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Germination Temperatures For Container Culture Of Southern Pines

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ABSTRACT. *Peak germination of unstratified longleaf, shortleaf, loblolly, and slash pine seeds occurred at 75° F. Longleaf seeds germinated better at lower temperatures and less successfully at higher temperatures than those of slash, loblolly, and shortleaf pine. Stratification broadened the range at which slash, loblolly, and shortleaf germinated satisfactorily. Improvement in germination was greater at temperatures below 75° than above 75°. Temperatures of 95° resulted in low germination under all conditions.*

Containerized pine seedlings are used more and more in the South. Since these seedlings are usually germinated in greenhouses where temperatures can be regulated to maximize germination, knowing what effects temperature can have on germination is essential. Efficient use of seed is important to container production because of the cost of containers and greenhouse bench space. In this study, the effects of temperatures of 55°, 65°, 75°, 85°, and 95° Fahrenheit on germination of unstratified and stratified southern pine seeds were evaluated. In all cases, results are 28-day germination percentages.

Responses due to temperature changes varied by seed lot, use and length of stratification, and, most impor-

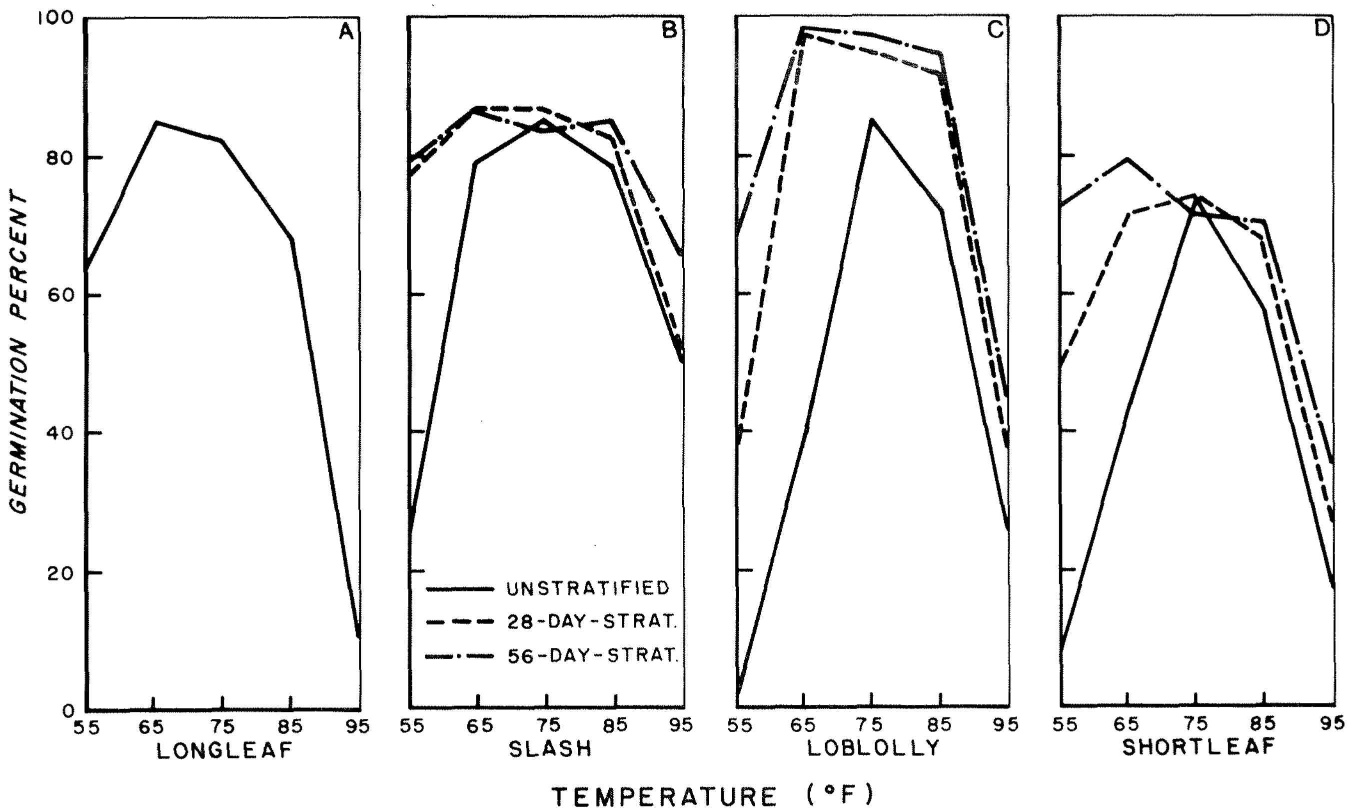

Figure 1. Germination of southern pine seeds at five temperatures following pregermination treatments.

tantly, by species. The results and their applications are presented in two sections: longleaf alone is in the first section; slash, loblolly, and shortleaf, combined, in the second. Unless otherwise noted, all differences discussed are statistically significant at the 0.05 level.

