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Comparisons of Seedlings From East Texas Loblolly, Shortleaf And Suspected Hybrid Pines

by

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ABSTRACT: Open-pollinated seedlings from suspected loblolly x shortleaf pine hybrids did not differ significantly from shortleaf pine for six morphological characters. These seedlings were significantly different from loblolly pine seedlings in hypocotyl height, cotyledon number, number of needles per fascicle and percent basal crook.

Hybrid indices were developed for parents and their respective open-pollinated progeny using morphological characters. One suspected hybrid parent produced progeny which had hybrid index scores which were consistently intermediate to loblolly and shortleaf pines. This parent is probably a natural hybrid but the hybridity of other individuals is questionable.

Natural hybridization between loblolly *(Pinus taeda* L.) and shortleaf *(P. echinata* Mill.) pines is widely recognized (Bilan, 1965a; Bilan, 1965b; Hare and Switzer, 1969; Mergen, Stairs and Snyder, 1965; Schmidtling, 1971). Trees which are morphologically intermediate between loblolly and shortleaf pine have been speculatively called hybrids (Zobel, 1953). To provide further evidence as to whether such intermediates actually are hybrids, and to investigate the reliability of morphological classification, open-pollinated seedlings from parents classified morphologically as loblolly, shortleaf and suspected hybrid pines were grown under homogeneous conditions. Traits of these three progeny groups should reveal genetic differences, if any, resulting from cross-breeding.

Five trees from each group (loblolly, shortleaf and "hybrid"[2]) were selected in the field by subjective evaluation of gross morphology. Sample trees were from two predominantly pine stands approximately 10 miles west of Nacogdoches, Tex-

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[2] Although the genotype of these morphologically intermediate trees was unknown, parental plants and resulting families from this group will be referred to as "hybrids."

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as. The sites varied from stream bottom to upland. In each stand, approximately 75 percent of the pines were shortleaf and 25 percent loblolly. The trees were ranked by Anderson's (1949) hybrid index technique on the basis of needle length, number of needles per fascicle, fascicle sheath length, terminal bud width and cone length. These characters were used because of their low within-tree sampling variance and because their values differed significantly for loblolly and shortleaf pine (Hicks, 1973). Mean values for these characters were based on a sample of 10 structures per tree except for cone length and bud width where five structures per tree were measured. Tree character means were equally weighted by expressing them as scores on a 0 to 4 scale, and the hybrid index value for a tree was obtained by summing its character scores. A detailed description of the parental morphology is available (Hicks, 1973).

Open-pollinated families from the above parents were propagated in the greenhouse and nursery bed. Five 6-month-old seedlings per family were transplanted into each of three blocks in a randomized complete block design in the nursery during January of 1972. At that time, seeds from the same families were planted in the greenhouse using the same design. Measurements of height to the cotyledonary whorl and cotyledon number were obtained from greenhouse-grown seedlings when the hypocotyls were fully extended. Measurements obtained from 1-year-old seedlings were: number of seedlings with basal crook, first year height growth, number of needles per fascicle, and needle length. For the latter two traits, seedling means were based on a sample of 10 fascicles.

RESULTS

Means and standard deviations for the seedling traits are listed by families in Table 1, and the results of analysis of variance of these data are summarized in Table 2.

In height to cotyledons, needle length and number of needles per fascicle, overall means of "hybrid" seedlings were intermediate between means for seedlings of loblolly and shortleaf parentage. For the other three traits, "hybrid" means fell slightly (not significantly) outside the span of the other parental group means. "Hybrid" means for cotyledon number, basal crook percentage and number of needles per fascicle were about equal to those of the shortleaf group and "hybrid" seedlings at one year of age averaged slightly taller than loblolly or shortleaf seedlings. Good growth of known loblolly x shortleaf pine hybrids has been reported previously (Sluder, 1970).

Two hybrid indices were constructed from morphological data of the seedlings; one in which all six characters were considered and a second using only traits for which "hybrid" seedlings had intermediate values (Fig. 1). Index values for seedling families were developed in a similar manner to parental indices, except family means were used to calculate character scores. With the exception of families S-4 and H-5, the index ranking of seedling families closely approximated that of their respective parent. This consistency was especially noticeable when seedling families were ranked on the basis of the three intermediate traits. Hybrid index scores of hybrid family H-1 were obviously and consistently intermediate to the two species as was the hybrid index score of the parent tree. This strongly suggests hybrid origin of parent H-1.

