COMPARISON OF SINGLE-CROSS AND POLYCROSS SLASH PINE PROGENY TEST RESULTS FOR RANKING SELECTED TREES

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To achieve the greatest gains from a tree breeding program it is necessary that the work continue over several generations. In order to maximize gains after the first generation it is almost imperative that some method be used of estimating the breeding value of the parents used in the establishment of second-generation seed orchards (seedling or clonal), or in speciality orchards. Depending on prior estimates of heritabilities or **in** some cases on experience in agronomic crops, there are three general approaches to progeny testing phenotypic selections of southern pines.

In clonal seed orchards the least intensive method of testing involves waiting until the seed orchard is in good general flowering, then collecting wind-pollinated seed from the various clones in the orchard and using them to establish progeny tests. We are hopeful these tests will be representative of the seed orchard production at maturity. A second method of testing clonal orchards is to control-pollinate the various seed orchard clones using a mixture of pollen from the selected trees; this pollen may be obtained either from the orchard or from the parent trees themselves when they are accessible. This method is generally more expensive than using wind-pollinated seed and may be more time consuming. The third method in common use is much more intensive and involves making controlled single crosses on the selected clones using four or five male parents as testers.

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If carried out under the right conditions, and with some forethought, all three methods should give reasonably good estimates of what is commonly called general combining ability. That is to say, that on the basis of the progeny test results we should be able to rank the seed orchard clones having the best to worst breeding values as female parents. The use of single crosses has the additional advantage that it should provide information on what is commonly called specific combining ability; that is, it should be possible to identify two clone combinations which are exceptionally good or poor. Presumably, the parents of these good crosses could then be used in orchards which would maximize the production of seed of the desired cross, and/or progeny from these crosses could be Used as a source of second-generation breeding material. The early results reported here of a comparison of polycross and single cross progeny tests indicate that either method is suitable for the identification of the better parents for use in a breeding program, particularly for resistance to Cronartium fusiforme (Hedgc. and Hunt ex Cumm.)

MATERIALS AND METHODS

Fourteen clones being used in the Georgia Forestry Commission seed orchards were used as female parents in single crosses with five male testers. Of the 70 planned crosses, 60 were successful and eventually outplanted in an 8 x 8 balanced lattice design. Three of the female parents had been crossed with only three male testers while the remainder were successfully crossed with either four or five males.

The same fourteen clones had previously been polycrossed and outplanted in progeny tests. There were nine of these progeny test plantations, established in four different years. Seven are at either of two locations in the upper coastal plain, while two plantings are in the flatwoods. The polycross plantings are in randomized complete block designs usually with six replications of 25-tree-plots, or ten replications of 5-tree-row-plots. Some of the polycross progenies were planted in more than one test in a particular year, some in different tests in different years and some were in only one test.

In order to make this preliminary comparison of the two testing methods the average total height, average number of fusiform cankers per tree and the percent of trees rust free of the polycross and single cross progenies were compared by using their average performance relative to the commercial check lots in their respective plantations five years after planting. These relative values for each female parent were then compared using correlation analyses.

RESULTS

For all three traits examined the correlation of the mean performance of the single crosses with the performance of the polycross progenies planted in the upper coastal plain were highly significant (table 1). The best correlations were with the two measures of damage caused by fusiform rust.

In all but two cases the correlations were poorer when calculated on the basis of single crosses from only one male parent, indicating that no single male was consistently 'successful in providing a good estimate of the female parent's breeding value (table 1).

When the results from the polycross plantings in the flatwoods were also included the correlations for height and number of fusiform infections per tree decreased, while that for percent of trees rust free increased considerably. There is very likely a scaling effect in the percentage data since rank correlations of the same data also show a lower correlation for percentage rust free when polycross data from all plantings are used.

CONCLUSIONS

The data indicate that for the evaluation of parent trees polycrossing will give essentially the same results as single crosses using male testers. It is possible that open-pollinated progeny, particularly those produced in the orchard, would give the same result. In tree improvement programs in which large numbers of selected trees must be evaluated the use of single crosses may prolong the initial testing and eventually require estimation of missing cross values. It might be more advantageous particularly in these early stages to identify at least the best half of these selections available. Then use those selections in a single crossing scheme to combine good traits such as height growth and rust resistance, or to emphasize particular crosses aimed at substantial gains in one trait such as rust resistance. Progeny from these single crosses could then serve either as a source of later generation selections or could be used to establish seedling seed orchards.

Table 1.--Comparison of single-cross and polycross progeny test results at 5-years

	Average total height	Average number of fusiform infections/tree	Percent of trees rust free
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Single cross mean vs. polycross, upper coastal plain plantings	0.700**	0.903**	0.808**
Male 1 vs. polycross, U.C.P.	.393	.854**	.806**
Male 2 vs. polycross, U.C.P.	.704**	.699**	.739**
Male 3 vs. polycross, U.C.P.	.548*	.594*	.767**
Male 4 vs. polycross, U.C.P.	.640*	.547*	.811**
Male 5 vs. polycross, U.C.P.	.222	.273	.673**
Single cross mean vs. polycross all plantings	.647*	.541*	.909**

*, ** Significant at the 0.05 and 0.01 **levels of probability**, respectively.