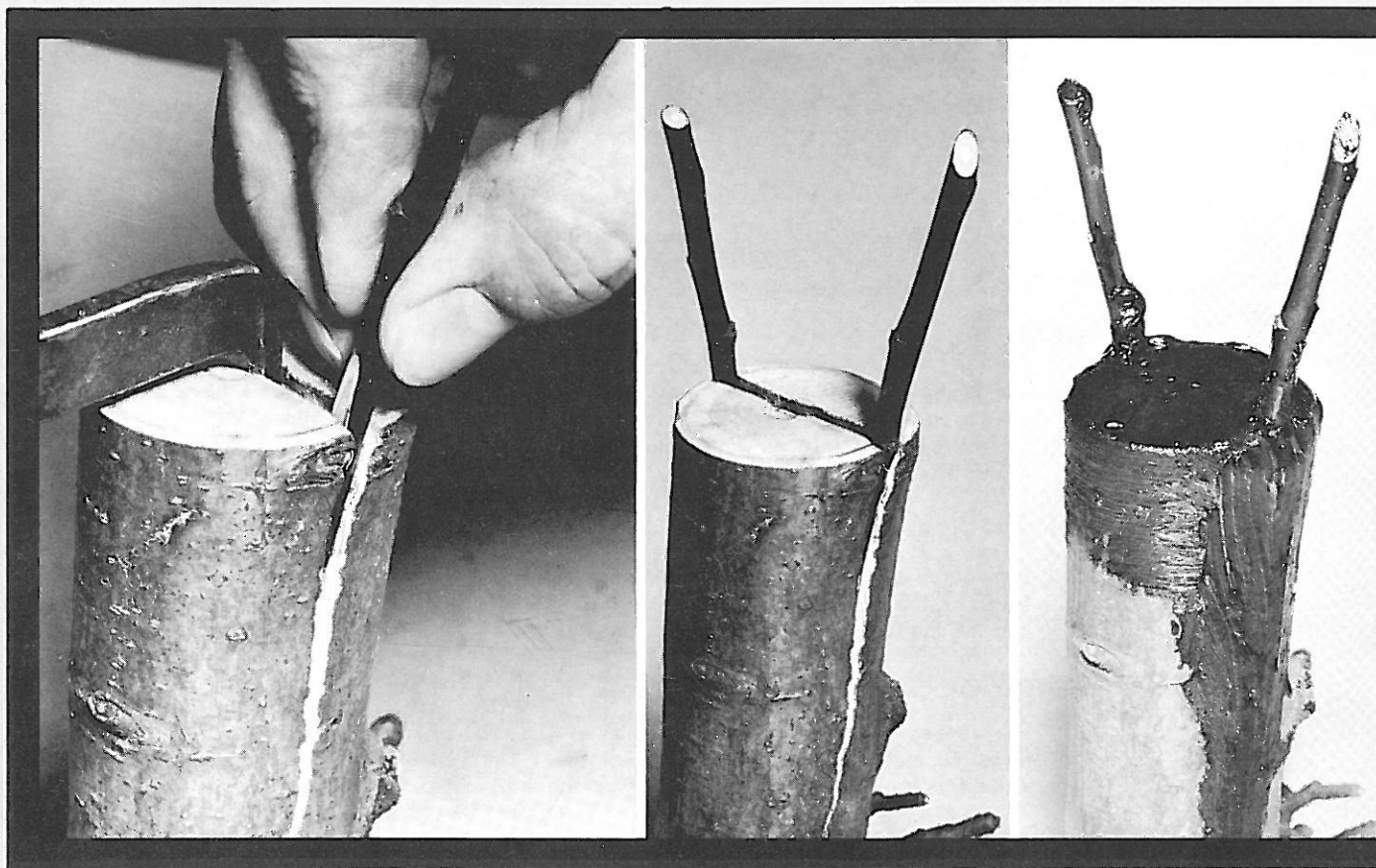


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GRAFTING FRUIT TREES



CLEFT GRAFT page 5

The cleft graft is commonly used for top-working trees, changing them from one variety to another. It works best on branches 1 to 2 inches in diameter, although it may be used on larger branches. This graft can be made any time you can get dormant scion wood, but the best time is from January to March or April.

SIDE GRAFT page 9

The side graft is also used for top-working trees. It is faster than the cleft graft and is particularly suitable for branches from $\frac{1}{2}$ to 1 inch in diameter. It can be made at the same time of year as the cleft graft.

BRIDGE GRAFT page 10

The bridge graft is used to repair injuries in which large areas of bark have been destroyed. Bridge grafting can be done only when the bark slips. Although it can be done as late as June, the sooner it is done after the bark slips in the spring, the better.

INARCH GRAFT page 12

The inarch graft is used to repair root injury. Young trees are set around the trunk of the injured tree and their tops are grafted into the trunk. This graft can be made only when the bark slips.

VENEER OR BARK GRAFT page 12

The veneer graft can be used in place of the cleft graft to top-work a tree. It is faster to make, but not always as suitable. The veneer graft can be made only when the bark slips. The sooner after the bark slips, the better.

WHIP, TONGUE, OR BENCH GRAFT page 14

This graft can be used to propagate nursery stock, to graft scion wood to a piece of root, and to top-work small trees. It is done from January to March, using dormant wood.

BUDDING page 15

Budding is the most common method of propagating new trees. It is easier than whip grafting. Budding can also be used to change varieties on young trees that are from one to three years old. Budding can be done any time buds are fully developed and the bark of the stock slips, but most budding is done in July and August.

This bulletin was written by John C. Snyder, Extension Horticulture Specialist, Washington State University, and Richard D. Bartram, County Extension Agent, Wenatchee, and reviewed by the Extension Horticulture Specialists of Oregon State University and the University of Idaho.

GRAFTING FRUIT TREES

WHAT YOU CAN GRAFT

You can usually graft most varieties of one particular kind of fruit interchangeably. But, because some varieties grow faster than others, placing a strong variety on a weak variety often results in considerable overgrowth. Delicious apple on Jonathan and sweet cherries on Montmorency sour cherry are examples (Fig. 1). Such combinations can stimulate earlier production, as with sweet cherries on Montmorency, but may cause structural weaknesses.

With apples, certain combinations appear to be better than others. Delicious grafted onto several varieties, such as Ben Davis, Arkansas Black, or Red Astrachan, grows almost as though no top-working had been done. But in certain other combinations, growth is sub-normal and unsatisfactory. Delicious on Winesap is an example, and in some locations, Van cherry on Mahaleb.

In general, only those combinations known to be satisfactory are commonly used. For practical use, it is usually safe to combine varieties of about the same growth rates.

In some cases you can graft one kind of fruit onto a different kind as long as stone fruits are

grafted onto stone fruits and apple onto apple. Occasionally, there is an advantage in grafting one stone fruit onto another. Plum on peach stock sprouts less than plum on plum. Standard pear varieties grafted onto quince stock produce trees that start bearing early.

TOOLS AND MATERIALS

A sharp knife has no substitute. Almost any pocket knife that takes and holds a sharp edge will do, but regular grafting and budding knives have worthwhile advantages.

