Survival of sand pine seedlings affected by time of lifting and bale-storage period

Russell M. Burns *Silviculturist. Southeastern Forest Experiment Station USDA Forest Service. Marianna. Fla.*

Sand pines growing within their natural range of Florida and coastal Alabama seldom remain dormant throughout an entire winter. Growth flushes frequently occur after unseasonably warm weather during winter along the eastern Gulf Coast. Choctawhatchee sand pine (Pinus clausa var. *immuginata* Ward), the more northern variety, requires longer periods of warm winter weather to break dormancy than does Ocala sand pine *(P. clausa* var. *clausa* Ward) (8).

This unseasonal growth of sand pine presents a problem at forest tree nurseries. Succulent new growth is extremely vulnerable to breakage and desiccation. Loss of this tissue means loss of food reserves and a decline in overall seedling vigor. Sometimes such seedlings die when outplanted.

The problem is compounded by the heat which accumulates within a bale of seedlings because of physiological processes. It may trigger growth of seemingly dormant sand pine. And, if the heat cannot dissipate because of improper storage or impeded circulation of air, the seedlings may cook to death even within refrigerated bales.

Sand pine seedlings are most apt to be dormant during January and February, normally among the coldest months of the year. Heat generated by the seedlings also is less likely to accumulate in the bales during cold weather, especially if the bales are stored as recommended: unstacked and in the shade. But how long can planters store unstacked bales of sand pine seedlings with no appreciable decline in quality as measured by planting survival? Previous observations indicate that the length of bale storage should be short and that sand pine seedlings lifted in November and December usually are insufficiently preconditioned to withstand transplanting satisfactorily. The following test was therefore installed in the sandhills of northwest Florida to determine the effects of time of lifting and of various lengths of bale storage on survival of sand pine.

Methods

Twelve thousand Choctawhatchee sand pine (CSP) seedlings (1-0 stock) were raised at the Chipola Experimental Forest near Clarksville, Fla., and the same number of Ocala sand pine (OSP) were raised at the State Nursery in Munson, Fla., On January 7. 21. and February 4, 1969, 4.000 seedlings were lifted at each nursery, packaged 1,000 to a bale with standard materials and procedures, and shipped to the planting area on Eglin Air Force Base in Okaloosa County, Fla. The four bales of seedlings lifted on each date at each nursery were randomly assigned to 1, 3, 6, or 8 days of unrefrigerated storage. Seedlings from each bale were machine-planted 6 feet apart in rows spaced every 10 feet on each of 4 separate areas. All planting was done by inexperienced labor. Half of the seedlings were planted in the woods amid scrub hardwoods-principally turkey oak *(Quercus laevis* Walt.) and bluejack oak *(Q. incana* Bartr.)-and pineland threeawn or wiregrass *(Aristida stricta* Michx.). The remainder were planted on a contiguous site prepared the previous summer by two choppings with an 11-ton duplex brushcutter. Each biweekly installation was replicated four times in a randomized complete block design.

Examination of the soils to a depth of $19^1/2$ feet according to standard procedures (1,4) indicated that, on all sites, the soils were Lakeland sand. The surface 6 inches contained less than 2 percent organic matter, and less than 4 percent available moisture on an ovendry weight basis. Climatological data from the Weather Bureau at Crestview. Fla. (5.6.7)-the station closest to the planting site and the State Nursery at Munson-indicated that winter temperatures during the period of lifting and transplanting were slightly below average (fig. 1).

Seedling survival was measured 6 months after outplanting and at plantation ages 1. 2. and 3. The third-year data were analyzed to determine the significant main effects and interactions of the various treatments.

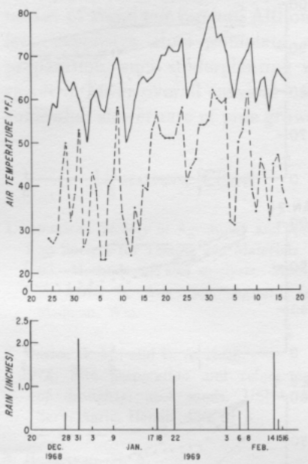

FIGURE 1.—Average high (——) and low (---) temperatures and rainfall recorded at Crestview, Fla. during the period of lifting and transplanting. (From U.S. Department of Commerce, Environmental Science Services Administration, *5*, *6*, and *7*.)

