

# Grafting and Propagating Fruit Trees



PENNSSTATE



College of Agricultural Sciences  
Cooperative Extension



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## Introduction

Many people mistakenly believe that fruit trees grow true to name from seeds. In reality, if you collect seed from a fruit grown on a plant, the seeds will produce plants that will be a hybrid of two plants. The new plant will be the same kind of plant, but its fruit and vegetative portions may not look the same as the parent because the plant is “heterozygous.” Therefore, all fruit trees must be vegetatively propagated by either grafting or budding methods.

Fruit growers frequently use grafting techniques to topwork new varieties or strains of fruit onto established trees bearing misnamed or obsolete varieties and to repair injury or damage caused by mice, rabbits, deer, or mechanical means. Commercial nursery workers propagate new fruit trees, and producing a tree ready for planting takes several years.

All of the temperate-zone deciduous fruit plants may be propagated by budding. Cleft,

whip, and bridge grafting of apple and pear is possible, but such grafts are not often successful on stone fruits. Sweet cherry and, occasionally, peach may be successfully grafted using the side graft onto a 2- to 3-year-old limb.

Materials needed for any type of grafting are scions, rootstocks, a sharp knife, a cleft grafting tool, and a lightweight hammer. Depending on the type of graft to be prepared, you will need grafting “wax,” rubber bud strips, waxcoated cotton twine, grafting tape, and wire nails (number 16 or 18). Having a sharp knife is of paramount importance—using a dull knife can lead to serious injury.

In this publication we will describe some successful propagation methods that can be used on tree fruit. The techniques described may be used in all instances where grafting is required. The choice of methods depends on the time of year, the type of material available, and the type of propagation desired.

## Wrapping and Waxing

As a general rule, all grafts made by budding or whipping should be wrapped. Grafts made by clefting, side limb insertion (often called “hip graft”), inarching, and bridging need to be waxed, and in some instances nailed tight.

Many cloth-backed and plastic tapes are available for use in wrapping the graft, although plastic tapes appear to be easier to use. Rubber composition bud strips are used to wrap the dormant buds. The plastic materials come in rolls of  $\frac{3}{8}$ - and  $\frac{1}{2}$ -inch widths and are well suited for grafting purposes. When carefully wrapped, they will form a very tight seal. The plastic tape is secured by pulling the free end under the last turn around the stem. Whether the tape is wrapped from the bottom up or vice versa makes little difference. However, making the wrapping as airtight as possible is important.

When rubber bud strips are used to wrap the bud or graft, no further attention is usually needed. When nursery workers' adhesive tape is used, care must be taken to slit the tape vertically about 4 to 6 weeks after growth starts to prevent girdling.

Cotton twine or cloth strips impregnated with wax may be used to wrap the graft. The waxed string is useful, but great care is necessary to ensure an airtight wrapping. The strips of impregnated cloth ( $\frac{1}{2}$  inch wide) are useful in wrapping bark grafts or T-buds.

Several wax-based and water-soluble waxing materials are available. When using the more liquid water-soluble materials, be sure to recoat the graft several times to make sure that any cracks (which often occur with these materials) are closed. Water-soluble asphaltic compounds, commonly sold as wound dressings, are simpler to use than the wax-based materials. Containers of water-soluble materials must be protected from freezing to prevent breakdown of the product. Grafting wax, also called “hand wax,” does not require a heating device to liquify it. It is soft, pliable, and simply pressed around the graft. Hand wax is suitable when only a few grafts are to be prepared since it is very sticky and unpleasant to use. Commercial formulations of hand wax can be purchased from the companies listed in the “Grafting Supply Resources” section of this publication.

You can also make your own hand wax using the following recipe:

- 4 parts (by volume) of rosin
- 2 parts (by volume) of beeswax
- 1 part (by volume) of tallow or raw linseed oil

Melt the tallow or heat the linseed oil (to about 125°F), and then add the beeswax. When these two parts have melted together, then add the powdered rosin. Stir until thoroughly mixed, pour into a bucket of water, and allow to cool. Form the wax into a ball and pull (or knead) it until it

assumes a yellowish or tan color. Divide into  $\frac{1}{4}$ - or  $\frac{1}{2}$ -pound balls and store in plastic bags until ready for use.

