SCREENING CLONAL ROOTSTOCKS OF SLASH AND LOBLOLLY PINE

Ralph C. Bower

Abstract.--Two clones of loblolly pine which had shown high rates of graft incompatibility in previous usage, were grafted to ramets of thirteen rootstock clones which had been propagated by rooting.

Significant differences were observed in both scion survival and scion growth among the rootstock clones. Scion survival ranged from 93 percent to 17 percent on the thirteen rootstock clones while mean scion growth ranged from 29 cm to 7 cm.

The results indicate that the first year survival and growth of the scion can be significantly influenced by the rootstock to which it is grafted.

Additional keywords: Pinus taeda, Pinus elliottii, grafting, stock-scion relationships, graft incompatibility

Horticulturists use special rootstocks to control the growth rate and final size of grafts, and to induce early and prolific flowering in many fruit trees. Specific rootstocks have also been used to develop resistance to certain diseases, insects or nematodes or tolerance to certain adverse weather or soil conditions.

The grafting of scion material from difficult-to-graft varieties to highly compatible rootstocks has long been used in horticulture. This has been possible because many rootstocks used for horticultural species are relatively easy to propagate vegetatively. Until recently it has not been possible to root sufficient numbers of loblolly and slash pine cuttings to make screening of clonal rootstocks worthwhile.

Techniques have been developed at the Texas Forest Service Genetics Laboratory to produce rooted cuttings of loblolly (Pinus taeda L.) and slash pine (Pinus elliottii Engelm.) in large enough quantities to begin a screening processing (van Buijtenen and others 1975).

This paper will discuss the first year results of a continuing study in the use of clonal rootstocks in forestry research. The first phase involves the grafting of difficult-to-graft clones onto clonal rootstocks.

---

[1] Forest Geneticist, MacMillan Bloedel Limited, Woodlands Services Division, Nanaimo, B.C. This work was accomplished while the author was a graduate student at Texas A&M University. Provision of assistance and facilities by the Weyerhaeuser Company and the Texas Forest Service is gratefully acknowledged.

The primary objective of the study is to find one or more rootstock clones which show a high degree of compatibility. The secondary objectives, as the grafts reach maturity, are to select rootstocks which increase flower production and/or have a dwarfing effect on the composite tree.

METHODS AND MATERIALS

The rootstocks used in this study were all rooted cuttings of slash and loblolly pine. All material was rooted during 1974 and 1975 at the Forest Genetics Laboratory at College Station, Texas, using the procedures described by van Buijtenen and others (1975). The age from propagation of the rootstock ranged from nine to eighteen months.

Table 1 is a listing of the rootstock clones used in this study. The first twelve clones were slash pines. Clones R7 through R42 were all half sibs. They were first rooted in 1969 from six-week old seedlings. Clones R74 through R90 were all full sibs, having been rooted in 1970 from six-week old seedlings. Clone R324 is unrelated to any of the other clones and was first rooted as a ten-week old seedling in 1972. Clone R343 is an open pollinated loblolly pine that was originally rooted in 1972 when it was six years from seed.

Table 1.--Listing of clonal rootstocks and number of each used in a particular scion rootstock combination

Rootstock clone	Species	Number of grafts per scion clone
R7[a/]	slash pine	6
R15[a/]	slash pine	6
R18[a/]	slash pine	8
R20[a/]	slash pine	5
R27[a/]	slash pine	7
R38[a/]	slash pine	10
R42[a/]	slash pine	7
R74[b/]	slash pine	7
R85[b/]	slash pine	5
R88[b/]	slash pine	10
R90[b/]	slash pine	5
R324	slash pine	7
R343	loblolly pine	5
Total		88

[a/] Related as half-sibs

[b/] Related as full-sibs

The rootstocks were transported to the Weyerhaeuser Company's Craig seed orchard near. Broken Bow, Oklahoma in January 1976. As scion material Weyerhaeuser chose two loblolly pine clones which had shown a high rate of incompatibility in previous usage. The number of grafts made of a particular scion-rootstock combination varied according to rootstock availability (Table 1). It has been shown that the performance of loblolly pine scion material grafted to slash pine rootstocks is equal to or better than the performance on loblolly rootstocks (Schmidtling 1973, McKinley 1975).

All grafts were made using a side graft and were performed over a two-day period in March 1976 by the same grafter. The grafts were maintained in a shadehouse and received irrigation as needed. None of the grafts received fertilization.

