Large Scale Seedbed Grafting and Seed Orchard Development

[1/]
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I'll re-word my subject by saying, a review of the Georgia Forestry Commission's experience in establishing seed orchards by grafting. These experiences might be mutual and, you just beginning a program may look forward to them with anticipation.

Our program began in 1954. The original mode of establishment was by grafting in February 1955, scions from initially selected parent trees on potted 1-1 seedlings. Ramets from additional selections were obtained by field grafting during the Spring of 1956.

Greenhouse or lath-house grafts on potted stock result in initially high grafting success but this is hindered by lack of grafting space and post-planting problems. Root binding (Figure 1) and wind-throw in later years are two hazards that can be overcome with intensive care such as judicious root pruning, use of large containers, and optimum soil mixes. A too friable soil mix might require extra field watering until established, due to the possible fibrous root system produced while in the container. This extra attention tends to put a higher cost on each graft.

Approach grafts on container stock and bagged seedlings gives a very high percentage take but is not feasible on a large scale due to lack of accessible scion material.

Well established transplants from containers result in a uniform, easily managed orchard (Figure 2).

Grafting in the field was performed, using a protective cover of foil and polyethylene bags on 1-1 stock planted two to the space (Figure 3). The idea being to cut one when a union was achieved. Field grafting will work well on an area that can be closely supervised,

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provided you get a good take the first two years. Attempts were made to establish 300 acres in two grafting seasons by using a crew of fifteen school boys. A good many trees were successfully grafted but a higher percentage were not. The stock plant of these unsuccessful grafts was regrafted until the tops were too high to reach. The result, the orchard had scattered grafted trees throughout but was understocked and uneven aged (Figure 4). The graft unions were 4 to 60" from ground level. Ungrafted trees also appeared to be grafted, a new terminal shoot having sprouted at the unsuccessful graft union.

Figure 1 -- Poorly developed root system caused by plant being grown in container too long.

Grafting too high resulted in intensive pruning practices and in general; a poorly formed tree (figure 5). Over a three year period, 1957, 1958, and 1959, a total of 43,657 field grafts were made. An average of 36% take for slash and 16% for loblolly was achieved.

The low degree of success can be attributed to summer grafting and detrimental weather conditions.

In 1960 an inventory of all trees as made. Trees with no identity, diseased trees, poorly formed trees, and areas understocked to the point that inter-planting was not feasible, due to the large size of the grafts, were rogued. We began searching for methods in vhich we could utilize a more controlled condition of growing. Grafting on nur sery seedbed seemed to be the most appli-:able method. 1-0 seedlings were thinned to grow approximately 12" x 12" on the

Figure 2 -- Uniform stand of grafts that were made on potted stock.

Table 1. Three year field grafting percentages. Grafts were made in February, March, June, July, and August.

Species	Year	Number Grafted	Number Lived 1 yr. from Grafting	Percent
Slash	1957	4,277	4,008	94
	1958	6,939	1,013	15
	1959	10,144	2,536	25
	Total	21,360	7,557	36
Loblolly	1957	2,265	1,905	81
	1958	10,757	249	2
	1959	9,175	1,626	18
	Total	22,297	3,780	16
	Total	43,657	11,337	26%

Figure 3 -- Field grafted 1-1 stock.

Figure 4 -- Larger trees were field grafted and interplanted with seedbed grafts five years later.

seedbed (Figure 6). They were root pruned in September and again in December. A complete fertilizer was applied in January. This attention is necessary to achieve the largest diameter possible by early Spring.

The first discovery made in seedbed grafting was to avoid use of low overhead shade such as cheesecloth, lath or saran, together with a cover over the grafts (Figure 7). This interrupted photosynthesis during extended periods of low light intensity. Instead of dying and turning brown, the grafts died and maintained a pale green color which was misleading in casual inspections. Several combinations of protective covers or bonnets were tried during 1961. When using an unvented polyethylene bag without a cover, just a few minutes of direct sun would cause a tremendous heat build up. Grafts without any cover or poly bag didn't survive, even when grafted under continuous mist. Grafts made after April in southeast Georgia, generally were not as successful as February-March grafts.

Spring of 1962 grafting was done with only a tin foil bonnet over a vented poly bag, using cleft grafts (Figure 8). The experience gained this season was to leave some stock limbs exposed outside the cover; if not, the grafts would achieve a union and grow several inches, then flop over as if they were growing so fast they couldn't support themselves. The stock limbs would be etiolated from being under the cover. Usually the whole plant would die upon removal of the cover and exposure to the hot sun.

The Georgia Forestry Commission has successfully established 38,307 grafts, 23,524 of these are nursery bed grafts established since 1961. We feel that for successful seedbed grafting, the following general conditions must be met.

