Effects of variety and seed source on survival of Arizona cypress planted in South Carolina

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Arizona cypress *(Cupressus arizonica.* Greene) is widely planted in southern United States for Christmas trees and as an ornamental (.3). Plantations of this species, however, have often proved unsatisfactory (2). and in South Carolina there have been numerous failures.' In an effort to discover whether seed source origin had an influence on survival and subsequent growth. Arizona cypress seed was collected from 26 source areas in Texas and Arizona in May and June 1970 (figure 1). The seedlings were grown in 1972 at the St. George. S.C., Coastal Nursery of the S.C. State Forestry Commission.

On March 21--22, 1973, the seedlings were lifted from the seedbeds and in the following 3 days were planted at the Manchester State Forest near Sumter, S.C., and at the Edisto Experimental Station of Clemson University. near Blackville, S.C. The Manchester site was an old field previously used for soybeans. The Edisto site was formerly a pasture. Sandy soils predominated in both areas.

The design used was a randomized complete block, with four blocks located at each planting site. Spacing of trees was 6 ft. X 6 ft. and a four tree row plot, each plot representing the progeny of an individual mother tree, was employed. However, in this analysis, all progenies derived from a seed source area were lumped because it was the seed source effect that was of primary interest in the study.

Results

Survival counts were made on the Manchester plot on January 15, 1974 and on the Edisto plot on February 2, 1974. The results are tabulated in table 1. along with basic geographical data for each seed source. The major findings were: survival was strongly affected by seed source, ranging from 0 to 67 percent at the Manchester site, and from 0 to 57 percent at the Edisto site: patterns of survival were

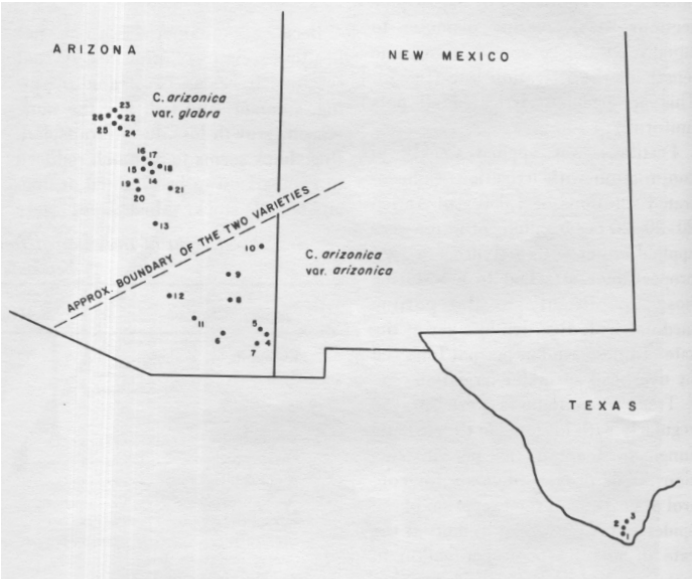

FIGURE 1.—Seed source locations of two varieties of Arizona cypress represented in two South Carolina plantations.

' Personal communication with S.C.. State Commission of Forestry personnel.

revealed in that sources 1 through 12 (except for source 3, which was a planted stand) had an average survival of 51 percent at Manchester and 45 percent at Edisto, whereas sources 13 through 26 had an average survival of only 5.5 percent at Manchester and 5.7 percent at Edisto.

This survival pattern follows precisely the separation of Arizona cypress into two varieties. According to Little (1). the smooth Arizona cypress *(C. arizonica* var. *glabra(Sudw.)* Little) is confined to central Arizona and lies north and west of the rougher-barked C. *arizonica* var. *arizonica* Greene which is more widespread in the Southwest and in Mexico. The location of the two varieties is shown in figure 1. The altitudinal range of the two varieties is also quite different. In the sources represented in the South Carolina plantations, var. *glabra* populations were gathered at a mean elevation of 4.600 feet and var. *arizonica* populations at 5,600 feet (figure 2).

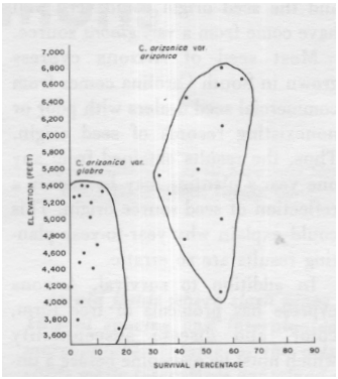

FIGURE 2.-Relation of elevation of seed source to survival of two varieties of Arizona cypress in two plantations (combined) in South Carolina.

