

EFFECTS OF RELATED AND UNRELATED GRAFT PARTNERS  
IN SLASH PINE (Pinus elliotii Engelm.)

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Abstract.--The paper presents the results of a study designed to test the effect of degree of relationship between scion and rootstock on the survival, height growth and incompatibility of slash pine grafts. After four years, no significant gain was made in survival, height growth or reduction of incompatibility by using rootstocks that were related to the scions to which they were grafted.

Additional keywords: Stock-scion relations, graft incompatibility, vegetative propagation.

In a comprehensive review of scion and rootstock relationships in woody perennials, Tubbs (1973) cited many examples of the use of genetically identified rootstocks to influence scion performance and to overcome some of the problems of grafting in these species. Lantz (1970) suggested that such an approach might be worthwhile in tree improvement programs, particularly in those cases where graft incompatibility is a significant problem.

Several authors have reported decreases in incompatibility of forest trees through the use of rootstocks that were related to the scion material (Copes 1973, Denison 1973, Slee and Spidy 1970, van der Sijde 1974).

Rootstocks of known genetic origin have also been shown to influence the growth of scion material in a variety of species (Schmidtling 1973, McKinley 1975, Melchoir 1984). The objective of this study was to determine if rootstocks that were related to the scions improved the survival and growth or reduced the incompatibility of slash pine scion material.

MATERIALS AND METHODS

Seeds were collected from a total of 26 open- and control-pollinated families in a Texas Forest Service slash pine seed orchard. Seeds were obtained with the following parentages: open-pollinated with the female parent being an incompatible clone, control-pollinated with either the male or the female parent being an incompatible, and control pollinated with both parents compatibles. Incompatible clones are identified as those clones in which certain individual ramets demonstrated definite symptoms of incompatibility such as scion overgrowth, stunted growth, and chlorotic needles.

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Seeds were germinated in sand and allowed to grow for two months in greenhouse conditions. Approximately 12 seedlings from each family were transplanted into three-inch peat pots and moved to a lathhouse.

Grafting was done at the beginning of the second growing season (February-March). All grafts were made by removing the top one-third of the seedling, then grafting this "scion" onto the desired rootstock with a cleft graft. By switching the scion material from two separate plants, the same genotypes could be used in two graft combinations; each as a scion and each as a rootstock. Grafts involving the same genotype (autoplastic) were made by removing the scion as above and grafting directly back onto the remaining stem. Table 1 lists the different relationships between the scion and rootstock which were utilized.

Table 1.--Relationship classes of grafts made in this study

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Graft Partners Related:

1. Rootstock and scion consist of the same genotype (autoplastic).

Graft made by removing the top of the seedling and then grafting it back onto the remaining part of the plant.

2. Rootstock and scion related as full-sibs.

Full sib members of control-pollinated families utilized as both rootstock and scion material.

3. Rootstock and scion related as half-sibs.

Scion material obtained from open-pollinated families and grafted back onto rootstocks of the same families.

Graft Partners Unrelated:

1. Scion material switched between open-pollinated families which had incompatible clones as female parents.
2. Scion material switched between control-pollinated sources which had incompatible clones as either male or female parent.
3. Scion material switched between control-pollinated sources which had compatible clones as both parents.

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The grafts were maintained in the lathhouse for one year. The surviving grafts were then outplanted in a field planting using a completely random design.

Total height, survival and incompatibility were assessed at the end of each growing season for four years. Lantz's (1973) definition of graft incompatibility was used. He defined graft incompatibility as a stock-scion interaction occurring in a successfully established graft which causes a decline in vigor of either stock, scion or both. This paper presents the results at the end of year four.

## RESULTS AND DISCUSSION

Statistical analyses were performed to test related versus unrelated combinations, degree of relatedness within related combinations and compatibility of parents within unrelated combinations. To compensate for differences in the initial height of the grafts, height growth was used in the analyses. Height growth was calculated as the difference between height for year four and the initial height.

