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# Longleaf pine x shortleaf pine—a new hybrid

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CAMPBELL, T. E., J. M. HAMAKER, and D. M. SCHMITT. (Southern Forest Exp. Sta., USDA Forest Serv., Alexandria, La., and Gulfport, Miss.). Longleaf pine x shortleaf pine—a new hybrid. Bull. Torrey Bot. Club 96: 519–524. 1969. Five specimens of a longleaf x shortleaf cross—a very difficult one to make—are growing at Gulfport, Mississippi. Mean measurements of 19 characters, when compared with similar data from unrelated specimens of the parent species, establish that the trees are $F_1$ hybrids.

The four major southern pines, shortleaf (*Pinus echinata* Mill.), slash (*P. elliottii* Engelm.), longleaf (*P. palustris* Mill.), and loblolly (*P. taeda* L.) belong in Group XI, Australes, according to Duffield's (1952) revision of Shaw's (1914) classification of the diploxylon pines. Duffield's groups were formed primarily on consideration of species crossabilities and morphological affinities. This paper describes a hybrid between two Australes that are decidedly difficult to cross.

Shortleaf crosses readily with slash and loblolly, but the shortleaf × longleaf cross has been reported a failure (Snyder and Squillace 1966; Righter and Duffield 1951). Critchfield (1963) obtained 0.6 sound seed per cone from this cross but no verified hybrids from it. During 3 pollination years at the Institute of Forest Genetics at Gulfport, Mississippi, 109 attempts yielded only 11 cones; they contained nine empty seeds. Crosses were tried in both directions.

The senior author, while working for the Hodges Gardens and Experimental Area at Many, Louisiana, attempted 200 crosses reciprocally between shortleaf and longleaf. He obtained two shortleaf × longleaf cones with a total of five empty seeds, and nine seedless cones from longleaf × shortleaf pollinations. In 1959, however, he tried 75 longleaf × shortleaf pollinations (in 30 bags with a four-tree pollen mix) on a single longleaf seed parent and obtained 11 cones that yielded 20 sound seeds. These seeds produced 17 seedlings. A photograph of one of them was published, but without a description, in the 1961 Annual Report of the Southern Forest Experiment Station (cited by Critchfield 1963). Nine were planted in the Hodges Gardens, where one died and eight were inadvertently destroyed. The remaining eight were planted in 1962 at Gulfport, Mississippi, four in

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each of two locations; unrelated longleaf and shortleaf seedlings of the same age were planted as check material. Five of the eight have survived. In 1966 one of them commenced flowering; this tree and another also flowered in 1967 and 1968.

Figure 1 shows representative saplings of the putative hybrid and of the longleaf and shortleaf checks. Nineteen characters, either of diagnostic value or of general interest (such as those related to vigor), were analyzed from these and comparable specimens. The results and the number of trees upon which they are based are shown in Table 1. Figure 2 illustrates the average position of the putative hybrid for 12 of the 19 characters. There was no overlap in the distribution of means in 12 of the 19 characters (based on two standard errors) for the three entities, although in number of needles per fascicle the hybrid strongly favored the seed parent. Eleven

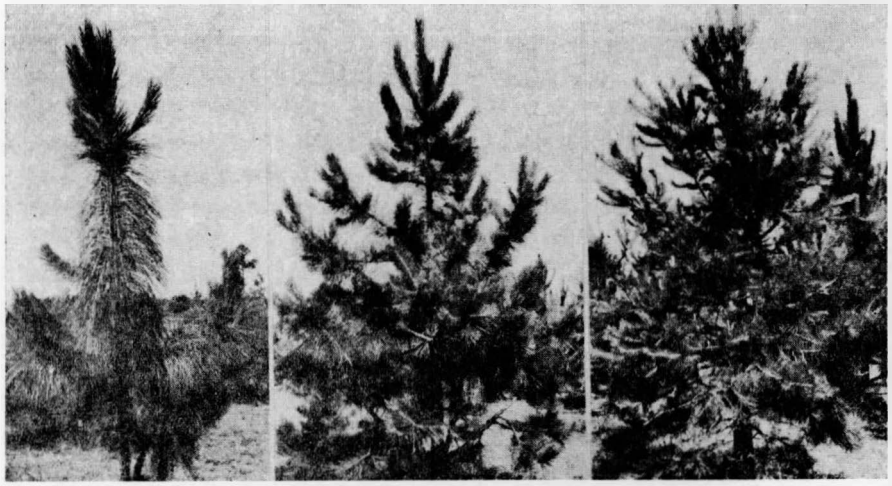

Fig. 1. Longleaf, longleaf × shortleaf, and shortleaf pines, respectively, after six growing seasons.

of the characters were clearly intermediate. The comparative sizes of the reproductive structures are particularly striking in this respect (Figs. 3, 4). However, the number of resin canals per needle cross section (Fig. 5) and the number of stomates/cm/needle were not intermediate; rather, their means were less than the lesser of the parent species, shortleaf in each case. In addition, the number of cells in the hypodermal layer is of interest. In longleaf the layer consists of 2–4 cells, in the hybrid 1–2, and in shortleaf almost always of 1 cell.