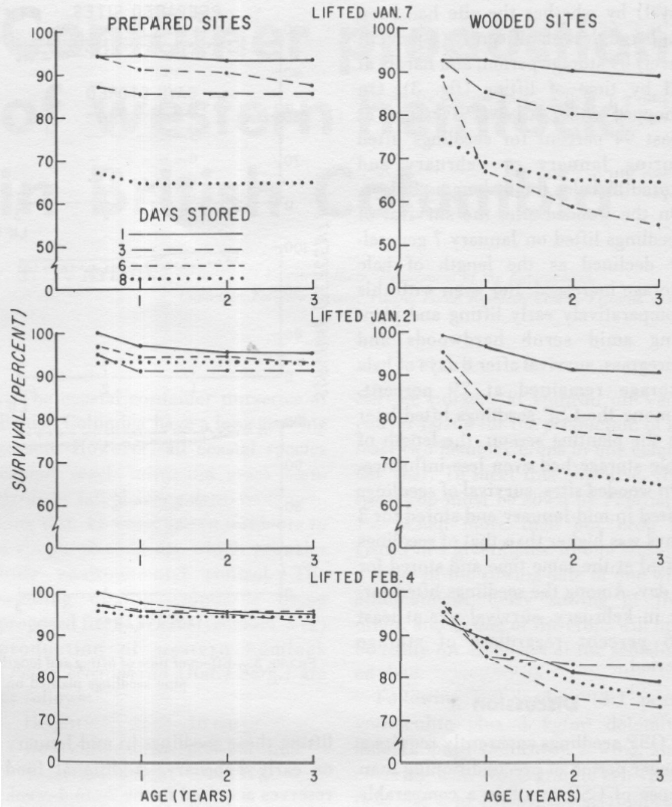

FIGURE 2.—Effect of time of lifting and length of storage on survival of Ocala sand pine seedlings planted on prepared and wooded sites.

Results

Ocala Sand Pine

Survival of OSP at plantation age 3 was influenced significantly (1percent level) by time of lifting in the nursery, length of storage in unstacked bales, and to a lesser extent (5percent level) by whether the site had been prepared (fig. 2). Competing vegetation on the wooded site provided an adverse environment for the introduction of planted pines; it also provided a more critical test of the effects of time of lifting and length of storage. Mortality continued through age 3 on wooded sites but was essentially complete by age 1 on prepared sites. Survival of underplanted seedlings averaged about 14 percent lower than that of seedlings planted on prepared sites.

Seedlings lifted early in January were less able to tolerate lengthy storage than those lifted later in the planting season. The trend among the former was for a decline in survival as the period of storage lengthened. Survival of OSP lifted on January 7 and planted on prepared sites exceeded 85 percent for storage periods as long as 6 days, but dropped to 64 percent when storage lasted for 8 days. Competing vegetation on the wooded site exaggerated these differences. Storage for more than 3 days caused a drop in survival on this site from about 80 percent to less than 60 percent.

Among the OSP seedlings lifted later in the planting season, the effects of the storage period on survival were less meaningful. On prepared sites, the survival of seedlings lifted in mid-January and stored for 8 days was not appreciably different from that of seedlings lifted at the same time and stored for only 1 day. However, among seedlings lifted at this time and planted on wooded sites, survival dropped from 76 to 64 percent as the storage period increased from 6 to 8 days. But when lifting was delayed until early in February, survival of OSP planted in the woods, or on prepared sites, averaged at least 73 percent even after the longest storage periods.

