

Evaluating Pecan Problems

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The pecan is native to Texas, it is the official state tree, it can be grown in every area of the state and it is a part of Texas tradition. All too frequently, the pecan is planted in anticipation of a large beautiful tree with heavy bearing. Unfortunately, there are times when this dream does not become a reality. A pecan tree can live with little or no care in much of Texas; however, if it is expected to look good as a landscape tree or if it is expected to produce high quality pecans every year, the pecan is a very high management crop.

When pecan problems occur the cause is frequently not easy to identify. However, once the problem or group of problems is identified, the grower can go about correcting the problem. If the problem cannot be solved, the grower at least knows what to expect and has the option of abandoning or destroying the trees.

The Pecan Tree Is A Survivor

Along the 10,000 miles of rivers and streams in Texas there are many very large pecan trees which are living testimony of their tremendous survival potential. These trees have made it through extreme droughts such as the early 1950s where little or no rain occurred for four straight years, yet the pecan survived when other species of large trees died.

The pecan is uniquely adapted to the hot, dry, windy Texas climate because it can tolerate stress. If pecans are stressed in the fall, they will not set a large crop the following year, and the tree will survive on food stored in the trees' massive limb, trunk and root system. On weak trees, the crop is shed by various ways throughout the season. This could be physiological drop, pollination drop, casebearer drop or waterstage drop. The shedding of pecans is an important natural stress management tool which contributes to the long survival of pecan trees. It is very difficult for pecan trees to absorb zinc from the soil; consequently, native trees do not make vigorous growth once they are mature and begin bearing. This natural vigor control via zinc unavailability plays an important role in long term native tree survival. Also, many alluvial river bottom soils have good depth, good internal drainage and a very high water holding capacity which are additional reasons native trees are good survivors.

What Kills Pecan Trees

Many things can kill a mature bearing pecan tree. Usually it is a combination of factors. Planting improved grafted varieties on poor soil is the most common reason pecan trees die in Texas. When no irrigation, no zinc, no nitrogen, no weed control, no insect management, no disease prevention are combined with a heavy crop on pecan trees growing on poor soil, death could be expected. A large number of mature pecan trees died in Texas in 1988, 1989 and 1990. This could occur again in 1996 because of the extremely heavy crop in 1995 combined with the very dry conditions of the 1995 growing season. If a major freeze occurs in the winter, especially early winter, tree death could occur.

Poor Soil Depth and Texture. Native pecan trees grow beautifully along rivers and streams in Texas because of water availability, good soil depth and good internal soil drainage. This is the ideal site for pecans -- native, commercial orchards or landscape trees. In many areas of Texas there are deep, well drained sandy or high-calcium clay soils which can also support beautiful and productive trees. However, many soils are too shallow and simply do not provide enough space or volume for the massive root system needed. For example, mature pecan trees require over 2,000 gallons of water per week, and this volume needs to be held by only 25 percent of the soil space. When soils are very shallow or very tight clay, very special management will be needed. Irrigation will need to be weekly and zinc and nitrogen needs to be applied in very small but frequent applications. Commercial orchards should never be planted on shallow or poorly drained clay soils; however, beautiful landscape trees can be maintained, especially if they are

natives or seedlings which are not grafted.

Poor Soil Drainage. The growth and development of healthy pecan trees depends on healthy roots. Good root growth occurs when the soil is 50 percent particles, 25 percent air and 25 percent water. When the pecan soil is dry the tree will survive by shedding the crop and making very little growth; however, when the soil is too wet, the tree roots will die and this can result in tree death. Good soil drainage is essential for good soil aeration and subsequential root growth with normal water and mineral absorption. When poor soil drainage occurs there is limited oxygen in the active root zone. This has very serious plant physiological consequences; low root zone oxygen results in death to small roots, reduced active transport of minerals and water into the roots, reduced hormone production by the root tips, and increased salt toxicity. Saturated soil also is an ideal environment for the development of many soil root rot diseases.

Over Cropping. A very large crop of pecans on mismanaged trees is a major problem. Poor soil, tree crowding, weed control, irrigation, zinc foliar sprays, nitrogen fertilization, insect control and disease prevention become very important during high crop years such as 1993 and 1995. Some growers are lightly shaking their tree trunks on overcropped trees during the waterstage to reduce the crop size and prevent stress. The most common symptom of overcropping is poorly filled kernels. However, when in combination with other limitations, limb death in the top of the tree or total tree death can occur.

Freeze. The pecan does not have an obligatory rest period such as apple or peach does, and it does not become dormant in the fall unless the weather is very cool. If growing conditions are ideal in the fall, pecan sap remains active. If a freeze occurs, it can kill the live wood, bark and cambium tissue. Bearing trees which are stressed are freeze-susceptible. Varieties such as Wichita, Barton and Mahan are very freeze-susceptible. Young pecan trees which are growing when an early fall freeze occurs can be killed to the ground. This is why nitrogen fertilizer is never applied to young trees after the month of June. Freeze damage usually occurs on the south or southwest side of the trunk next to the ground line. Cutting through the bark with a knife can expose brown, freeze-damaged tissue soon after it occurs. Trees with frozen trunks will produce healthy shoots from the ground line the next growing season.

Tree Crowding. The most difficult cultural practice pecan growers must accomplish is tree removal when crowding occurs. Shade from tree crowding reduces the total photosynthesis and with less food the tree will be less healthy. The first stage of crowding is low percent kernel. This is followed by alternate bearing and death of shaded limbs. As crowding continues limbs continue to die, moving higher and higher each year. The final stage of crowding is no production or production only in the very top of the tree. Once trees are thinned, as many as six years may be required for the trees to come back into production. Some growers attempt to maintain production via mechanically hedging the trees with large saws, however, this only prolongs the problem. Only 30 percent of the trees' production potential will be harvested from hedged trees when a three- to five-year hedging cycle is used. The solution to tree crowding is tree removal the year the lower limbs touch. It is best to remove trees immediately after a heavy crop. The winter of 1995-96 will be an excellent time to remove trees because the 1996 crop is going to be very low in Texas.

Cotton Root Rot. There are many disease which are serious problems for Texas pecan growers. Many destroy the foliage or the fruit; however, Cotton Root Rot kills the tree. Death comes fast in late summer with all the leaves turning brown and remaining on the tree. This is a major cause of tree death in Mexico where a combination of high soil pH, high soil temperature and poor drainage occur. Under these conditions, it is almost impossible to control Cotton Root Rot. In Texas, the problem occurs mainly in the southern counties, near Mexico where similar conditions exist. Rapid tree death in late summer or early fall with no shoots developing from the tree crown is the most common symptom. The fungus can be identified with a microscope.

Management. Growers do their best in taking care of their trees, but occasionally the trees have problems and die. Time, money, orchard size, labor, equipment, knowledge, bad luck, personal problems or many other limitations can cause pecan growers to let management slide for a year or two. Because the pecan is a strong survivor, the tree will live for years without showing any serious signs of stress other than poorly filled nuts on alternate years. Eventually the trees will stop bearing altogether, but can remain alive. With total neglect and poor soil, the trees can eventually die.

