Moisture Stress Affects Germination of Longleaf and Slash Pine Seeds

Note by J. P. Barnett

Abstract. Osmotic stresses greater than 8 atm markedly reduced germination of both *Pinus palustris* Mill. and *P. elliottii* Engelm. seeds. At stresses of 18 or more atm, no germination occurred. Moisture content at the onset of germination was twice as high in longleaf as in slash pine seeds.

Additional key words. *Pinus palustris*, *Pinus elliottii*, water absorption.

SEEDS OF most plants must imbibe moisture from the soil before they germinate. Maull (1962) found that as soil moisture decreased, the onset of germination in pitch pine (*Pinus rigida* Mill.) seeds was delayed, and speed and completeness of germination were reduced. This note reports water absorption and germination patterns of longleaf (*P. palustris* Mill.) and slash pine (*P. elliottii* Engelm.) seeds under varying moisture stresses.

Tests were run with three single-tree lots of longleaf and three of slash pine seeds which had been stored for 1 year at −4° C. Prior to testing, empty seeds were removed by McLemore's (1965) flotation technique. For each of 10 moisture-stress treatments, 50 longleaf and 100 slash pine seeds were placed on filter paper in germination dishes. Each treatment was replicated three times, once for each seed lot.

Osmotic stresses were imposed in the dishes by adding various molar concentrations of d-mannitol in water. No ideal substance is known for regulating osmotic stress. The major disadvantage of mannitol is that it supports fungal growth. In addition, in the present study small amounts of it appeared to be taken up by longleaf pine seedcoats, slightly increasing dry weight. Neither difficulty was large enough to change germination or absorption patterns.

Molar concentrations ranged from 0.0 M to 1.0 M in 0.1-M intervals. These concentrations represent osmotic stresses from 0 to 35 atm. Solutions in the dishes were changed every 2 to 3 days to maintain nearly constant moisture stress, and the progress of germination was observed for 30 days. Both absorption and germination tests were carried out at 22.5° C with a 16-hour photoperiod.

Water absorption measurements were independent of the germination tests. Weighed samples of 10 seeds from each single-tree replicate were placed in each mannitol solution. At least once a day, the samples were removed, blotted, and weighed to determine the amount of water uptake. After 6 days, the seeds were ovendried, and moisture contents were calculated for the previous weights.

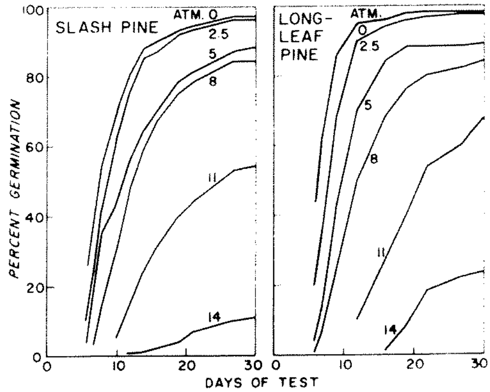

FIGURE 1. *Germination patterns under moisture stress.*

Germination was markedly influenced by moisture stress. Viability was 98 percent for longleaf and 97 percent for slash seeds in the distilled-water control. Each successive increase in stress beyond 2.5 atm significantly (0.05 level) reduced germination, until at 14 atm only 23 percent of the longleaf and 11 percent of the slash seeds germinated in 30 days (Fig. 1). No seeds germinated at stresses of 18 or more atm. Although all stresses greater than 2.5 atm reduced germination, the greatest effect occurred beyond 8 atm. Similar trends were reported in seeds of Japanese conifers by Satoo and Goo (1954). In addition to the effect on total germination, increasing moisture stresses delayed the start of germination and reduced the rate at which it occurred.

There was a statistically significant species-stress interaction, which probably reflects the better germination of longleaf than slash pine seeds at the stresses at which germination occurred (Fig. 2).

The patterns of water uptake and stress are shown in Figure 3. Increasing moisture stress re-

The author is on the staff of the timber management research project which is maintained at Alexandria, La., by the Southern Forest Expt. Sta., Forest Service, U. S. Dept. Agric. Manuscript received Oct. 10, 1968.

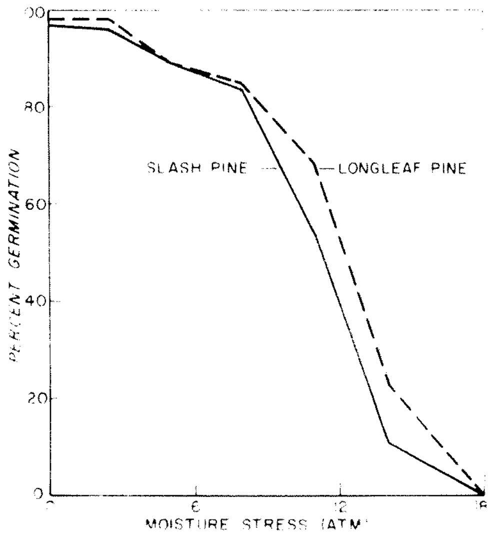

FIGURE 2. *Relation of 30-day germination of longleaf and slash pine seeds to osmotic stress of solution.*

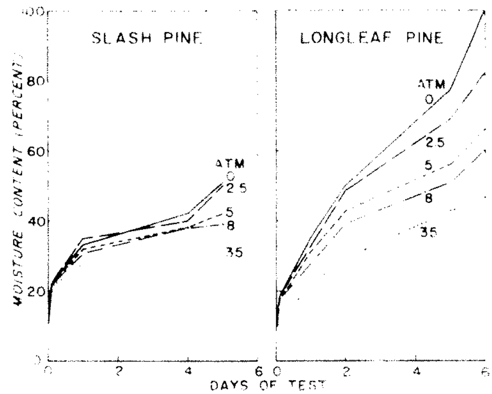

FIGURE 3. *The effect of moisture stress on water uptake during the early phases of germination.*

duced the rate of absorption. Moisture contents of longleaf seeds were almost twice those of slash pine seeds when germination started.

Goo (1951) described three phases of absorption: rapid initial imbibition, a period of slow uptake, then rapid uptake again as germination begins. Stone (1957) confirmed this pattern in *Pinus jeffreyi* Grev. & Balf. when he showed that more water is required for germination than is taken up during stratification. A similar pattern seemed to be developing for the longleaf and slash pine seeds in the present study. Because all seeds were removed from the solutions in the absorption tests when the radicles of seeds in distilled water began to appear, the final phase of rapid uptake was not reached by seeds under stress.

Literature Cited

Goo, M. 1951. Water absorption by tree seeds. Tokyo Univ. Forest. Bull. 39:55–60.

McLEMORE, B. F. 1965. Pentane flotation for separating full and empty longleaf pine seeds. Forest Sci. 11:242–243.

MAULL, T. W. 1962. Seed germination and establishment of *Pinus rigida* Miller (An autecological study). Ph.D. Thesis, Penn. State Univ., Univ. Microfilm 63-3067, 163 pp.

SATOO, T., and M. Goo. 1954. Seed germination as affected by suction force of soil and saccharose solution. Tokyo Univ. Forest. Bull. 46:159–168.

STONE, E. C. 1957. Embryo dormancy of *Pinus jeffreyi* Murr. seed as affected by temperature, water uptake, stratification, and seed coat. Plant Physiol. 32:93–99.