Choctawhatchee Sand Pine

Third-year survival of CSP was affected significantly (1-percent level) by whether the site had been prepared, less significantly (5-percent level) by storage period, and hardly at all by time of lifting (fig. 3). On chopped sites, survival averaged at least 94 percent for seedlings lifted during January or February and stored in bales for as long as 8 days. On the wooded site, the survival of seedlings lifted on January 7 generally declined as the length of bale storage increased. But even with this comparatively early lifting and planting amid scrub hardwoods and wiregrass, survival after 8 days of bale storage remained at 79 percent. Among the CSP seedlings lifted later in the planting season, the length of bale storage had even less influence. On wooded sites, survival of seedlings lifted in mid-January and stored for 3 days was higher than that of seedlings lifted at the same time and stored for I day. Among the seedlings lifted early in February, survival was at least 76 percent regardless of storage period.

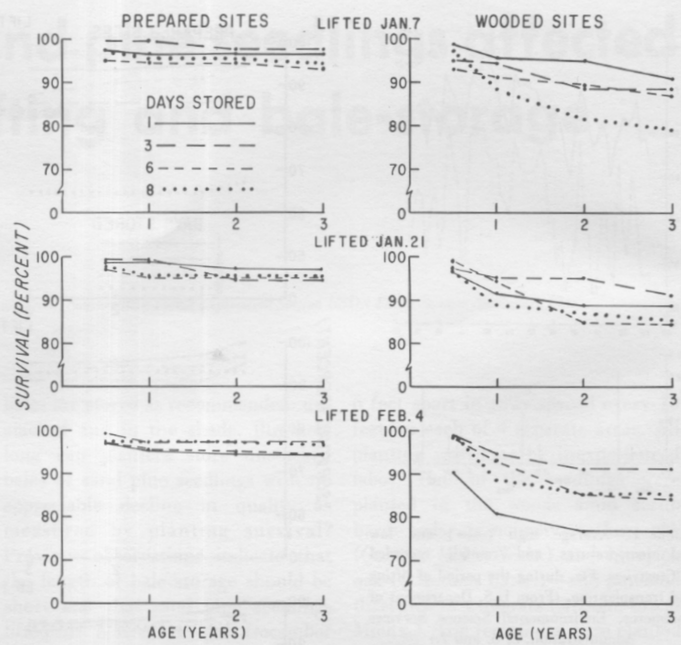

FIGURE 3.—Effect of time of lifting and length of storage on survival of Choctawhatchee sand pine seedlings planted on prepared and wooded sites.

Discussion

OSP seedlings apparently require a longer period of preconditioning than those of CSP to attain a comparable state of dormancy. It will be recalled that climatological data recorded near the State Nursery where the OSP were raised indicated that winter temperatures during the period of lifting and transplanting were slightly below average. If, as has been suggested (8), OSP has no typical winter dormancy within the range of temperatures normally encountered within the State of Florida, then they may require lower temperatures over a longer conditioning period to harden-off adequately. Nurseries located north of Florida are likely to provide both of these conditions.

A greater degree of dormancy does not in itself appear to have been solely responsible for both the improved tolerance of OSP to storage, and to the increased survival associated with lifting these seedlings in mid-January or early February. Additional food reserves acquired in the 2- to 4-week interim may have been equally important. Huberman (3) reported such an increase between late fall and early winter for longleaf, slash, loblolly, and shortleaf pine seedlings at Stuart Nursery. The dry weight of their tops increased 23 to 84 percent and that of their roots increased 20 to 164 percent in the nurserybed. Although no record was kept of seedling weight in the present study, it appears likely that sand pines follow a food storage pattern similar to that of other southern pines. Seedlings with large food reserves are better able to survive the trauma involved in the transplanting process than those with small reserves.

Conclusions

Land managers can improve prospects of successful establishment of sand pine seedlings by planting only dormant stock, and by choosing the Choctawhatchee variety in preference to Ocala. Planting should be scheduled so that seedlings are lifted in January or early February in quantities that can easily be planted within I week. If Ocala sand pines lifted from a Florida nursery in early January are to be planted on prepared sites, they should not be stored for more than a few days. However, bales may be stored for as long as 6 or 8 days if dormant seedlings are lifted in late January or early February.