The fluid hot waxes and water-soluble materials flow freely around all cut surfaces of the graft and are less troublesome to apply than the hand wax; however, a special wax melter is needed for the hot waxes.

Sealing all cut surfaces is important for the graft to succeed. This includes all exposed surfaces where the stock and scion are joined and the free end of the scion.

## Collecting Scion Wood

The success of any form of propagation depends on the quality of the scion wood to be grafted. Collect scion or budwood early in the day while temperatures are cool and the plants are still fully turgid. The best vegetative buds usually come from the current season's growth or dormant wood that grew the previous year. Mature buds are most desirable; discard terminal and younger buds. To keep buds from drying out, getting hot, or freezing (depending on the season), place the budwood into plastic bags or wrap it in moist towels or burlap as you collect it. Place budwood of only one variety in a labeled bag.

Budsticks that will not be used immediately should be bundled, labeled, and stored in moisture-retaining containers such as plastic bags or waxed cardboard boxes, which should be kept cool (32 to 45°F). The longer budwood is stored, the less likely it is to "take." Generally, budwood stored for more than a few days should be discarded.

In budding, the situation is somewhat different in that the "June bud" technique involves the use of previous season's terminal growth, whereas the dormant budding is made from nongrowing buds on the current season's growth. In either case, only one-year-old material is suitable for any form of graftage discussed here.

Using water sprouts (or suckers) from the interior branches of the tree—especially older fruit trees—is not recommended for propagating a variety but is excellent for bridge grafting purposes.

The scions for all forms of graftage (except dormant budding) must be collected in late March while still completely dormant. Although not universally held, it is a good idea not to take scion wood while it is frozen. You should wait 2 to 3 days after the initial thawing to collect the scions.

The scions should be wrapped in nonperforated plastic (a plastic bread wrapper is excellent) and placed in cold storage (30 to 40°F) or buried in moist sand or sawdust until ready for use. When making the graft, remove an inch or two of the tip and basal portions of the scions to eliminate wood that may have dried out. Another reason for discarding the tip and basal portions is that the tip portion is too small and the base too large for proper handling. Furthermore, neither portion will have properly matured buds.

## Types of Grafting or Budding

Time of season will largely determine what type of propagation techniques you will need to use to create new plants. All forms of topworking and repair grafting are done only when the plants are dormant in late winter to early spring. Budding can be done in the dormant season with a dormant chip bud but is most often done during the growing season using either T-budding or chip budding.

## Dormant or Winter

Propagation to be done during the dormant or winter period is usually carried out in late March to early April. Both the receiving and inserted plant material must be fully dormant. If either piece of plant material is not dormant, the grafts may fail. Propagation techniques used when trees are dormant include bench grafting, dormant chip budding, cleft grafting, bridge grafting, bark grafting, and inlay grafting. The first two methods are primarily used to create new trees; bridge grafting and inarch grafting are used to repair damage to the tree trunk; and cleft grafting, bark grafting, and inlay grafting are used to topwork a tree to a new variety or to add multiple varieties to a single tree.

## Bench Grafting

Bench grafting, also known as whip and tongue grafting, is performed indoors, preferably in a cool area. An unheated garage or barn is an ideal location.

This method is most successful for grafting material pencil sized ( $\frac{1}{4}$  to  $\frac{5}{8}$  inch) to about 1 inch in diameter. Because of the large amount of cambial contact, it heals quickly and makes a strong union. Ideally, the stock and scion should be the same diameter. This type of graft is made when both the stock and scion are dormant (late March to early April).

