



Propagating Pecan and Black Walnut in Missouri*

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Pecan and Black Walnut in Agroforestry Practices

Agroforestry is an integrated set of land management practices that help land and forest owners to diversify products, markets and farm income, while simultaneously improving soil and water quality, enhancing wildlife habitat and sustaining land resources for long-term use. The five practices of agroforestry — alley cropping, silvopasture, riparian forest buffers, forest farming and windbreaks — offer a landowner opportunities for short-term income from areas that may not be currently utilized, like shady, forested areas, or the alleyways between tree crops.

Pecan and black walnut are among the most intensively managed native tree species in the Midwest. By applying agroforestry principles, nut growers maximize the productivity of their land by producing nuts, wood products and livestock forage, all on the same acreage. By learning and applying the basics of nut tree propagation, landowners can increase the value and productivity of the nut production portion of an agroforestry practice.



In this alley cropping practice, a double tree row planting system allows access to trees while growing an intercrop on 60 percent of the land area.

Nut trees reach their full nut-bearing potential only if careful consideration is given to the rootstocks and cultivars used to establish an orchard. To ensure top-quality orchard trees, many growers choose to grow their own rootstock trees and graft those trees with superior nut cultivars. Through grafting selected, improved varieties of pecan and black walnut,



Cattle graze among native pecan trees and selected forage in this well-managed silvopasture practice.

a landowner can be more certain of consistent nut size, nut yield, flavor and quality — resulting in a higher market price and increased consumer satisfaction. This publication addresses nut tree propagation, from germinating seeds to grafting large trees.

Seed Propagation

Nut trees are easily grown from properly stratified nuts. Collect nuts for planting during fall harvest season. Black walnuts should be hulled and washed as soon as you collect them. During the washing process, discard all walnuts that float to the top (these floaters are poorly filled and will not germinate well). Even though seed from any walnut tree can be used to grow rootstock trees, 'Kwik-Krop,' 'Sparrow,' and 'Thomas' nuts have proven to produce superior rootstock trees. Collect pecans as soon as they fall from the tree then soak nuts in water for 24 hours. 'Colby' and 'Giles' pecans have proven to produce excellent cold-hardy seedlings. Stratify pecans and black walnut in moist sand by placing them in layers about 3 inches deep and holding them in a refrigerator (33 to 40°F) for 120 days. Be sure the nuts are kept moist throughout the stratification process to ensure uniform germination after planting. Inspect frequently and remove spoiled nuts.



*Root stock recommendations are applicable to Midwestern states of similar latitude (Iowa, Ill., Ind., Kan., Neb., Ohio).

Three methods can be used for growing seedlings for later use in establishing orchard of nut trees:

1. *Growing trees in place*
2. *Establishing a nursery*
3. *Growing trees in containers*

Growing trees in place Prepare a fine seedbed in the area you intend to plant nut tree seed. During early spring, plant three to five stratified nuts, 2 inches deep, at each tree location. Be certain to mark the area where nuts are planted and to keep the area weed-free. During the first year, select the strongest-growing tree and remove the others by cutting them off below the root collar. Fertilize the seedlings in mid-June with 1/4-cup of a slow release fertilizer per tree location. Water trees when conditions become dry.

Establishing a nursery Choose a deep, sandy loam soil for a nut tree nursery to facilitate digging and transplanting. Prepare a fine seedbed for the nursery area in early spring. Plant stratified seed 2 inches deep, 2 feet apart, in rows at least 4 feet apart. Keep the nursery weed-free and well watered. Sidedress by applying a slow-release fertilizer along the nursery row in mid-June. Nursery-grown trees should be dug for transplanting in March of the following year. When digging 1-year-old seedlings, be sure to dig at least 16 to 18 inches deep and preserve as many fibrous roots as possible.

Growing trees in containers There are several sizes and shapes of containers that can be used for growing pecan and walnut seedlings. Choose a container with an open bottom. When placed on a screen wire bench, tree roots will grow to the bottom of the pot and then become “air-pruned.” The air-pruning process prevents taproot circling — a common problem in container-grown trees.