LONGLEAF

Only unstratified longleaf seeds were evaluated because they are rarely dormant. They germinated well at 65° and 75° but poorly at other temperatures (Figure 1A). Since longleaf is naturally a fall germinator, this pattern was expected. It is clear from the pattern that germination is risky at 85° and disastrous at 95°. The safest temperature range is between 65° and 75°.

LOBLOLLY, SLASH, AND SHORTLEAF

The responses of loblolly, slash, and shortleaf seeds to temperature are similar. The temperature at which unstratified seeds of the three species reached peak germination was 75°. Germination of unstratified shortleaf seeds was about 11 percentage points lower than that of the other two species (Figure 1D).

Unstratified slash pine seeds were less affected by temperature extremes than loblolly and shortleaf seeds. They have a wide temperature range (65°–85°) at which germination was greater than 70 percent, the generally accepted minimum for normal use (Figure 1B). Germination was better at 95° than for the other species and inferior only to longleaf at 55°.

For loblolly, slash, and shortleaf seeds, stratification for either 28 or 58 days widened the range of temperatures at which a fairly uniform plateau of satisfactory germination occurred. The greatest benefit from stratification was at temperatures below 75°, although benefits were obtained at 85°.

For loblolly seeds, increases in germination after stratification were considerably greater than expected, especially at high temperatures. At 65°, the two lengths of stratification had about the same effect. Germination at 75° was 10 to 12 percentage points higher than for unstratified seeds, but the difference between treatments was not significant (Figure 1C). Only at the lowest temperature did the effects of the shorter and longer stratifications differ. At 55° the 56-day treatment resulted in germination 31 percentage points higher than for the 28-day treatment. The shorter stratification period increased germination by 35 percentage points over the unstratified controls but the percentage was still too small for greatest economy of seed.

Stratifying slash pine seeds for 28 and 56 days increased germination at both temperature extremes (Figure 1B). Both periods were equally effective. Stratification did not improve germination at 75°. For both periods germination remained fairly constant from 55° to 85°, but fell off markedly at 95°, as it did for unstratified slash pine seeds.

As with loblolly and slash, stratification of shortleaf seeds broadened the range at which their germination was equal to that of unstratified shortleaf seeds at 75°. The pleateau at which satisfactory germination occurred extended from 65° to 85° for both stratification treatments. At 65° and above, the two treatments were comparable (Figure 1D). At 95° germination percentages were very low. As with loblolly, 56-day stratification resulted in higher germination at 55° than the shorter period, and it was comparable to peak germination of unstratified seed.

Speed of germination was markedly affected by treatments and, generally, variations among species, stratification, and temperatures followed the patterns established by the 28-day germination percentages shown.

APPLICATIONS

Several important applications are apparent from these results. First, optimum temperature ranges are fairly well defined for germination in the controlled environments used in container culture. Safe temperatures for longleaf seeds range between 65° and 75°. For loblolly, slash, and shortleaf pine, 65° to 85° seems satisfactory for stratified seed, but high temperatures are a greater hazard than low ones. Second, stratification for one or two months seems very important in environments where temperature cannot be controlled. Third, direct seeding in the field or nursery should be done as early as possible after severe cold weather has passed. Stratification lowers the minimum threshold temperature for germination and could result in seedling losses if early germination occurred. Delaying too long in the spring, however, may result in substantial losses in germination if temperatures exceed 85°. Longleaf seeds, which require no stratification, should be sown in the fall or late winter when high temperatures are least likely.

LIMITS OF APPLICATION

Because the tests were conducted under standard laboratory conditions with constant temperatures and 16 hours of 130 foot-candles of light each day, these data cannot be applied directly to field conditions where temperatures fluctuate. The greatest value this pattern of responses has for such field conditions is as an indicator of dangerous limits. It is doubtful if temperature determinations more precise than the 10-degree increments used here are necessary because responses varied among the three seed lots used for each species. This difference in response may be indicative of the protective mechanism which nature has developed to insure some germination under a wide range of environmental conditions.

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