Good management is difficult and expensive but it can bring pecan trees back into profitable production if water is available and if the trees are on good soil. However, trees on poor soil without irrigation will be difficult to manage for a profit. Good looking landscape trees can be managed on almost any soil if hard work, money, and water are not limiting factors.

Commercial orchards, which require a profit, need good management plus well drained soil, wide tree spacing, weekly irrigation, weed control, foliar zinc sprays, nitrogen fertilization, insect control and disease prevention. Unfortunately, the failure of only one of these factors can kill the entire program.

Problems From Varieties

Native pecan trees have been in Texas for a very long time with nature to manage their success. When man decided to select, propagate and plant orchards with larger nut size and heavier fruiting, the natural limits of the pecan were exceeded and man's management became essential, otherwise the trees stress and die. One must always remember that small native nut size, alternate bearing, low yield and many other characteristics of native pecan production are a vital part of pecan survival in Texas and should be considered good. Today's pecan growers push their trees far beyond the natural limits of production of native pecans. Orchards with the best varieties have a high profit potential, but pecan growing is a high risk business even with the best of management. Old standard varieties, Stuart and Western, are the highest planted varieties in the industry because they tolerate stress and are easy to manage. In the future, varieties may become the standard because of management ease.

Landscape trees usually receive very little management; therefore, native or seedling trees are the best choice. If a grafted variety is essential, disease-resistant varieties with small nuts and moderate production would be the best choice. There are a few low yield varieties such as Jackson, Elliot, Vogt, Schley, and others which do not produce yields high enough to be of commercial value, but make excellent landscape trees. If the landscape soil is excellent and some management could be given, productive varieties with small nut size such as Caddo, Candy, Osage and Prilop could be planted.

Signs Of Trouble

Many times growers have trees which are in trouble but they cannot see it. Consequently, it is good to have other growers, county Extension agents, or pecan specialists look at the trees to see if problems exist. Foliage, crop and tree decline can be slow and hard to recognize if you are in the orchard every day. Problems are slow to become obvious because pecans store food reserves in limbs, trunk and roots. The tree can look healthy to the untrained eye until all of the stored food is utilized, then problems become very easy to see. During heavy crop years such as 1995 in Texas, growers have a good chance to see how healthy their trees are. Signs of trouble can be many. The good news is that these problems can frequently be corrected with good management if the trees are on good soil.

A Guide for Evaluating Pecan Problems

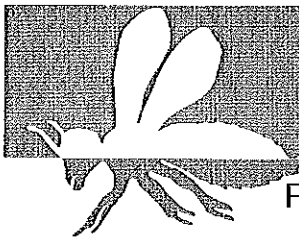
- Poorly Filled, Wafer Kernels.....Soil, Irrigation, Heavy Crop, Management
- Kernels with Air Centers and Fuzz.....Drought Without Irrigation or Other Stress
- Green or Black Sticktight Pecans in November.....No Late Season Irrigation or Other Stress
- Pecans Sprouting (Vivipary) While on The Tree.....No Late Season Irrigation or Other Stress
- Rapid Tree Death in August or Early September.....Cotton Root Rot
- Blue, Green and Grey Moss (Lichens) on Limbs or Trunks.....Shallow Soil, No Management
- Little Leaves, Short Shoots.....Zinc, Soil, Irrigation, Nitrogen, Weeds
- Little Yellow Leaves on Young Trees.....No New Root Growth, Too Much or Too Little Water

Young Tree New Growth Dies Repeatedly.....Root Desiccation or Freeze Damage at Nursery
Small Leaves Which Curve.....Zinc Deficiency
Leaf Edges Wavy.....Zinc Deficiency
Leaves With Dark Interveinal Discoloration.....Zin Deficiency
Shoots Growing Thick in Bunches, Some Dead, Some Alive.....Zinc Deficiency
Zinc Deficiency Symptoms with Frequent Sprays and Other Good Conditions.....Nematodes
Zinc Deficiency Symptoms with Frequent Sprays and Other Good Conditions.....Sheep Manure
Very Rapid Twisting and Turning Shoots on Young Trees.....Barnyard Manure Effect
Very Twisted and Distorted New Shoots on Old Trees.....2,4-D Herbicide Damage
Spring Buds and Leaves Wild and Irregular Shaped.....Last Year Roundup Herbicide Damage
Shoots Growing Thick in Bunches, on Trunk, All Alive.....Bunch Disease
Nuts Shedding in May with No Hole.....Natural or Pollination Drop
Nuts Shedding With Small Hole at Base of Nut.....Pecan Nut Casebearer
Nuts Shedding in August During Waterstage.....Any Stress or Insect Feeding
Nuts Shedding in August with Black Shucks and Half Filled Kernel.....Shuck Dieback
Bark Peeling Off.....No Problem, Rapid Growth
Vertical Splits in the Bark with Yellow Moist Wood Exposed.....No Problem, Rapid Growth
Vertical Splits in the Bark and Wood Which Is Dried Out and Grey.....Freeze
Perfect Ring or Rings of Small Holes Around the Trunk.....No Problem, Sapsucker Woodpecker
Large Patches of Young Green Bark Missing on New Growth.....Squirrel Feeding
Pecans on the Ground Wwth Holes Punched in The Shuck or Shell.....Bluejay or Crow Feeding
Dead Limbs or Trees, April to June with Sprouts at Ground Line.....Freeze
Dead Trunk on South or Southwest Side with Ground Suckers in Spring.....Freeze
Limbs Die Suddenly Followed By Regrowth Which Also Dies.....Freeze
Black Spots on Leaves or Leaf Midrib, Black Lesions on Shucks.....Pecan Scab Disease
Brown Dead Tissue Around the Edge of the Leaflet.....Chloride, Salt Burn
Sticky Sap or Honeydew Dripping From Shiney Leaves.....Yellow Aphid Feeding
Black and Yellow Areas on Leaflets in August or September.....Black Pecan Aphid Feeding
Leaves Dull Color With Many Small Brown Spots and Defoliation.....Spider Mites

Black Spots on Kernel.....	Stink Bug Damage
White Fuzz on Green Shucks.....	Powdery Mildew
White Weblike Growth on Clusters.....	Spittlebug
Galls on Nuts, Cluster, Leaves.....	Pecan Phylloxera
Young Tree Dead, Small Holes in Trunk with Sawdust Tube Sticking Out.....	Ambrosia Beetle
Small Fat White Grub with Red Head in Pecan.....	Pecan Weevil
Small, 1/8" Hole in Shell with Kernel Eaten.....	Pecan Weevil
Small White Grub Tunneling in the Shuck.....	Hickory Shuckworm
Small Limbs Drop in Late Summer or Fall with Perfect Circle Cut in Bark.....	Twig Girdler
Mass of Dark Grey Caterpillars Eating Foliage.....	Walnut Caterpillar
Mass of Thick Grey Webbing Filled with CaterpillarsIn Late Summer.....	Fall Webworm

Summary

Pecan culture in Texas, whether it is commercial, native or landscape can be a very rewarding profession or avocation. There are millions of trees which produce good crops and reward the owners with a lifetime of satisfaction, pride, beauty and profits. The material presented here is not intended to discourage anyone who wants to grow pecans, but rather to help the grower who could be having problems. When all things are right for pecans at a site in Texas, there is no better crop one could choose.