Use a potting soil mixture that allows free movement of water through the pot. Mix in a slow-release fertilizer that can provide both macronutrients (primary elements essential for plant growth: nitrogen, phosphorus and potassium) and micronutrients (trace elements essential for plant growth: boron, chlorine, copper, iron, manganese, molybdenum and zinc) for seven to nine months. Plant a single, stratified nut in each pot. Nut tree seedlings grown in containers need daily watering and the careful attention demanded by all containerized nursery plants. Container-grown stock can be transplanted into the field in the early fall. The fall planting season starts three to four weeks before the first killing frost and continues until mid-November. Containerized stock can also be planted during the traditional spring planting season. However, if you are holding container trees over the winter, you must protect tree roots from sub-freezing temperatures during the winter. After trees become dormant in the fall, cover the trees with an insulating cover or hay mulch.

Grafting Trees

The only way to ensure each tree in your orchard produces quality nuts is to graft superior cultivars onto your rootstock trees. Trees grown from seed will, in most cases, bear nuts that are inferior to the nut planted. The seed-grown tree exhib-

its characteristics from both male and female parents. Since walnut and pecan trees are wind pollinated, the source of male pollen is usually unknown. The pollen that fertilized the flower and resulted in the nut you plant may have come from a small, hard-shelled “wild” tree. As a consequence, a seedling tree often produces nuts that are intermediate between that small, hard nut and the big, thin-shelled nut that was planted.

Grafting is an age-old horticultural technique that can be defined as attaching a twig from one tree to the stem of another in such a way that the twig continues to grow and become a permanent part of the tree. All of the branches that grow from that twig will have the identical characteristics of the tree from which the twig was taken. Grafting a twig (the scionwood) from a tree that produces high-quality nuts onto a seedling tree (the stock) is the only way to ensure that your tree will produce desirable nuts.

Collecting scionwood

The first step in the grafting process is to obtain scionwood from trees of known nut production performance. There are several pecan and black walnut cultivars recommended for commercial nut production in Missouri (Table 1, page 3). Scionwood should be collected during the late dormant season (late February to early March). Cut scions from the previous season’s new growth making sure there is an ample supply of large plump buds on the twig. Store scionwood in plastic bags under refrigeration (35°F) until the spring grafting season. Make sure the scionwood does not dry out during storage by wrapping the wood with moistened paper towels. Check stored scions frequently and rewet the paper towel if it becomes dry.

Tools for grafting trees

Before the grafting season begins, you should collect all the tools and equipment you will need to graft trees that are from 1/2” to 4” in diameter.

Necessary grafting supplies include:

- Sharp grafting knife (sheep’s foot blade)
- Pair of pruning shears (with by-pass blade)
- Pruning saw (turbo style)
- Light-duty staple gun (Arrow model JT 21)
- 5/16” staples for staple gun
- Plastic sandwich bags
- Aluminum foil
- Bottle of white glue
- 4 mil plastic grafting tape
- Black plastic electrical tape

Season for grafting

During the spring, rapid wood and bark growth allows the bark to be easily removed from the wood. We use this natural phenomenon to our advantage during the grafting process. But because the bark of the stock tree must ‘slip,’ grafting season is largely confined to a six-week period during the spring.

Pecan	Black Walnut*
Hirschi	Brown Nugget
Kanza	Emma K
Major	Hay
Pawnee	Kwik Krop
Peruque	Sparrow
Posey	Sparks 127
Shepherd	Thomas

Table 1: Popular pecan and black walnut cultivars currently propagated in Missouri.

Graft small trees as soon as the emerging buds are 1-inch long. Start grafting larger trees when the leaves begin to unfurl. You can continue to graft until the leaves of the stock trees are completely expanded. During certain periods of the grafting season you will note excessive sap flow when stock trees are cut. This ‘bleeding’ inhibits callous formation and can cause graft failure. To avoid ‘bleeding’ problems, cut stock trees off just above the location you intend to graft. Wait a couple of days, and then make a fresh cut one inch below your previous cut before making your graft.

When you are ready to start grafting, take your scionwood out to the field in a small cooler. Ice down your scionwood to keep it fresh. Avoid leaving bags of scionwood out in the sun, where the wood can become very hot.

The Three-Flap Graft (*Images, pages 4-5*)

The three-flap graft is the best method for propagating pecan and walnut cultivars onto stock trees 3-5 feet in height. The three-flap graft works best when both scion and stock are approximately the same diameter. Take a piece of scionwood out of your cooler and hold it up to the stock tree and choose the proper height for grafting (Fig. 1, page 4). Cut off the top of the stock tree at that point with hand shears. As a general rule, the scionwood should be large enough to allow you to cut off at least one third of the stock tree.

