PUBLICATION 781 FARMER'S BULLETIN 136

Frameworking Fruit Trees

By

R. J. HILTON

Dominion Experimental Station, Kentville, N.S.

DOMINION DEPARTMENT OF AGRICULTURE
OTTAWA CANADA

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Richared apples on young frameworked tree, three years after grafting.

Frontispiece

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FRAMEWORKING FRUIT TREES

THROUGHOUT all of Canada there is a healthy trend towards the production of new and better varieties of tree fruits. This trend follows changing marketing conditions, consumer preferences and improved packaging. Many orchardists are showing an increased interest in methods of changing over all or part of their existing plantations either to new varieties, or to varieties more suitable for higher priced markets than those already being grown.

These, and other factors also, are responsible for the increased amount of orchard grafting. The most important of the additional factors are listed below:—

(1) The recently developed practice of double-working to make a tree more winter hardy and to offset structural weaknesses in some varieties. This lends itself ideally to the improved grafting technique known as frameworking.

(2) The need for further restriction in the number of varieties grown commercially. This often may be done most efficiently by framework grafting.

(3) Further expansion of the fruit products industry may depend upon the use of larger proportions of high quality fruit than heretofore.

(4) Large blocks of one variety or of varieties that do not inter-pollinate readily may be made to fruit quickly by the practice of frameworking a proportion of the trees to a satisfactory pollinator.

WHAT IS FRAMEWORKING?

General Outline

Frameworking is the practice of grafting or budding in such a way that most of the original framework of the tree is retained, only branch ends, small or poorly placed laterals, spurs and surplus larger branches being removed.

The well-established methods of topworking (top grafting) call for the cutting away of most of the tree top, and it is usually at least six to eight years before this top can be regrown to its original size. Moreover, a serious shock to the tree root system often results from this severe cutting back. When the topworked tree does start fruiting again, the apples of the first two or three crops are oversized and "punky", typical of fruit grown on rapidly growing "juvenile" wood.

Frameworked trees, on the other hand, have so little of the original top removed that the shock to the root system is reduced to that of a heavy pruning, and by the end of the first growing season the leaf area is very close to normal for the age of the tree.

Frameworking may be accomplished either by grafting or budding, but the budding is slower to do and slower to replace the top, than grafting. Hence, framework-budding is not recommended for any but peach and apricot trees, which do not graft readily.

A brief review of experimental results comparing topworking with frameworking will be found later in this bulletin.

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Figure 1.—This 12-year-old Laxton Superb tree was a 9-year-old Ben Davis in 1939. Photographed Sept., 1942. Frameworking was done with cleft methods only. Note how the weight of fruit is spreading the branches. Compare with Figure 2.

The History of Frameworking

The grafting technique, first called porcupine-grafting, and now known as frameworking, received its first large-scale practical application on the farm of W. F. Walker and Sons, Launceston, Tasmania, in 1928. There a dieback canker disease in newly top-grafted apple trees was making it very risky to graft over large blocks of undesirable varieties. Since the canker organism appeared to prefer large wounds for its entry into the tree tissue, it was reasoned that if the tree could be grafted *without* making large wounds, the disease might be avoided. Thereupon, several trees were prepared for grafting by removing *only* spurs, limb ends and small laterals. Scions were inserted to cover the framework at 12- to 15-inch intervals, by placing them between bark and wood. The method was later modified and is discussed in a following section as the "inverted L" bark graft.

This unorthodox treatment not only entirely prevented the dieback canker, but the trees so grafted produced small crops the following year and were in full production the third growing season after grafting had been done.

An article in a Tasmanian agricultural magazine, appearing early in the 1930's, led to trials in 1935 and 1936 in Nova Scotia and also to extensive trials in England at about the same time. Since that time many growers have utilized the frameworking technique for converting trees of unprofitable varieties to more valuable ones, and also for double-working desirable sorts on hardy young trees.

Methods

There are four frameworking methods that research and practical experience has proved to be most widely suitable for commercial grafting. Two of these are "cleft" methods, meaning that scions of the desired "top" variety are inserted into clefts cut *into* the wood of the stock tree. The other two are "bark" or "rind" methods, in which the scion is placed *between* the wood and the bark of the stock, so that no cut into the wood itself is necessary. There are many variations of the four methods described below, and no doubt each interested grafter will experiment with new methods, and with improvements on those already named.

