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A TEST OF GRAFTING PONDEROSA PINE

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Cleft grafting ponderosa pine proved best of five methods of vegetative propagation tested for field use in the dry hot climate of eastern Oregon. Ponderosa pine has been successfully grafted under many conditions elsewhere, but first trials in this area during 1955 were a failure. This study was made in 1956 at the U.S. Forest Service nursery at Bend, Oreg., to find a field method suitable for propagation of plus-tree stock.

The Study

Four types of grafts and a budding technique were included in the study. All grafts were made on limbs of 6-year-old ponderosa pines in the nursery windbreak. Attempts to graft limbs are usually less successful than grafting leaders, hence limb grafts were used in this study to provide a more sensitive test of methods. The freshly cut shoot was immediately grafted back onto the same branch. This procedure eliminated any possible incompatibility between scion and understock.

The first part of the study--to graft dormant scions (shoots) just prior to growth initiation--was done April 18 and 19. Although bud elongation and cambium growth had started about a week previously, the material was considered dormant for purposes of the study. Twenty-eight trees were used, with all five graft types installed once on each tree. Grafting was confined to ends of main limbs in the upper two whorls. In order to avoid personal bias, each author grafted 14 alternate trees in a row. Typical sunny weather with low

humidity necessitated fast work to prevent dessication of cut surfaces.

All grafts were tied with soaked raffia, a palm fiber, and coated with a thick, black semi-liquid grafting wax. The scion and part of the stem were enclosed in a plastic (polyethelene) bag to maintain high humidity around the scion. The plastic bag, in turn, was shaded with a kraft paper bag well ventilated by holes torn at four corners. This was done to prevent high temperatures within the plastic bag.

The second part of the test--to graft succulent shoots at a later growth stage--was accomplished June 18-20. New shoots were just beginning to harden after shoot elongation was nearly complete. Only cleft and patch grafts were tried since they showed most promise during the April trials. Grafting procedures were the same as those in the April trials.

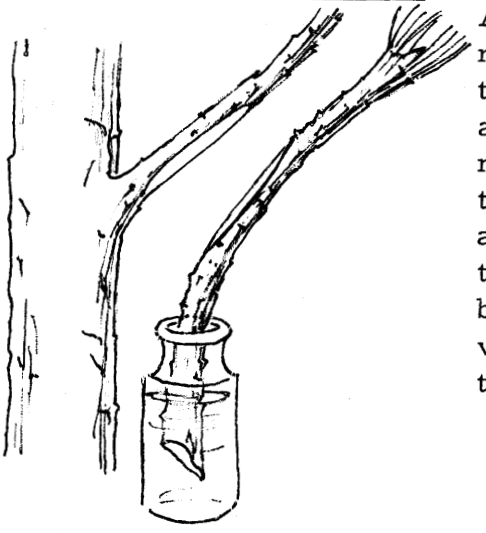
Methods Tested

Cleft graft: The end of the shoot (scion) was cut wedge shaped and inserted into a cleft made in the cut branch. Shoots were about 3 inches long, with needles stripped except for about 1 inch of the tip.

Whip graft: Both shoot and cut branch were cut at the same slant and cambiums fitted together.

Patch graft: The "patch" was made on the cut branch by peeling back a strip of bark 1/2-inch wide. The exposed wood was slightly flattened with an additional cut. A long slanting cut on the shoot was made to match the flattened part of the branch. In addition a light cut to the cambium was made on the opposite side of the shoot so that the cambium of the shoot would make contact with the inner face of the bark "patch".

Bottle graft: Shoots at least a foot long were used. A 3- to 4-inch-long shallow cut was made through the bark a small distance into the wood about midway along the shoot. A matching cut was made on the branch near the tree trunk and the two cuts fitted together and bound with raffia. The end of the shoot was fitted with an 8-ounce bottle filled with water. Live foliage was left on the cut branch beyond the point of grafting.



Budding: An inverted L-shaped cut was made in the bark of the stem on the shaded north side of each tree, on 1- or 2-year-old wood. A bud with about 1 inch of stem cut on a slant was inserted into the cut. An additional cut on the leading edge of the inserted stem provided a wedge-like cross section for better contact with exposed cambium of the stem.

Results

In all, eight examinations were made during the growing season, but data are presented only for the final examination on October 30. Inspection of earlier data for dormant trials indicates that grafts listed as "growing" on June 19 were, with few exceptions, the same ones that survived the entire summer. Percentage of success of succulent grafts was closely indicated by August 28. Ninety-five percent of all grafts that appeared successful in October were living in July of the following year. As shown in the following tabulation, the cleft graft was definitely superior to other methods tested:

Method of propagation	Alive at end of first season		Relative time requirement
	(Number)	(Percent)[1/]	
Dormant:			
Cleft graft	15	54	1.00
Whip graft	6	21	.88
Patch graft	6	21	1.34
Bottle graft	0	0	1.84
Budding	3	11	.91
Succulent:			
Cleft graft	20	71	--
Patch graft	8	29	--

1/ As a percentage of 28, the total number of replications for each graft type and class of scion material.

More than half of the cleft grafts using dormant material and almost three-fourths of those using succulent material were living at the end of the first season. This record of success was far better than those of whip grafts, patch grafts, budding, and bottle grafts. Analysis of variance showed that the superiority of cleft grafts could scarcely have occurred by chance (differences were significant at the 1-percent level). Grafts with succulent material were somewhat more successful than those with dormant material, but the difference was not significant.

The authors differed greatly in extent of grafting experience but this also proved to have little bearing on final outcome. Cleft grafts were clearly more successful for both. Considering time

required, as well as grafting success, the cleft graft was superior for conditions at the Bend Nursery.

Bottle grafts, which were thought to have the best chance of success in dry areas, were a complete failure. Failure of union between scion and understock was due in part to a mold that developed on needles in the bags. Bottle grafts are also most costly to prepare and need occasional watering. In the Bend area they require plastic bottles because late frosts break glass containers.

Whip and patch methods of grafting gave identical results. Budding unexpectedly produced a few living shoots. The three buds that lived, however, formed a union chiefly with stem bark and thus seemed very insecure. While the test demonstrated that budding is possible, the method does not appear to hold much promise for grafting ponderosa pine under field conditions.

Veneer or side grafting, which has proved successful under moist greenhouse conditions, was not included because scion and stock are matched in nearly the same way as in bottle grafting. The method merits field trial with ponderosa pine, however. Approach grafting, the inarching of potted or root-wrapped seedlings, was not tested because the immediate goal was to graft scion material rather than seedlings.

Time records were kept for only 20 dormant grafts. Since the time required for each method of grafting was fairly consistent, however, the average relative times shown in the tabulation are believed representative. Actual average time for cleft grafting was 6.73 minutes, only a little longer than for whip grafting. Budding was also relatively fast. Patch grafts required about one-third more time than clefts, and bottle grafts nearly twice as long. An experienced, nimble-fingered worker with proper equipment could make grafts in substantially less time.

Conclusion

Of the five methods of vegetative propagation tested, cleft grafting, with either dormant or succulent material, was the only reasonably successful method found for ponderosa pine under dry atmospheric conditions. This conclusion applies only when protective measures similar to those used in this test are followed. Experience indicated that plastic bags should be left on for about 2 months and the kraft bags an additional 2 weeks.