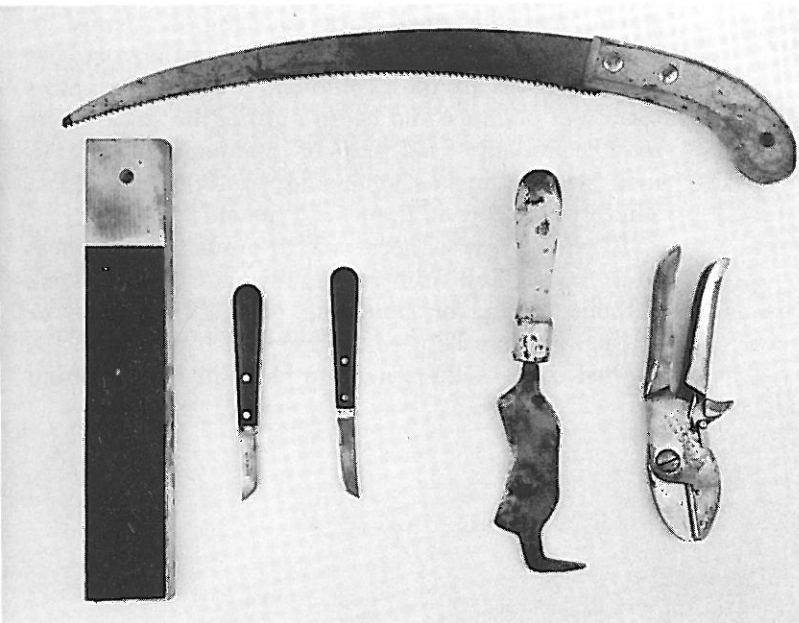
The grafting tool is designed especially for making the cleft graft. It has a curved blade that is used to split the stub and a non-cutting wedge that is used to hold the two sides of the cleft apart as you insert the scion (Fig. 2). If you do not have a grafting tool, a heavy knife and some type of wedge will do. The wedge should be at least 2 inches long and fairly wide. If the wedge is too short, it will slip out of the cleft. If it is too narrow, it will bury itself in the wood without opening the cleft enough.

A mallet or hammer is needed to pound the grafting tool when splitting the stub.

FIG. 1—Graft in which scion (upper left) has overgrown stock. The scion is Delicious apple and the stock is Jonathan. It is usually better to combine varieties that grow at about the same rate. Generally only combinations known to be satisfactory are used.



FIG. 2—Top: Fine-toothed saw for sawing off stub to be grafted. Bottom (left to right): Leather strop glued to 1-inch board, budding knife with curved cutting edge, budding knife with straight cutting edge, grafting tool, and hand clippers.



GRAFTING TERMS

SCION—A piece of detached twig or shoot used in propagating the plant from which the twig is taken. The scion usually contains two or three buds. It may contain more. For most kinds of grafting it is the top part of the graft.

STOCK—The portion of the graft to which the scion is attached. It may be a piece of root, a seedling, or a tree with part of the top removed in preparation for grafting.

CAMBIUM—A very thin layer of living cells lying between the outer sapwood and the inner bark. Because cambium cells divide and make new cells, the cambiums of two different but related plants will grow together if they are fixed and held firmly in contact.

Nails are required for veneer, bridge, and inarch grafts. You need long, thin nails, preferably 19 or 20 gauge, with flat heads. The nails should be long enough to go well into the sapwood of the stock. For bridge grafting you need nails about $\frac{3}{4}$ inch long. For inarch grafting, unless the bark is very thick, $\frac{1}{2}$ inch nails are long enough and are easy to drive without bending.

Grafting tape is necessary for the whip graft. It is also good for binding cleft grafts in which there is not enough natural pressure of the wood to keep the cambiums of the stock and scion together. Some grafters use it to bind veneer grafts, too. If regular non-elastic canvas grafting tape is used, it must be slit before it starts to girdle the branch. There also is a non-canvas grafting tape which does not require slitting. Electrician's tape and masking tape can also be used without being slit. Masking tape is excellent for whip grafts that do not require a lot of pressure for binding.

Budding strips are important for holding the bud shield, and the stock bark covering it, firmly in place. Raffia was used at one time, but now rubber budding strips are most common. Rubber maintains continual pressure and doesn't girdle the stock. The most commonly-used size of budding strip is $\frac{1}{4}$ inch wide, 5 inches long, and 16/1000 inch thick. There are 1,200 of these in 1 pound.

Grafting wax is necessary to protect cut surfaces from drying and from rot organisms. It must stick without peeling or sloughing off. Either hand or brush wax may be used. Some brush waxes can be applied cold. Others need to be heated to brushing

consistency. They should be heated just enough to brush well—about like thick paint. Wax that runs freely like water or milk is too hot. It will burn the tissue of the graft. Commercial grafting compounds are available at your local garden store, feed store, or fruit supply store. Do not use unproved materials; they may injure the cambial tissue and cause considerable loss.

A *brush* is needed to apply the grafting wax. An inexpensive paintbrush, about $1\frac{1}{2}$ inches wide, is satisfactory. Between jobs, the brush should be thoroughly cleaned and wrapped tightly in a piece of plastic. It can be cleaned by rubbing the bristles energetically in loose soil and then washing it out. One brush can easily last a season.

WHEN TO GRAFT

The sooner you graft after conditions are ready, the better. Grafts set in March or April or even earlier usually become established before hot weather sets in.

For some fruits certain periods are definitely better than others. For example, while you can cleft graft any time you can get dormant scion wood, the ideal time with apples is just as the buds start to swell. For peaches and cherries, earlier is better.

COLLECTING AND STORING SCION WOOD

A graft can be no better than the scion wood, so the scion wood must be disease-free wood that will grow.

For most grafting, one-year-old wood is preferable to older wood although there are cases in which

older wood has been used satisfactorily. The wood should be of average vigor and well hardened. Wood grown in sunlight is better than wood grown in shade.

It is usually best to use wood about lead pencil size, or $\frac{1}{4}$ inch in diameter (Fig. 3). Wood of this size is usually firm enough to be cut into a well-shaped, solid wedge. Smaller wood is hard to handle and the pressure of the cleft graft stock may crush it. For long bridge grafts it may be necessary to use wood $\frac{1}{2}$ inch or more in diameter.

Wood that has been injured by low winter temperatures, particularly in early fall, is not satisfactory. Injured wood turns brown in the cambial area soon after the freeze. Discoloration at the base of the bud is common. Slightly discolored buds seem to grow all right, but if the inner bark is seriously discolored, scion wood probably will not grow.

Most scion wood is collected while the wood is dormant, in the late fall immediately after leaves drop. This safeguards against winter damage. Some good bridge grafting has been done with wood collected after growth had started. These grafts were put on right after being collected.

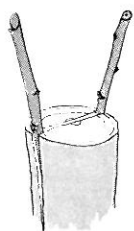
As you collect scion wood, tie it in convenient bundles. Store the bundles in a cold, moist place. About 34° F. is a good temperature. Protection from mice may be necessary.

A convenient way to store scion wood is to bury



FIG. 3.—Bundle of scion wood. One-year-old wood is preferable for most grafting. It should be free from disease or winter injury and well hardened.

the bundles in soil or sawdust on the north side of a building. Bury them deep enough so they will stay cold even in late spring. If you have just a few sticks, you can put them in a plastic bag and store them in the refrigerator. Scion wood can also be stored in a warehouse if it is kept moist and cool. If properly stored, scion wood can be kept well into the following growing season.