Cleft Methods

Stub.—For this method, small laterals and stout spurs are left on the tree when it is prepared for grafting, and at the base of the small branch, a cut is made not more than half-way through. The scion, with a double wedge basal cut about one-half inch long, is inserted into the cut with one hand, while the branch itself is bent with the other hand so as to spring the cut open. The branch is then cut off with knife or pruning shears just beyond the scion, leaving a short "stub" firmly holding the scion.

Side.—The side graft is essentially the same as the stub graft, except that the scion is placed at any desired point along a branch, and the branch is cut off beyond it, unless the side graft is placed very near the end of a branch, that has no suitable lateral for a stub graft. Frequently side grafts are placed on branches of three or four inches diameter, although they may be placed also on small branches of one-half inch diameter or less. Stub grafts, on the other hand, are seldom used on branches of larger diameter than one inch. Side graft scions are placed in the cut by bending the branch to open the cleft, or by forcibly pushing the scion into the cleft.

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Figure 2.—This is a sister tree to that shown in Figure 1. The only difference in treatment has been that this tree was topworked at the time the sister tree was frameworked. Comments—No fruit, and several years must elapse before the tree has a bearing surface comparable with that of the frameworked counterpart.

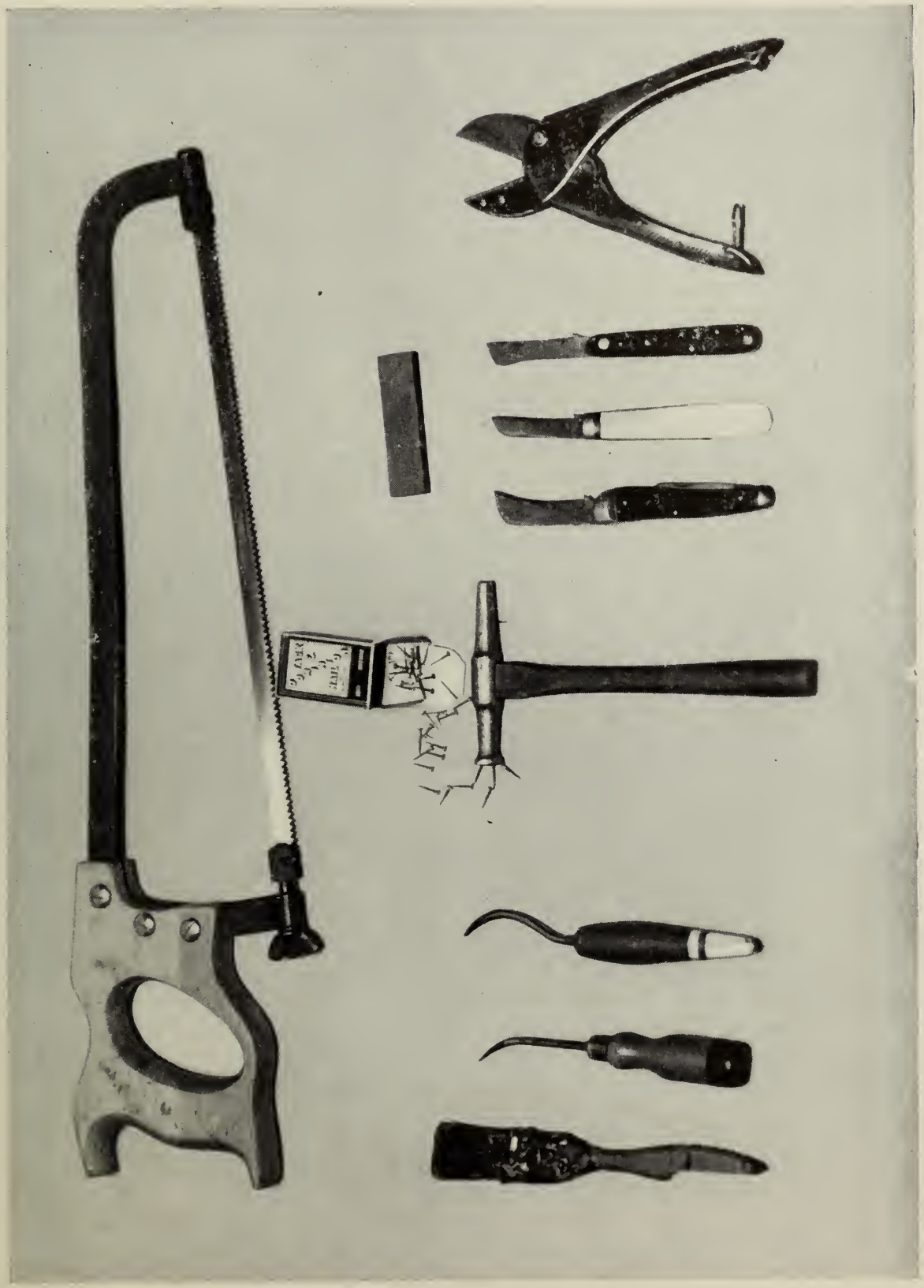

Figure 3.—Frameworking tools. Note (*a*) fine-toothed swivel-bladed saw; (*b*) wax brush with part of handle cut away to accommodate an extension; (*c*) awl tools made from screw-driver and utensil handle; (*d*) magnetized upholsterer's hammer and shoe tacks; (*e*) three useful thin-bladed knives; (*f*) pocket whetstone; (*g*) blade-on-anvil type pruning shears.

Bark Methods

Inverted L.—The method name derives from the shape of the cut into the bark of the stock tree. It was originally made like the inverted letter "L", but a later modification uses an obtuse angle between the "arms" of the cut, and the wider angle makes a stronger hinge of bark, with less danger of breaking or curling back. The scion is cut with a through stroke on the side that will lie against the wood, with a thin sliver taken from the reverse side to expose the cambium. It is then slipped into place along the longer side of the bark cut, and a tack or small nail is driven through the bark and scion and into the wood. Where the bark of the stock is quite thick, the shorter arm of the L should be made obliquely so that the scion will lie close to the cambium of the stock.

