Techniques for Improved Grafting

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Grafting has been used for centuries and continues to be an important propagation tool. In tree improvement, grafting may be used for concentrating breeding stock, stimulating flowering, increasing seed yield and viability, and for growing exotics on native hardy root stocks (Ahlgreen, 1962). The grafting techniques described in this article are modifications of current procedures aimed at improving grafting success.

Materials and Methods

Several different experiments were conducted to test factors affecting grafting success. The first of these was a nursery grafting trial testing the effect of several scion treatments (indolebutyric acid, 25 ppm; ascorbic acid, 100 ppm; 6 mercaptopurine, 50 ppm.; dexamethasone 21-phosphate, 50 ppm; and nitrogen, 100 ppm) applied by scion stump infiltration prior to grafting and one stock treatment (nitrogen fertilizer, 100 lbs. N/A) applied I week after grafting. The stocks, grown in the University of Florida nursery, were all from the same clonal seed source. The scions, from each of four clones (slash pine sources 70-56, 0-56, CCA142, and loblolly pine source T-603) showing phenological superiority, were collected in the same week from mother trees near Gainesville, Fla. Scions were placed in plastic bags containing sphagnum moss and kept at 4°C. until placed into treatment solutions or grafted I week later. The scions were cleft grafted onto the stock, bagged with polyethylene (open at bottom), and then covered with a kraft bag. Both bags were secured to stakes. After 2 months, the bags were removed and the grafts rated (10 = alive and growing; 6 = all green but no growth; 3 = alive but with some foliar abscission, and 1 = dead).

In a second trial, the same chemicals listed above were applied as foliar sprays to difficult- and easy-tograft slash pine clones (classification based on prior attempts). Additionally, three different irradiation treatments (250 R. from a gamma source applied to scion and stock, and 1000 R. from a beta source applied to graft union at 2-week intervals) were tested. All grafting was done on potted stock and grafted plants were maintained under an intermittent mist system during the course of the experiment. Grafting success for all treatments and scion sources was near 100 percent. Hence, it appeared that the high humidity in this system may have eliminated many potential grafting failures.

Scions from loblolly, sand, and longleaf pines were collected for a third experiment because they form an array of increasing difficulty-tograft. They were grafted onto potted slash pine stock, polyethylene and kraft bagged, and placed in three environments : (1) In open sun, (2) under 50 percent shade (saran cloth) and (3) under 50 percent shade with 15 seconds of mist at 10 minute intervals. After 2 months, the grafts were unbagged and survival rates determined.

A fourth trial tested modifications of the bagging procedure described above. Slash pine scions were, grafted on potted slash pine stock under 50 percent saran cloth shade. Bagging treatments were: (1) Polyethylene bag over graft (open at bottom) plus a kraft bag with an upper corner clipped ; (2) polyethylene bag only (open at bottom) ; (3) polyethylene bag over graft and tied around pot, with 2-inch aeration holes just above the pot, and (4) polyethylene bag over graft and tied around pot (closed). As in the second test, al most 100 percent grafting success was obtained with all treatments and with

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two different grafters. Scion growth was measured 2 months after grafting.

All experiments were in complete block and the data were subjected to variance analyses.

TABLE 1.—*Variation in grafting success among clonal scion sources and the effect of nitrogen applied to stocks.*

Supplemental stock treatment	Average grafting index Scion[2]				
	70-56	0-56	T-603	CCA-142	Ave.
None	6.0	7.3	7.3	5.0	6.3
Nitrogen[1]	6.0	6.7	2,3	2.3	4.3
fertilized	6.0	6.7	2.3	2.3	4.3
Ave.	6.0	7.0	4.8	3.7	

[1]Effect of N significant at p(0.01)
[2]Effect of scion source significant at p(0.01)

Results and Discussion

In the nursery and potted grafting trials, large differences in grafting success were associated with clonal source of scions. In fact, after 6 months only three grafts of clone T-603 (loblolly pine) and CCA-142 (slash pine) survived (table 1). When the stock was N fertilized just before grafting, grafting success was reduced significantly (table 1). Perhaps this is related to differential growth rates of stock and scion. Alternatively, metabolites analogous to foreign proteins that cause rejection responses in animal grafts could have formed. Tests of animal immunosuppressants (6-mercaptopurine and dexamethosone 21-phosphate) failed to improve grafting in other experiments. Similarly, none of the chemical treatments applied to the scions improved grafting in either experiment. Radiation treatment of scions reduced growth but did not affect grafting success.

One factor observed in one of these trials was that all grafts (regardless of treatment) of a difficult-to-graft slash pine source succeeded. In this experiment, an intermittent mist system was employed. This suggested that the effect of a mist system on maintaining a humid environment be evaluated when difficult-to-graft materials are involved. (Sand pine and longleaf pine are species that are known to be difficult-to-graft.)

Under conventional grafting procedures and with no shade, and /2 shade, the three pine species tested showed different grafting patterns, with longleaf pine always being least successful (table 2). Differences in the grafting success between sand pine and loblolly pine were not apparent when the grafts were under mist. Shade had little effect on grafting, presumably because the scions were sheltered by kraft bags. The success of grafting with all species was improved by placing them under shade and mist. Grafting success with sand pine was increased from 70 to 93 percent under mist. Although longleaf grafting was improved under mist, it did not approach the 90+ percent *take* recorded for the two other species.