The scions should be collected only from dormant terminal twigs. Scion wood comes from the previous season's growth. If you need to store the scion wood for a brief period, keep it in moist sphagnum moss, sand, or a plastic bag in a cool place. Scion wood must be kept moist and cool until used. After the cuts are made, scions must be inserted immediately. Do not store scion wood in a refrigerator or storage room that has held or currently holds apples. Apples give off ethylene gas, which can damage the scion wood.

The stock is prepared by making a 1- to 2-inch sloping cut at the top of the stock, as shown in Figure 1a. A second downward cut (Figure 1b) is made into the stock, starting a third of the way down from the top end. The second cut is made about half as long as the first. The scion is prepared in the same manner.

The two pieces are then fitted together with the tongues interlocking (Figure 1c), and the graft is wrapped (Figures 1d and 1e) and waxed immediately. When the scion is of a smaller diameter than the stock, be sure to match the cambium layer of both pieces on one side. Examine the graft after the wax hardens and rewrap any holes or cracks that may have developed.

Alternatively, you can purchase a grafting tool (Figure 2a, next page). The tool makes an omega cut in one stock (Figure 2b) and a corresponding cut in the other stock (Figure 2c). The two pieces are then fitted together (Figure 2d) and wrapped.

Store the completed trees in a cool, moist area for 7 to 10 days to make sure the cambiums heal together. Be sure to plant them out before the buds begin to expand.

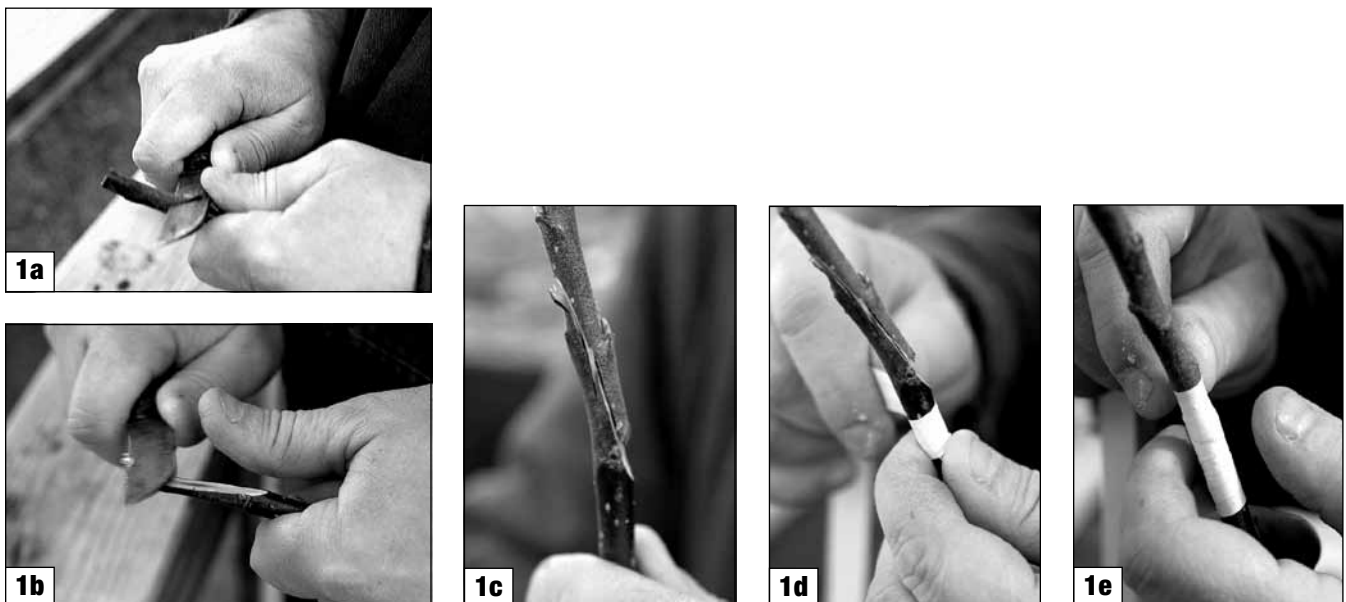
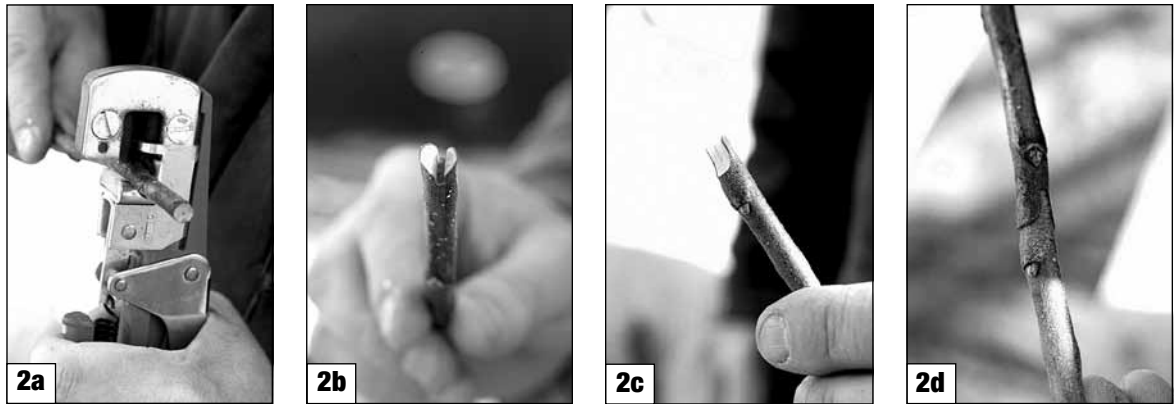