Awl.—This method is so called from the bent awl first used to make the insertion into the stock bark. A cheap screwdriver, bent slightly and sharpened, makes an excellent awl-grafting tool. It is the simplest of any frameworking method. The sharpened scion (two equal basal cuts, about one inch long) is pushed into the hole made by forcing the awl tool between bark and wood. The bent tool allows the blade to slip around the branch wood perimeter without breaking through the bark, but a knife point, carefully inserted, also may be used. Unless a thick scion splits the bark, no nail is used.

The only artificial fastening generally used in any of the frameworking methods is the tack or nail used with inverted L grafting, although a tack will occasionally be needed to control bark splitting with awl grafts. With all methods, the waxing is most important. The four methods outlined above are illustrated in figures 4 to 8.

HOW TO FRAMEWORK-GRAFT

Now that the methods of framework-grafting have been outlined, there are other considerations equally important to the success of the operation. These are considered briefly in the following paragraphs.

Time to Graft

A trial conducted at the Dominion Experimental Station, Kentville, N.S., has established that the best time for frameworking apple trees is during the month of April or early in May. Since this is before the bark begins to "slip", only cleft methods may be used then, but the Kentville trials also demonstrated that excellent results followed grafting any time up to late June. Growth and fruit bud formation are not so great on the later frameworked trees, but in any extensive grafting program there is no need to stop grafting simply because growth *is* somewhat stronger when scions are put on early in the spring.

Due to the formation of gummy sap deposits on wound surfaces, scions grafted on stone fruit trees after growth has started in spring do not unite readily. Hence, plum and cherry frameworking should be done when the trees are dormant, or at the latest, in the delayed dormant stage. For this reason, only cleft methods may be used when frameworking stone fruits.

Condition and Preparation of the Stock Tree

It is common experience that any tree to be grafted should be in good health. This observation applies as well to frameworking as to topworking. If nitrogen is lacking, the "take" of scions will be poor to fair only, and growth will be slowed up so that sun scald will affect the unprotected scaffold branches, causing severe dieback.