Table 1. Means and standard deviations for morphological characters of seedlings, by open-pollinated family and parental group.

Parental group and Family	Cotyledons (number)	Height to Cotyledons (cm)	Height at 1 Year (cm)	Needle Length (cm)	Needles per Fascicle (Number)	Basal[a] Crook (percent)
Loblolly						
L-1	7.27±0.80	3.07±0.58	28.28±6.16	12.41±2.05	3.00±0.10	0.00
L-2	7.20±0.86	3.05±0.66	28.77±8.64	13.51±3.23	2.99±0.10	0.00
L-3	6.87±0.74	3.69±0.58	27.99±5.22	12.79±1.91	3.00±0.05	0.00
L-4	7.87±0.64	3.21±0.70	29.12±3.95	13.74±1.53	2.99±0.04	0.00
L-5	6.53±0.74	2.67±0.52	33.36±5.02	13.28±1.13	2.97±0.10	33.33
Mean	7.15±0.50	3.14±0.37	29.50±2.20	13.15±0.54	2.99±0.01	6.67
"Hybrid"						
H-1	5.47±0.64	2.21±0.47	34.15±9.68	12.38±1.32	2.63±0.30	66.67
H-2	5.73±0.70	1.93±0.32	31.80±5.80	12.29±1.67	2.41±0.28	73.33
H-3	6.67±0.72	1.87±0.56	28.29±5.66	12.06±1.57	2.54±0.30	86.67
H-4	6.53±0.52	2.21±0.33	34.39±5.64	11.83±1.28	2.52±0.31	68.33
H-5	6.13±0.64	1.52±0.42	26.55±5.67	10.42±1.25	2.36±0.31	80.00
Mean	6.01±0.51	1.95±0.28	31.04±3.51	11.80±0.80	2.49±0.11	75.00
Shortleaf						
S-1	5.93±0.59	1.78±0.55	26.44±5.74	11.05±0.63	2.31±0.30	60.00
S-2	6.20±0.94	1.71±0.33	24.84±3.87	11.12±0.98	2.59±0.28	86.67
S-3	6.33±0.80	1.93±0.41	24.45±6.80	10.39±1.63	2.52±0.37	66.67
S-4	6.13±1.12	1.60±0.46	31.26±4.88	11.76±1.54	2.44±0.34	56.67
S-5	6.60±0.74	1.52±0.43	21.16±3.00	10.52±1.28	2.40±0.33	78.33
Mean	6.24±0.25	1.71±0.16	25.63±3.69	10.97±0.54	2.45±0.11	69.67

a/Standard deviations for percent basal crook cannot be calculated.

Table 2. Calculated "F" values and Tukey's multiple comparison tests from analysis of variance on parental group means of seedling morphological traits.

Trait	Calculated "F"	Tukey's multiple comparison test[a] Ranked means
Cotyledon No.	8.43*	hyb sh lob[b] 5.91 6.24 7.15
Height to cotyledons (cm)	36.29**	sh hyb lob 1.72 1.93 3.14
Height of 1-yr. seedlings (cm)	3.79	sh lob hyb 25.73 28.87 31.69
Needle length (cm)	14.76**	sh hyb lob 10.97 11.80 13.15
Number of needles per fascicle	57.61**	sh hyb lob 2.45 2.49 2.99
Percent of seedlings with basal crook (arcsin)	38.22**	lob sh hyb 6.92 69.76 72.60