BUG BIZ

Pest Management and Insect Identification Series



Pecan Phylloxera

Distribution

Pecan phylloxera are found throughout the native pecan-producing regions of the United States.

Damage

Beginning in mid-April, galls (knots) begin to appear on the leaf veins, leaf rachises, catkins, current seasons shoot growth and nuts of the pecan, *Carya illinoensis* (Fig. 1). These galls are caused by the feeding of a small, aphid-like insect known as the pecan phylloxera, *Phylloxera devastatrix*. During some years, the galls may be extremely numerous, covering the entire tree and giving the twigs a knotty appearance. Galls can remain on the twigs for several years. Because of this, some growers refer to pecan phylloxera, as stem phylloxera. High infestation levels of this insect cause the current season shoots or twigs to become deformed, reducing their rate of growth. In some cases, severe infestations can lead to dieback of the current seasons shoots. Galls also can form on the nuts causing nut deformity and premature nut loss. Galls formed by pecan phylloxera are an alternate host for larvae of the hickory shuckworm, *Cydia caryana* (Fitch).

Description and Life Cycle

Pecan phylloxera overwinter as a single egg within the body of a dead sexual female (Fig. 2). Prior to dying, the female seeks shelter on the tree under dead bark (Fig. 3), within old galls and even under the carapaces (shells) of dead scale insects.

The overwintering eggs begin hatching in early spring about the time the buds are beginning to open. In northwest Louisiana, hatching begins in early March. Upon hatching, the nymphs (stem mothers) move from the overwintering sites to the opening buds (Fig. 4).

Once on the buds, the nymphs begin feeding. As they feed, a gall begins to form around the insect, eventually enclosing it within (Fig. 5). It is only this generation that forms a gall. Once the stem mother reaches maturity, she begins to lay eggs within the gall. The number of eggs laid ranges from 300 to 1,300 per gall (Fig. 6).

The young that hatch from these eggs feed and develop within the gall. As they mature they develop into wingless and winged females (Fig. 7). The winged forms are often referred to as winged migrants (Fig. 8).

The winged migrants emerge as the galls begin to split open in late April and May. They disperse within the tree and with the aid of the wind are carried to other trees within the orchard. Soon after emergence, egg-laying takes place. The small, light yellow eggs are deposited on the upper and lower leaf surfaces (Fig. 9). When infestation levels are high, the leaves often take on a yellowish tint because of the high numbers of eggs deposited on



Fig. 1. Phylloxera gall mass.

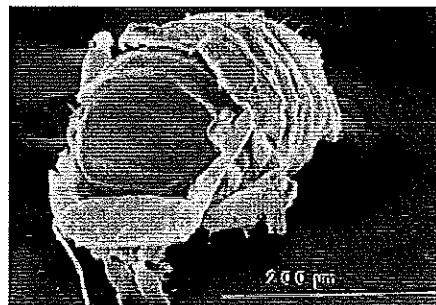


Fig. 2. A phylloxera egg within the body of a female.



Fig. 3. Overwintering females under the bark of a pecan tree.



Fig. 4. Stem mothers feeding on opening buds.

the leaves. The eggs deposited by the winged migrants hatch into sexual males and females. Fig. 10 shows a closeup of one of the eggs deposited by the winged migrant.

Almost immediately after hatching, the male and female phylloxera mate, and a single egg forms within the body of the female. Prior to dying, the female seeks shelter in a protected area on the tree, usually under the bark, in old galls or under dead scale insects. The egg will remain dormant within the body of the dead female until it hatches the following spring to repeat the cycle.

Control

Infestations of pecan phylloxera do not occur on a regular basis, nor are all pecan cultivars susceptible to attack. Before an insecticide application is made, it is important to determine if phylloxera are present and on what cultivars. One method is to inspect the buds as they begin to open in the spring for the presence of the emerging nymphs. Another method is to attach white cloth adhesive tape coated with a bead of Tangle-Trap (a brand of insect-trapping glue) to smooth-barked

branches of the tree to capture the nymphs as they move from the overwintering sites onto the opening buds.

If phylloxera are present, insecticide applications are usually made at the time of bud break when there is approximately one-half to three-fourths inch of new growth appearing. If large numbers of phylloxera are present, a second application, seven to 10 days later might be needed. Insecticide applications need to be made prior to gall formation, because once the phylloxera are enclosed within the gall, control is no longer possible.

For a listing of insecticides that can be used to control pecan phylloxera, refer to the "Louisiana Recommendations for Control of Pecan Insects," found at www.lsuagcenter.com.

When using insecticides, be sure to check the pH of the water being used for spraying. The pH needs to be between 5.5 and 6.5 for optimal insecticide efficacy. Use of a buffering agent will help maintain the desired pH once pesticides have been added to a solution.

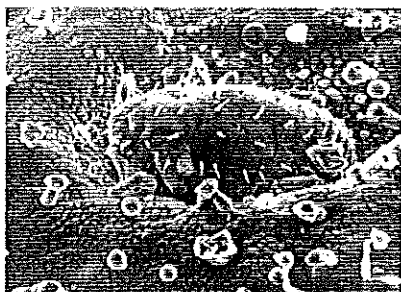


Fig. 5. Stem mother feeding on tissue. Note the beginning of the gall.

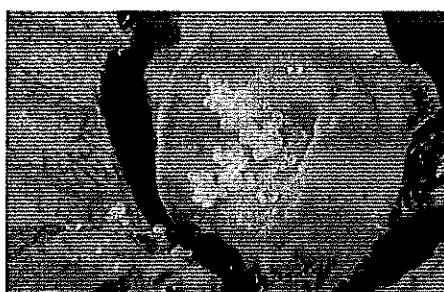


Fig 6. Eggs of pecan phylloxera within a gall.



Fig. 7. Winged and wingless females within the gall.

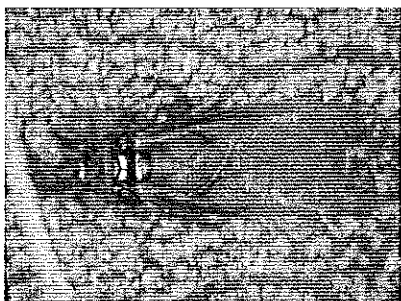


Fig. 8. Winged female (migrant).

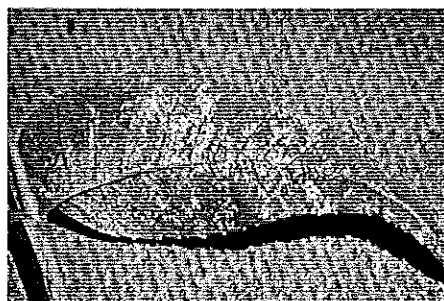


Fig. 9. Eggs deposited on the leaf surface by the winged migrants.