When a clone is known to graft easily, it appears that early growth of the scion is improved by placing the plant in a closed system (table 3). The closed polyethylene bag keeps the aerial environment humid while effecting gaseous exchange. Polyethylene is known to be only slightly permeable to water vapor but to allow relatively high transmission of 0, and CO_2 (Renfrew and Morgan, 1957). This experiment, further confirms the importance of preventing scion desiccation during the time of union formation. Incidentally, this last method is both simpler and cheaper than conventional procedures.

TABLE 2.—*Effect of shade and mist on grafting success*

	Percent Success Treatment[1]		
Species[2]	No Shade No Mist	½ Shade No Mist	½ Shade Mist
Loblolly pine	64	64	91
Sand Pine	78	70	93
Longleaf Pine	36	29	46

[1]significant at p(0.05)
[2]significant at p(0.01)

TABLE 3.—*Effects of bagging and ventilation on early scion growth*

Ht. of scions (in.) Treatments[1]			
Poly bag (open at bottom) + kraft bag	Poly bag only (open at bottom)	Poly bag over pot with hole	Poly bag over pot no hole
3.8	3.9	4.3	6.1

[1]Significant at p(0.01)

Summary

Treatments that cause differential growth rates of stock and scion (e.g., N applied to stock) tended to decrease grafting success with difficultto-graft scions. Shade and mist, both of which prevent the desiccation of the scion during union formation, improve the success of grafting plant materials that usually show poor grafting results. A closed polyethylene bag appears to be suitable for maintaining the graft in a humid environment and facilitating early growth. Thus, these related experiments emphasize the importance of maintaining humid environments around grafts to prevent desiccation during critical phases of union formation.

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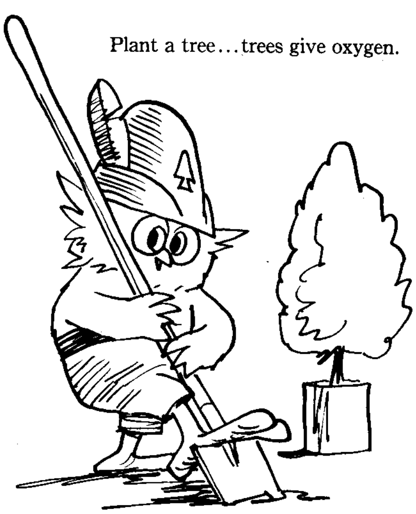

News & Reviews

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Now! Nursery Stock Inventories by Computer

Compiling nursery stock inventories by hand can be a thing of the past. An inventory program is available from the Forest Service's Southeastern Area which takes data from inventory plots in the seedbeds, computes present and projected inventory figures, and compares them with number of trees requisitioned. Program also calculates statistical sampling error and number of plots necessary to sample the lot to any desired sampling error. Write Southeastern Area, State and Private Forestry, for details.

New Zealand Root Pruner Being Tested

A root pruner designed in New Zealand is now being evaluated by the Forest Service Equipment Development Center (Missoula, Mont.) at nurseries in nine States. The pruner is of special interest because it does both lateral and horizontal root pruning in one operation. The horizontal cutting blade reciprocates 1080 times a minute with a 3-inch stroke. Blades of various size and pitch can be used. The results of the evaluation will be of special interest to nurserymen who are looking for a better way to root prune.

Containerized Seedling Planting Encouraging

On National Forests of Florida (reports Ben Fenton of FS Region 8 office), many seedlings planted in June 1971 in spiral bound Kraft paper tubes are growing vigorously ... survival on some plots as high as 80 percent after 10 months ... long leaf pine survival and growth is outstanding. According to Fenton, many of the slash pine seedlings already have a stem diameter of %4-inch to 3/8-inch and are 8 inches or taller in height. Plans are to outplant some 600,000 containerized seedlings on various National Forests this year using Japanese paperpots 1 inch in diameter and 6 inches long.

Freezing Is Bad News For Seedlings

There are several areas in North Carolina where forest tree seedlings in transit are subject to freezing. It appears that very few species of hardwoods will survive following freezing in the shipping bundle.

During the 1969-70 shipping season 50 each of several hardwood species were bundled and frozen at 10° F. for 10 to 15 days, thawed slowly at outside temperature, then field planted. Listed below are the species and the survival results which were quite drastic

Species	Survival Percent
Bald Cypress	0
Black Cherry	14
Black Gum	0
Black Locust	0
Black Oak	0
Black Walnut	0
Cherry Bark Oak	0
Chestnut Oak	0
European Black Alder	0
Green Ash	0
Nuttall Oak	0
Red Maple	21
Red Oak	2
Sweetgum	0
Sycamore	46
Tupelo	0
White Oak	0
Yellow Poplar	54

This planting season a similar study has been installed with freezing times of 2 and 6 days. In the meantime, it is suggested that hardwoods be handled the same as southern pine with reference to freezingDON'T. (From "Hardy Hardwood's Observations," Vol. III, No. 2, May 1972, pub. by North Carolina Forest Service)

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