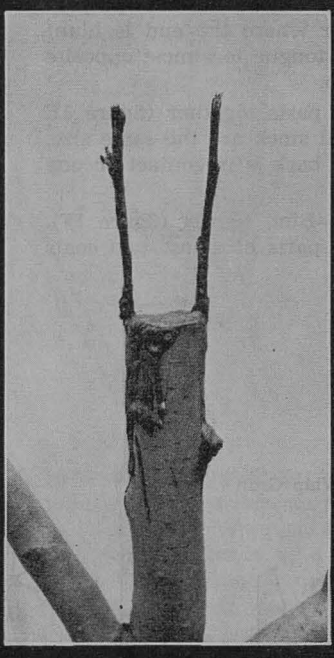
Extension Folder 132 June 1945

GRAFTING

METHODS USED IN TOP-WORKING



Cleft graft on stub of apple tree

Cion growth after two months

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U. S. DEPARTMENT OF AGRICULTURE

HOW, WHEN, WHERE, AND WHY OF GRAFTING

Terms Used

TOP-WORKING—The operation of cutting back the branches and top of an established tree (for example, Hibernal) and grafting on another variety (for example, McIntosh).

UNDERSTOCK OR STOCK—The part upon which the cion is inserted; the part below the graft.

CION—The part inserted on the understock: a piece of last year's growth with three or four buds.

CION WOOD—Vigorous, well-matured dormant shoots of last season's growth, up to 18 inches or more. Such a stick might make three or four cions.

CAMBIUM—The growing part of trees located between the wood and bark. At the season when bark separates freely, cambium will be on the wood surface and on the inner bark.

DORMANT—The condition of live plants at rest—as trees in winter.

BUD STICK—A shoot of the current season's growth used for budding. Leaves removed, retaining one-half inch of leaf stem for a handle.

SUCKERS OR SUCKER GROWTH—New shoots that start below the graft.

SUITABLE TREES TO GRAFT

Young, vigorous trees that have been planted from two to five years are best for top-working. Older trees can be top-worked, but the operation is more severe and they must be "worked" higher up the tree. Hibernal and Virginia crab, because of their vigor and strong, well-placed branches, make exceptionally good understocks.

In top-working branches of young trees, be sure to have 1 to 2 feet of branch between the trunk and the graft. Otherwise, the good crotch formation of the understock will be lost by the trunk expanding past the union.

Trees up to five years can be grafted all at one time. On older trees about half, the upper and center part only, should be worked at one time. The remainder should be done a year later.

STORAGE OF CIONS

Cion wood for grafting can be taken any time after November first until growth begins in spring. There is some danger of the buds starting to grow or of winter injury if cions are left on the tree until spring. November is a good time to collect cion wood. This wood should be tied securely and carefully labeled. If placed in moist (not wet) sawdust or moss and kept in a cold place, cions should be in good condition in the spring. They also may be stored in a quart fruit jar and kept in the refrigerator. It is important that cion wood be kept dormant until the time to graft. Temperatures slightly below freezing are best. Cions will keep in good condition frozen, but are not available for use on short notice. With moss or sawdust packing they would need about a week to thaw out.

WHEN TO GRAFT

It is best to graft in the spring, from the time the buds of understock trees are beginning to open until blossoming. With good dormant cions the author has had excellent results grafting apples just before the blossom buds opened.

Bark grafting and bridge grafting cannot be done before the bark of understock will slip easily, i.e., the bark should separate readily from the wood. Bark is "tight" or will not slip until the buds of the trees begin to open. Budding is done in the summer (see Budding).

GRAFTING WAX

All graft unions should be immediately covered with a suitable dressing to prevent drying. There are a number of suitable preparations. All will be referred to here as "wax."

Grafting wax is easily applied, cracks very little, and will last a long time. It can be obtained from a seed store, nursery, or an orchard supply dealer; or it can be prepared from the following formula:

4 pounds resin
2 pounds beeswax
¾ pint raw linseed oil or 1 pound tallow

Heat these together over a slow fire until melted. Cool slightly. Pour into a tub or bucket of water. Grease the hands with tallow or oil and pull the wax until it assumes a smooth grain. Shape into lumps of a convenient size and it will keep for years. This wax works best if melted and applied with a brush. CAUTION—if used too hot it may injure cions.