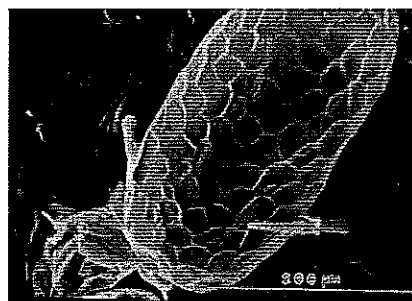


Fig. 10. A scanning electron microscope photograph of an egg.

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Texas Inlay Bark Graft

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Inlay grafting is one of the best and most popular systems of propagating pecans in Texas. It has been successfully used when other systems have failed because of heat, drought and wind. It has also been successfully used on walnuts, apples, pears, grapes, rabbiteye blueberries and persimmons.

The Texas method of inlay grafting, developed by B.G. Sitton, L.D. Romberg, F.R. Brison, B.G. Hancock and others in the 1950s, follows the basic fundamentals of the standard bark graft. However, this technique uses an inlay cut and employs an entirely new system of covering the graft and stock. The inlay occurs when two parallel cuts are made through the stock bark forming a scion inlay pattern on the stock. Aluminum foil is used as a stock cover, reflecting sunlight and reducing temperatures around the graft. The foil is covered with polyethylene film to assure constant high relative humidity around the graft. This system not only results in a high percentage of growing grafts, but it is easy to use. All necessary equipment can be carried in an apron since the need for a burdensome wax melter is eliminated. The more stressful the grafting conditions, the more important this grafting technique becomes. This method gained popularity and wide use throughout the pecan industry following numerous method demonstrations and promotions by B.G. Hancock and his many students.

Anyone can successfully use the inlay graft by following these instructions and practicing to develop skill in the basic techniques.

Figure 1. Use rootstock trunks or major side limbs that are 1 1/2 to 3 1/2 inches in diameter. Leave one or two side branches below the cut to keep the tree vigorous, to protect from sunburn and to keep the graft from overgrowing and blowing out. Cut straight across the trunk or limb with a sharp saw above a straight section of the trunk or limb. Make the cut 7 or 8 feet above ground if cattle or horses are grazing in a native grove.

Figure 2. Select a section of stock with a flat surface so the flat cut surface graft stick will fit cambium to cambium without air space separation. Choose a spot on the south or

southwestern side so that prevailing winds will blow the graft shoot toward the trunk instead of away from the trunk. If the old bark is rough, cut it down to live bark, forming a clean shield. Leave the bark as thick as possible to securely hold the graft. Do not cut through the bark into the wood.

Figure 3. Use a knife with a very sharp blade and a sheepfoot point, similar to that illustrated. Grafting knife blades are beveled only on one side to give a flat cut. Firmly hold the knife in a closed fist and cut the graft stick with numerous thin slices.

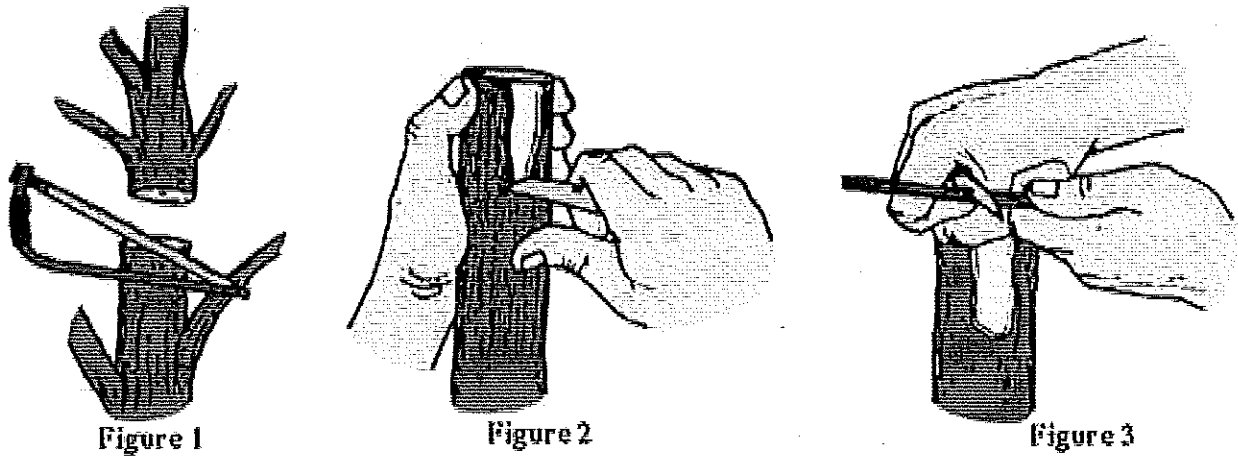


Figure 4. The finished graft stick will have one to three buds and three cuts; a slant cut, a long cut and a back cut. The slant cut should begin 1/2 inch below and on the side opposite the lowest bud. It should extend half the distance through the graft stick at approximately a 45 degree angle. The long cut is the same thickness from the slant cut to the end of the graft stick. Make the long cut perfectly flat at the midpoint of the graft stick. The back cut is chisel-shaped and is 1/2 inch long on the back side and lower end. This makes it easier to insert the graft stick and provides additional cambium contact. The long cut can be 1 1/2 to 3 inches long.

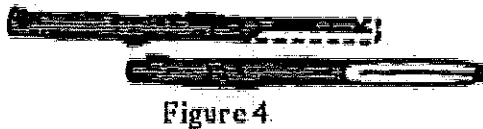


Figure 5. Place the long cut surface of the graft stick against the clean shield of live bark on the stock. Allow the slant cut to extend above the stock. Firmly hold the graft upright with the left thumb. Begin the first inlay cut at the top of the stock on the right side of the graft stick. Cut through the bark down into the wood. Draw the knife straight down the right side of the graft stick to within 3/4 inch of the bottom portion of the graft stick. It is very important to make this cut straight into the bark. Do not angle the knife to the left or right.

Figure 6. Hold the graft firmly in position with the thumb of the right hand. Do not allow the graft to move after the right inlay cut is made.

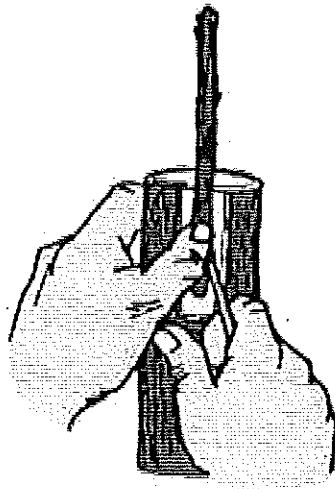


Figure 5

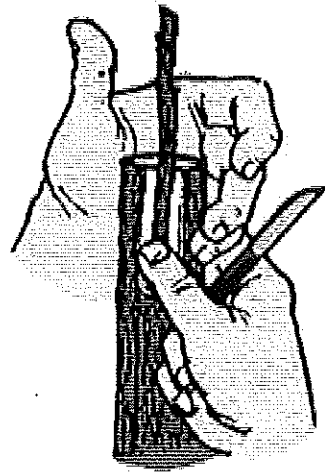


Figure 6

Figure 7. Bring the left hand around the back of the stock. Catch the graft with the first three fingers of the left hand and hold in exact position. Make the second inlay cut on the left side to the graft stick, cutting straight into the stock as on the right side.