The reproductive phenologies of longleaf and shortleaf pine differ greatly. In south Mississippi the time difference in pollen release varies from 3 weeks to a month. During the 2 years that the hybrid produced pollen, longleaf began shedding on March 15 and 20 and shortleaf on April 5 and 15, in 1967 and 1968, respectively. The hybrid shed pollen 11 and 19

Table 1. Means and standard errors for various traits in longleaf and shortleaf pine and their putative interspecific hybrid.

| Character | Longleaf | | | | Putative hybrid | | | | Shortleaf | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. trees | n | $\bar{X}$ | $S_{\bar{x}m}$ | No. trees | n | $\bar{X}$ | $S_{\bar{x}m}$ | No. trees | n | $\bar{X}$ | $S_{\bar{x}m}$ |
| Height (m) at 6 years | 5 | – | 4.97 | 0.12 | 5 | – | 5.06 | 0.24 | 5 | – | 3.84 | 0.32 |
| dbh (cm) at 6 years | 5 | – | 9.40 | 0.25 | 5 | – | 9.91 | 0.76 | 5 | – | 8.13 | 0.76 |
| Bud length (cm, spring) | 10 | 50 | 25.0 | 2.2 | 5 | 50 | 16.1 | 1.1 | 10 | 50 | 9.2 | 1.8 |
| Bud diam (mm, spring)[a] | 10 | 50 | 14.8 | 0.13 | 5 | 50 | 7.6 | 0.10 | 10 | 50 | 3.7 | 0.09 |
| Needle length (cm) | 10 | 20 | 33.1 | 0.6 | 5 | 50 | 20.1 | 0.3 | 10 | 40 | 11.6 | 0.3 |
| Needle width (mm)[a] | 10 | 20 | 1.44 | 0.02 | 5 | 50 | 1.26 | 0.02 | 10 | 40 | 1.11 | 0.01 |
| Needles/fascicle | 10 | 20 | 3.0 | 0.0 | 5 | 50 | 2.8 | 0.04 | 10 | 40 | 2.5 | 0.08 |
| Sheath length (cm) | 10 | 20 | 2.3 | 0.05 | 5 | 50 | 1.1 | 0.02 | 10 | 40 | 0.6 | 0.02 |
| Stomates/cm[a] | 10 | 20 | 118 | 1.8 | 5 | 50 | 104 | 1.2 | 10 | 40 | 115 | 1.6 |
| Serrations/cm[a] | 10 | 20 | 39 | 0.6 | 5 | 50 | 36 | 0.6 | 10 | 40 | 39 | 0.9 |
| Stomate rows/needle[a] | 10 | 20 | 19.0 | 0.4 | 5 | 50 | 18.9 | 0.4 | 10 | 40 | 20.6 | 0.3 |
| Resin canals/needle[a] | 10 | 20 | 4.6 | 0.20 | 5 | 50 | 2.7 | 0.15 | 10 | 40 | 3.9 | 0.19 |
| Conelet length (mm) | 10 | 10 | 27 | 1.0 | 1 | 10 | 16.0 | 0.4 | 10 | 40 | 9.0 | 1.0 |
| Conelet diam (mm)[b] | 10 | 10 | 12.5 | 0.5 | 1 | 10 | 6.7 | 0.2 | 10 | 40 | 4.2 | 0.08 |
| Catkin length (cm) | 10 | 10 | 6.6 | – | 1 | 10 | 3.4 | 0.07 | 10 | 40 | 2.1 | – |
| Catkin diam (mm)[a] | 10 | 10 | 7.8 | – | 1 | 10 | 6.1 | 0.09 | 10 | 40 | 4.7 | – |
| Mature cone length (cm) | 10 | 10 | 15.3 | 0.24 | 1 | 1 | 9.5 | – | 10 | 40 | 4.3 | 0.12 |
| Mature cone diam (cm)[b] | 10 | 10 | 10.2 | 0.46 | 1 | 1 | 7.0 | – | 10 | 40 | 3.1 | 0.06 |
| Pollen width ($\mu$)[c] | 10 | 100 | 50.7 | 0.36 | 1 | 100 | 48.1 | 0.36 | 10 | 100 | 44.6 | 0.30 |

[a] At midlength.
[b] At widest point.
[c] Equatorial axis, from intine to intine, 400×.