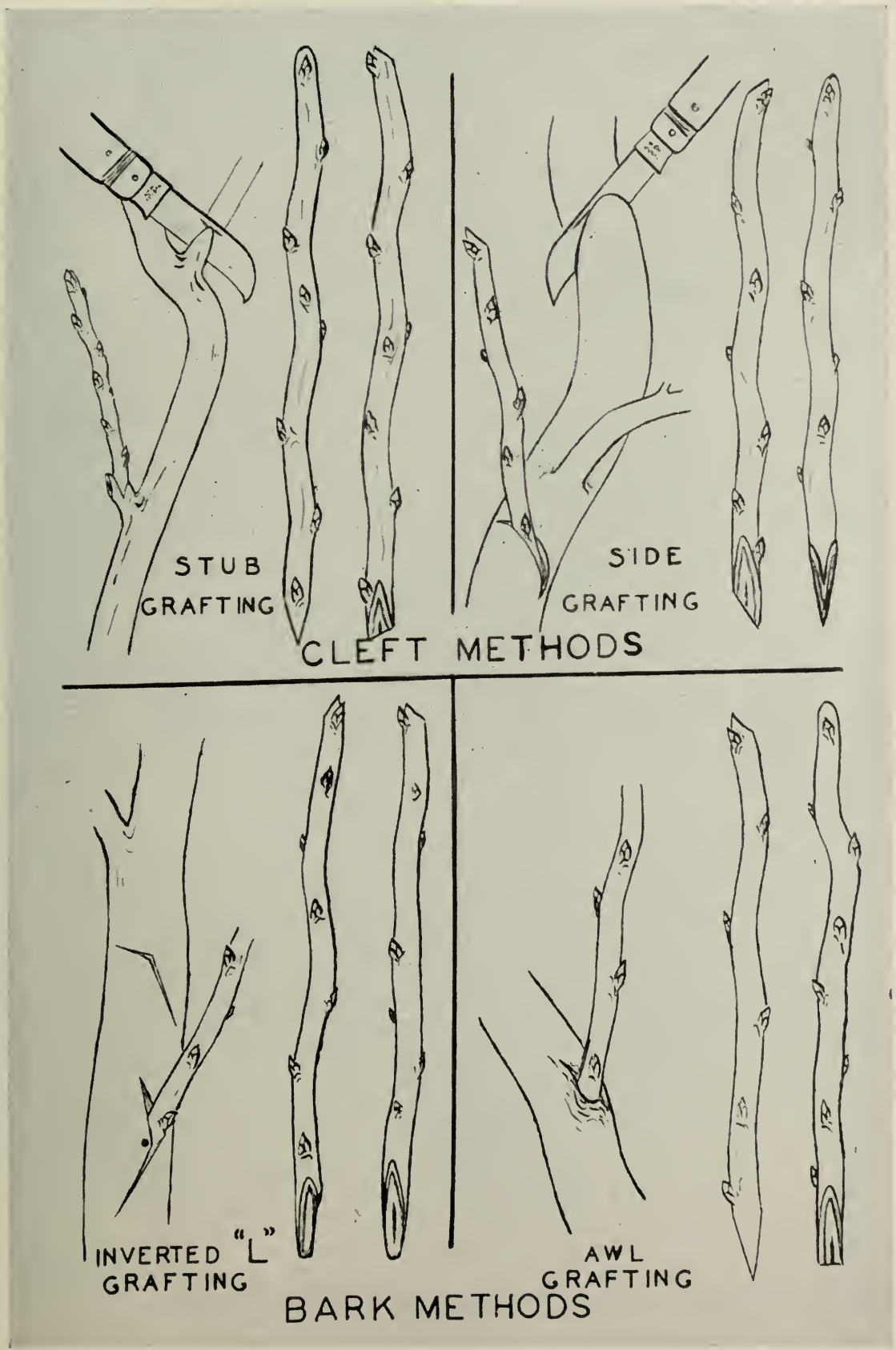

Figure 4.—Detail of framework-grafting methods. Cleft methods may be used at any season; bark methods only when sap is flowing and bark "slipping".