Intensive site preparation affords an additional means of improving survival of planted seedlings but should be done far enough in advance of planting to allow disturbed soils to settle (2). Underplanting scrub hardwoods, especially with Choctawhatchee sand pine, offers the land manager a relatively inexpensive means of stand conversion. Although less expensive than complete site preparation, such underplanting will result in lower overall survival and a somewhat slower rate of pine growth.

Literature Cited

1. American Society of Agronomy and American Society for Testing and Materials. 1965. Methods of soil analysis. Monogr. 9. 1,572 P. Am. Soc. Apron., Inc., Madison. Wis.

2. Burns. R. M.. and E. A. Hebb. 1972. Site preparation and reforestation of droughty. acid sands. USDA For. Serv. Agric. Handb. 426. 61 p.

3. Huberman. M.A. 1940. Normal growth and development of southern pine seedlings in the nursery. Ecology 21:323-334.

4. Jackson. M. L. 1958. Soil chemical analysis. Prentice-Hall, Inc., N.J. 498 p.

5. U.S. Department of Commerce. Environmental Science Services Administration. 1969a. Florida. Dec. 1968. Climatol. Data 72:115-I17.

6. U.S. Department of Commerce, Environmental Science Services Administration. 1969k. Florida, Jan. 1969. Climatol. Data 73:3-5.

7. U.S. Department of Commerce. Environmental Science Services Administration. 1969c. Florida. Feb. 1969. Climatol. Data 73:15-17.

8. Zelawski, W., and R. K. Strickland. 1973. Temperature effects on growth, assimilation. and bud development of sand pine. p. 73-81. In Sand pine symposium proceedings. USDA For. Serv. Gen. Tech. Rrp. SE-2. southeast. For. Exp. Stn., Asheville, N.C.

Container production of western hemlock in British Columbia

J. T. Arnott

Forests officer. Department of the Environment, Canadian Forestry Service. Pacific Forest Research Centre. Victoria. B.C.

The coastal container nurseries of British Columbia have a long growing season. However. all coastal species cannot reach minimum stock standards by fall planting dates (commencing Oct. 1) when grown outdoors in a simple shadehouse which provides little environmental control. The seedling quality standards being proposed for B(:/(:F-,S styroblock-2 (2) production of western hemlock *(Tsuga heleroph ylla* (Raf.) Sarg.) are a5 follows:

Height	16 cm
Root collar diam.	2.0-2.5 mm
Total dry weight	1.0-1.5 g
Shoot/root	2/1

So far, for example, we have not been able to produce such plug seedlings in the styroblock-2 by the fall when grown for the whole season outdoors. We have counteracted this deficiency by growing these styroplug seedlings in a greenhouse or a shelterhouse for at least part of the growing season. The shelterhouse is an open-sided structure with a translucent fiberglass roof which provides additional environmental control through removable side panels.

Greenhouse Production

Ickes-Braun' greenhouse, were built at the British Columbia Forest Service nursery at Duncan on Vancouver Island for the production of at least two hemlock crops in one calendar year. To meet this objective, the first crop must be sown by February 15. When more than one crop is grown in a greenhouse in one season. a delay in the sowing (late of one will automatically delay sowing of the other, and so one of the crops will not he ready for shipment at the scheduled date.

Following soil loading (3:1 peat-vermiculite plus 3 kg/m^3 dolomite lime 12 mesh and finer), sowing, and covering with No. 2 granite grit (particle size 2 to 4 mm). the styroblocks are placed in the greenhouse, misted 3 times daily and watered to saturation once a week. A soil-wetting agent. "Soil Wet.[2]" is added to ensure continued wettability of the growing medium (3). Before sowing, the seed was pretreated by soaking in tap water for :36 hours and stratified at 2° C for 3 weeks. Germination temperatures should he kept as close as possible to 20° C. the optimum for this species.

Application of water soluble fertilizers begins in the fourth week following sowing: 10-52-10 PlantProd(2) fertilizer is applied twice a week for 3 consecutive weeks as a starter to build up roots. All fertilizers are applied through the overhead irrigation system from a series of fixed watering heads or, more recently, from traveling irrigation booms.

[1] Ickes Braun Glasshouses. Deerfield, III.
2Produced by Plant Products. Ltd.. Bramalea. Ont.