OTHER MATERIAL—If grafting wax is not available, melted paraffin may be used. This tends to crack in cold weather. Extra care should be taken to rewax if paraffin should begin to flake off. Certain asphalt emulsions sold for treating pruning wounds are satisfactory and do not require melting.

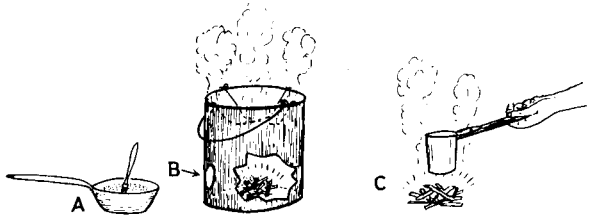


FIG. 7. Melters for grafting wax

Tools and Equipment

1. Suitable understock.
2. Dormant cions—true to name and in good condition.
3. Sharp knife of good steel that holds edge well.
4. Hand saw—for cutting branches to be cleft- or bark-grafted.
5. Pruning shears—9-inch and sharp.
6. Cleft-grafting chisel and mallet—a heavy knife or hatchet can be used for a small job.
7. A light hammer and No. 20 gauge ¾-inch flathead nails for bridge or bark grafting.
8. Grafting wax, paraffin, asphalt water emulsion, or other material for covering the grafts.
9. If grafting wax is used, a melter and a paint brush about an inch wide will be needed.
10. A good whetstone to keep the knife sharp.
11. Tying material—No. 18 knitting cotton (waxed), nursery tape, adhesive tape, electrician's tape, strips of cloth, raffia, or ¼-inch rubber strips.
12. Bark separator—a smooth, dull tool, the size and shape of a cion wedge. Make it of plastic, bone, or hard wood.

WAXED STRING—No. 18 knitting cotton is useful for tying whip grafts. It is strong enough to bind well, yet can be broken easily without need for cutting. The wax sticks well enough so a tie is not necessary. Immerse a ball of No. 18 knitting cotton in melted grafting wax for about five minutes. When taken out for cooling the ball should be rotated slowly to prevent the hot wax from settling on one side. Run a wire or stick through the ball for convenience in handling.

MELTERS

If one has many trees to graft, a good wax melter is necessary—there are good ones on the market. For small jobs, however, it is an easy matter to melt wax with simple equipment. Use a large metal container and make a hole near the bottom for a vent (figure 7B). Place some heavy wires near the top for a grid and heat the wax in a pan or similar container—preferably one with a handle (figure 7A). For heat build a small fire of chips, shavings, etc., in the larger container. This can be carried from place to place. Use a paint brush (one inch wide is best) to apply the melted wax.

A still more simple device is shown in figure 7C. Attach a handle to a tin can and heat the wax over a small open fire.

CAUTION—At grafting time, grass and weeds burn very readily. Build the fire or place the pail only on bare ground and watch them carefully.

HOW, WHEN, WHERE, AND WHY OF GRAFTING

WHIP GRAFT

The whip or tongue graft is used where the understock is nearly the same diameter as the cion.

CUTS—Cut off a branch of the understock leaving a stub at least a foot long. Make a straight, slanting cut about 1½ inches long on both cion and stock (figure 1A and C). Try to have a bud on the cion close to the point of union. Make the cut straight and even—one stroke with a sharp knife will do it. The bevel need not go all the way across.

For the tongue make a straight draw cut (not split), beginning one-third way from the pointed end of the bevel or nearer where the end is blunt (figure 1B and D). Cut the tongue to almost opposite heel of bevel; make it thin.

UNION—Match the two parts together (figure 1E and F). Unless the cion and stock are the same size, offset the cion so the inner bark is in contact on one side (figure 1E).

TYING AND WAXING—Bind tightly (figure 1F). Wax the union and upper parts of cions; two coats are preferable (figure 1G).