Once a healthy stock tree is selected for frameworking, the first step is to remove damaged and crossing branches. Then the pruning shears and fine-toothed saw are used to remove small laterals and spurs, leaving only healthy, well-placed "handles" for stub grafts. The ends of the scaffold branches are removed, usually at a junction with a small lateral so that one or two stub grafts may be inserted for the "limb-end graft". This is not essential, however, as any one of the four methods may be used at the end of a scaffold. Clearing the tree thus for frameworking is known as "pollarding", and after most of the cutting is done the tree may then be checked over to see if any of the main or secondary scaffolds are superfluous to a well balanced tree, in which case the unnecessary branches are removed.

Pollarding wounds of more than $1\frac{1}{2}$ to 2 inches diameter should be painted over with grafting wax when waxing the scions, but careful use of shears and saw will leave clean cuts that heal very rapidly as the scions burst into leaf.

Selecting and Storing Scion Wood

Contrary to a belief held by many orchardists, the age of the tree has nothing to do with the quality of its scion wood. Scions are always cut from one-year-old wood, and for best results this should be reasonably stout, and vigorous. Weak growth should be avoided, whether from young or old trees, but healthy, unbranched suckers (water sprouts) make excellent scion sticks. In frameworking practice, very stout scions may be used readily on large branches or for large stubs, and those of medium thickness may best be used for smaller branches or for bark methods.

All scion wood must be cut in fully dormant condition and kept in a cool, moist storage until used. Moist moss, sand and sawdust are good materials in which to pack the scion sticks. The farm ice-house makes an excellent storage, or the scion sticks may be buried in moist soil on the north side of a building. A very keen knife blade is essential for rapid, efficient, framework-grafting, and sand or soil particles adhering to the scions is definitely not good for the blade; hence, washing scionwood so stored is a good practice.

Length of Scion

Experience has shown that slightly earlier fruiting and considerably more growth in the first two seasons after frameworking, results from the use of scions of six to eight buds in length, compared with scions four buds long. In theory, the longer scions have more potential growing points, and some of the buds near the base form young spurs, instead of shooting into vegetative growth. The tree top is refurnished more quickly with *bearing* wood, since on short scions every bud frequently becomes a vigorous shoot. Thus, where sufficient scion wood is available, it is advisable to use scions at least six buds in length.

Grafting Waxes

There are many grafting waxes (also known as "grafting compound" and "mastics"), on the market, and also there are many formulae for home preparation of waxes. The first necessity for a frameworking wax is that it must in no way injure the tender plant tissues, and it must go on quickly and smoothly. Several compounds having an asphalt base have recently become available, their advantage being that they can be applied with a brush when cold. Whether or not they retard the rapid healing of the union has not been investigated thoroughly, although some of them are definitely known to adversely affect the "take" and growth of scions. A good home-made wax has the disadvantage of having to be heated before being applied with the brush, but has advantages in that it is known to be harmless to plant tissues, and also may be used on wet wood during rain with no lessening of efficiency.

Figure 5.—Stub graft (upper) and side graft (lower). Compare with Figure 6. Note that useless tip of bark on the side graft cleft has been cut away to make smooth waxing easier.

Figure 6.—Stub graft (upper) and side graft (lower), after one year's growth. Note that stub graft growth shows spur initials on young wood, but that the side graft, placed in a more upright position, has grown too strongly and sent out numerous spiny twigs instead of spur initials.

A very satisfactory "hot" wax, differing only slightly from one developed at the East Malling Research Station, Kent, England, by R. J. Garner, and which has been used with excellent results at the Experimental Station, Kentville, is based upon the following formula:—

Resin	6 lb. 10 oz.
Tallow	1 lb.
Paraffin Wax	1 lb. 4 oz.
Venetian Red Powder	1 lb. 8 oz.

This wax has some advantages over those in general use. These are (1) the replacement of beeswax (that is commonly used) by paraffin wax, or even with the cheaper crude paraffins, makes a very inexpensive wax; (2) the Venetian Red powder serves the purpose of giving the wax a good "binding" property—that is, it enables it to better withstand extremes of heat and cold without running or cracking off; (3) the Venetian Red also gives the wax a vivid red-brown colour that enables "misses" to show very clearly, since exposed cut surfaces are yellowish-white, and air-holes show black.