THE CLEFT GRAFT

The cleft graft is commonly used to top-work a tree, changing it from one variety to another. To cleft graft, choose small branches—1 to 2 inches in diameter. Large branches do not heal as fast as small ones. Using small branches shocks the tree less and reduces the danger of rot.

Branches that are fully exposed to sunlight and in the stream of sap flow are better than those in shaded or inactive areas of the tree. Grafts on upright branches grow better than those on horizontal branches.

Any number of cleft grafts may be made on a tree as long as the grafts do not crowd each other

out. The more there are on a tree the sooner it comes into bearing.

PREPARING THE STOCK

Branches have to be sawed off to provide a stock for the scion. Before sawing, select a smooth, knot-free, straight-grained section of the branch.

To avoid tearing the bark where you want to put the graft, first saw the branch off several inches above the straight-grained section. Then, saw the branch off again in the upper part of the smooth section at right angles to the grain. Avoid tearing or splitting the bark.



FIG. 4—If the saw cut is not smooth, use a knife to trim off the rough edge on the stub to be grafted. Trimming helps make sure the bark is tight and helps insure a good seal in waxing so the graft will heal rapidly.

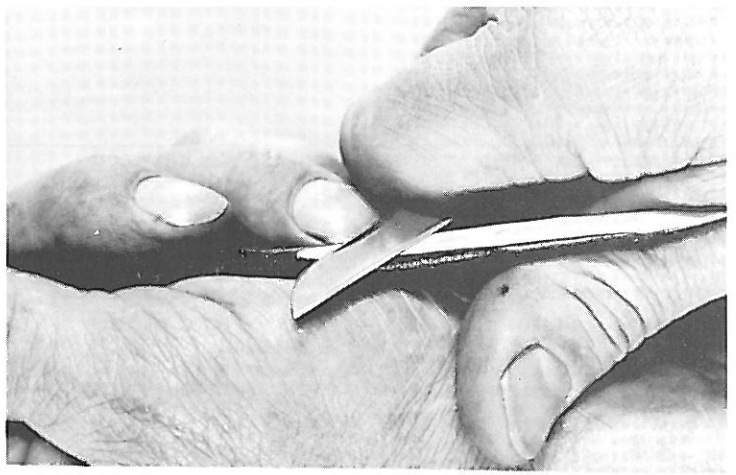


Fig. 5—Cleft graft scion with one side of wedge cut, showing position of knife to make cut. Make cut toward you, with single, straight stroke, leaving smooth, level surface.



FIG. 6—Scion after both sides of wedge have been cut. One edge is thicker than the other. Wedge is usually cut so bottom bud is on the thick side.

If you do not make a smooth cut all the way across, trim off the rough edge with a knife (Fig. 4). This trimming helps make sure the bark is tight where you put the graft. It also helps exclude air as you cover the graft with wax.

Using the grafting tool, split the stock so a crack extends through the center of the branch. You will usually not have to drive the grafting tool more than 2 inches into the branch. Driving the tool too far splits the branch more than needed. If there are slivers in the crack, cut them with a knife. Otherwise, slivers interfere with inserting the scion.

PREPARING THE SCION

The cleft graft scion should be healthy, one-year-old wood that is about $\frac{1}{4}$ inch in diameter. Smaller wood is hard to handle and to cut into a well-shaped, solid wedge. Also, the pressure of the stock may crush it.

To prepare the scion for grafting, cut a wedge on the butt end of the scion stick. Start about 2 inches from the end and make a long, smooth cut toward you that has a surface about 1 to $1\frac{1}{2}$ inches long (Fig. 5). Cut with a single straight stroke that leaves a smooth level surface such as you would make with a carpenter's plane. Just whittling will help you develop skill for making well-fitting wedges.

Some grafters like to start cutting the wedge

just below a bud. This leaves the bottom bud of the scion near the top of the wedge.

Turn the scion over and make a similar cut on the opposite side. These two cuts make a two-sided wedge (Fig. 6). When making the second cut, hold the knife so that you make one side of the wedge slightly thicker than the other. Be sure the wedge is about $1\frac{1}{2}$ inches long.

The wedge is usually cut so that the bottom bud is on the thick side. This bud sometimes grows when others fail.

The wedge does not need to come to a sharp point. A blunt point is preferable, particularly when grafting large branches. The cut surfaces of a blunt-pointed wedge more nearly parallel the split surfaces in the stock.

After cutting the wedge, shorten the scion to the desired length, usually three buds. You may get fewer takes if you leave more than three buds. If wood is scarce or expensive, you can leave just one or two buds.

INSERTING THE SCION

The cambiums of the scion and stock must be in contact for the graft to grow. To insure contact, slant the scion slightly. Although maximum contact is obtained when you set the scion straight, there is also a chance that the cambiums will not

touch at all if you do not slant it. It is better to be sure of getting some contact by slanting the scion than to try to get more and miss completely.

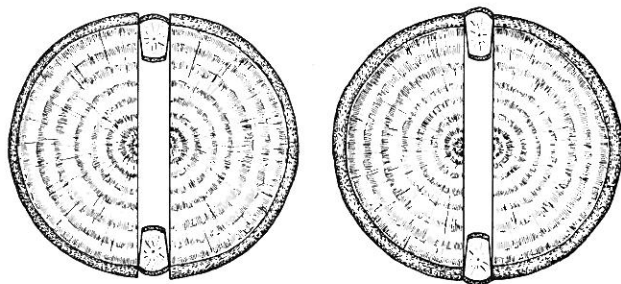
Where the cambiums touch is important. They must touch where the stock is tight against the scion (Fig. 7). It is better for this contact point to be about $\frac{1}{4}$ inch below the shoulder of the stock.

With the non-cutting edge of the grafting tool, open the crack in the stock wide enough to insert the scion without much force. Insert the scion so the thick side of the wedge is toward the outside and its cambium is in contact with the cambium of the stock (Fig. 8). Then the pressure of the stock against the scion will be greatest at the point where the cambiums touch. Be sure to push the scion wedge down into the crack far enough to hide nearly all its cut surface.

Two scions are usually inserted in each cleft (Fig. 9). This gives you two chances of getting the graft to grow. Two growing scions cover the stock faster than one. When using only one, insert it on the top side of the stub.

WAXING THE GRAFT

Wax the graft so that all cut surfaces are well covered. Pay special attention to the cracks on the top and sides of the stock. Coat the side of the



A. Right

B. Wrong

FIG. 7—Cambiums must touch where stock is tight against scion. Point of contact should be $\frac{1}{4}$ inch below shoulder.

stock to about $\frac{1}{2}$ inch below the shoulder to be sure the top surface is well covered (Fig. 10).

As you finish, coat the cut end of the scion and recheck to see that all cut surfaces are covered. Cracks sometimes develop as the wax sets. It is well to check a few days later and then several weeks later to be sure all cut surfaces are kept covered.

CARE OF THE GRAFT

Making the graft properly doesn't finish the job. You must give it attention as it grows.

The graft usually produces one to several branches each growing season. Allow all branches

FIG. 8—Inserting scion. Thick side of scion wedge is toward the outside and cambiums of stock and scion touch. Push scion down far enough to hide nearly all its cut surface.

FIG. 9—Graft with both scions inserted and ready for waxing. Notice that scions slant slightly and that bottom bud is on outside of scion.

FIG. 10—Cleft graft after waxing. All cut surfaces have been covered, except for the end of one scion, which still needs waxing.