Figure 8. The two parallel inlay cuts through the bark should be exactly the same shape as the long cut section of the graft stick.

Figure 9. Peel the bark flap 1/2 inch down between the two parallel inlay cuts. Slide the graft stick between the bark and wood of the stock. There should be no air space between the long cut and the flat wood surface. If the bark does not easily separate from the stock, the cambium is not slipping and you will need to wait several days, then try again.

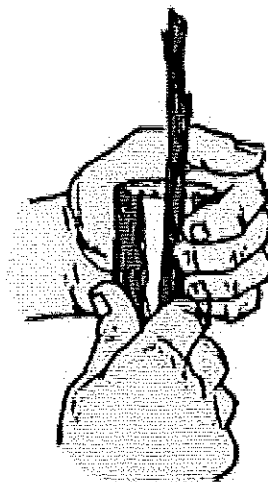


Figure 7

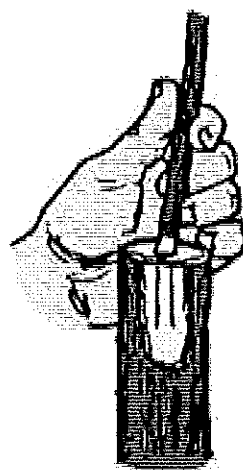


Figure 8

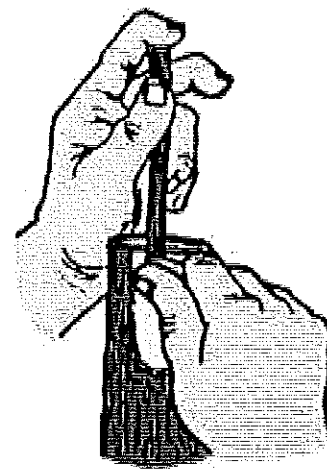


Figure 9

Figure 10. As the graft stick is inserted, press the bark flap against the graft stick with the thumb of the right hand to firmly hold the graft stick in the slot. Apply firm but gentle pressure on top of the graft until it is forced into the inlay slot.

Figure 11. Stop pushing the graft stick when the bottom of the slant cut touches the top of the stock. This exposed slant cut surface will form callus and new tissue, which will cover the top to the stock and securely anchor the graft to the stock in 1 to 3 years. Do not push the slant cut below the top to the stock because it will separate the graft stick from the flat wood.

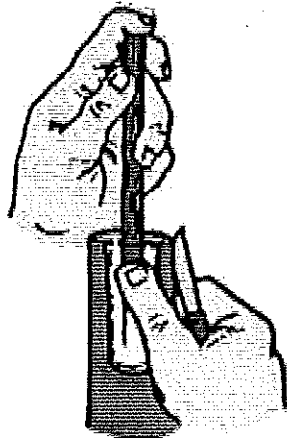


Figure 10

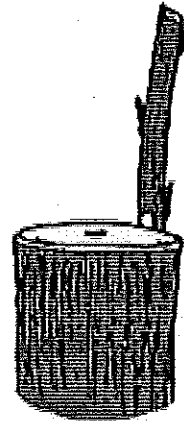


Figure 11

Figure 12. The graft can be secured by any one of several methods. Eighteen gauge 3/4-inch nails, 5/8-inch flat point staples in a vertical position, budding tape or flagging tape have all been successfully used.

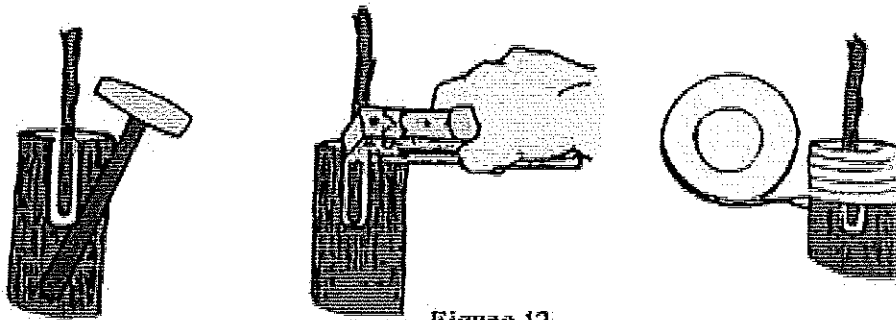


Figure 12

Figure 13. Take a 2-inch square of household aluminum foil and tear a line halfway down to the center of the square. Fold the aluminum foil around the stock so that the bottom of the tear fits right under the lowest bud.

Figure 14. Fold each side of the divided end of the square of aluminum foil. Cover all cut surfaces with the foil, including the slant cut of the graft stick. Crimp the foil to form a loose mod around the stock. All cut surfaces of the trunk and graft stick should be covered.

Figure 15. Cut off one corner of a pint- or quart-sized polyethylene bag. Slip the bag over the graft stick and gently pull it down until the cut corner rests below the lowest bud and

above the slant cut.

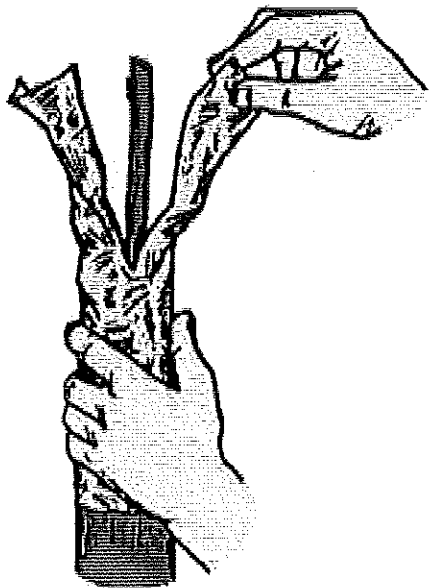


Figure 13

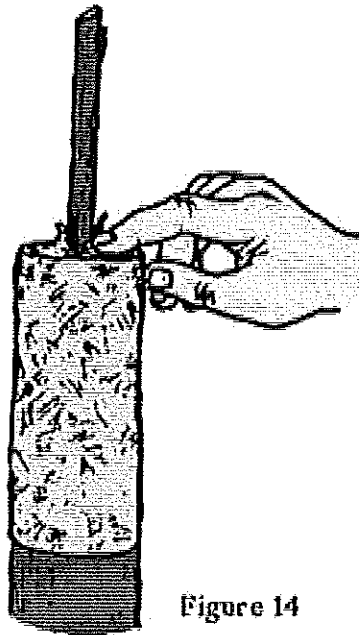


Figure 14

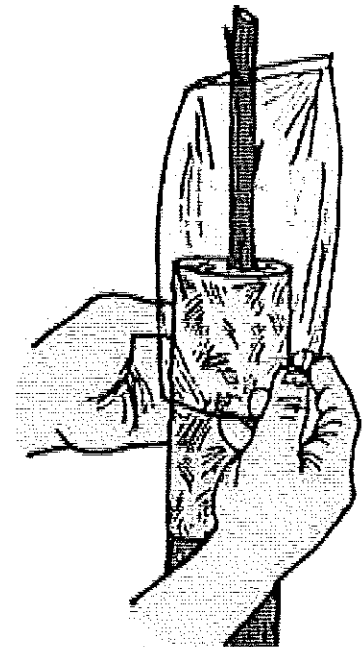


Figure 15

Figure 16. Tie the polyethylene bag at the cut corner around the graft just below the lowest bud and above the slant cut so that no air leaks occur. Tie with one wrap of a rubber band, small rubber strip or polyethylene tape so that the graft will not be girdled as it grows.