Making the Wax

The formula given above is made up as follows: Melt the resin and paraffin first, remove the container from the fire and put in the tallow. After this has melted, stir in the Venetian Red powder. This powder should have been heated, while the resin and paraffin was melting, in order to lessen the air content of the powder. The thick red liquid wax is poured into a sink or other container of cold water. Hands and forearms should be well covered with tallow to prevent the wax sticking, and almost immediately after pouring the wax into the cold water, it should be separated into easily handled blocks of about one pound each, and pulled like toffee candy until it is smooth.

Heating Wax in the Orchard

When using the wax in the field, if all the air bubbles have not previously been worked out of the lumps, the wax will be frothy in the wax melting pot. In this case, leave the pot on the heater until most of the froth is gone and until the level of the wax returns to normal. When it cools off enough to adhere to the brush like thick paint, it is ready for use and no more trouble will be experienced with effervescing.

Braziers may be made from old 5-gallon tins that will burn wood, charcoal, coal or coke, and these are useful wax heaters. It has been found by experience that the most efficient heater is a small, easily transported, one-burner gasoline stove or plumber's pot-torch. Brushes may be made from twine, but a cheap one-inch paint brush, with a large scion lashed to the handle for greater reach, is most satisfactory.

Framework-budding or Framebudding

When it is desired to change the variety on young or mature peach and apricot trees, framework-budding is recommended, since these fruits do not graft readily. To framebud successfully, a good supply of stout current-season wood on the stock tree is necessary, and if the tree to be worked over does not carry plenty of succulent new growth, it should be pruned heavily in the early spring. This will bring on just the type of sucker growth best suited to framebudding.

Buds are inserted at or near the base of the new growth by the well-known "T" or "shield" method. To do this a cut shaped like the letter T is made in the bark of the stock, and a bud of the desired variety is sliced off

Figure 7.—Awl graft (upper) and inverted L graft (lower). Note tack holding bark and scion to the wood in lower graft. Compare with Figure 8.

Figure 8.—Detail of inserting a scion into the inverted L bark cut. Note knife point lifting bark flap as scion is inserted. An awl graft ready for waxing appears on the uppermost branch.

the bud stick and carefully inserted under the bark of the T cut. The bud is then tied in place with raffia, string or rubber budding bands. If raffia or string is used, this must be cut away after two weeks to relieve the constriction caused by the still-growing shoot.

Framebudding of peaches and apricots is best done from August 10 to 25, a little later than apple and pear budding usually is done.

FRAMEWORKING HINTS

The following hints may point the way to quicker, surer results with frameworking technique. They are compiled not only from the experience of the writer, but also from that of several practical orchardists, who regularly use frameworking for variety change-over and for double-working.

(1) Provide yourself with a carpenter's apron or similar apron of light canvas, having two tight, clean pockets. Scions will go in one pocket, tools in the other.

(2) A magnetized upholsterer's hammer is excellent for tacking inverted L grafts. If the handle is too long for your apron pocket, cut some off it. Such a tool will pick up tacks from the bottom of the apron pocket with no discomfort to fingers.

(3) Cut plenty of scions from the scion sticks before starting to graft. These may be cut very quickly with the "blade on anvil" type of pruning shears, so that there is no stub left beyond the top bud. Note the way in which scion tips are cut in figure 4.

(4) When the scion is cut at the base, do not handle the fresh cut with the fingers or mouth. Dirt, saliva and perspiration may slow the union growth between stock and scion.

(5) To speed up frameworking, some good grafters make a practice of making the basal cuts on a hundred or so scions just before starting to graft. In this case a sort of "general" base cut, double-wedged and about $\frac{3}{4}$ to 1 inch long is made, and the already prepared scions are carried in the *clean* apron pocket while grafting. If the pointed end of the scion protrudes beyond the stock cut after the scion is forced into place, this unnecessary tip should be cut off by drawing the knife point along the bark of the stock. The union will wax over more smoothly if there are no jagged ends sticking out.

(6) Scions placed in a "herring-bone" pattern on a scaffold will leave the back-bone of the branch without protection from sun scald. Therefore, scions should be placed more or less in a spiral pattern upon the branch. Such a pattern is, of course, subject to interruption by lateral branches along the larger scaffolds.

(7) Scions placed more directly in line with the straight flow of sap from the tree roots will grow strongest. Since the object in frameworking is to replace *bearing* wood as quickly as possible, too strong growth is not desired. Therefore it is unwise to place scions in such upright positions, else their very strong growth will upset the balance of the remaining scions.