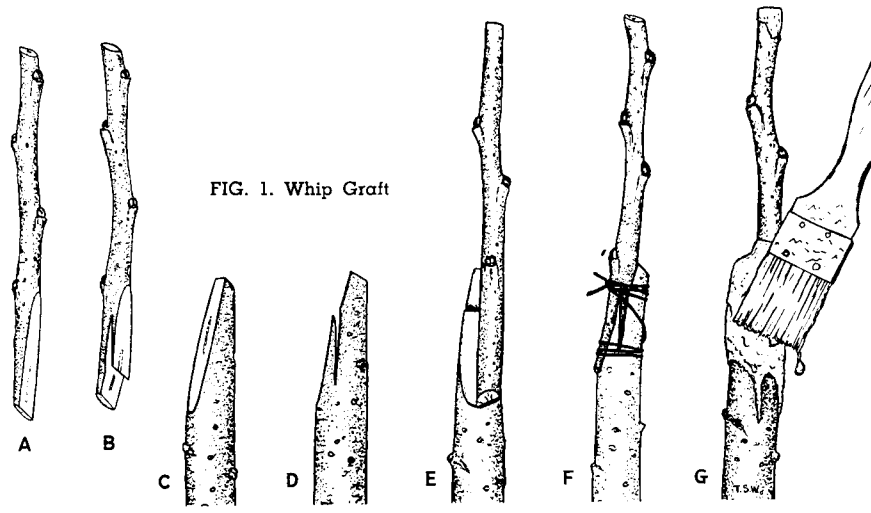


FIG. 1. Whip Graft

Why Top-Work

- An undesirable variety can be changed over by grafting the branches (the top) to a preferred variety.
- Less hardy or poor-crotched varieties can be made more durable by grafting them on hardy, strong-crotched varieties such as Hibernal or Virginia crab.
- By top-working, pollinator varieties can be secured much sooner than by planting young trees.
- New varieties for trial can be brought into bearing in two or three years if top-worked on stock of bearing age.
- Interesting novelties can be developed by grafting several varieties on one tree.

In dry seasons cover with a paper bag to help prevent rapid drying. This should be removed gradually—merely tear the bag at first.

AFTER-CARE—Grafts should be thoroughly covered with wax or other material. It may be necessary to rewax in 5 to 10 days.

If the graft has been tied, the binding should be cut shortly after growth starts, to prevent girdling. Some sucker growth from below the graft may be allowed to grow the first season, but it should not be permitted to shade the cion growth. After the first season all growth but that from the graft should be cut off.

Grafts should be inspected during the growing season to guard against faulty waxing or binding. If aphids appear, spray with nicotine sulfate. If fire blight attacks the shoots, cut them 3 or 4 inches below the symptoms.

CLEFT GRAFT

The cleft graft is used with large understock—up to about 2 inches.

CUTS—Select a place free from knots and cut off the stock with a saw. Cut the cleft (avoid splitting if possible) with grafting chisel, large knife, or hatchet. After a trial or two the proper depth of cleft will be learned. In horizontal branches the cleft should be sidewise, i.e., not perpendicular, to reduce breakage from birds, etc.

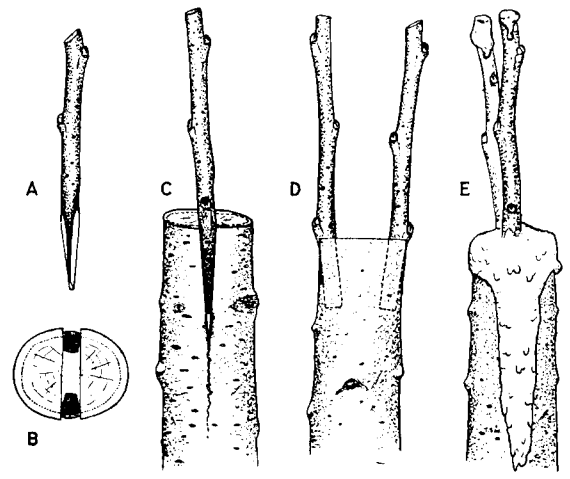


FIG. 4. Cleft Graft

Cut cions to a blunt wedge about 1½ to 2 inches long, with one side slightly thicker than the other (figure 4A and B). If cion wedge is cut to a sharp point there is danger of the bark peeling. Also a sharp cion wedge will not fit the cleft as well (figure 4C).