The overall poor survival rates could also have been affected by weather conditions. The planting was made on relatively cool days (high temperatures of 62°-67° F); two light freezes (29°-32° F) were recorded at Manchester and one at Edisto shortly after planting. The first part of the growing season was wet, changing to a general dry spell commencing in August: however, no period of extended drought was recorded at either site. A factor possibly of some significance was that 16 inches of snow was recorded on February 9, 1973 while the seedlings were still in the seedbed. (This was an unprecedented storm, of the kind occurring once in a century.) As the snow did persist for a few days, damage may have occurred then, only to show up later when the seedlings were transplanted. Taller seedlings

TABLE 1.—Survival of 26 seed sources of Arizona cypress at two planting sites in South Carolina

Seed Source Location	Longitude ° W	Latitude ° N	Elevation (ft.)	Survival: Manchester	Survival: Edisto
				Percent	
1. East Rim, Brewster Co., Texas	103.4	29.2	7,000	53.8	Not rep.
2. Boot Spring, Brewster Co.	103.4	29.2	6,700	67.4	57.1
3. Chisos Basin, Brewster Co.[1]	103.4	29.2	5,200	7.1	5.0
4. Portal, Cochise Co., Arizona	109.1	31.9	5,000	63.5	48.2
5. Chiricahua, Cochise Co.	109.4	32.0	5,600	52.8	45.3
6. Stronghold, Cochise Co.	109.9	31.9	5,300	42.2	25.0
7. Rucker Canyon, Cochise Co.	109.4	31.6	6,100	57.6	55.0
8. S. Ash Creek, Graham Co.	110.1	32.4	4,700	42.1	41.7
9. Frye Canyon, Graham Co.	109.8	32.8	5,500	30.6	33.3
10. Clifton, Greenlee Co.	109.4	33.3	6,600	55.6	51.4
11. Happy Valley, Pima Co.	110.3	32.2	4,100	53.8	53.6
12. Mt. Lemmon, Pima Co.	110.7	32.4	6,500	47.4	42.8
13. Pinto Creek, Gila Co.	111.2	33.4	3,800	2.8	0.0
14. Natural Bridge, Yavapai Co.	111.4	34.4	4,500	1.5	1.3
15. Cypress Thicket, Yavapai Co.	111.4	34.2	4,000	4.8	2.3
16. Pine, Yavapai Co.	111.5	34.4	5,300	9.0	15.3
17. Shannon Gulch, Yavapai Co.	111.4	34.4	5,400	4.9	3.2
18. E. Verde Creek, Yavapai Co.	111.4	34.4	5,000	7.4	6.9
19. Bernie Mine, Yavapai Co.	111.5	34.0	5,300	1.9	1.7
20. Mt. Ord, Yavapai Co.	111.4	33.9	5,300	2.5	0.0
21. Sierra Ancha, Gila Co.	110.8	33.8	4,200	0.0	0.0
22. Schnebley Hill, Coconino Co.	111.8	34.8	4,700	10.9	7.3
23. Oak Creek Canyon, Coconino Co.	111.8	35.0	5,400	5.5	10.0
24. Jacks Canyon, Yavapai Co.	111.8	34.8	4,600	7.4	3.6
25. Dry Beaver Creek, Coconino Co.	111.8	34.8	3,700	10.9	25.0
26. Dry Creek, Coconino Co.	111.8	34.8	4,400	8.3	3.8

[1]Planted stand, seed source unknown.

above the snow line were subjected to cold, drying winds for 2 days following the storm.

The data were subjected to an analysis of variance to determine the effects of planting site, seed source, and interactions between them. The following results were obtained: planting site location was found not to be significant; seed source was found to be highly significant (P<.01); and interaction between location and seed source was found to be not significant. Thus, the survival pattern of the seed sources was shown to be consistent at the two planting sites.

Next, a correlation analysis of survival and collection point by latitude, longitude, and elevation was made with the following results:

Comparison	Correlation coefficient (r)	Probability level
Latitude/ survival	–.48	P<.01
Longitude/ survival	–.39	P<.01
Elevation/ survival	.46	P<.01

All results were highly significant. Thus, the seed sources that survived best came from the more easterly and southerly parts of the species range, and from the higher elevations.

Discussion and Conclusions

The study strongly suggests that first-year survival of Arizona cypress in South Carolina is determined mainly by the geographic variety that is used for planting. The survival of var. *arizonica* seed sources was 8 to 10 times better than var. *glabra* seed sources. Variation within a variety was much less pronounced, although some differences were also noted. Stand 3 in Chisos Basin, Big Bend National Park, is of special interest because its survival pattern appears more like var. *glabra* than var. *arizonica* (where its geographic positions would place it). It turns out, however, that this is a planted stand' and the seed origin could very well have come from a var. *glabra* source.

Most seed of Arizona cypress grown in South Carolina comes from commercial seed dealers with poor or nonexisting records of seed origin. Thus, the results obtained from any one year's planting may be mainly a reflection of seed source origin. This could explain why year-to-year planting results are so erratic.