Figure 17. Tie the lower end of the polyethylene bag around the stock with foil covering all of the enclosed area. Make a small puncture above the lower tie to allow water to drain out of the bag.

Figure 18. Coat the cut surface of the tip end of the graft stick with orange shellac or white glue.

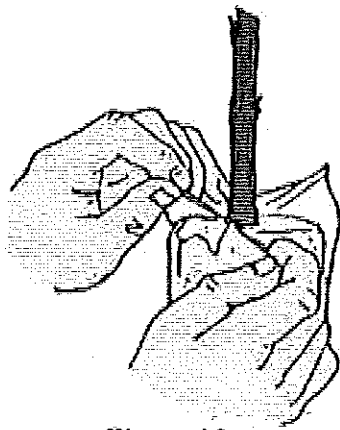


Figure 16

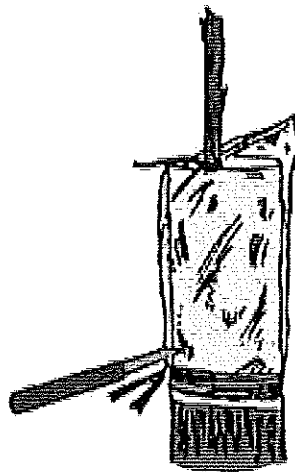


Figure 17

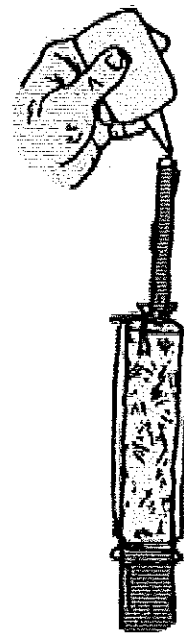


Figure 18

Figure 19. The buds on the graft stick should begin growth in 6 weeks. Remove the polyethylene bag and foil when the shoots are over 6 inches long. Keep these shoots pruned back to only 24 inches to prevent wind blowouts. If maximum growth is needed, in 6 to 10 weeks select the strongest shoot and tie it to a brace to prevent it from blowing out. After one year, select the strongest shoot on the graft stick and remove all others. After 2 or 3 years, when three-fourths or all of the trunk is covered with overgrowth, remove all shoots below the graft.

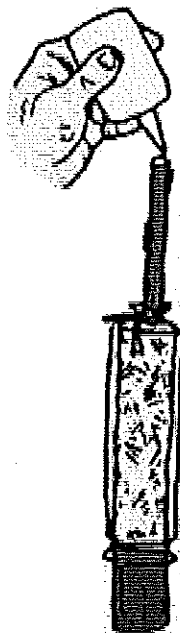


Figure 18

Hypertext markup and graphics colorization by Gretchen Eagle and Dan Lineberger.
<http://aggie-horticulture.tamu.edu/propagation/inlay/inlay.html>

The Four-Flap Graft

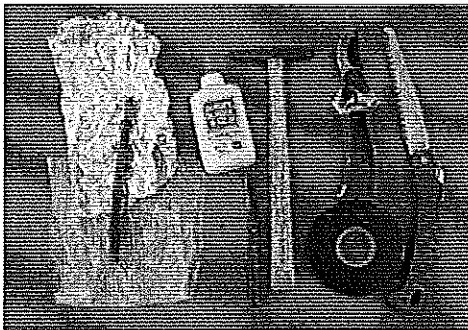
Larry A. Stein, Ph.D. and Julian W. Sauls, Ph.D.
Professors and Extension Horticulturists
Texas Cooperative Extension

The four-flap graft is an easy-to-do, highly successful grafting procedure for both amateurs and professionals. It is ideal for small-caliper trees up to an inch in diameter. The procedure is sometimes called a "banana graft" because the four bark flaps not only peel but also cover the scion much like a banana. This presentation is adapted from an original Extension publication by Sammy Helmers and Austin Stockton.

In this presentation, 22 images are used to illustrate the finer points of the technique. Each image is presented with the text as a thumbnail version for speed of downloading. Click on the thumbnail image to see it as a full-screen version, then click "Back" to return to the text and thumbnails.

Four-flap grafting is most successful when the scion and stock are about the same diameter. The best fit is obtained when the scion is slightly larger than the stock. The best time to graft is April to May when the stock is actively growing and the bark "slips" freely. Scion wood must have been cut in January or February and placed in cold storage prior to budbreak. The stored wood should not be allowed to dry out, or grafting success will suffer.

Materials needed for four-flap grafting include dormant graftwood, aluminum foil, polyethylene bags, a sharp knife, budding tape, pruning shears, rubber bands and common household glue. All of the equipment easily fits into an apron.



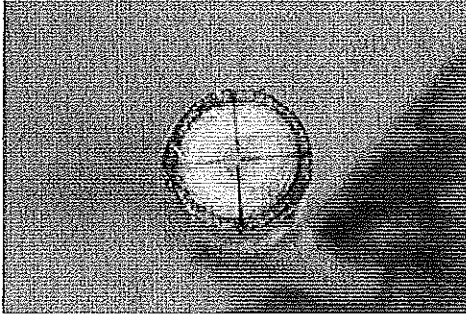
Common tools used in grafting.



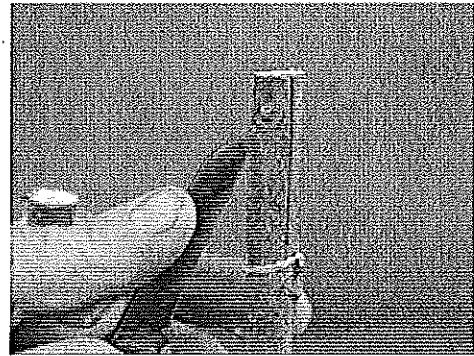
Seedling pecan tree.

Select a young tree with either its main trunk or a branch about one-half to an inch in diameter. If livestock or deer are expected to be present, the grafting height should be 7 or 8 feet above ground; otherwise, select a comfortable working height. If there are side branches below the point that you plan to graft, cut them back to about a foot in length, as they will support the plant while the graft heals.

At the point that you plan to make the graft, cut the top of the plant off straight across the stock with sharp pruning shears. Wrap a rubber band around the cut-off stock and roll it down the stock about 3 inches. Make four straight vertical incisions through the bark of the stock, each about 1.5 inches long and equally spaced around the stock. Beginners may find it helpful to mark a cross on the cut surface of the stock to show exactly where the vertical incisions must be made. Be sure that the incisions completely penetrate to the underlying wood.