UNION—Open the cleft slightly with a grafting tool or screw driver. Insert a cion on each side, with inner bark of stock and cion in contact. Have thick side of cion outward (figure 4B).

Keep in mind that the bark of larger stock is thicker than the cion bark: the cion should not be flush with the stock.

A very slight tilt will assure a contact, at least where cambium layers cross (figure 4D).

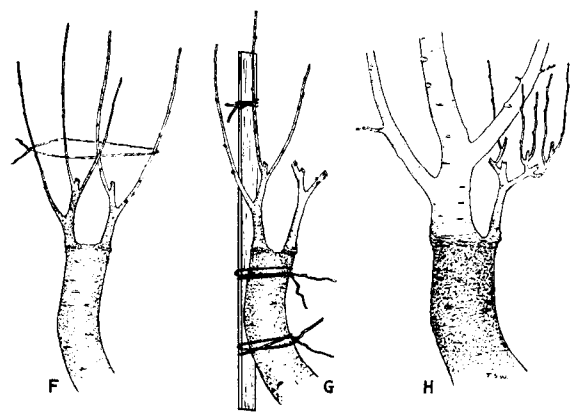
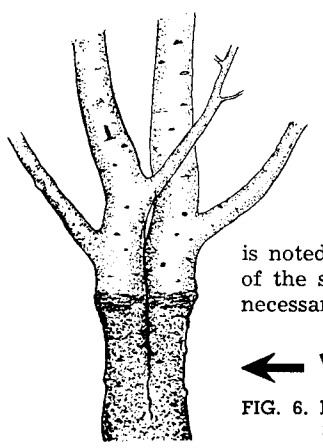


FIG. 5. After-care of Cleft Graft

TYING AND WAXING—There is no need to tie—unless the stock is small and does not bind well. Wax the unions. Be sure the cleft is covered its full length (figure 4E).

AFTER-CARE—Vigorous growth from cions will need attention to prevent breakage by birds, ice, storms, etc. Either tie the cion to a supporting brace (figure 5G) or pinch back the tips before growth becomes "leggy." A twine encircling all the shoots from one stub will give some support (figure 5F).

The first season let all the cions grow undisturbed. The second spring select the most suitable as the permanent branch and consider the others as "spares." The spare cions should be left on to assist in healing over the stub, but they should be cut back to a few buds on each (figure 5G). The third spring, cut the spare cions back severely again. The fourth season or when crowding is noted, cut off some or all of the spare cions as seems necessary.



← WRONG

FIG. 6. Result when spare cion is not cut back.

BARK GRAFT

The bark graft is not commonly used, but it is a very good way to work branches too large to cleft. The bark of the stock must slip or separate easily from the wood. The chief objection to this graft is that the cions may break out later unless supported.

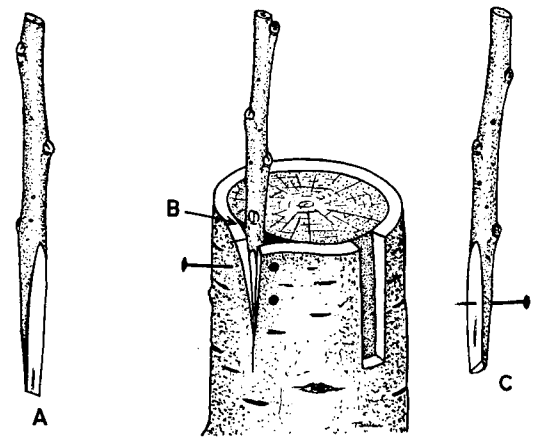


FIG. 2. Bark Graft

CUTS—Figure 2B and C shows two kinds of cuts. Slit the bark of the sawed stub about 1½ inches (figure 2B). Start an opening with a bark separator. A knife blade may injure the cambium.

Cut the cion to a wedge, making surfaces straight and even, about 1½ inches (figure 2A). Try to have a bud on cion near the point of union. For inlays, shape the cion first (figure 2C). Use the thickest cions as they hold nails better. Measure and mark the place on the bark of the stock, then carefully cut out a piece of bark the same size as the cion.