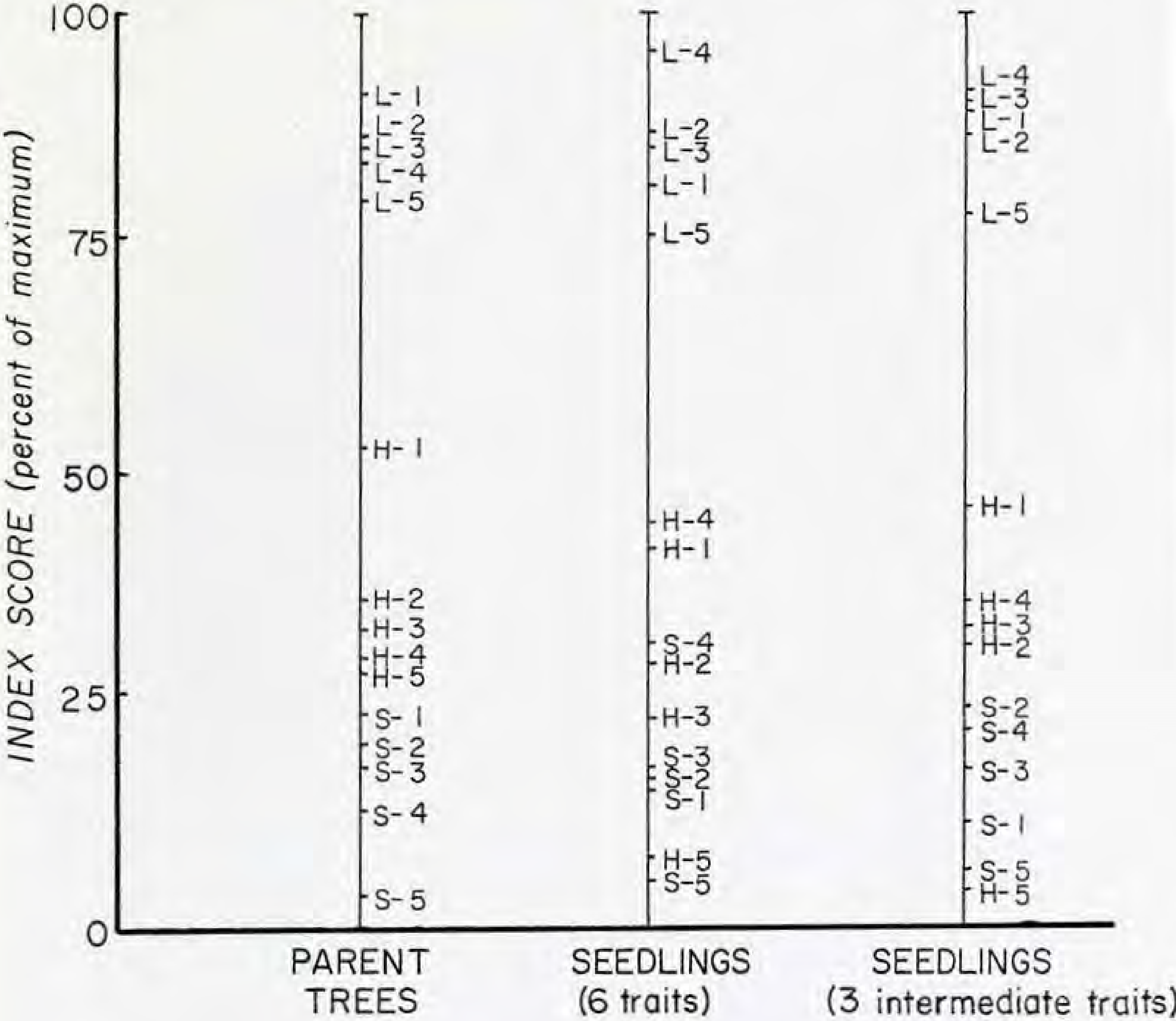
*Calculated F indicates a significant difference among the means for parental groups at the 5% level of significance.

**Calculated F indicates a significant difference in the means at the 1% level of significance.

[a]Means underscored by a common line are not significantly different at the 5% level of significance.

[b]Hyb, sh and lob denote "hybrid", shortleaf and loblolly pine, respectively.

Figure 1. Ratings of parent trees and their open-pollinated seedling families by three indices. Numbers identify parent trees or corresponding families; L-loblolly, H-"hybrid," S-shortleaf. When scored by three intermediate traits, all progeny of putative hybrid trees except family H-5 ranked between progeny of loblolly and shortleaf pines. When scored by six traits, grouping was similar except that family S-4 ranked above three "hybrid" families.



Parent trees which were initially classified as "hybrid" were morphologically more like shortleaf than loblolly pine, and with the exception of parent H-1, observations on seedlings from the "hybrid" parents produced no conclusive evidence to support the contention that they were of hybrid origin.

I conclude that the five morphological characters used to classify parent trees were good indicators of parental genotypes, since progeny from these trees growing in a relatively uniform environment produced a similar pattern of hybrid index classification. The identification of hybrids by this technique appears feasible as evidenced by the parental and progeny data for H-1.

The hybrid index score variability of shortleaf pines included in this study is greater than that of the loblolly pines if all "hybrids," excluding H-1, are considered shortleaf pines. Such a situation could reflect introgressive hybridization in which shortleaf pine is the predominant backcross species.

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