Figure 1. Preparing and performing bench grafting.

**Figure 2.**  
Using an  
omega cut  
grafting tool.



### Cleft Graft

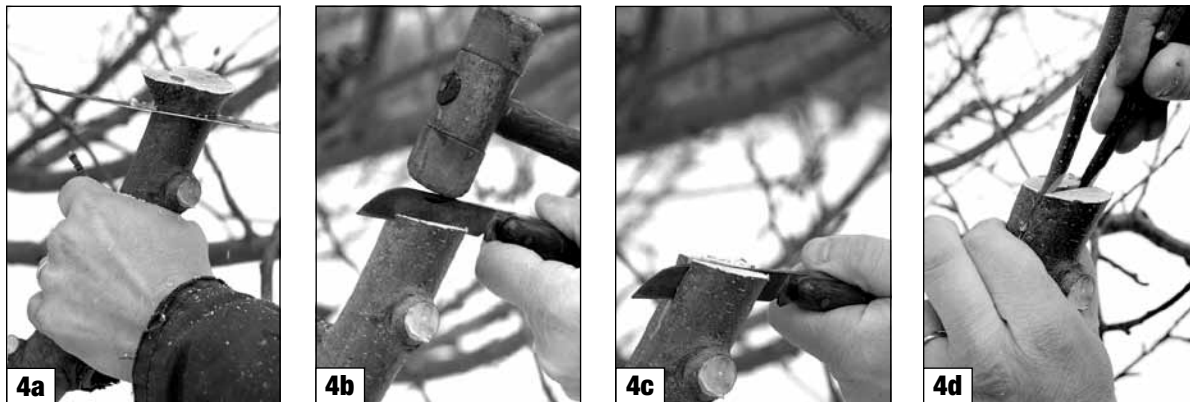
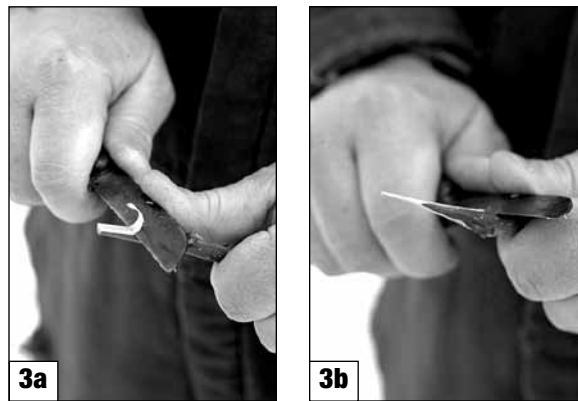
Cleft grafting is the most commonly used method for topworking a relatively mature tree over to another variety. This system is used on stocks from 1 to 3 inches in diameter. The scion is pre-