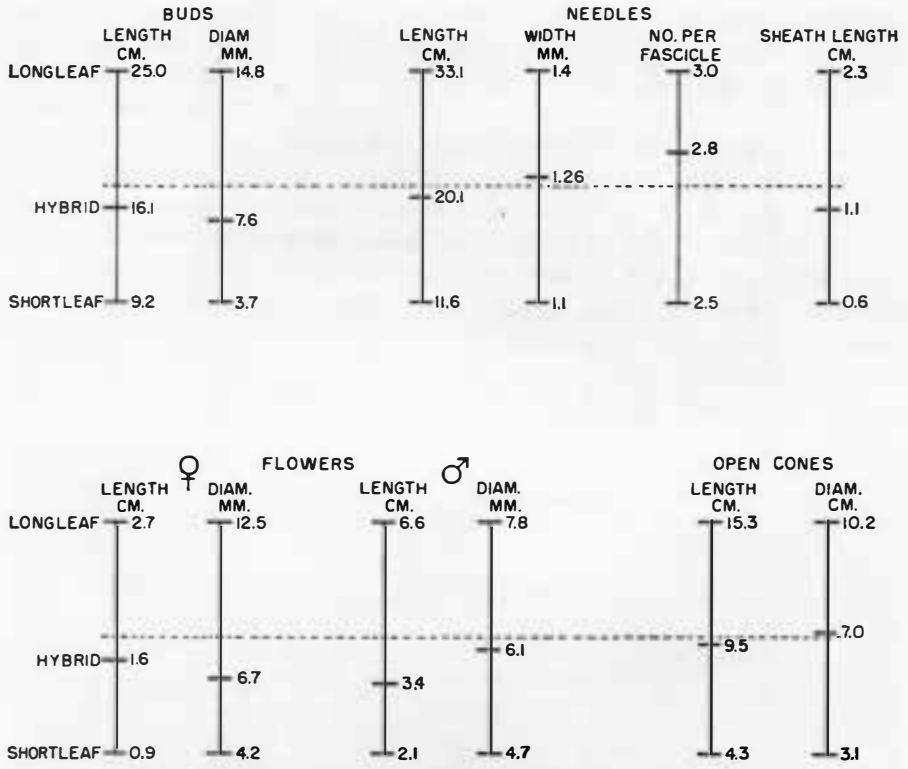


Fig. 2. Character means for shortleaf, the hybrid, and longleaf pine. Dashed lines indicate midpoints.

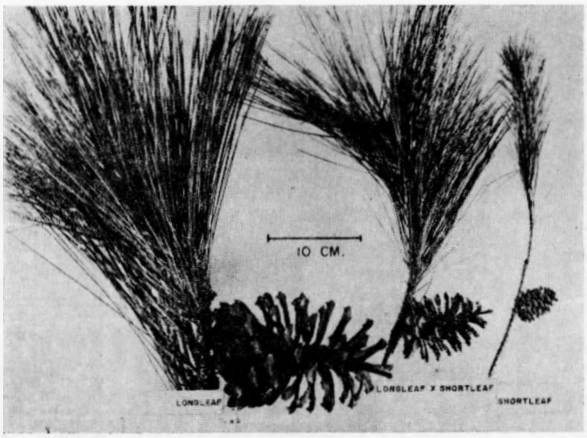


Fig. 3. Mature cones of longleaf, longleaf × shortleaf, and shortleaf pines.

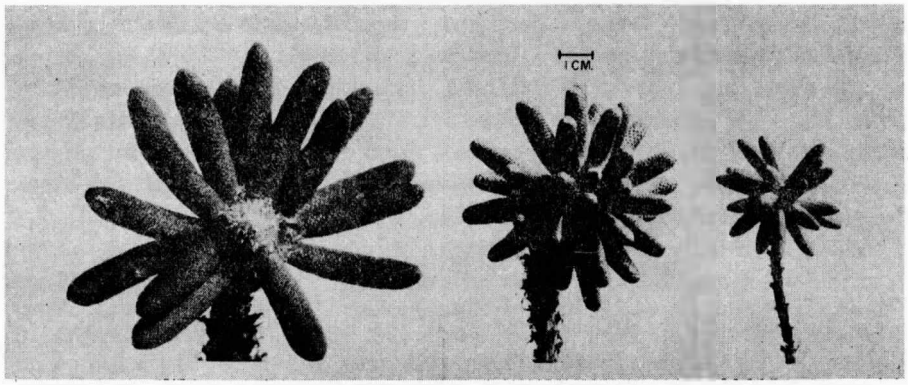


Fig. 4. Longleaf, longleaf × shortleaf, and shortleaf pine male strobili.