After choosing the site for grafting, set your scion back in the cooler while working on stock. Begin preparing the stock by making three vertical incisions, 3 inches long, through the bark at the top of the stock. Space these evenly around the diameter of the stock. If a bud and leaf scar are present, rub off the bud and make the first vertical cut directly through the bud (Fig. 2). To facilitate tying the graft union during a later step, tie an 18-inch piece of plastic grafting tape on the stock just below the three vertical cuts.

Now turn your attention to preparing the scion. First, trim 1/2 inch off the bottom of the scion to fresh, green wood. With a sharp grafting knife, make a shallow cut through the bark

and into the wood approximately 2 inches long at the bottom end of the scion (Fig. 3). This cut should expose a long “U”-shaped area of cambial tissue with woody tissue inside the “U” (Fig. 4). Repeat this step twice more so that the scion has three evenly spaced cuts around its diameter. Leaving a strip of bark between each cut ensures maximum cambial exposure (Fig. 5).

Sometimes, a bud and leaf scar are found in a position where cuts are to be made. If so, make the first shallow cut so that it removes the bud. Before moving back to working on the stock, hold the cut end of the scion in your mouth (away from tongue and teeth) to keep the scion from drying and to free your hands. Using the tip of your knife, separate the bark from the wood at the top of the stock. With your fingertips, carefully peel the bark away from the wood in three flaps, each 2.5 to 3 inches long. Use shears, blade side down, to hold the three flaps down while clipping out the wood on the inside of the flaps (Fig. 6). Avoid excessive fingering of the flaps — oily fingers can impair graft callus formation.

Next, attach scion to stock. Place the scion inside the three flaps, lining up each cut surface with a flap. Hold the three flaps up over the cut surfaces with one hand and begin wrapping the graft union with grafting tape (already in place) (Fig. 7). Wrap the graft tape spirally up the stem, making certain the flaps and scion do not twist (Fig. 8). Tie the tape above the three flaps. Push straight down on the scion to ensure the scion is firmly seated against the wood of the stock.

Protect the graft from sunburn by wrapping with a small piece of aluminum foil (Fig. 9). Foil also acts as a splint, protecting the graft from wind injury. Next, tear the corner out of a plastic sandwich bag and place the bag over the graft (Fig. 10). Tie the bag above and below the graft union with grafting tape. The plastic bag helps prevent moisture loss and speeds graft callusing. Cover the cut surface at the top of the scion with a drop of white glue (Fig. 11), which prevents moisture loss. Pound a steel fence post into the ground next to your graft. This post will prevent birds from breaking out your graft and provide a stake for training the young tree.

Three to four weeks after grafting, scion buds should start to break (Fig. 12). After the scion has made 3-5 inches of new growth, carefully remove the plastic bag, aluminum foil and grafting tape to prevent graft girdling. A strong graft should have callous tissue growing between each flap.

Wrap up the graft again in reverse order, first with the plastic bag, then aluminum foil, and finally grafting tape. This wrapping will not girdle the graft but it provides wind and sun protection. Force the scion to grow by pruning back any new shoots growing from below the graft (on the root stock) and by fertilizing with nitrogen. To prevent wind damage, train shoots growing from the scion to the steel fence post by tying with grafting tape or plastic flagging tape.

**Black walnut recommendations reflect current understanding of cultivar performance based on 13-year-old trees grown in central Missouri. With time, we expect this list to change as our trees grow older and additional nut yield data is obtained from plantings established in other parts of the state.*

The Three-Flap Graft



Figure 1. The three-flap graft is applied where the scion and stock are the same diameter.

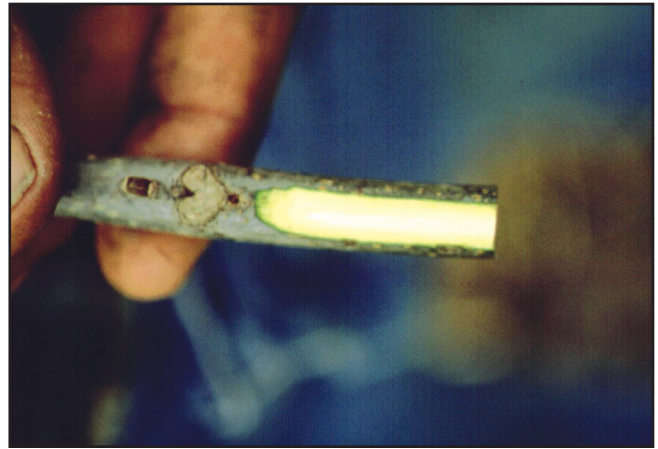


Figure 4. Cut deep enough to expose a long "U" shaped area of cambium.