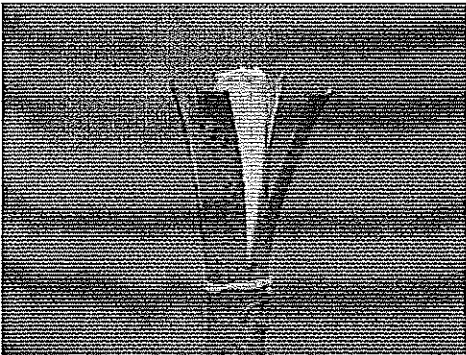
Stock marked for the vertical cuts.



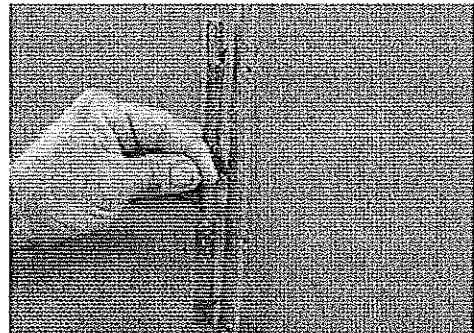
Side view of vertical incisions.

Separate the bark flaps from the wood briefly to assure that the bark is slipping, then slip the rubber band up onto the bark flaps to hold them against the stock and prevent drying while the scion is being prepared.

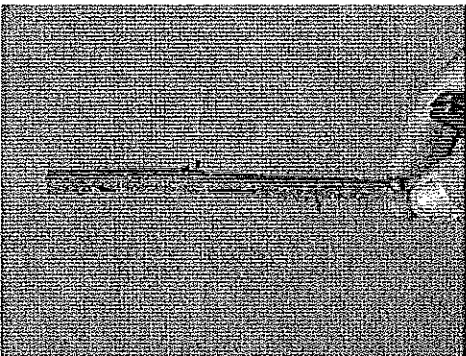
Select a smooth, straight graft stick of the appropriate diameter and about 6 inches long. It should have two or three plump buds on the upper half. Cut off about half an inch of the base of the graft stick to assure healthy green tissue. If the wood is brown or shriveled, indicating dryness from improper storage, do not use it.



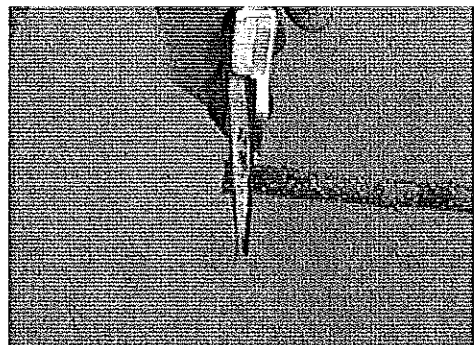
Bark flaps pulled away.



Comparison of stock and scion sizes.

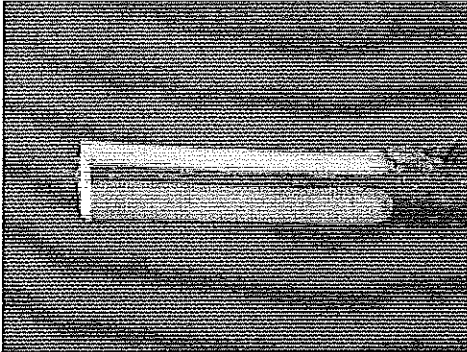


Typical pecan graft stick.

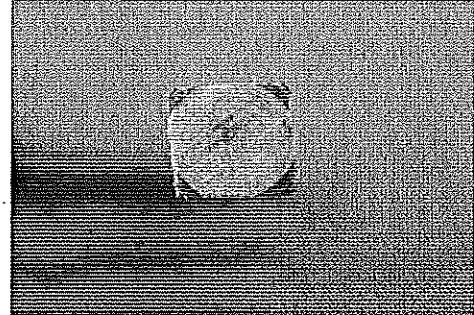


Cut off the base of the graft stick.

With a sharp knife, cut the graft stick on four sides, starting about 1.5 inches above the basal end and slicing towards it. Before attempting this for the first time, look at the images showing both side and end views of the prepared scion so you will know how the finished scion should look. Basically, the cuts will create a square-shaped end, with four inch-and-a-half long, thin slivers of bark (and cambium) remaining at each corner.

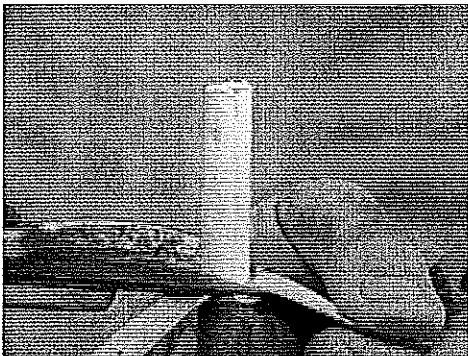


Side view of the prepared scion.

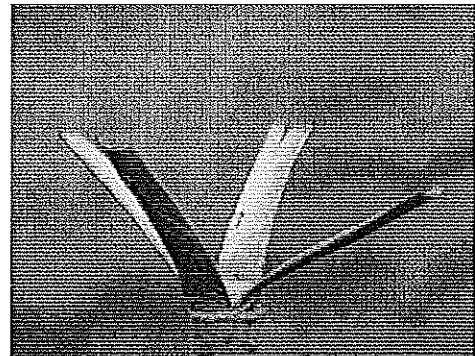


End view of the prepared scion.

Now that the scion is prepared, roll the rubber band back down on the stock so that the bark flaps can be pulled down. Some propagators find it helpful to pull the flaps down against the stock and hold them there by rolling the rubber band up on them. Either way, carefully position the pruning shears and cut off the upper 1.5 inches of the exposed stock without damaging the four bark flaps.

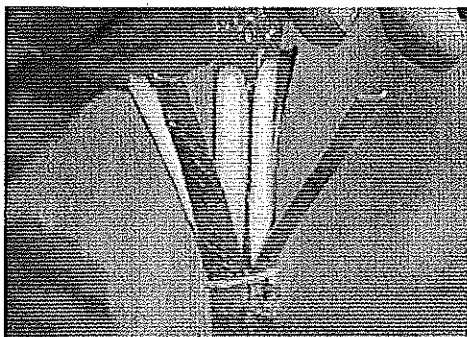


Preparing to remove the stock top.

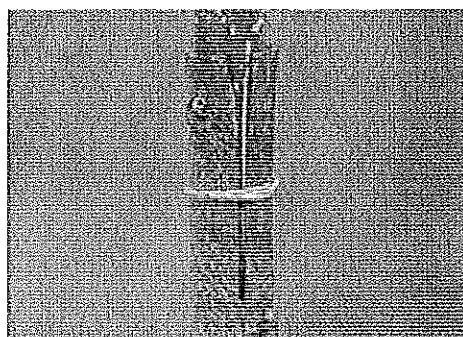


Stock ready for insertion of the scion.