Final survival and height measurements were made in October 1976. The surviving grafts were then outplanted to be kept under observation until they had reached full flower production so that growth rate and form, incompatibility and seed production, could be more fully evaluated.

RESULTS AND DISCUSSION

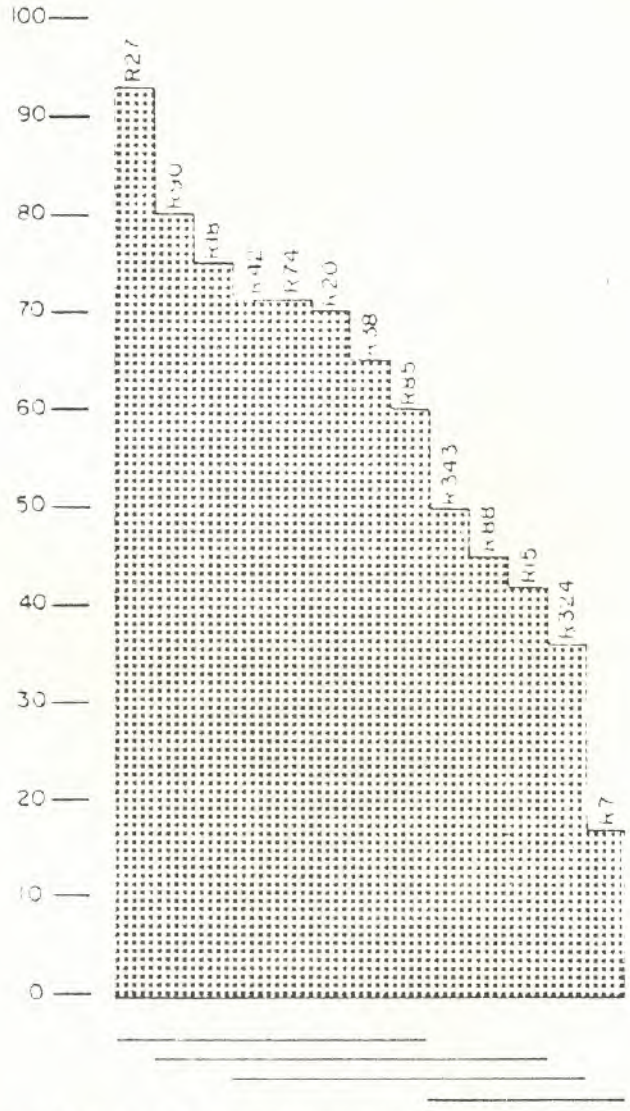
Scion A had an overall survival of 51 percent while scion B had an overall survival of 68 percent. The mean survival for both scion clones grafted to each rootstock ranged from 93 to 17 percent. F values for scions and rootstocks were both significant at the 0.05 level of probability.

Duncan's Multiple Range test was performed on the rootstock means (Figure 1). It is evident that significant gains in first year scion survival can be obtained by selecting the proper rootstock clone.

Scion growth was calculated as the difference between initial height and final height. Analysis of variance showed significant (.05) differences among rootstock clones, but no significant differences between the two scion clones. The mean growth **for** both scion clones grafted to each roostock clone is presented in Figure 2. Duncan's Multiple Range test was performed on these means, the results of which are also presented in Figure 2. If the variation in growth rate shown by these first year results continued to maturity it would be possible to select rootstocks which would increase or decrease average scion growth. The use of dwarfing rootstocks would have very practical importance in seed orchard management because small trees would facilitate cone collection.