Figure 2. Slice through the bark of the stock.



Figure 5. Leave a strip of bark between each cut on the scion.



Figure 3. Start your first cut on the scion two inches from the base.



Figure 6. Clip out the wood inside the flaps on the stock.

The Three-Flap Graft (cont.)

Figure 7. Insert the scion into the stock so that each flap covers each cut surface of the scion.

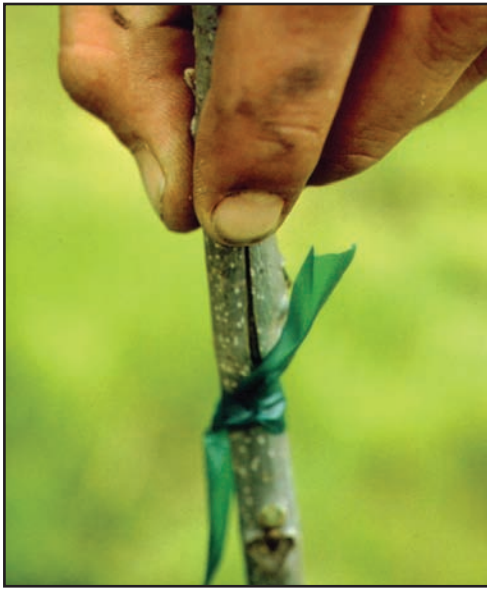


Figure 10. Attach a sandwich bag over the graft to prevent moisture loss.



Figure 8. Wrap the graft with plastic grafting tape.



Figure 11. Seal the top of the scion with white glue.



Figure 9. Protect the graft with aluminum foil.



Figure 12. Buds should begin to break three to four weeks after grafting.



The Bark Graft (*Images, pages 6-9*)

The bark graft is an effective way to propagate walnut and pecan cultivars onto trees 2" to 4" in diameter. Select a point on the stock above the first whorl of branches and at a comfortable working height (Fig. 13, bottom right). Retain lower branches to help maintain tree vigor until the new graft becomes established. Leaves on these branches also will shade the trunk to prevent sunscalding. Remove the top of the stock tree with your turbo saw. Check for excessive sap flow, and be prepared to graft another day if necessary.

Inspect the cut surface of the stock. You'll notice that the stem is not perfectly round. Choose the flat side of the tree to make your graft. At this point, remove some of the rough bark with your knife or small wood rasp. Pare down the bark until it becomes about 3/16" thick in an area 1.5" wide and 3" long. Reducing bark thickness will make the bark more pliable and more able to conform to the scion. Use your grafting knife to make a 2.5" long vertical slit through the bark (Fig. 14, p. 7). The stock is now ready to accept the scionwood.

Scionwood approximately 3/8" in diameter works best for the bark grafting. Trim 1/2" off the bottom of the scion with your pruning shears to expose fresh, green wood. If a bud is found near the base of the scion, your first cut should remove the bud (Fig. 15). Draw your knife through the scion starting about 2.5" from the base. Carve the scion down through the pith to less than half its original thickness using several passes of your knife (Fig. 16). This deep cut should be parallel to the scion and feature a right angle shoulder. Be certain that two buds remain above the cut.

Turning the scionwood piece over, make a shallow cut into the wood of the back side from your first cut (this cut is similar to preparing a scion for three-flap grafting). This cut is not made parallel to the deep cut but angled to one side (Fig. 17). When finished, you should have a thin piece of bark adjacent to the deep cut on one side and a much thicker strip on the other. The cut on the back side of the scion should start just below the shoulder of the deep cut and should give the scionwood a wedge shape when completed (Fig. 18). A third cut is made perpendicular to the deep cut along the thick bark strip edge. This cut should be made just deep enough to expose the cambium (thin layer of cells between the inner bark and wood). Be certain to leave a strip of bark between the backside cut and the perpendicular cut. At this point, your scionwood should have a triangular shape (Fig. 19). Complete scionwood preparation by making a chisel point on the end of the bud stick (Fig. 20). This final cut should be made on back side of the scion.