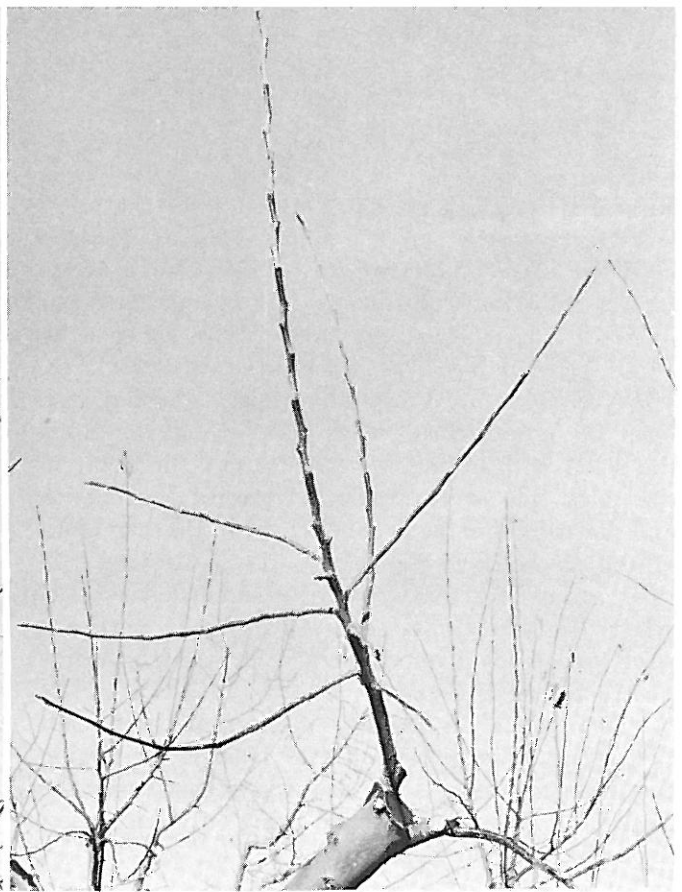
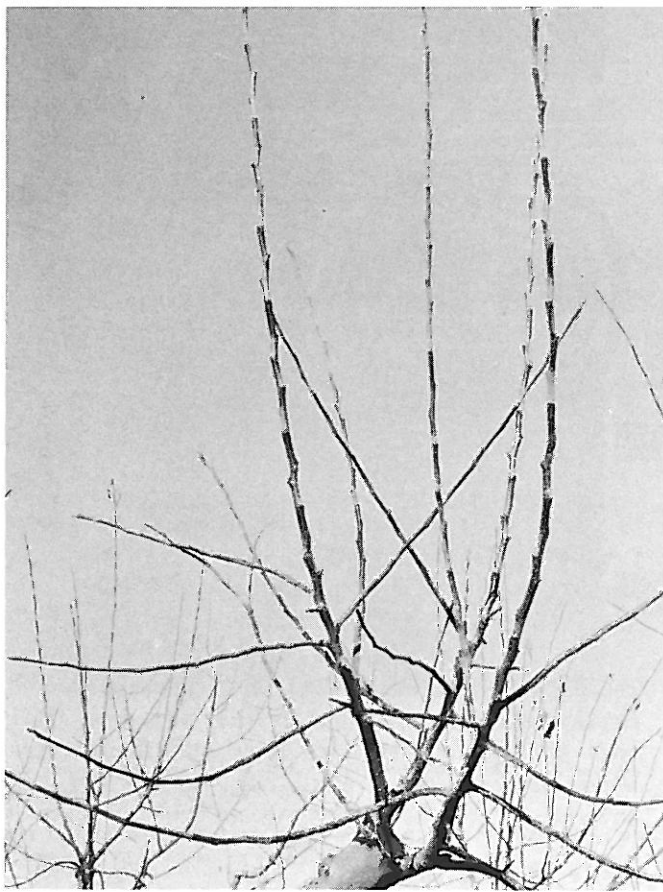


FIG. 11—Prune graft after first growing season. Left: One-year-old graft without any summer pinching or dormant pruning. Both scions have grown vigorously. Right: The same graft after pruning.

Lower graft was pruned to keep from crowding upper one. Remaining main stem of upper graft was not headed; if there had been no side branches, it would have been headed at 18-24 inches.

to grow without pruning during the first season. You can, however, pinch back very vigorous shoots that would otherwise grow several feet without producing lateral branches. When these shoots reach the point where you want a lateral branch, pinch out the end. This pinching will give some protection from wind. Grafts that are growing more slowly and do not appear likely to grow more than 2 or 3 feet during the first season do not need to be pinched.

For most cleft grafts, light pruning is definitely preferable to heavy pruning. Heavy pruning stimulates the graft. As a rule, cleft grafts are vigorous and need to be slowed down rather than stimulated. Light pruning can shape them and at the same time permit them to bear early. Light pruning also helps to speed the growth of new tissue over the wound and reduce the danger of infection.

After the first growing season you will need to do some training and branch selection (Fig. 11). Do it in late winter or early spring. Even if both grafts on a stub grow, and they usually do, one is usually better than the other. If one is on the top side of the stub and the other on the bottom, gen-

erally the top one is preferable. It is less apt to pull out. Remove weak crotches from it and do any other structural pruning that may be necessary. If the branch is long and whippy, head it.

Shorten the other graft enough so that it will permit free branching of the selected one, but do not take it off. Keeping both grafts helps to cover the wound faster. Follow this same practice when there are several scions on any particular stub.

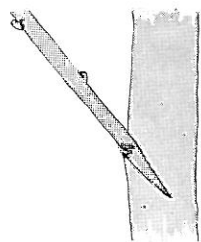
When pruning top-worked trees, leave stock branches of the variety you are replacing as long as they do not interfere with the grafts. When grafting only small wood, you can remove nearly all the stock branches during the first dormant pruning after grafting (Fig. 12). When grafting larger wood, removing all of the stock wood during the first or second year usually shocks the tree unnecessarily, complicates training, and delays bearing. You should take two or three years to get rid of larger wood.

It is a good idea to check the wax as you prune, even during the second year, to be sure that the wound is completely covered. It may be necessary to recover some areas, particularly in the cracks.



FIG. 12—Nearly all the stock branches can be removed during the first dormant pruning if you are grafting only small wood. Left: A

top-worked apple tree before pruning. Right: The same branch after pruning.



THE SIDE GRAFT

The side graft is simple and easy to do. It is considerably faster than the cleft graft. More side grafts are usually put on a tree than cleft grafts because side grafts are put on smaller branches.

When choosing the stock branch, select one that is from $\frac{1}{2}$ to 1 inch in diameter. The scion should be about $\frac{1}{4}$ inch in diameter.

Shape the butt end of the scion into a two-sided wedge like that used for the cleft graft, but make the wedge shorter.

MAKING THE GRAFT

Select a smooth area near the base of the stock. Using a strong, sharp knife, make a slanting cut about halfway through the branch.

To insert the scion, spring open the crack by bending the branch away from the crack. Insert the scion with the thick side of the wedge out (Fig. 13). Only the top surface of the wedge should be exposed above the crack. Then let the branch spring back to its natural position. The spring holds the scion in place, so no tacking or binding is necessary.