pared by making a tapering cut 1 to 2 inches long on each side (Figures 3a and 3b). The scion should be 3 to 4 inches long and about  $\frac{3}{8}$  to  $\frac{1}{2}$  inch in diameter.

The stock is cut off squarely (Figure 4a) and split vertically

with a knife or cleft grafting tool to a depth of about 2 to 3 inches (Figures 4b and 4c). Keep the knife in position or insert a chisel to keep the split open and insert the scions (Figure 4d). The scion is placed so that its cambium layer and the cambium layer of the stock are in contact. All exposed surfaces are waxed or coated immediately. Usually, no wrapping is needed because the stock exerts sufficient pressure to hold the scions; however, wrapping the stock will ensure a tighter connection and less chance for the scion to be bumped out of the stock.

**Figure 3.** Tapering cut  
used to prepare the  
scion for a cleft  
graft.



**Figure 4.** Splitting stock for a cleft graft.

After wrapping the scion and stock, paint the stock surface and the ends of the scions with a wound dressing or cover them with wax (Figures 5a and 5b).

Once growth starts in the spring, the bark loosens, or slips. When this occurs, the bark and wood portions may not split evenly and clefting may not be satisfactory. You should then switch to either the bark or inlay type of graft.

After the scion starts to grow in the spring, a good idea is to cut off all of the wood from the old variety except one limb as a “nurse” limb (Figure 6). Later in the summer revisit the grafts to see how much growth is occurring.

If excessive growth occurs or you are in a windy area, you may want to support the new scions. Tack a 1-inch piece of wood board below the union and fasten the new scion to the wood with ties.



**Figure 5. Covering scion and graft with wound dressing.**



**Figure 6. Nurse limb on recently grafted tree.**

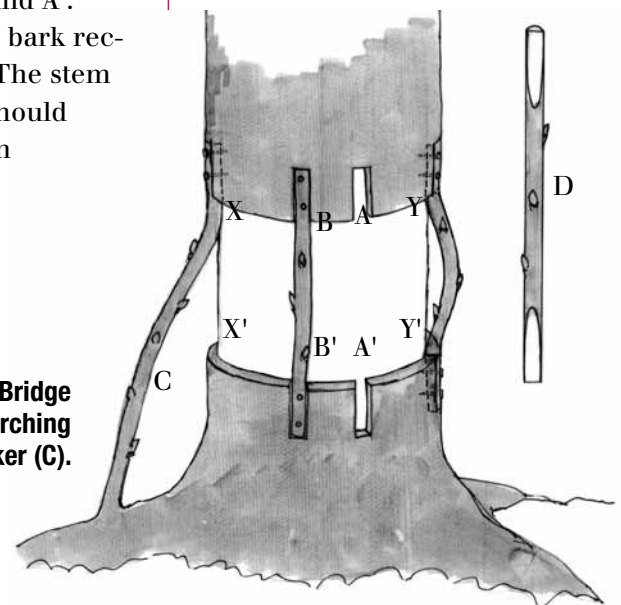
### Bridge and Inarch Grafts

Rodents, machinery, and cold weather often cause the bark to be removed or separated from a part (or all) of the trunk. When a minor injury is noticed early, bridge grafting may be used to save the tree. Trim the edges of the girdled section back to sound bark as shown along lines in Figure 7X to Y and 7X' to Y'. and cut the scion as illustrated in 7D. Place the scion along the trunk so that the beveled edges rest on sound bark at 7A and A'. Mark and remove the bark rectangles as indicated. The stem piece to be inserted should be slightly longer than needed to ensure a snug fit.