Place the prepared scion upright on the stock, pull the four bark flaps back up against the scion and roll the rubber band up onto the flaps to hold them and the scion in place. Be sure that the thin slivers of bark on the scion are situated in the openings between adjacent flaps of the stock-if not, gently twist the scion until they are.

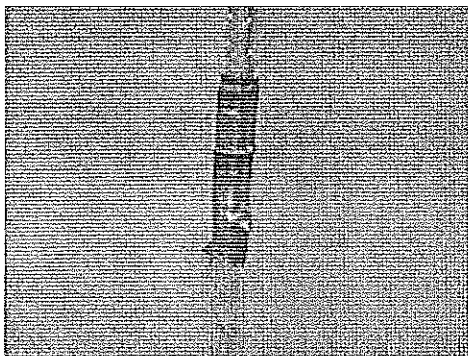


Orientation of the scion on the stock.

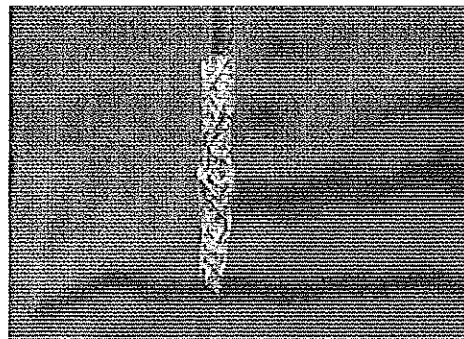


Flaps closed with rubber band.

Wrap the entire cut area of the stock and lower part of the scion firmly with budding tape, floral tape or other suitable material that stretches. Neither masking tape, packing tape nor electrical tape are adequate. Be careful not to twist the bark flaps as you make the wraps. Wrapping is started at the bottom, each turn overlapping the previous one until all cut surfaces are covered. Secure the end of the tape by tucking it under the last wrap before you pull it tight. Some propagators prefer to wrap to the top, then wrap back down, but such double wrapping is not absolutely essential with strong budding tape.



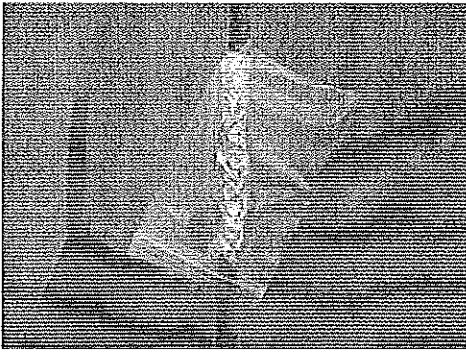
Securely taped graft.



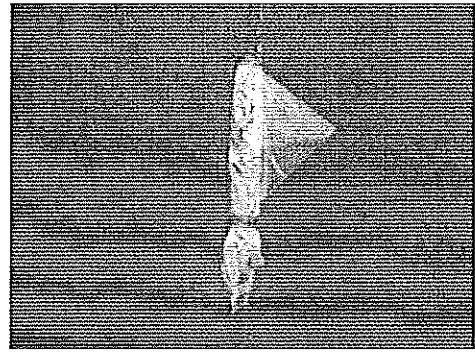
Aluminum foil in place.

Cut a piece of aluminum foil to the appropriate size and loosely cover the entire taped area, crimping it slightly to compress it around the graft and hold it in place. Aluminum foil will reflect sunlight and prevent the graft union from getting too hot.

Cut off one corner of a pint or quart polyethylene freezer bag and carefully slip it down over the graft, with the scion protruding through the cut-off corner of the bag. Be extremely careful not to break off the scion buds while this is being done. Tie the cut-off corner of the bag to the scion at the top of the aluminum foil wrap, below the lowest bud on the scion. Then tie the lower part of the bag firmly around the stock near the lower edge of the foil wrap. In both cases, the ties should be atop the foil, as no exposed wood should be covered by the bag. These ties should be with budding tape, rubber band strips or other material that will stretch.



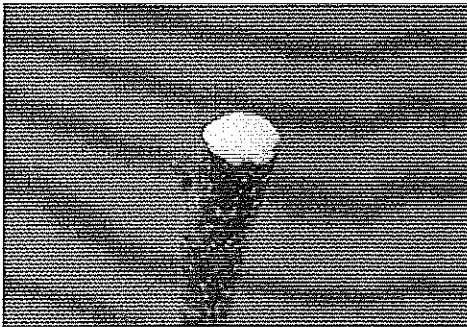
Bag positioned over graft.



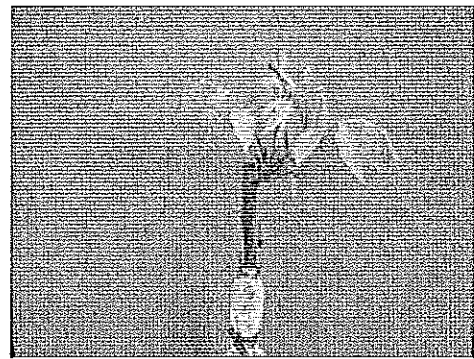
Bag secured top and bottom.

Coat the tip of the scion with a dab of glue to prevent its drying out while the graft heals.

Generally, the buds on the scion will begin to grow in 3 to 6 weeks. All wrapping materials should remain in place for another 4 to 6 weeks after the scion buds begin to grow, at which time the ties, the bag and the foil may be removed.

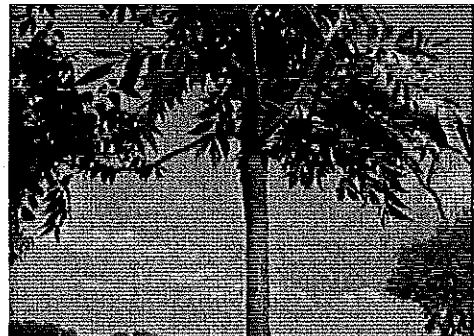
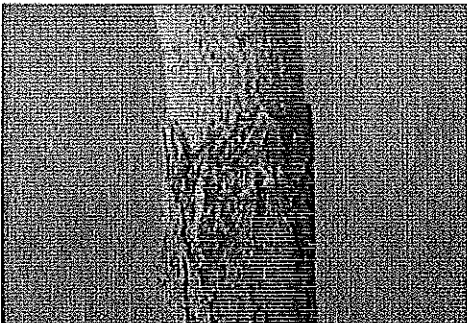


Scion end covered with glue.



Early growth of the scion buds.

In addition to the growth of the scion buds, a number of buds along the stock will also grow. To aid in the recovery of the tree, these shoots on the stock should be maintained, but they must be kept pruned back to preclude their overgrowing the new scion. The simplest means to control them is to pinch off or cut off their tips periodically as necessary during the rest of the season.



Completely healed graft.

Growth of the new tree.

Healing of the graft union is quite rapid as compared to some other grafting methods. You can easily distinguish the union by noting the different appearance of the bark of the stock and the scion. After 2 or 3 years, the trashy branches along the stock should be completely removed. Too, the scion should be trimmed to leave only one single, strong shoot to develop into the new tree.

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This procedure was demonstrated by [Larry A. Stein, Ph.D.](#), with imagery and web posting by [Julian W. Sauls, Ph.D.](#)

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