(8) Waxing should be quickly but thoroughly done. Make a habit of touching the *scion tip* with the wax brush before waxing the union and this will make certain that the tip is not forgotten.

(9) It sometimes pays to go over the frameworked trees with a hot wax pot and brush a week or so after grafting, to touch up such missed unions and air holes as occasionally occur.

(10) Use a good thin-bladed knife, and *keep it sharp.*

Figure 9.—Home-made brazier, burns wood, coal, coke, etc., and has a slatted metal bottom bolted on above side vent. Cakes of wax are nearby, ready for melting down.

Figure 10.—Stark tree, 30 years old, frameworked to Crimson Gravenstein in late May, 1942. Five hundred and fifty scions inserted, being waxed. Note useful and inexpensive ladders.

Figure 11.—Fourteen-year-old Red Stark tree frameworked by bark methods only to Crimson Gravenstein in May, 1942. One-half the scions are 8-bud length, one-half are 4-bud. About 325 scions in all.

Figure 12.—Fourteen-year-old Red Stark frameworked to Crimson Gravenstein in late April, 1942, using cleft methods only. About 250 scions. Photographed July 11, 1942. Compare with Figures 13 and 14.

WHAT TREE FRUITS MAY BE FRAMEWORKED

Apples, pears, plums and cherries should be framework-grafted in the spring, for best results, although there is some interest in the newly developed technique of grafting in September—late enough to use quite well-hardened current season's growth for scion wood, but early enough for the scions to "set" and callus before freeze-up. This practice is not as yet generally recommended. The time for framebudding peach and apricot trees is late summer.

Figure 13.—Fourteen-year-old Red Stark frameworked to Crimson Gravenstein in late May, 1942, using cleft methods only. About 225 scions. Photographed July 11, 1942. Compare with Figures 12 and 14.

Incompatibility is the lack of affinity between a stock and scion that causes poor scion growth, early death, and in some cases the death of the scion before growth begins. Thus, plum grafted on apple will not grow at all, whereas some plums on sweet cherry, for example, will grow well for one or two years, then die out. In the first case, we have complete incompatibility, and in the latter case, a delayed incompatibility.

Apples and Pears

Between common Canadian apple varieties there is no evidence of incompatibility; thus any variety of apples may safely be frameworked upon another variety, so long as scion wood and the stock tree are reasonably healthy and vigorous. The same observation is true with pears; that is, the common commercial sorts will intergraft with no difficulty so far as variety affinity is concerned.

Plums and Cherries

Some varieties of plums and cherries will not graft successfully upon others, but in general all common varieties *within a species* are compatible. Thus European plums may be intergrafted successfully, also Japanese plums, and the damsons, but it is unwise to attempt to graft a European plum upon a Japanese variety, and vice versa. Similarly, sweet and sour cherries should

Figure 14.—Fourteen-year-old Red Stark frameworked to Crimson Gravenstein in late June, 1942, using cleft methods only. About 250 scions. Photographed July 11, 1942. Compare with Figures 12 and 13.

not be mixed in grafting. Some combinations such as those mentioned above might be successfully grafted, and experimentation might be suggested as a matter of interest, but not as a commercial venture.

AFTER CARE OF FRAMEWORKED TREES

General Culture.—If the frameworked trees are in a cultivated orchard, the ground beneath them should be harrowed soon after grafting is completed. This cultivation, together with the normal application of fertilizer made in the early spring, should stimulate rapid growth and consequent rapid "setting" of the scions.

If the trees and scions are in good vigour when grafting is done, the scions will make rapid growth, as also will sucker shoots arising from latent buds on the stock. Once or twice throughout the first two growing seasons, the sucker growths from the stock trees should be rubbed off. Very few will appear after two seasons.

The first season's growth on frameworked cherries and plums often is so vigorous that heavy winds may cause some damage by blowing out important "limb end" scions. Such vigorous growth may be summer pruned in late July, by being pinched back to about half its length.