CARE OF THE GRAFT

Stub the stock branch at 5 or 6 inches beyond the graft. As soon as the graft is made, remove

any lateral branches on the stub that will crowd the graft. Over a period of two or three years remove any other lateral branches that may be on the stub. Wax the graft carefully so that all cut surfaces of both scion and stock are covered. Cover the tip of the scion and the wounds made by removing lateral branches from the stub.

FIG. 13—Insert scion of side graft with thick side of wedge toward outside of cut. Stock should be stubbed off 5 or 6 inches above graft and all cut surfaces should be covered with wax.





THE BRIDGE GRAFT

The bridge graft is used to repair injuries in which large sections of bark have been destroyed. Bridge grafts restore the passage of food and cover the sapwood. The sooner you graft after the injury occurs and the more grafts you use, the sooner the tree will recover. Place the grafts 3 inches or less apart. Eventually, they grow together and form a relatively smooth trunk surface.

When bridge grafting mice-girdled trees, you often see narrow strips of bark which the mice have missed. Even though these may be very small, they are valuable. They are more effective than bridges and also cut down the number of grafts needed.

Bridge grafting can be done only when the bark slips. Although it can be done as late as June, the sooner it is done after the bark slips in the spring, the better. In the slipping stage, some cambium cells stay on the sapwood when you separate the bark from the wood. Then when you place the scion against the wood, cambium cells are in contact with those on the wood all the way around the cut surface of the wedge.

SELECTING THE SCION

Dormant wood that is collected in the fall is preferable for the scion. But you can use wood cut directly from the trees even after the buds have swollen. Well-hardened, one-year-old wood will usually make the best scion.

The size of the scion may vary from $\frac{1}{4}$ to $\frac{1}{2}$ inch or more in diameter, depending on the needed length of the graft. For longer grafts it may be necessary to use wood of larger diameter.

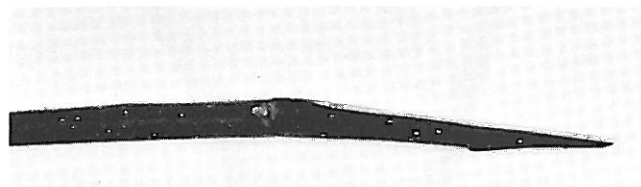


FIG. 14—One-sided wedge for bridge grafting. Cut surface of scion should be about 2 inches long, smooth, and level. Clip off the tip of the wedge to make it easier to insert.

PREPARING THE STOCK AND SCION

Select a smooth accessible place on the stock for the graft. Rough surfaces and places that are hard to get at require more time. It is not necessary to trim the margins of the injured area unless trimming will help you do a smoother job of grafting. Trimming takes time and may expose more cut surface.

To prepare the scion, first select a whip that you are sure is long enough to bridge the injured area. Fit it, right end up, in the exact position that you later expect to nail it. While the whip is still in place, mark where you want to cut it off at the top and bottom. Also use it as a guide to cut strips or tongues of bark in the stock. You can later slip the ends of the scion under these strips. Cut only through the bark. The tongue need be only long enough for starting the scion wedge—about $1\frac{1}{2}$ inches. Sliding the wedge under uncut bark helps snug the tip of the scion firmly against the wood.

Cut regular one-sided wedges on each end of the scion (Fig. 14). Each cut surface should be about 2 inches long. After cutting one side, you may want to turn the wedge over and clip off the tip. This makes a better point for slipping the wedge under the bark. Shape the other end of the scion in the same way. But, before you cut it, again fit the scion exactly where it is to be nailed. This is to make sure that it fits snugly into place without having to be twisted.

INSERTING THE SCION

When you are ready to insert the scion, begin with the bottom end, as it is often hard to insert and to keep free of loose dirt. Keep the top end free while you work.

Lift the end of the bark strip enough to start the tip of the wedge, but don't peel the bark all the way back. The wedge will loosen it as you slide the scion into place (Fig. 15). In this way, you keep the wood with which you must make contact clean and fresh. Insert the scion far enough so all the cut surface of the one-sided wedge is firmly in contact with freshly uncovered wood.



FIG. 15—Insert scion far enough under bark so that all the cut surface of the wedge is in contact with freshly uncovered wood.



FIG. 16—To tack scion in place, put a nail through tongue of bark and scion, then drive second nail through scion.



FIG. 17—Wax between scion and stock, especially toward ends of scion. Also cover injured part of stock with wax.

Then tack the bottom of the scion with two nails (Fig. 16). The first nail should go through the tongue of bark and the scion. Cut off the loose end of the tongue. Drive the second nail through the scion 1 to 2 inches above the first nail. As

soon as you have the bottom end of the scion tacked in place, insert the top end the same way. In young trees where the trunk is apt to bend considerably, it is a good idea to set the scion with some bow to allow for the bending.

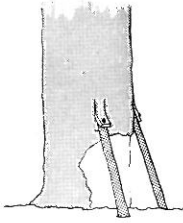
WAXING THE GRAFT

It is rather difficult to get wax between the scion and stock, especially toward the ends of the scion. When waxing, pay special attention to this area (Fig. 17). You need not cover the middle section of the scion, but covering the injured section of the stock protects it from weathering and decay.

CARE OF THE GRAFT

A bridge graft should be kept from producing shoots. Remove starting shoots as soon as they appear (Fig. 18). This will force food to pass through the scion. The entire length of the scion will increase in diameter very rapidly. But if shoots are allowed to grow, the bottom of the scion will grow much faster than the top. Numerous branches on the scion may virtually dwarf out the top union. A properly cared for bridge on a grown tree can grow to 1 inch in diameter during the first season.





THE INARCH GRAFT

You can repair hard-to-get-at and extensive root injury to a tree by using the inarch graft (Fig. 19). To make this graft you simply set young trees around the trunk of the injured tree and graft their tops into the trunk. Vary the number of inarch trees with the severity of the injury. For a badly injured apple tree, you may want to use as many as five or six.

MAKING THE GRAFT

Use only healthy trees for inarching. One-year-old trees are preferable. When setting the trees, slant them so their tops lie against the trunk on which they are to be grafted. The top of the young tree is grafted onto the trunk of the injured tree with a bark graft like that used for bridge grafting.

Make a one-sided wedge on the top of the young tree. Insert the wedge into the bark of the injured tree so that all the cut surface of the wedge is in contact with the sapwood of the trunk. The young tree is then usually nailed to hold it firmly in place.



THE VENEER OR BARK GRAFT

The veneer graft can be used in place of the cleft graft to top-work a tree. It is faster to make, but not always as suitable.

The cut surface of the scion is placed against the surface of the sapwood instead of being set in a cleft or notch cut into the wood. Contact obtained is much greater than with the cleft graft. However, the union during the first year or two sometimes is weak. Fast-growing shoots sometimes blow out.

