Field Grafting of Sweet Pecan to Bitter Pecan Rootstock in Seasonally Flooded Bottomlands

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*Four grafting techniques were used to join sweet pecan (*Carya illinoensis *Wang) K. Koch) scions to bitter pecan (*C. aquatica *(Michaux) Nuttall) rootstock in seasonally flooded bottomlands of northern Louisiana. Dormant season grafts resulted in negligible survival; however, inlay bark grafting, a non-dormant-season technique, resulted in a 76% survival rate. Differences in origins of scion material had a significant effect on survivability, whereas degree of crown closure above the grafted trees and origin of scion material were related to scion growth rates.* Tree Planters' Notes 40(3):25-28; 1989.

Bottomland forests in the southeastern United States are being cleared at an alarming rate. Turner (14) estimated that between *1960* and *1975* approximately *3* million hectares of bottomland forests in the southeastern United States were cleared for agricultural purposes. Lands that have poor drainage, and thus little agricultural potential, represent the majority of bottomland forests remaining in many areas of the southeast today. On many of these poorly drained sites, overflow typically begins in November and persists into May (15), so that standing water usually remains on these sites well into the growing season.

Only a few tree species are suited to withstand this duration of flooding, and of these, a limited number have any commercial or wildlife value (2). Conventional management techniques for improving hardwood species composition, such as planting seedlings or direct seeding, are not effective options in areas prone to growing season inundation (1).

Interspecific grafting, however, might provide an alternative to allow some degree of timber stand improvement, particularly for wildlife management. Grafting scion material capable of producing fruit with high wildlife value or upper stem wood of commercial value to rootstock material already acclimated to growing-season inundation could be a method for improving some of these marginal sites.

We report on efforts to graft scions of sweet pecan (*Carya illinoensis* (Wang) K. Koch), a *species* with high commercial and wildlife food value, to rootstock of bitter pecan (*C. aquatica* (Michaux) Nuttall), a wet-site species with negligible commercial value and marginal wildlife value (9). The objectives of this study were to determine if grafting these two species was feasible under field conditions, and to identify a grafting technique that would require little time, effort, or cost, while achieving a high survival rate.

Methods and Materials

Three suitable sites were found in northcentral Louisiana. These sites were typical of the many poorly drained areas found in the southeast United States with fine-textured soils, level topography, and water depths between *2* and *75* cm during the growing season. The primary overstory type consisted of bitter pecan and overcup oak (*Quercus lyrata* Walt.), some baldcypress (*Taxodium distichum* (L.) Rich.) on the permanently flooded areas, and limited amounts of water oak (*Q. nigra* L.) and willow oak (*Q. phellos* L.) on slightly higher elevations. Many of the bitter pecan stands were almost pure, with very few other species interspersed, a typical situation in that few other species can survive or reproduce on such sites (12).

Four grafting techniques commonly used in sweet pecan orchards were used to join the sweet pecan scions to bitter pecan rootstock. These included three dormant season grafting techniques (side, saddle, and cleft grafts), and one non-dormant-season technique (the inlay bark graft). Dormant season grafting was done prior to bark slippage (February and March) and non-dormant-season grafting was accomplished within a 5-day period after initiation of rootstock bark slippage (typically the first or second week of May).

Ninety saddle grafts, 190 side grafts, 200 cleft grafts, and 160 inlay bark grafts were made over a 2-year period on the three study sites. The grafts were made according to techniques described by Hartmann and Kester (5). The inlay bark grafts were protected with a wrapping of aluminum foil, covered with a plastic bag, and wrapped with grafting tape. After healing, the wound was covered with pruning paint. This is similar to the "Texas" (fig. 1) method of graft protection as described by Hancock (4). Time per graft was recorded for each grafting technique. Sweet pecan scion diameters ranged from .95 to 1.3 cm. Grafts were made 1.4 m above the groundline on rootstock that ranged from 2.5 to 10.2 cm in diameter.

Figure 1—*Inlay bark grafting (Texas method) using sweet pecan scions on bitter pecan rootstock on a typical site in northcentral Louisiana.*

Sweet pecan scion material was collected from two sources: a wet-site donor tree growing on a site subjected to dormant season flooding and a dry-site donor tree growing on a site not flooded at any time. The distinction between sites was made because of evidence that the timing of spring growth initiation may be related to moisture characteristics of a site (6,13). Scion material was collected in January and immediately placed in cold storage (2.2 °C). Half of all grafts for each of the four grafting techniques were made using the wet-site scion material and half were made using the dry-site material.