Use your grafting knife to gently pull the stock's bark away from the wood on the right side of the bark slit (Fig. 21). Insert the scion between the bark and the wood of the stock (Fig. 22). Tap the scion down into the stock until the shoulder of the deep cut fits snugly against the upper side of the stock (Fig. 23). The deep cut should be facing the wood, while the shallow cut should be covered by the raised bark flap and per-

pendicular cut should fit snugly against the bark slit. Secure the graft union with staples (Fig. 24) or brad nails (Fig. 25). It is important to staple down the bark firmly against the scion and be sure all air pockets are removed. Use as many staples as needed but be careful not to split the bark.

Like the three-flap graft, cover the graft union with aluminum foil. Place the foil over the cut surface of the stock and around the base of the scion. Next, cut the corner out of a sandwich bag and place over the scion. Tie the plastic bag with grafting tape at the base of the scion and below the aluminum foil on the stock (Fig. 26). Place a drop of white glue on the cut surface at the top of the scion to prevent moisture loss. To prevent bird damage, use black electrical tape to fasten a 3' long stick (bird perch) to the stock so it extends well above the scion. You can also tie the scion's new growth to this stick during the early part of the summer to prevent wind damage.

The bark graft can grow very rapidly. In mid-summer, cut off the grafting tape that was used to tie the plastic bag to the scion to prevent girdling. Remove the bird perch and attach a 2 x 2"-diameter stake to the trunk of the stock tree, making sure the stake extends at least 3' above the graft union. Tie new growth from the scion to the stake to prevent the wind from blowing out the graft. The young graft will need support until new wood grows over the cut surface on the stock (2 or more years).

The Bark Graft



Figure 13. The bark graft should be applied above the first whorl of branches.

The Bark Graft (cont.)



Figure 14. Cut a slit through the bark of the stock.



Figure 17. Make a shallow cut on the back of the scion angled to one side.



Figure 15. If a bud is found near the base of the scion, your first cut should remove the bud.



Figure 18. After making your second cut, the scion should have a wedge shape in cross section.



Figure 16. Carve the scion down to less than half its original thickness.



Figure 19. After making your third cut, the scion should have a triangular shape.

The Bark Graft (cont.)



Figure 20. Complete scion preparation by making a chisel point at the end of the bud stick.



Figure 23. Tap the scion down until the shoulder of the deep cut touches the wood of the stock.



Figure 21. Use your knife to lift the bark of the stock away from the wood.

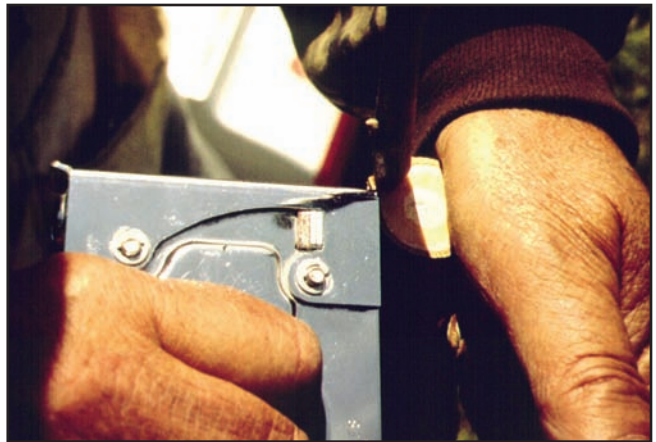


Figure 24. A staple gun can be used to secure the graft union on smaller trees.



Figure 22. Insert the scion between the bark and wood of the stock.

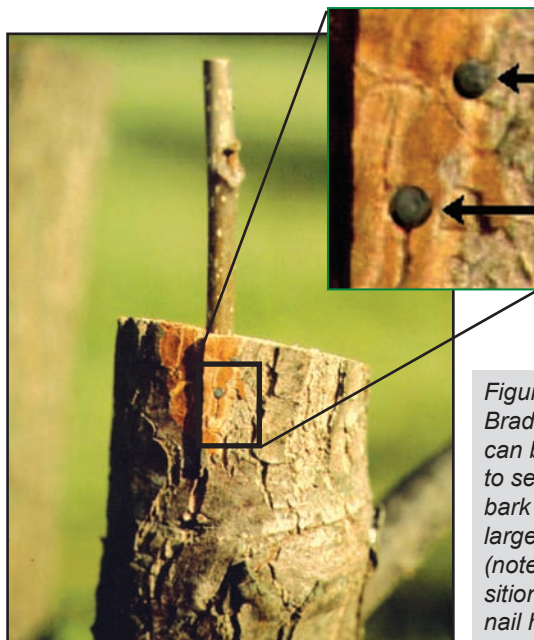


Figure 25. Brad nails can be used to secure a bark graft on larger trees (note the position of the nail heads).