1. Root pruned 1-0 stock plants at one foot spacing and at a diameter approaching the diameter of the scion.

2. Irrigation.

3. A moisture retainer such as a poly bag, vented for heat release, covering two-thirds of the plant.

4. Outside of the poly bag, some type of shade or insulator such as aluminum foil or kraft bag should be used.

5. Begin grafting as early in the Spring as weather conditions permit and stop by the last of May.

Using grafting data of one slash orchard as an example (Table 2), the average grafting success over 64 clones, containing 9,567 seedlings grafted, is 76% for four grafting seasons Success in a clone might vary as much as 50% in two successive years. Some clones expressed a good grafting potential by having two to three years of low take then exhibiting 95% success. No more than 3% of the clones grafted successively for three years displayed a consistently below average success. Even then the low take was not so low that it was a disqualifying factor. One clone having 145 grafts made in three years resulted in 99% success. A factor that might have influenced the average percentage take could involve human skill. Over the three years a total of 25 prison inmates, with varying degrees of interest, participated in actually making the grafts.

TRANSPLANTING OF GRAFTED STOCK

Table three shows transplanting success of 5,472 grafts planted over a three year period.

Three thousand three hundred fifty-three bare root transplants (Figure 9) gave 75 and 69 percent respectively; compared to 2,119 plants balled with 87 percent transplant success. This data was taken one year from transplanting. Other test plots indicate that a 10 to 15% transplanting advantage of ball over bare root is consistent.

Table 2. Example of grafting percentages of slash in one orchard for four years. Grafting performed only in the spring.

Number Clones	Year	Number Grafted	Number Live	Percent Success
39	1961	2,421	1,437	59
58	1962	2,537	2,118	83
45	1963	2,754	2,366	86
42	1964	1,855	1,304	70
	Total	9,567	7,225	76

Table 3. Grafted slash transplanting percentages.

Year	Full Planted	Living After One Year	Percent
1961	1,437 (Bare root)	1,078	75
1962	1,916 (Bare root)	1,330	69
1963 *	2,119 (Balled)	1,842	87

* Balled and transported to field in three gallon containers.

Figure 5 -- Poorly formed field graft. Note graft union approximately 60 inches from ground.

Figure 6 -- 1-0 root stock grown 12" x 12" on nursery seedbed.

Figure 7 -- Seedbed grafts under shade cloth.

Figure 8 -- Grafts in the seedbed.

Figure 9 -- Bare root nursery seedbed graft showing root system prior to being planted.

Figure 10 -- Established ramets in the seed orchard all propagated by nursery seedbed grafting.

A consistently below average transplanting success was noticed in 20% of 34 clones transplanted to the orchard for three consecutive years. Most of these clones had a high grafting potential. All the above plants were planted in 14" auger dug holes and were watered when weather conditions made it necessary.

TIME REQUIRED FOR PROPAGATION AND VARIOUS CULTURAL OPERATIONS FOR SEEDBED GRAFTING.

The time required for making 13,771 grafts, including the various cultural operations and the lifting of 10,658 of these grafts, is 45 minutes each. Prison inmate labor was used in all operations.

Table 4. Time required by various type operations for seedbed grafting.

Item	Man Hours	Number Grafts	Time per Graft
Grafting	3,920	13,771	17 Min.
Cultural *	2,202	13,771	10 Min.
Lifting	3,172	10,658	18 Min.
Total			45 Min.

* Cultural includes spraying for disease and insect control, pruning, weeding, etc.

SUMMARY AND CONCLUSION

Establishment of seed orchards by grafting may be accomplished by using three approaches.

1. Grafting on potted or container grown stock.

This results in initially high take but the number of plants established in the field is limited by physical facilities available for propagating. Post planting problems of root-to-shoot ratio occurs in varying degrees. It is more expensive due to intensive cultural and handling practices.

Field grafting on planted stock.

Success depends upon ideal weather conditions. Grafting during early Spring is recommended. A full stocked stand is less likely to be achieved if repeated graft failure results at certain locations in the field. An uneven age stand is possible, complicating cultural and spraying schedules by making it necessary to continue these practices over a longer period. Continued grafting failure raises cost. Field grafting complicates supervision by increasing area to be supervised.

Nursery bed grafting.

This method lends itself more to mass production by concentrating efforts at one location under closer supervision and environment control. Cost of established plants are less expensive. In most cases, established plants are nearer the same age and uniform in size (Figure 10). Plants are less subject to fusiform on the stock because of protection in the grafting bed and subsequent pruning of stock limbs when planted. A higher number of plants can be established in a shorter period using the nursery bed system. It is essential when using this method of orchard establishment that stock be grafted to allow for mortality in grafting and in transplanting of low potential clones.