Family differences were not analyzed in this study. Several families had too few seedlings to allow grafts to be made in enough combinations to make a valid test. All graft combinations within a relationship class were treated as individual observations without regard to family designation. It is known that specific scion-rootstock combinations can have a significant effect on survival, incompatibility and growth (McKinley 1974, Bower 1977). However, it was felt that the large number of observations within a relationship class would give a reasonable average value for the relationship class.

Mean survival, height growth and incompatibility by relationship class are presented in Table 2. For ease of discussion, all analyses for a specific class will be presented together.

Table 2.--Mean fourth-year survival, growth and incompatibility by relationship class

Relationship Class	Survival (%)	Growth (cm)	Incompatibility (%)
Related	75	237	13
Self	86a	243a	3a
Full-sib	72b	238a	19b
Half-sib	65b	229a	18b
Unrelated	69	228	15
Both parents incompatible	60a	224a	20a
One parent incompatible	78b	215a	11a
Neither parent incompatible	82b	243a	9a

Means followed by the same letter are not different at the 0.05 level of probability.

## RELATED VERSUS UNRELATED

Analysis of variance showed no significant differences in survival, height growth or incompatibility between the related and unrelated combinations.

### GROUPS WITHIN RELATED COMBINATIONS

Analysis of variance showed highly significant (0.01) differences for survival, no differences for height growth and significant (0.05) differences for incompatibility among the three related groups. The autoplasmic grafts had the highest survival and lowest incompatibility. There were no differences between the grafts that were related as half-sibs and those that were related as full-sibs for survival or incompatibility.

Three of the autoplasmic grafts were classified incompatible in year three, based on short chlorotic needles. These three grafts were dead in year four. No evidence of scion overgrowth was observed. Since the scion and rootstock of these grafts were of identical genotypes, an incompatible reaction would not be expected.

Three types of material were used in making the autoplasmic grafts: (1) seed collected from incompatible ramets of incompatible clones, (2) seed collected from compatible ramets of incompatible clones, and (3) seed collected from controlled pollinations in which one parent was an incompatible clone. It is notable that the three grafts classified as incompatible were all from families in which the seed had been collected from incompatible ramets of incompatible clones. The results of a chi-square analysis showed that the three incompatible grafts could have occurred in this category purely by chance. Unless there is evidence of scion overgrowth, classifying a graft as incompatible is somewhat subjective, therefore, these grafts may have been incorrectly classified.

### GROUPS WITHIN UNRELATED COMBINATIONS

Significant (0.05) differences in survival were observed among groups within the unrelated category. Graft combinations in which both the scion and the rootstock were from compatible sources had the highest survival. Those graft combinations in which both the scion and rootstock were from incompatible sources had the poorest survival.

The analysis of variance for height and incompatibility showed no significant differences.

Since all unrelated grafts were made in reciprocal form, an analysis was performed to determine if any groups performed differently used as rootstocks or used as scions. No significant differences were observed in survival, incompatibility or scion growth among groups of reciprocal grafts.

## CONCLUSIONS

After four years, no significant gain was made in survival, percentage of incompatibility or height growth by using rootstocks that were related to the scions to which they were grafted. The related combinations tended to have

better survival, a lower percentage of incompatibility and more height growth than the unrelated combinations. However, further analyses showed this trend to be the result of the autoplasmic grafts.

Among unrelated combinations, there were significant differences in survival. Those grafts in which both the scion and rootstock were from incompatible sources had the poorest survival. Those grafts in which both the scion and rootstock were from compatible sources had the highest survival. Although the differences were not significant, those grafts in which both the scion and stock were from compatible sources had less incompatibility than those in which both scion and rootstock were from incompatible sources.

No significant differences were seen in scion growth among the various unrelated combinations.

The results of this study are consistent with Schmidtling's (1986) conclusion that for slash pine, grafting clones onto related rootstocks would be a wasted effort for most clones.

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