Figure 26. The graft union should be wrapped in aluminum foil and a plastic bag much like the three-flap graft.

The Arrowhead Graft (*Images, pages 10-11*)

The first decision you make when grafting nut trees is how best to attach the scion to the stock with a grafting method that will be successful. When scion and stock are roughly the same size, use the three-flap graft. When the stock is 2-4 inches in diameter, use the bark graft. But when the stock is too large for a three-flap yet too small for a bark graft, the arrowhead graft provides the best option for propagating pecans and walnuts (Fig. 27, p. 10).

The arrowhead graft takes its name from the arrowhead-like point you carve on the scion to make the graft. This form of grafting should be used on stock trees with smooth bark, $\frac{3}{4}$ to 2 inches in diameter. Use scionwood that is on the small side, about $\frac{3}{8}$ " in diameter. The timing is late April through May, like our other grafting methods.

Start the grafting process by choosing a spot on the stock tree that has smooth bark and is free of buds and leaf scars. You should remove at least $\frac{1}{3}$ of the stock tree's top when deciding where to place your graft. After removing the top, prepare the stock by making an incision through the bark straight down the stem, about 3 inches long (Fig. 28).

Select a small diameter (about $\frac{3}{8}$ ") piece of scionwood from your cooler for this graft. Make a sloping cut ($2\frac{1}{2}$ " long or longer) through the scion, making sure you remove the lowest bud on the scion (Fig. 29). Take a few additional slices off the scion to create a shoulder at the top of the cut and a smooth, tapered 'tongue' towards the base of the stick (Fig. 30). Next turn the scion over to carve the arrowhead point. Starting at a point near the base of the scion's shoulder, shave a thin strip of bark off one side of the scion to expose the cambium along the edge of the stick (Fig. 31). This cut should be made like you were trying to sharpen the edge of the scion. Repeat the process on the other side of the scion and you have just finished sharpening your arrowhead. A strip of bark should remain down the center of the arrowhead (Fig. 32).

To insert the scion into the stock, pull back the corners of the bark on both sides of the incision made in the stock and insert the arrowhead under the bark (Fig. 33). Slide the scion down into the bark until the shoulder of the sloping cut touches the top of the stock. When the scion is properly placed, the bark flaps should cover the cambium you exposed when carving the arrowhead and the strip of bark you left on the scion should be seen between bark flaps (Fig. 34). For this graft to take, the bark of the stock tree must be forced to fit tightly over the cut surfaces of the scion. Starting near the base of the graft, use a light-duty staple gun to bend the bark inwards so it conforms to the scion (Fig. 35, p. 11). Repeat this step on the opposite side of the scion. Add additional staples up both sides of the scion, switching sides as you go. Make sure the scion stays in the center of the bark slit while stapling. A total of six staples are usually adequate to conform the bark to the scion (Fig. 36).

To further stabilize the arrowhead graft, wrap the graft union firmly with grafting tape (Fig. 37). Like the other grafting techniques described in this bulletin, cover the graft with aluminum foil and a sandwich bag (Fig. 38). Seal the top of the scion with some white glue. Be sure to attach a stick to the tree with electrician's tape to provide bird protection and for training the new growth once the graft starts growing (Fig. 39). The arrowhead graft is very prone to wind damage and every precaution needs to be taken to prevent graft blowout.

Graft aftercare for the arrowhead graft is similar to all grafting methods. In mid-summer, loosen the tape used to attach the sandwich bag to the graft to prevent girdling. Trim off competing sucker growth. Remove the bird perch and drive a steel fence post into the soil adjacent to the tree. Train the graft's new growth to the fence post by tying the tree to the post with flagging tape (Fig. 40). The fence post should remain in place for several years to discourage deer from rubbing the bark off your tree.

