P1S	P1WS	P3WS	C4WS	P3S	C4S	S
Treatment means	55	50	50	50	48	47	45
	Seedlot F						
Treatments	P1S	P1 WS	C4S	P3WS	S	P3S	C4WS
Treatment means	78	73	64	53	50	44	30
	Combined seedlots						
Treatments	P1WS	C4S	S	P1S	C4WS	P3S	P3WS
Treatment means	66	65	60	60	53	46	45

[1]Treatment means not underscored by the same line are significantly different at the 0.05 level.

by one and two soaks, respectively. A significant interaction showed P1S detrimental to germination in seedlot D, but beneficial to lots E and F. When the three seedlots were combined, none of the soaks were beneficial, but the two P3 treatments were harmful.

While the first and second tests combined are not statistically comparable, a look at each sterilization effect on overall laboratory germination is of interest. Averages for 30 observations (6 seedlots with 5 replications each) per treatment were as follows:

Treatment	Treatment mean
C4S	67
P1WS	67
S	65
C4WS	62
P1S	56
P3WS	51
P3S	7

Although two sterilants resulted in slightly higher seed germination than the repellant alone, the 2-percent increase would hardly justify the cost of treatment for a mixed lot of average- to poor-quality seeds.

Nursery germination. In the third test no statistical differences appeared between germination of seeds with the repellant coating alone and those with any of the soaking treatments for seedlots D and E (table 3). However, for lot F and for all seedlots combined, each one of the soaking treatments reduced germination by a significant amount. These differences between treatments by seedlot also caused a significant seedlot by treatment interaction.

The reason lot D with the repellant germinated 33 percent less in the nursery than in the laboratory and P1S and P1WS in lot F more than 50 percent less is not apparent. A slight decrease, such as that for repellant-only treatments in lots E and F (5 and 3 percent), is more normal.

Conclusions

On the basis of this study, sterilization of seeds before application or repellants cannot be recommended for direct seeding. The only trials in which sterilization improved germination of longleaf seeds were with

Table 3.—*Nursery germination percentages-third test*[1]

			Seedlot D				
Treatments	P3WS	P1 WS	S	P3S	C4WS	PI S	C4S
Treatment means	56	54	53	53	53	50	49
			Seedlot E				
Treatments	S	P1 WS	P3S	C4S	C4WS	P3WS	PI S
Treatment means	40	32	32	31	30	28	26
			Seedlot F				
Treatments	S	P3S	Pi s	C4S	P3WS	P1 WS	C4WS
Treatment means	47	28	27	24	22	20	20
			Combined seedlots				
Treatments	S	P3S	P3WS	P1 WS	C4S	C4WS	PI S
Treatment means	47	38	35	35	35	34	34

[1]Treatment means not underscored by the same line are significantly different at the 0.05 level.

poor-quality seedlots of 50 percent viability or less. It is reasonable to assume that other pine species would be similarly affected. Mann (*2*) recommended against direct seeding with seeds of less than 80-percent viability, so poor-quality seeds susceptible to improvement are not an accepted option.

Some of the treatments may be beneficial to seeds sown for nursery seedlings or container production. Seeds of lower viability may be acceptable for use in such situations, especially when a large inventory of poor-quality seeds must be used or discarded.

Literature Cited

1. Barnett, James P. Sterilizing southern pine seeds with hydrogen peroxide. Tree Planter's Notes 27(3): 17-19,24; 1976.
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3. Pawuk, W. H.; Barnett, J. P. Root rot and damping off of container-grown pine seedlings. In: Proceedings, North American containerized forest tree seedling symposium; 1974 August 26-29; Denver. Great Plains Agricultural Council Publication 68: 173-176; 1974.