Insert the scion as indicated at B and B' and then secure with two number 16 or 18 wire nails at each end as shown.

Inarch or approach grafts are used when there is an insufficient area of trunk below the damaged portion because the trunk is too close to the soil line. If a rootsucker is present, it can then be grafted above the damage as shown in 7C. The loose end should be handled as explained for the top portion of the bridge graft. Alternatively, if no root-suckers are present, planting a rootstock liner and grafting it into the healthy portion of the tree is necessary. You may also wish to grow your own seedlings (see the section on propagating fruit plants from seed).

Wax all exposed surfaces of the inserted scions. The beveled cuts on the scion (7D) should be from 1 to 1½ inches long and tapered across the stem. Insert one bridge for each 2 inches of the injury's width.



**Figure 7. Bridge graft and inarching of a rootsucker (C).**



Figures 8a and 8b show a successful inarch graft 3 years (8a) and 6 years (8b) after grafting.

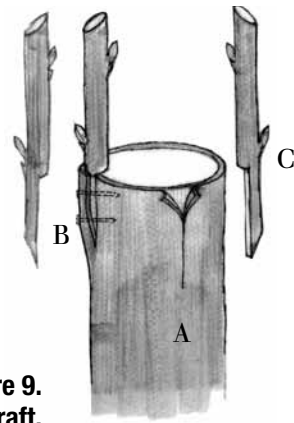


**Figure 8. Successful inarch graft using rootstock liners when young.**

### Bark and Inlay Grafts

The bark graft is used frequently to obtain a larger amount of surface contact when topworking a tree to a new variety (Figure 9). The scion, however, is not as secure as when the inlay graft is used. The stock is cut off and a vertical slit is made as at 9A. The bark is loosened, the scion is set, and then the bark is pressed in place and the trunk is tightly wrapped. Alternatively, nails can be inserted as indicated at 9B. The properly cut scion can be seen at 9C. All exposed surfaces should be waxed.

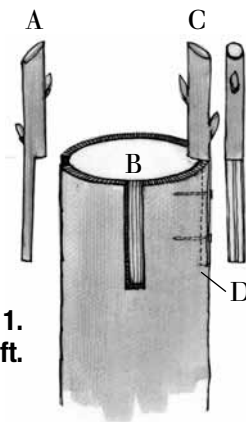
Figure 10 shows a finished bark graft after it has started to



**Figure 9. Bark graft.**



**Figure 10. Finished bark graft.**



**Figure 11. Inlay graft.**

grow. Be careful that birds do not land on the scion and dislodge it before it is completely callused.

Inlay grafting is suitable for topworking stocks that are more than 1/2 inch in diameter (Figure 11). Scions are cut as in 11A,

and set on the stock as in 11C. The area of the stock covered by the scion is then marked with a knife and the bark is removed (11B). After removing the bark, insert the scion and secure it with number 16 or 18 flat-head wire nails (11D). Several scions (up to four or five) can be inserted, and grafting should be done when the bark slips for the bark graft. Wax all exposed parts. The following year, return to the tree and remove all but the strongest-growing graft.

### Budding

Budding is another form of grafting where only the bud is used rather than a piece of scion with several buds. There are two types of budding: shield or T-budding and chip budding. Budding is commonly done in late summer, but dormant chip budding can be done in late winter before growth starts. Budding is the primary method used by nursery workers propagating fruit trees.

A third variation in which buds are forced to grow the same season they are grafted is called June budding. As the name implies, it is done during the growing season in late May or early June. June budding can either be a chip or T-bud technique. The top of the rootstock is broken over (but not off) several inches above the bud 3 to 4 weeks after the bud has been inserted. As soon as bud growth starts, the top of the rootstock is cut. June budding will only work in areas where there is a long, warm growing season.