The degree of crown closure above each grafted tree was estimated and tallied according to percentage covered. Crown closures were listed by 10% increments and ranged from 0 to 50% coverage.

One-year survival rates were compared between grafting techniques, by degrees of crown closure, and according to site origin of scion material using Chi-square (10). Scion growth variables measured were height and incremental growth (difference in diameter at the scion base from the beginning to end of the growing season). The influences of the amount of crown closure and site origin of scion material on these variables were analyzed by analysis of variance (10).

Results

Survival. The only dormant season grafting technique with any appreciable survival was the cleft graft, with a first-year survival of 5%. This low sample size precluded any analysis of what effects crown closure or scion source may have had on survival. Average time per graft was slightly more than 10 minutes per specimen.

Of the 160 inlay bark (non-dormant-season) grafts made, 142 (93%) exhibited leaf initiation and 122 (76%) survived the first year. Of the 38 that died, 44% died because of insect damage during leaf initation, 15% died because of mechanical damage (falling trees or limbs), and 41% from undiscernible causes.

No significant correlation between degree of crown closure and survival was detected. There was, however, a positive correlation between source of scion material and survivability, with scions collected from the dry-site tree surviving better than those from the wet-site tree (table 1). Each inlay bark graft required slightly less than 6 minutes to accomplish.

Growth. Surviving cleft graft scions grew an average of 88 cm in height and 0.64 cm in diameter in 1 year, with an average of 38 cm of height growth for every 0.04 cm of diameter growth. Due to the low survival with this type graft, no comparisons were possible relative to site source of scion material or degree of crown closure.

Significantly greater height and diameter growth rates for surviving inlay bark graft scions were associated with wet-site scion material (table 1). Additionally, the degree of crown closure above grafted specimens had a significant effect on growth rates with greater degrees of closure associated with increased height and diameter growth (table 2).

Conclusions

For a field grafting of sweet pecan scions to bitter pecan rootstock, non-dormant-season grafting seems best. By using the inlay bark graft and protecting it according to the Texas method, we achieved a 1-year survival rate of 76%, which compares favorably to 74% survival rates reported for sweet pecan to sweet pecan grafts (3). This technique was considerably quicker than dormant season grafting techniques used in this study and can be quickly taught to someone with no previous experience.

The source of scion material apparently affected growth and survival in that scions from the dry-site tree had significantly greater survival but significantly lower height and diameter growth. Because only one tree was used as a dry-site donor and only one as a wet-site donor, differences in survivability may be attributable to individual tree variation rather than to differences exclusively due to site variation. There does, however, appear to be a correlation between slower growth rates and better survival rates.

Another factor affecting growth rates was the degree of crown closure above the grafted specimen. Faster growth rates were associated with increased amounts of crown closure. Other workers (8,11) have documented greater stem elongation associated with shaded conditions. Etiolation is associated with higher rates of auxin production that occur under such conditions (7). If excessive scion elongation occurs without commensurate diameter growth, the possibility of mechanical damage by wind will increase. The relationship between height growth and diameter growth should be closely monitored in future years.

This study demonstrated that field grafting of sweet pecan to

Table 1—*Survival and growth of wet-site and dry-site sweet pecan scions grafted to bitter pecan rootstock in northcentral Louisiana*

	No. trees grafted	No. with leaf initiation	No. surviving*	Ht. growth** (cm)	Diameter growth** (cm)
Wet site	80	74 (92%)	55 (69%)	93	.49
Dry site	80	76 (95%)	67 (84%)	73	.34

* Significantly different at .05 level (Chi-square).
** Significantly different at .05 level (ANOVA).

Table 2—*First-year sweet pecan scion growth rates according to degree of crown closure above the grafted specimen*

% Crown closure	No. grafted that survived	Height growth (cm)	Diameter growth (cm)
50	6	117*	.71**
40	33	86	.46
30	21	84	.36
20	33	86	.43
10	24	66	.28
0	5	51	.32

* Height growth at 50% crown closure significantly different ($P < .05$) from height growth at 10% and 0% crown closure (ANOVA).
** Diameter growth at 50% crown closure significantly different ($P < .05$) from diameter growth at 10% crown closure (ANOVA).

bitter pecan can be successfully accomplished with a minimum of time and effort. However, because this report is based on survival and growth rates for only 1 year, more research is needed on long-term survival and growth, fruit production, and development of upper stem wood.

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