Pruning.—On most trees, a few scions will be inserted near the main crotches, merely to give leaf cover for the first season, to prevent sun scald. These may be cut out the following spring, if their usefulness is over. In the interests of rapid production of fruit buds, heavy pruning should not be done on frameworked trees. Therefore, except where growth is obviously too dense, only crossing laterals and leaders growing too high or in an undesirable direction, should be pruned out or headed back.

After the third growing season, which should be a heavy cropping year, the branches and fruiting laterals will have been spread and lowered sufficiently for normal pruning practice to be resumed.

Figure 15.—"Pollarding", or preparing the tree for frameworking. This is a well-grown strong 30-year-old tree, and was grafted May 26, 1942. Just under 4 barrels of fine fruit were picked from this tree in Sept., 1944. Note how little of the frame is removed. Compare with Figure 16.

Figure 16.—This is the top we remove when trees are topworked. This was a fine vigorous sister tree to that shown in Figure 15. Up to 1946 no bloom has been borne upon this topworked tree, and it will be many years before it carries a profitable bearing surface. Compare with Figures 15 and 17.

Figure 17.—Same tree as in Figure 14, photographed in late August, 1942, three months after frameworking. All trees of this series that were frameworked in 1942, cropped heavily in 1944 and had a heavy blossom killed by frosts in early June, 1945. Compare with Figure 18.

Figure 18.—A sister tree to that shown in Figures 15 and 16. The tree was top-worked in 1942, and the branches left as sap-drawers were grafted in 1944. Every scion grew well, but it will be many years before a commercial crop is borne. Compare with Figure 17.

FACTS ABOUT FRAMEWORKING

Several large-scale trials involving framework-grafting have been under way since 1942 at the Dominion Experimental Station, Kentville, N.S. Some of the facts brought out by this research may be of interest.

Frameworking vs. Topworking

Several 30-year-old Stark trees in good condition were grafted in late May, 1942, to Crimson Gravenstein. One-third of the trees were frameworked with scions at 8 inches apart, one-third with scions 16 inches apart, and one-third were topworked. The frameworked trees held an average of 537 scions, and the difference in scion spacing did not prove to make much difference in growth nor in speed of return to cropping. The topworked trees held only 32 scions each. In 1944, the frameworked trees bore an average of about four barrels of fine quality picked fruit, after a crop of just under a bushel each in 1943, the year following grafting. The 1945 blossom, a heavy one, was almost entirely destroyed by frost. Up to and including 1945, the topworked trees have borne no blossom.

The frameworked trees averaged about 12 man-hours for the operation, exclusive of collecting the scion wood, whereas the topworked trees took only $1\frac{1}{3}$ man-hours to graft. *The added cost of frameworking, however, was more than compensated by the value of the 1944 crop alone.*

Grafting Time, Methods and Scion Length

Another large trial at Kentville, also begun in 1942, involved twenty 14-year-old Red Stark trees that were frameworked to Crimson Gravenstein in April, May and June.

For the first year, April grafted trees made definitely more growth than those grafted in May, and similarly May grafted trees grew much more strongly than those done in June. By the third growing season these differences had smoothed themselves out, but in the meantime, the April grafted trees had made the largest tops upon which to bear their first crop. Consequently, in 1944 the crop ratio between April and May grafting was greater than 2:1, and the June grafted trees bore only a few pounds per tree.

No great differences were shown in per cent "take", growth and cropping between the four methods (stub, side, inverted L and awl), although in general the cleft methods grew more strongly and bore more fruit than the bark methods. Of course, bark grafting could not be done in April, so records for these methods are available only for May and June.

Scions were divided into two lengths (8-bud and 4-bud) and the longer scions showed definitely more growth in 1942 and 1943 than short scions, and a little more fruit in 1944. The per cent "take" of long scions also was slightly better than that of the 4-bud length. It is suggested that where sufficient scion wood is available, scions of six buds length or longer will allow two or three good strong growing points, and in addition a proportion of the remaining buds will become spurs. This should speed up the return to fruiting of the frameworked tree.

ACKNOWLEDGMENTS

Sincere thanks are due C. M. Spurr, Scotian Gold Limited, Middleton, N.S., for painstaking care in the production of all photographs in this bulletin; and to G. W. Hope, Experimental Station, Kentville, N.S., for helpful suggestions regarding the presentation of text and illustrations.

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