When the veneer graft is used in place of the cleft graft, the size, position, and other character-

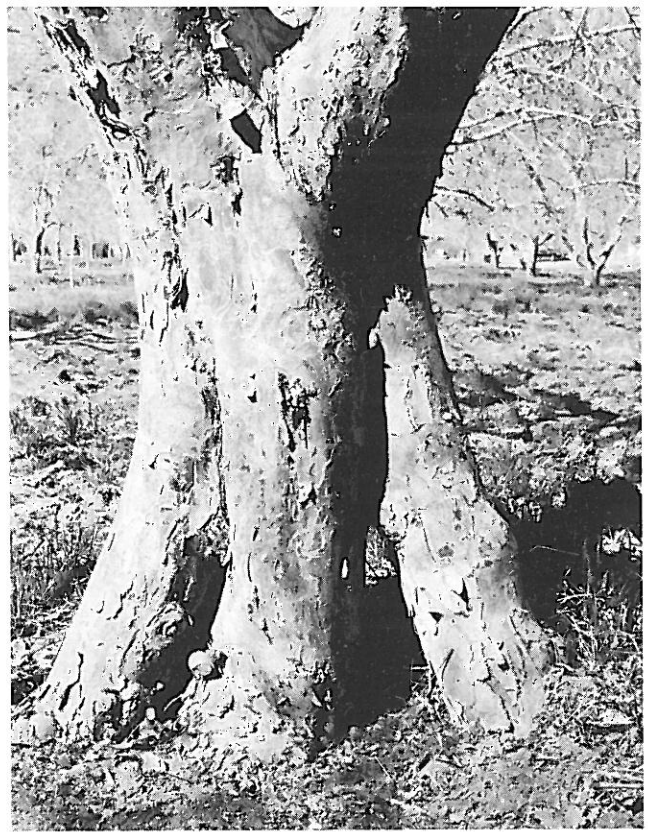


FIG. 19—A bearing apple tree repaired by inarching. The inarch grafts have grown together and completely replaced the trunk.

CARE OF THE GRAFT

Keep branches from developing on the young trees. Go over them several times during the first season and occasionally later, pinching off new sprouts as they appear.

istics of both the stock and scion are quite similar to the cleft graft. It can be used on stocks $\frac{1}{2}$ inch in diameter, but works better on larger wood. When very small stocks are used, medium-sized to small scion wood should be used and the graft should be wrapped.

The veneer graft can be made only when the bark slips. The sooner after the bark slips, the better.

PREPARING THE STOCK AND SCION

Saw off the stock branch as you would for a cleft

graft. Shape the scion into a one-sided wedge about $1\frac{1}{2}$ to 2 inches long. Dormant scion wood gives better results than wood with swollen buds, although the latter can be used.

INSERTING THE SCION

There are several different ways of inserting the scion. The most common is to cut a tongue in the bark like that used for the bridge graft (Fig. 20, 21). But some grafters short-cut this method by making only one short slit in the bark at the point where the scion is inserted (Fig. 22). To insert the scion, they lift the bark at this point with the knife blade if necessary and then slide the scion down to the proper depth, wedging it between bark and sapwood. The bark may or may not crack. Still other grafters insert the scion without even making a short slit for starting the scion. These short-cut methods usually yield somewhat fewer takes, but under some circumstances are economically satisfactory.

By far the most common method of fastening the scion is to nail it to the stock (Fig. 23). However, some grafters insert the scion and do not bind or nail it. Nailing has certain disadvantages. The nail sometimes splits the scion. This injury is especially objectionable on small scions and with certain plant materials. To avoid it, binding materials of various kinds can be used. Electrician's tape, paper grafting tape, and masking tape are quite satisfactory.

The veneer graft calls for usual waxing care to be sure that all hard-to-get-at surfaces are covered.



FIG. 22—Scion can be inserted by making a short slit in the bark instead of cutting tongue, but this method results in fewer takes.

FIG. 20—Use scion to mark width of tongue to be cut. Cut through bark only. Make tongue just long enough to start wedge.

FIG. 21—Insert wedge under tongue of bark. Push down far enough so all the cut surface is firmly in contact with stock.

FIG. 23—Drive one nail through tongue of bark near base of scion. Then drive second nail about 2 inches higher.





THE WHIP, TONGUE, OR BENCH GRAFT

The whip graft is easy to do and heals over rapidly. It is generally used on small trees, particularly in propagating nursery stock. It is also used for top-working trees and is especially useful on young trees.

The bench graft is a variation of the whip graft in which a piece of root is used for the stock. To make this graft, remove a piece of root from a healthy tree and whip graft the variety you are propagating onto it. You can then plant the graft with the graft union at the soil line or a little lower.

For all whip grafts the stock should be smooth and straight grained. It is important to avoid side branches in the area where the graft is to be made. In the case of root grafts you may have to trim off side roots.

When selecting the scion, choose one-year-old wood, preferably the same size as the stock. When

the stock is larger than the scion, you can get contact on only one side.

PREPARING THE STOCK AND SCION

How you cut the stock is important. Starting about 2 inches from the butt of the whip, make a smooth, straight cut about $1\frac{1}{2}$ inches long (Fig. 24). With practice and a sharp knife you can make this cut with one good sweeping movement. It should not be necessary to do any extra whittling to make it straight and even.

You are now ready to make the final cut. Hold the one-sided wedge up with the cut surface facing you and support the wedge with your pointing finger. Starting about one-third of the way down from the tip of the cut you have already made, make a downward cut about $\frac{1}{2}$ inch long (Fig. 25). Make the cut approximately parallel with the grain of the wood. Prepare the scion in the same way and leave it two or three buds long.

With scion and stock cut, fit them together (Fig. 26). Push them together far enough so the cut surfaces match. The toe of the scion then just comes to the heel of the stock. If the scion and stock are not the same size, be sure to match the cambiums on one side only.

WRAPPING THE GRAFT

Whip grafts must be wrapped to maintain contact (Fig. 27). When wrapping see that the scion does not move out of position. The tips of both wedges should be bound tightly against matching cut surfaces.

When using non-elastic binding material that may girdle the graft, or material that will not dis-

FIG. 24—Scion and stock of whip graft cut into one-sided wedges and ready for next cut. Note that scion and stock are of same diameter. Cut surfaces are about $1\frac{1}{2}$ inches long.

FIG. 25—To make final cut, hold the one-sided wedge up with cut surface facing toward you. Start about one-third of distance down from tip of cut surface and cut straight down for about $\frac{1}{2}$ inch. Cut should extend to $\frac{1}{2}$ inch from lower end of cut surface.

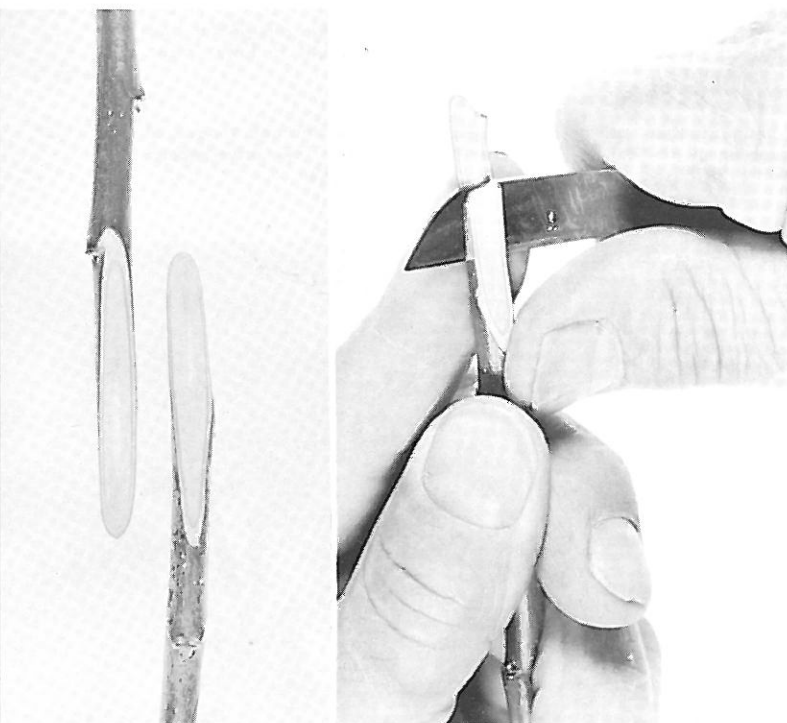




FIG. 26—Fitting scion and stock of whip graft together. Push them far enough together so cut surfaces match.