### Shield or T-Budding

T-budding operation is limited to the period of the summer when the bark is said to slip (Figure 12)—when it separates easily from the wood. This usually occurs from late May to early June and from mid-July to early September, but most budding is done during the latter period. Budsticks of the scion variety (Figure 13A) are prepared from the mid-portion of the current season’s growth. The rootstock is either a one-year-old seedling or rooted layer. This is also referred to as fall (or dormant) budding and is the common budding system used.



Figure 12. Slipping bud.

In dormant budding, the bud remains in place on the trunk of the rootstock until the following spring, when the rootstock is cut off just above the scion bud. A tree may be produced in one year by June budding, but producing a finished tree by dormant budding requires at least two growing seasons. In either case, the scion buds (13B) are cut from the budstick and placed in the “T” as indicated at 13C and 13D. The bud is then wrapped in place with a rubber bud strip as shown at 13E. The rubber bud strip will disintegrate in several weeks. If it does not, or you use a nonbiodegradable tie, you will need to cut the rubber band.

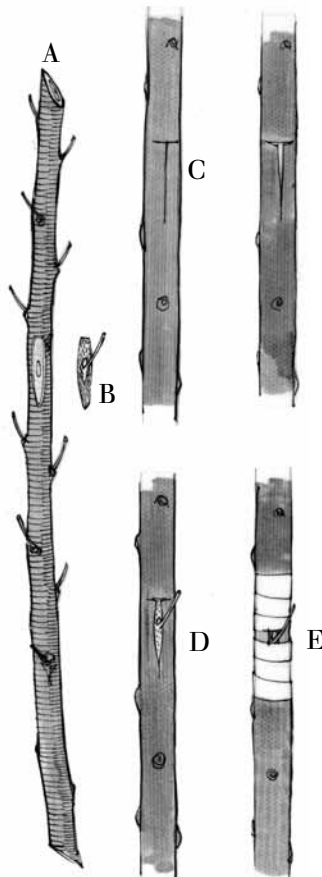


Figure 13. Budstick (A), bud to be inserted (B), T-cut (C), bud insertion (D), and finished wrapping (E).

There has been considerable success budding sweet cherries using an inverted “T.” The only difference in the procedure is the placement of the cross-cut at the bottom of the vertical cut on the stock.

### Chip Budding

Chip budding is a technique that can be used whenever mature buds are present and the bark is not slipping. It can be done in the spring before growth starts and when the stock and the scion are still totally dormant. Chip budding is generally used when the stock and scion are relatively small (1/2 to 1 inch in diameter). In recent years, most commercial tree fruit nurseries have changed from T-budding to chip budding because the buds tend to grow out better.

In chip budding, the first cut is made below the bud and down into the wood at an angle of 30 to 45 degrees (Figure 14). The second cut is started about 1 inch above the bud and goes inward and downward behind the bud until it intersects the first cut.

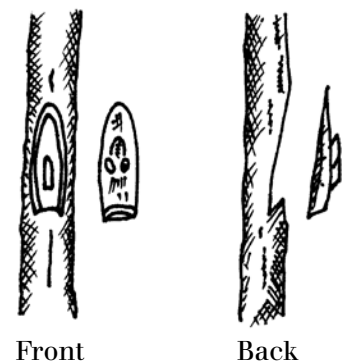


Figure 14. Chip budding cuts.

The same procedure is then followed on the stock, making sure to match the size of the “chip” cut from the budstick.

Unlike the T-bud, there are no protective flaps to keep the chip bud from drying out. Therefore, securely wrapping the bud is necessary to seal the cut edges, as well as to hold the bud piece in place. Nursery workers’ adhesive tape works well, although white or transparent plastic tape is more often used. Once the buds start to grow, the tape must be cut.

In chip budding the stock is not cut back above the bud until the union is complete. If the bud is inserted in the fall, the stock is cut back just before growth starts the next spring. If the budding is done in early spring, the stock is cut back about 10 days after the bud has been inserted.

## Growing Fruit Plants from Seed

Grafting and budding require a compatible rootstock or stock plant onto which you attach your desired variety of fruit plant. An inexpensive way to obtain a seedling rootstock is to collect seeds from the type of plant you are propagating. This section gives a simple method to help germinate seeds to produce grafting rootstocks.