days later than longleaf and 10 and 7 days earlier than shortleaf (March 26 and April 8) for the 2 years. Consequently, it appears to be intermediate in this character also.

The results clearly indicate that the progeny of the longleaf × shortleaf cross described here were not longleaf contaminates, nor can there be any doubt concerning the specific status of the pollen and seed parents. Moreover, phenological isolation and extreme cross-incompatibility render natural hybrids highly unlikely. We conclude that the trees are in fact $F_1$ interspecific hybrids of longleaf (♀) and shortleaf (♂) pine.

The hybrid can readily be distinguished from longleaf by its prompt initiation of height growth, brown bud scales as opposed to the grayish-white bud scales of longleaf, and a marked color contrast in the male strobili. It is distinguished from shortleaf by the shape and size of the vegetative buds. These are narrowly cylindrical with an acuminate tip for shortleaf, while the larger hybrid buds are conic. Shortleaf and the hybrid also differ in the color and size of their strobili. The shortleaf male strobilus

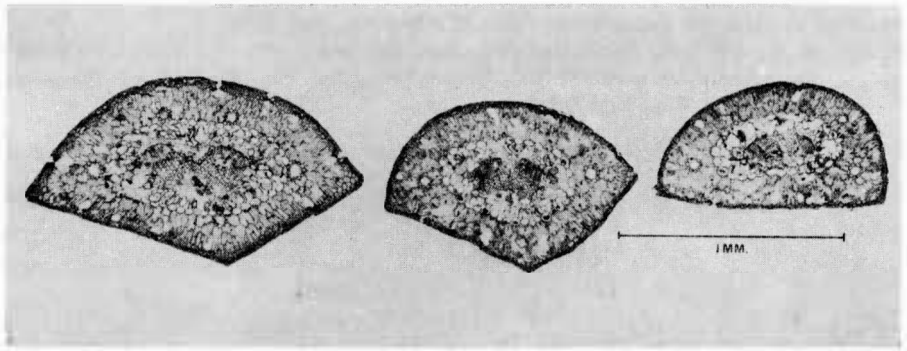


Fig. 5. Needle cross sections of longleaf, longleaf × shortleaf, and shortleaf pines.

is yellowish-green while the larger hybrid male strobilus is a bright yellow, sometimes with rose or purple coloration at the apex.

The surviving hybrids at Gulfport, Mississippi, have grown normally (Fig. 1). They exhibit good apical dominance and have well-developed crowns. One of the original germinates from the seed lot was an albino, and another was a dwarf. They, and one other, subsequently died. The other five trees are thrifty and well established.

The hybrid is described as follows:

Artificial hybrid between *Pinus palustris* Mill. (Gard. Dict. Ed. 8, *Pinus* No. 14, 1768) of Coastal Plain of Southeastern United States, and *Pinus echinata* Mill. (Gard. Dict. Ed. 8, *Pinus* No. 12, 1768), of wide range in Eastern United States. Bark rough with gray plates, brown exposed in furrows. New shoots yellowish-green, glabrous, first-year shoots rust-brown becoming gray with age. Buds 16.1 cm in maximum elongation, cylindrical, acuminate apex. Leaves mostly three per fascicle, 16–24 cm long, flexible, serrulate. Hypodermis biform with one to two, sometimes three, layers of cells, endodermis of thin-walled cells, resin canals chiefly (76%) medial, occasionally internal. Male strobili yellow to straw-colored, approximately 3.4 cm long and 0.6 cm broad at anthesis in late March or early April in south Mississippi. Conelets elliptic, single or in whorls nearly sessile. Mature cones approximately 9.5 cm long and 7 cm wide, apophyses nut-brown and elevated along transverse keel with a raised (0.57 mm) umbo terminating in a short (1.0 mm) prickle. Hybrid specimens have been deposited in four herbaria: Institute of Forest Genetics, Placerville, California; Forest Service Herbarium, Washington, D.C.; Arnold Arboretum, Harvard University; and the Bailey Hortorium, Cornell University.

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