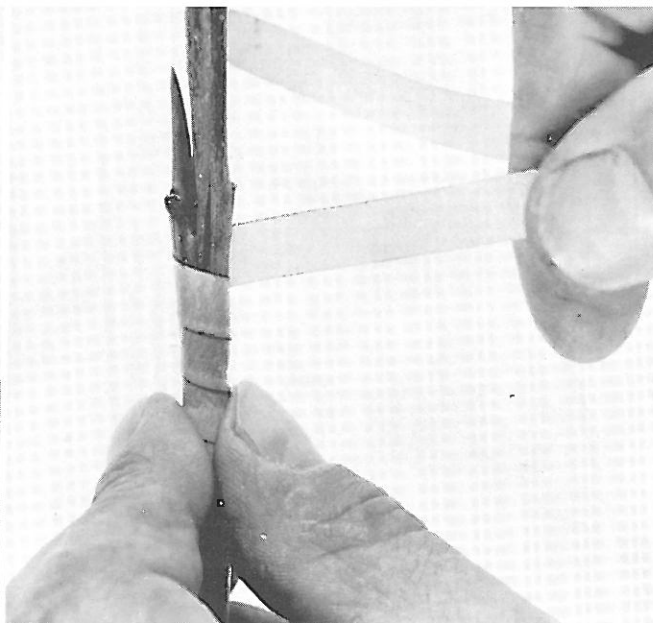


FIG. 27—Wrapping whip graft. Tips of both wedges should be bound tightly against matching cut surfaces.

integrate as the graft grows, you can either slit the material as you complete the wrapping or do it several weeks later.

Although it is not considered necessary to wax whip grafts, doing so often increases the percentage of takes. This is especially true of grafts that are not covered with soil. Waxing may not be needed when you use highly elastic material, such as electrician's tape, because you can make a fairly tight

wrap. But with masking tape, waxing is certainly an improvement.

CARE OF THE GRAFT

Because the whip graft heals rapidly and grows straight, it needs only a minimum amount of care. When whip grafting seedlings, be sure that sprouts from the stock do not develop and interfere with the graft.



BUDDING

Budding is the most common method of propagating new trees. On seedlings it is easier than whip grafting. It is also often used on young trees that are from one to three years old.

The time of year when you will be propagating can determine whether you whip graft or bud. Whip grafting is done from January to March using dormant wood, while most budding is done during July and August.

Some people prefer the whip graft because the resulting branch grows straight out from the stock. A branch grown from a bud usually has a slight crook in it. This is simply a matter of personal preference. Both make good unions and reasonably straight trees.

WHEN TO BUD

Budding can be done almost any time if buds are fully developed and the bark of the stock slips. But most budding is done in July or August. Buds set at this time ordinarily remain dormant until the following spring.

Growth in the fall is undesirable because new shoots are susceptible to winter injury. Because some fruits start growing immediately if budded early, it is better to bud these late. Apple varieties on Malling IX rootstock are good examples.

Washington nurserymen usually bud peach or apricot trees first. Cherry trees are budded last because the "take" of cherry buds set during hot weather is usually poor. Budding is usually done



FIG. 28—Clip leaves from budstick to reduce transpiration and keep buds fresh. Leave short stubs of leaf petioles.

FIG. 29—Apple budsticks after leaves have been clipped off. Buds should be plump and well developed.

in this sequence—peaches, apricots, prunes, pears, apples, cherries.

PREPARING THE STOCK

Nursery stock which is to be budded must first be prepared. In early summer, strip off the lateral shoots on the lower 6 inches of the trunk. When you get ready to bud, you will then have a smooth surface on which to work.

You need to develop some good, new growth on

which to bud. You can force it by heavy pruning or dehorning, but young trees will usually produce plenty of good wood without heavy pruning.

On nursery trees you usually place the bud 2 or 3 inches above the ground. Apple trees budded onto certain dwarfing stocks are exceptions. They are budded 6 to 18 inches above the ground.

THE BUDSTICK

The budstick is a twig, usually of the current season's growth, taken from the plant you want to propagate. It should be from a healthy tree. Mature wood of average vigor, with plump, well-developed buds is preferable to weak or succulent wood. Buds from the top or base of the stick are not as good as those from near the middle. As soon as budsticks are removed from the tree, the leaves should be clipped off (Fig. 28). This reduces transpiration and keeps the buds fresh.

Although it is best to use budsticks as you take them from the tree, you can hold them for several weeks. Keep them cool and moist while they are being stored (Fig. 29).

REMOVING BUDS FROM THE BUDSTICK

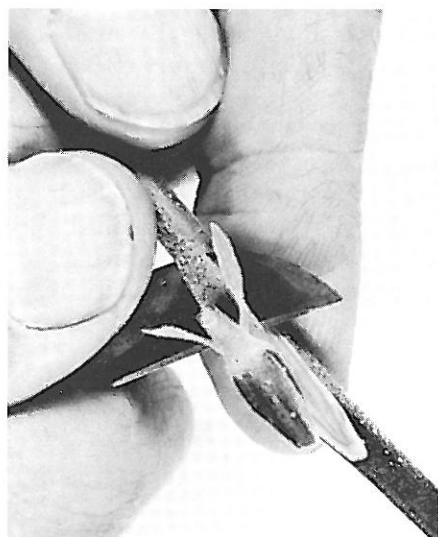
Each budder has his own technique for cutting buds off the budstick. Most commercial fruit tree budders remove both the wood and bud from the budstick in one smooth stroke.

When following this practice, you should be sure your knife is sharp. Start $\frac{1}{2}$ to $\frac{3}{4}$ inch below the base of the bud. Make a smooth slicing cut upward that extends $\frac{1}{2}$ to $\frac{3}{4}$ inch above the bud (Fig. 30). As you complete the cut, use the thumb to pinch the bud shield against the knife blade. You will then have the detached bud in position for inserting it into the stock. There will be no

FIG. 30—To remove bud, start cut about $\frac{3}{4}$ inch below bud. Make smooth, slicing upward cut to $\frac{1}{2}$ to $\frac{3}{4}$ inch above bud. Then pinch bud shield against knife with thumb.

FIG. 31—Surface of left bud is straight. It will have good contact with stock for its entire length. Right bud has bulge which makes good contact unlikely.

FIG. 32—To remove wood from bud shield, cut upward to $\frac{3}{4}$ inch above bud. Remove knife and make crosscut in bark. Peel bud free, leaving sliver of wood attached to stock.



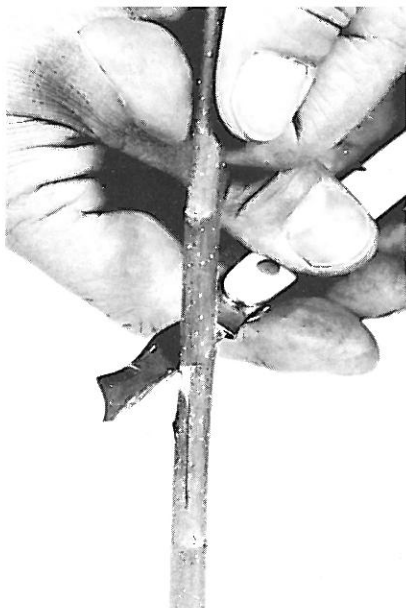


FIG. 33—Make vertical cut on stock, then make a crosscut to form a T. Cut just through bark, not into wood.