The seeds of all common tree fruits (apple, pear, peach, and cherry) require a chilling period before they will germinate and form new plants. The chilling period, known as dormancy or

after-ripening, occurs after the fruit portion is ripe. During this period the embryo develops until it is mature. The necessary after-ripening could be accomplished by the following two systems.

### Method 1—Outdoors

Prepare a garden-soil plot in the fall as you would for planting any other type of seeds. Make a furrow no deeper than one or two times the longest dimension of the seed. Cover the seeds with a light cover of soil and add an inch or two of sand over the row. The sand will prevent the soil from crusting, which inhibits germination.

Next, place wire screen, or hardware cloth, over the row—be sure that all of the edges are pushed several inches into the soil and that the ends are closed. This prevents chipmunks and squirrels from digging up the seeds. The following April watch the seeded area closely for newly germinated seedlings. As the seedlings grow, remove the wire screen to prevent restricting the

new plants (see “Handling in the Nursery” below).

### Method 2—Refrigerator

Extract seeds and/or pits from the fruit you want to reproduce. Remove all adhering fruit portions and allow seeds to air-dry. Then, place them in a glass jar or other suitable container to which a loosely fitted lid or cover may be added. Set the seeds aside in a cool place until mid-January.

Seeds require after-ripening. The length of this period varies by type of fruit (Table 1). The temperature at which the seeds are stored will also impact the success of germination. Seeds should be stored dry in a sealed container at the appropriate temperature. Most seeds can be stored in airtight containers for up to 1 year if temperature is controlled.

If seeds have not previously received a cold treatment, mix the seeds with either moist (not wet) peat moss, sand, or shredded paper towels in mid-January. Return the mixture to

**Table 1. After-ripening requirements for certain fruit tree seeds.**

TREE	EFFECTIVE TEMPERATURE (°F)	BEST TEMPERATURE (°F)	DAYS REQUIRED
Apple	40–50	40–41	70–80
Apricot	40–50	45	60–70
Cherry	33–50	41	90–140
Peach	33–50	45	120–130
Pear	33–41	40	60–90

the container and replace the lid. Place container and seeds in the refrigerator until after the last severe spring frosts. The seeds should remain in the refrigerator for at least 60 days. In early April prepare a garden-soil seedbed with furrows as described above and plant the seeds. Keep the soil moist but not wet. Do not add fertilizer.

### Handling in the Nursery

When the plants are 6 to 8 inches tall, apply 1 to 2 tablespoons of urea along every 12 inches of row in a band on one side of the seedlings. Keep the fertilizer about 3 inches away from

the seedlings. Water thoroughly every 10 to 12 days.

The new seedling has a taproot. To facilitate transplanting, cut the taproot by pushing a spade under each plant. Push the blade into the soil to cut the taproot about 5 to 6 inches below the surface.

Peach, nectarine, almond, and apricot seedlings may be budded the first summer, usually in late July or early August. Apples, cherries, pears, and plums should be allowed to grow through to the July-August period of the second year before budding is done.

## Grafting Supply Resources

Orchard Valley Supply  
Phone: 888-755-0098  
Web site: orchardvalleysupply.com

A.M. Leonard Inc.  
241 Fox Drive  
Piqua, OH 45356  
Phone: 800-543-8955  
Web site: www.amleo.com

OESCO, Inc.  
PO Box 540, Route 116  
Conway, MA 01341  
Phone: 800-634-5557  
Web site: www.oescoinc.com

Ben Meadows Company  
PO Box 5277  
Janesville, WI 53547  
Phone: 800-241-6401  
Web site: www.benmeadows.com

Forestry Suppliers  
205 West Rankin St.  
PO Box 8397  
Jackson, MS 39284  
Phone: 800-647-5368  
Web site: www.forestry-suppliers.com

Prepared by R. M. Crasweller, professor of tree fruit.

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