UNION—As in figure 2B, carefully push the cion down until most of the cut surface is covered. Fit the "inlay" (figure 2C) into the prepared place. The more cions the better chance there is for the stub to heal over. Place them about 2 inches apart.

TYING AND WAXING—The graft shown in figure 2B can be tied or nailed. If the bark edges are loose, nail them down. Nail the inlay as shown in figure 2C. Two nails may be needed.

Use cigar box nails or No. 20 gauge ¾-inch wire nails, driving them with a light hammer to avoid crushing the bark.

AFTER-CARE—See under Cleft Graft.

SIDE GRAFT

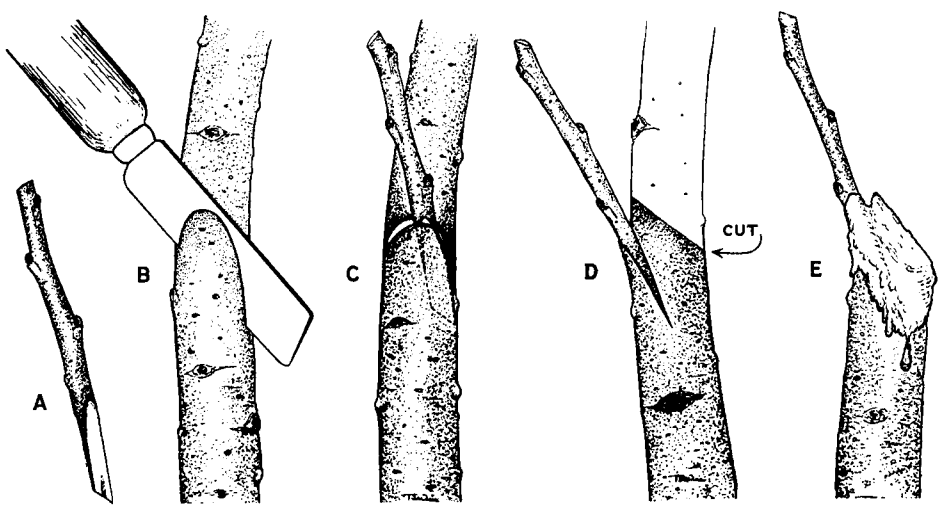
The side graft is very useful and easily made. It is adapted to a fairly wide range of sizes of understock up to ¾ inch. It can be made before the bark will slip.

CUTS—Select a smooth place on the understock branch no nearer than a foot from the trunk. Make a slanting cut at a narrow angle almost to the pith (figure 3B). Cut the cion to a short, sharp wedge (about 1 inch) with one side thicker than the other (figure 3A).

UNION—Bend the branch slightly to open the cut. Press the cion in so the cambium of the stock and cion meet at one side; have thick side of cion toward edges in contact (figure 3C). Cut off the stock above the union (figure 3D). Use sharp shears to avoid disturbing the union.

TYING AND WAXING—Tying is unnecessary if the stock binds well, but it may be needed on small material if cion is not held firmly. Wax all cut surfaces carefully (figure 3E).

AFTER-CARE—See under Whip Graft.



← FIG. 3. Side Graft

WHY GRAFTS FAIL

1. Cion and stock incompatible. Apple will not unite with plum, but apple on apple is O.K.
2. Grafted at wrong season.
3. Understock in weak condition.
4. Cions not vigorous.
5. Cions dry or winter injured.
6. Cions not dormant.
7. Cambium of cion and stock not meeting properly.
8. Cions upside down.
9. Improperly waxed or wax too hot.
10. Cions displaced by wind, birds, etc.
11. Too shaded after growth starts.
12. Damaged by aphids or other insects.
13. Killed by fire blight.
14. Union girdled by failure to release binding in time.