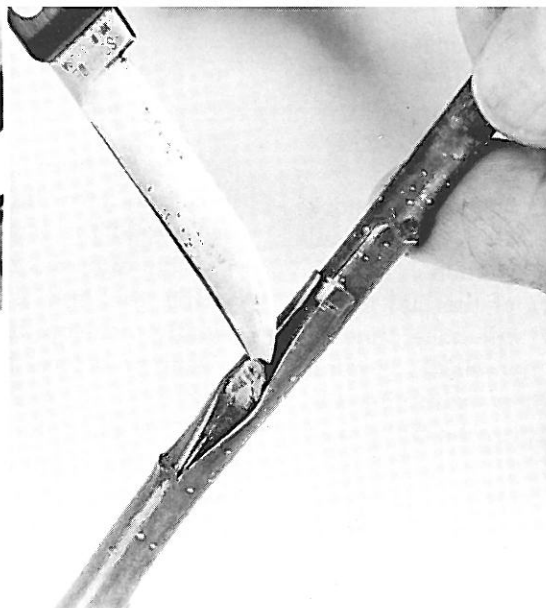


FIG. 34—Slide bud shield into place on stock. Top of shield should be even with crosscut or below it.

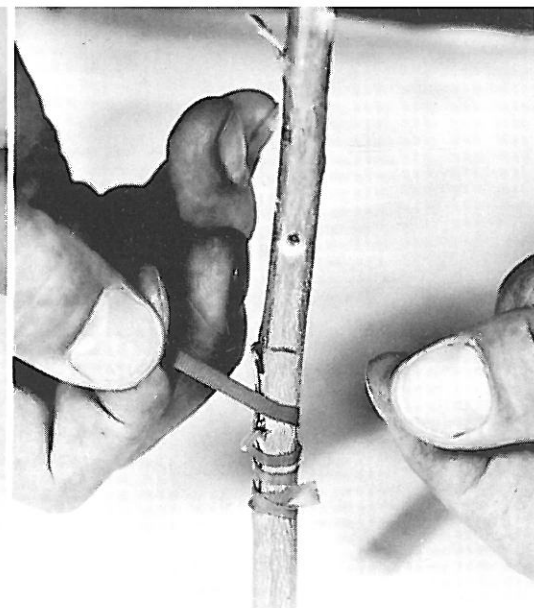


FIG. 35—Start wrap with self-binding loop. Make three or four wraps below bud and several above it.

chance of its becoming dry or dirty before it is inserted.

The cut surface of the bud shield should always be straight from one end to the other. With a straight cut you will get good contact all the way between the bud and the stock. If there is a big bulge in the middle of the shield, good contact is unlikely (Fig. 31). Avoid "rocking chair buds."

Or, if you prefer to remove the wood from the bud, start $\frac{1}{2}$ to $\frac{3}{4}$ inch below the base of the bud and cut into the wood about twice the thickness of the bark. Hold this depth until you reach the end of the cut, $\frac{3}{4}$ inch above the bud. Then remove the knife and make a crosscut about $\frac{3}{4}$ inch above the bud. Cut only through the bark, not into the wood. As you complete the crosscut, grip the top of the bud shield between your forefinger and the knife blade (Fig. 32). As you remove the bud from the stick, you will have it in position for inserting. To remove the bud, peel it free so that the sliver of wood is left attached to the stock.

INSERTING THE BUD

To make the opening where you insert the bud, select a smooth, branch-free place on the stock. In this smooth area make a vertical cut parallel with the grain of the wood. Start it about $\frac{3}{4}$ inch below the place where you want to set the bud. Draw the knife upward for about $1\frac{1}{2}$ inches. If the stock is in good condition for budding this cut is free and easy. But when the bark is tight, more pressure is needed. Extend the cut only through the bark.

Next, make a crosscut which forms a T with the vertical cut. By holding the knife blade at a slightly acute angle with the trunk, you can open the bark as the cutting edge passes the vertical cut (Fig. 33). This opening will make it easy to start the bud. When making the crosscut, cut just through the bark and not into the wood. If you chafe the wood the bud will not slide down freely.

To insert the bud, place the tip of the bud shield in the opening at the top of the T cut. If the opening is properly made, you should have no difficulty in starting the bud. Slide the bud down so the top of the shield is even with or below the crosscut (Fig. 34).

It is important that the bark slips easily. If the bark is in good condition, the bud will go in readily. If the bark is too tight, you can't force the bud in.

WRAPPING THE BUD

When the bud is in place, you are ready to wrap it. Rubber budding strips are commonly used, although you can use raffia or string of almost any sort. To make the wrap, start with a self-binding loop slightly beyond the tip of the bud shield (Fig. 35).

Ordinarily, you can start either above or below the bud. If the bark is very loose, you should start above the bud and wrap downward to keep from pushing the bud out. Make three or four wraps above the bud and several below it. When completing the wrap, make a self-binding loop as you did when starting. It is probably worthwhile to cover the top of the T cut when you wrap.

CARE OF THE BUD

A bud starts getting nourishment from the stock soon after you set it. In about a week you can tell if it is going to grow. Examine it then. If both the bud and the surrounding bark of the bud shield are shriveled and dry, you may still have time to set another bud. If you used a non-elastic binding material such as raffia, cut it when examining the bud at this time. Adhesive bands can be cut almost any time after budding.

In the spring, as soon as the buds start swelling, cut off the stock just at the cross of the T cut or 4 or 5 inches beyond the bud. Sometimes buds

developing from stocks cut off just at the T are broken by birds lighting on them. Cutting the stock off beyond the bud avoids such breakage.

The bud shoot will soon grow over the stub. While the bud is starting, numerous other buds usually develop below it. Remove these as they appear or before they are more than 2 or 3 inches long.

It is not advisable to prune the new branch during the summer unless it is very vigorous or there is danger of the wind blowing it out. Even so, a support to which the whip can be tied is usually preferable to pruning.

FOR SUCCESSFUL GRAFTING

Choose healthy, disease-free material for the scion. One-year-old twigs that are free from winter injury make the best scion wood. They should be well hardened. Material used for budding should have plump, well developed buds.

Use a sharp knife when shaping the graft and make straight, even cuts. A smooth, level surface is essential for maximum contact between stock and scion.

Make sure the cambiums of stock and scion touch. For cleft and whip grafts, this means careful matching of the cambium of the stock with the cambium of the scion. For bridge, inarch, and veneer grafts, it means making sure that all the cut surface of the scion is firmly in contact with freshly uncovered wood.

After fitting stock and scion together, keep them in contact. Wrap the graft or nail it if there is not enough natural pressure to hold the stock and scion together. Whip grafts and buds should be wrapped; bridge grafts and inarch grafts should be nailed. The veneer graft can be wrapped or nailed, depending upon your preference.

Wax cut surfaces to keep out air and prevent entry of rot organisms. Buds do not need to be waxed since they are wrapped tightly and very little cut surface is exposed.

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