Graft After Care the Following Spring and Beyond

During the following spring, remove all wraps from the graft union. On bark and arrowhead grafts, trim the stock to remove dead wood in the area opposite of the scion. This can be accomplished by making a sloping cut at about 30 degrees down and away from the scion. Prune the growth on the graft to a central leader. If more than one bud grows from the bud stick, leave only the growth coming from the strongest bud to form the new top of the tree. On three-flap and arrowhead grafts, prune off all shoots below the graft. Prune off about one-third of lower limbs on bark-grafted trees to force more of the tree's energy to the graft. In subsequent years, continue pruning the top of the tree to a central leader and remove limbs below the graft.

The Arrowhead Graft



Figure 27. Use the arrowhead graft when the scion is too small for a three-flap graft and the stock too small for a bark graft. (Scion on left, stock on right)



Figure 31. Turn the scion over and slice off enough bark along one edge to reveal cambial tissue.



Figure 28. Prepare the stock by cutting a slit through the bark.



Figure 32. Slice off some bark on the other side of the scion. The finished scion should have an arrowhead appearance with a sharp point and a strip of bark down the center of the stick.



Figure 29. Carving the scion starts with the removal of the lowest bud.



Figure 33. Insert the scion under the bark of the stock, right down the middle of the incision.



Figure 30. Make a sloping cut through scion leaving a prominent shoulder on the upper portion of the cut.



Figure 34. Push the scion down until the scion's shoulder reaches the top of the stock. The stock's bark should cover the cambium exposed on the arrowhead.

The Arrowhead Graft (cont.)

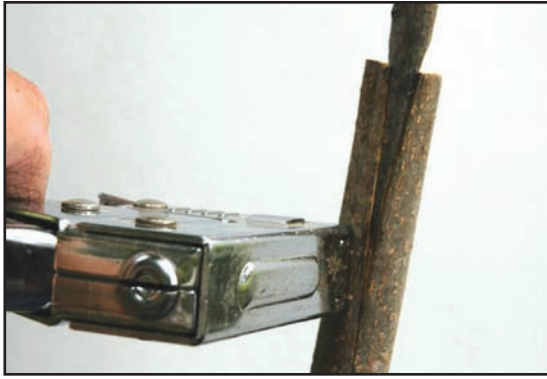


Figure 35. Use your staple gun to press and hold the stock's bark firmly against the scion.



Figure 36. Six staples are used to form the bark around the scion.



Figure 37. Wrap the graft with tape to strengthen the union.



Figure 38. Wrap aluminum foil around the graft to prevent sun scald. Attach a plastic bag over the graft to preserve moisture.



Figure 39. Attach a stick to the side of the graft with electrical tape to prevent birds from breaking over the new graft.



Figure 40. Once the graft starts growing, use a steel fence post to train the new growth and prevent graft blowout.

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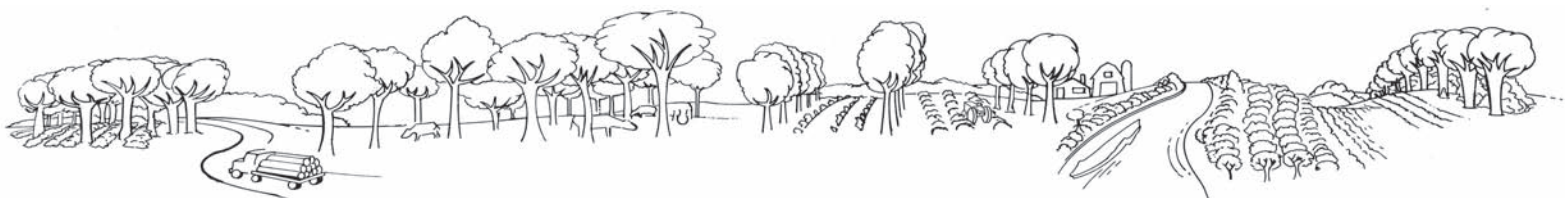
Additional suggested reading

UMCA publications: The following University of Missouri Center for Agroforestry publications are available from www.centerforagroforestry.org or University of Missouri Extension at <http://extension.missouri.edu/explore/agguides/agroforestry/>

Agroforestry in Action: Growing Pecans in Missouri
Agroforestry in Action: Growing Black Walnut for Nut Production

In the library: *The Grafter's Handbook*, R.J Garner
Plant Propagation: Principles and Practices, H.T Hartmann, D.E. Kester, F. T. Davies and R.L. Geneve

On the Web: Northern Nut Growers Association: <http://www.icserv.com/nnga/>



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