SHIELD BUDDING

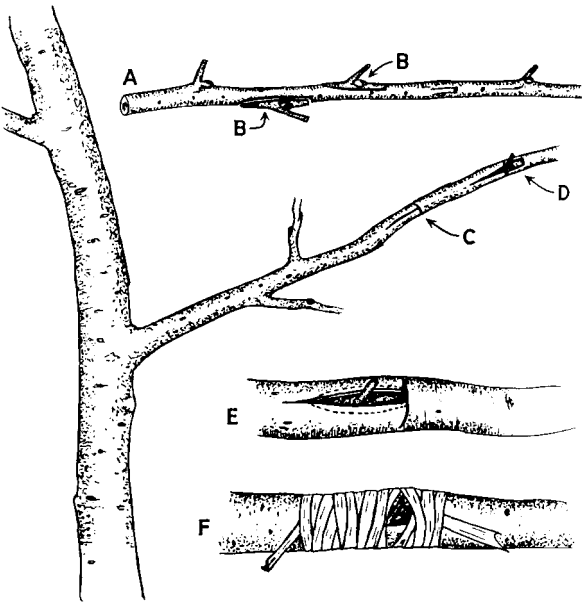


FIG. 8. Shield Budding

This is another method of grafting, done in summer when the bark of the stock slips easily and when there are well-grown buds—usually from July 15 to August 15. Cut bud sticks of the desired variety from strong shoots of the present season's growth (figure 8A). These buds should be mature, as indicated by a slightly brownish color. Clip off the leaves as soon as the bud stick is cut, leaving about ½ inch of the leafstalk for a handle. Discard the soft tips of the bud stick. Wrap the bud sticks in moist burlap, moss, paper, etc., to prevent their drying out.

Branches from the size of a lead pencil up to ½-inch diameter may be worked by this method. The bark of larger branches is too thick for satisfactory budding.

CUTS—On the branches of the stock, about 15 inches or more from the trunk, make a T cut just through the bark (figure 8C). With knife blade or bark separator lift the corners and carefully loosen the bark. Cut a bud from the bud stick with a thin piece of attached wood (figure 8B) or "wood" the bud as shown in figure 9. Start the bud under the flaps of bark and lead it down by the "handle" (figure 8D and E). "Wooded" buds have a complete cambium surface exposed to meet the cambium of the stock and sometimes result in better "take," but they are less rigid to handle. Buds with wood attached handle easier and usually give good results. In bud grafting branches, put in two or three buds on each branch.

TYING AND WAXING—Start the tie above the the bud. Use raffia, rubber, electrician's tape, adhesive tape, cloth, or soft twine. Wrap and tie tightly—do not cover the bud (figure 8F). Waxing is not necessary if weather is not too dry and hot. Paraffin wax applied melted will help if weather is unsuitable. Raffia for tying buds should be cut into lengths of from 12 to 15 inches and moistened before using.

AFTER-CARE—Cut the tie before it binds too tightly; in two or three weeks. Cut on the side away from the bud. The bud should remain dormant until the following spring.

As soon as the bud starts growing, cut off the stock above or beyond the bud.

Keep shoot growth from the stock from shading or crowding the bud growth. After the second year remove all extra growth from the stock, i.e., keep only the bud-grafted shoots. Where two or more buds "take," more than one may be used if desired, but one is enough to produce a new branch.

WOODING THE BUD

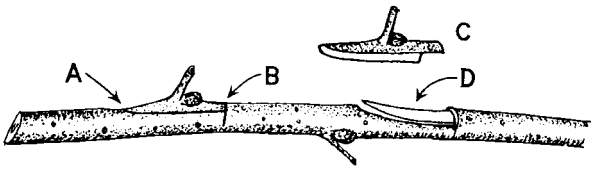


FIG. 9. Wooding the Bud

Cut from (A) well under the bud to (B). Remove the knife and rock the blade just through the bark at (B). Grasp the bark between thumb and finger and pinch the bark with attached bud free from the wood (D). If the bud stick is fresh and in good condition, this operation can be learned in a couple of tries.

IF GRAFTS FAIL

One hundred per cent success in grafting is rare. The failure of one or two cions is not serious, since usually more cions are inserted than are necessary for the completed tree. On branches where the cions fail, sucker shoots should be permitted to grow. These can be budded the same summer or grafted later.

UNIVERSITY FARM, ST. PAUL 8, MINNESOTA
Cooperative Extension Work in Agriculture and Home Economics, University of Minnesota, Agricultural Extension Division and United States Department of Agriculture Cooperating, Paul E. Miller, Director. Published in furtherance of Agricultural Extension Acts of M[illegible] ine 30, 1914.
15M—6-45