In addition to survival, Arizona cypress has problems of tree form, color, and disease susceptibility which must be overcome before a uniform good quality Christmas tree or ornamental can be produced. There is some indication, based on the appearance of trees in natural stands, that *var. glabra* has more intensely blue color and is more columnar in form than var. *arizonica.* It also has a smooth reddish bark, which is lacking in all but *very* young trees of the latter variety. As plantations develop from known seed origins, traits characterizing each variety will become more evident, and selections for good quality trees can be made.

Meanwhile, we recommend that growers of Arizona cypress in South Carolina obtain their seed from known var. *arizonica* origins. The two largest stands of the var. *arizonica* variety that were sampled came from the vicinity of Clifton in Greenlee County and from the Mi. Lemmon highway in Pima County, both in southern Arizona. Seed from these sources could probably be obtained from local collectors.

2- Personal communication from R. Wauer. naturalist. Big Bend National Park. U.S. Dept. of Interior. National Park Service.

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New Publications

Agriculture Handbook 450, "Seeds of Woody Plants" is now available. Send check or money order in amount of $13.60 to Superintendent of Documents. Government Printing Office. Washington, D.C. 20402.

Brown, James K.

1974. Handbook for inventorying downed woody material. Intermt. For. Range Exp. Stn., Ogden, Utah. 28 p. USDA For. Ser, Gen. Tech. Rep. INT-16

To facilitate debris management, procedures for inventorying downed woody material are presented in this handbook. Instructions show how to estimate weights and volumes of downed woody material, fuel depth, and duff depth. Using the planar intersect technique, downed material is inventoried by 0- to 0.25-inch, 0.25- to 1to 3-inch diameter classes; and by 1-inch classes for sound and rotten pieces over 3 inches. The method is rapid and easy to use and can be applied to naturally fallen debris and to slash. It involves counting downed woody pieces that intersect vertical sampling planes and measuring the diameters of pieces larger than 3 inches in diameter. The piece counts and diameters permit calculation of tons per acre.

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TABLE 2.—Yield and viability of slash pine seed when cones were held 1 week before kilning

Date of collection	Specific gravity	Seeds per cone	Germination
		Number	*Percent*
August 21	0.93	0	88
August 28	.88	0	91
September 5	.84	47	94
September 11	.80	61	98
September 18	(opening)	87	99

weeks. For optimum yields, however, collection should be deferred as long as possible.

Germinability ranged from 92 to 100 percent regardless of date of collection or length of storage. Other studies have established that collection dates and handling procedures for loblolly are less critical than those for slash or longleaf (1).

Longleaf Pine

Yields of longleaf seed also increased from early to late collections and with increasing periods of cone storage. As with loblolly, 3 or 5 weeks of storage increased yields more for the first five collections than for the last one.

After only 1 week, all cones except those from the October 14 collection (specific gravity 0.83) yielded practically no seed. Longer storage increased yields from early cones but also decreased germinability. For example, cones in the September 30 collection released two seeds after 1 week's storage and 70 after 3 weeks, but germination dropped from 84 percent to 70 percent.

With longleaf, the safest course apparently is to collect after cones reach a specific gravity of 0.90 or below and to store them from 3 to 5 weeks. Again, the longer that collection can be deferred the better. Fortunately, although the collection period is more critical for longleaf than for the other two species, the seed is also in less demand. An adequate amount can usually be supplied by collecting late in the season.

Previous research has shown that initial viability of longleaf seed is unaffected by storage of mature cones for up to 60 days. If seed is to be kept for use in future years, however, cones should not be held longer than 5 weeks before processing (3).

Peeling and Cold Storage of Cones

Peeling the cones appeared to have no practical value. It increased yields from some cones, especially from those that were collected early and kilned without storing, but it had little or no effect on cones that were stored or collected when fully mature. Since cones collected early should not be kilned immediately, peeling cannot be recommended.

Storing cones in moistureproof polyethylene bags at 5° C reduced yields drastically but did not impair :viability. The overall yield from unpeeled longleaf held in cold storage averaged only one seed per cone; the average yield was 63 seeds from cones stored in paper bags at air temperature. Yields of slash were reduced by 90 percent, and yields of loblolly were reduced by 50 percent.

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NEW PUBLICATIONS

(Continued front p. 18)

McQuilkin. Robert A.

1974. Site index prediction tables for black, scarlet, and white oaks in southeastern Missouri. North Cent. For. Exp. Stn., St. Paul, Minn. 8 p. USDA For. Serv. Res. Pap. NC-108

Site index prediction tables for black, scarlet, and white oaks for southeastern Missouri are presented based on site index/height regressions of data from 741 sectioned trees. Formulae for site index conversion between species and confidence intervals for mean stand site index estimates are also presented.

Williams. Robert D.

1974. Planting methods and treatments for black walnut seedlings. North Cent. For. Exp. Stn., St. Paul, Minn. 12 p. USDA For. Serv. Res. Pap. NC-107.

Neither planting method nor stock treatment had any appreciable effect on survival and growth of black walnut, but survival and growth were significantly affected by the planting site and site preparation.

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