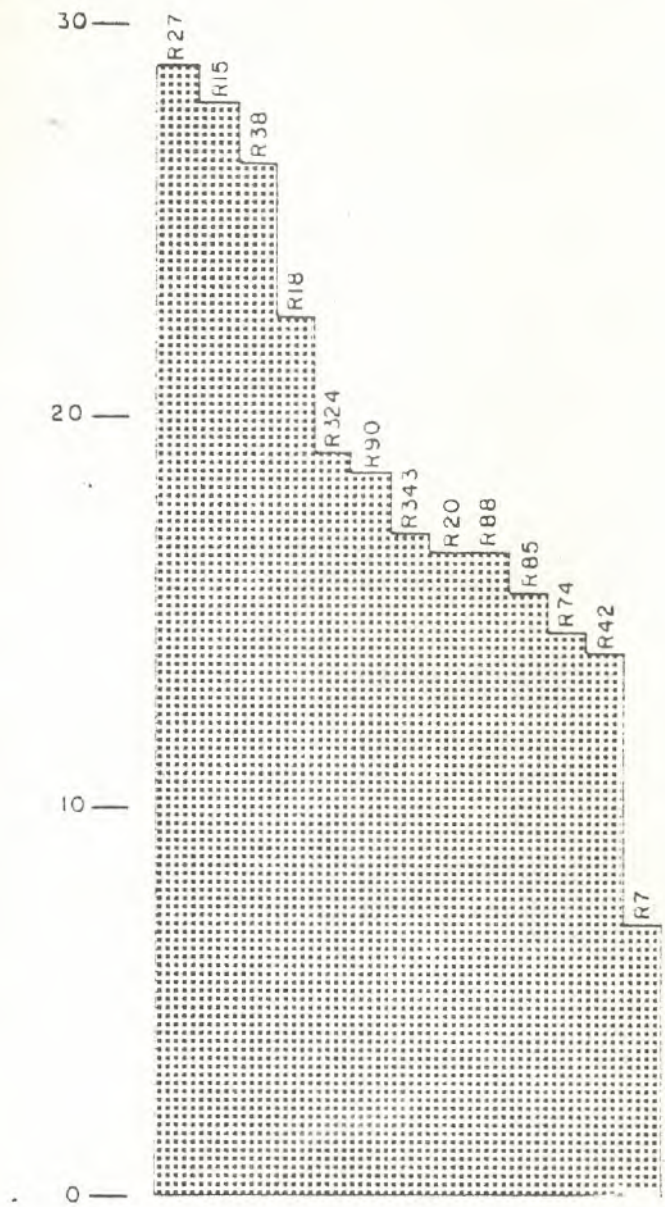
Much variation in scion growth was observed among replications of the same scion-rootstock combination. As an example, the six replications of A on R38 had a range in scion growth of 10 cm to 52 cm with a mean of 30 cm. This gave a coefficient of variation of 57 percent. Since these were clonal scions grafted onto clonal rootstocks, the expectation would be for much more similarity in performance. Personal observation has shown that there is considerable variation in the size of root systems developed by individual ramets of the same clone, thus there is variation in the amount of water and nutrient absorption possible. This variation in water and nutrient uptake is one possible explanation for the large amount of variation in scion growth observed among grafts of identical genotypes.

FIGURE 1. MEAN SURVIVAL FOR BOTH SCIONS GRAFTED TO EACH ROOTSTOCK



ROOTSTOCKS NOT CONNECTED BY A LINE ARE DIFFERENT AT THE .05 LEVEL USING DUNCAN'S NEW MULTIPLE RANGE TEST.

FIGURE 2. MEAN SCION GROWTH FOR BOTH SCIONS GRAFTED TO EACH ROOTSTOCK



ROOTSTOCKS NOT CONNECTED BY A LINE ARE DIFFERENT AT THE .05 LEVEL USING DUNCAN'S NEW MULTIPLE RANGE TEST.

CONCLUSIONS

There were significant differences in graft survival among rootstock clones. The range in survival was from 93 percent to 17 percent. Therefore, obtaining a highly graftable rootstock by screening clonal rootstocks shows promise.

Significant differences in scion growth rate were obtained on the rootstocks used. If these differences continue to exist through to maturity, it will be possible to select rootstocks that can increase or decrease scion growth.

Considerable differences exist in scion growth among replications of the same scion-rootstock combinations. Since both scion and rootstock are of clonal origin a similar response would be expected from all replications of a specific scion-rootstock combination, unless environmental factors were different among the replications. A possible explanation for this variation is the difference in size of the root systems among ramets of a rootstock clone causing differential nutrient and water availability to the scions. Further research is needed to elucidate the role of these environmental factors.

No conclusions can presently be made about the effect of any of these thirteen rootstocks on incompatibility or flower production. For this reason the grafts have been planted in an experimental seed orchard to undergo further evaluation.

LITERATURE CITED

McKinley, C.R. 1975. Growth of loblolly scion material of known genetic origin. Thirteenth Southern Forest Tree Improvement Conf. Proc. 1975: 230-233.

Schmidtling, R.C. 1973. Rootstock influences early fruitfulness, growth, and survival in loblolly pine grafts. Twelfth Southern Forest Tree Improvement Conf. Proc. 1973:86-90.

van Buijtenen, J.P., J.R. Toliver, R.C. Bower and M. Wendel. 1975. Operational rooting of loblolly and slash pine cuttings. Texas Forest Service Publication 111. 9 p.