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## PROPAGATION OF DECIDUOUS FRUITS

J. L. STAHL

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Strictly speaking there is no single way in which a particular fruit *must* be propagated. For example, apple trees, which are usually budded in California might be grafted or, conceivably, grown from hardwood cuttings, softwood cuttings, or even from layers. However, budding is usually cheaper than grafting, and it is impractical to use either cuttings or layers on account of the trouble and expense. The methods that nurserymen, florists, and others use in propagating plants are the result of long years of experience and are based on convenience and cost of operation. Sometimes it is more convenient or cheaper to use one method and sometimes another. Certain methods have become standard for particular fruits and these methods will be described in this circular.

It frequently happens that a fruit grower or farmer needs to make use of a method to suit his particular conditions that would not be practical for a nurseryman to use on a commercial scale—for example, the propagation of a favorite vine or shrub. This can be easily accomplished by drawing down a branch and covering it with earth until it takes root. The layered part is then cut away, thus producing a separate plant. The nurseryman, on the other hand, could not afford the time nor the expense to propagate on so small a scale for commercial purposes. To multiply the same plant on a large scale it would be necessary to resort to hardwood cuttings and to be provided with all the necessary equipment in the way of hotbeds, coldframes, callus pits, etc., for carrying on the work.

One of the methods of propagation most frequently used is that of grafting or top-working established trees in the orchard. Every fruit grower has to resort to this method to some extent, but obviously the nurseryman makes use of this plan only in a limited way if at all, because his business is to propagate young trees to sell, and merchantable trees at the nursery are never more than one or two years old.

The question most frequently asked is, "Why not grow all fruits and shrubs from seeds?" The answer is that where improvements have been made these qualities are not transmitted through the seed but are perpetuated through the buds. Hence the necessity of using parts of the plant itself by budding, grafting, and layering. If we merely desire a peach or plum tree without regard to the variety, seeds may be used. Occasionally a variety will come true to type from the seed as does the old Heath Cling peach, but such cases are rare. In propagating fruits, therefore, seeds are used only for growing stock plants on which to bud or graft varieties. This is true for most tree fruits. Some stocks are profitably grown from cuttings, such as quinces, roses, grapes, and certain types of plums.

The question of what kind of stocks to use even for the common deciduous fruits is a long story in itself—much too long to be narrated here with any degree of completeness. The following summary must suffice:

*Apple.*—Stocks for apples may be grown from the seeds of any variety of apple. As there is no commercial source of supply in this country aside from very limited quantities from old seedling orchards in New England referred to as "Vermont crab," nurserymen procure their seeds from France and Austria. These are native seedlings known to the trade as "French crab." Stock for dwarf apples consists of stool or mound layers from the Paradise apple, a natural dwarf type.

*Almonds.*—In producing stock for the almond, seeds of bitter almond are commonly used, although sweet almonds are doubtless just as good. Other stocks on which almonds are propagated are peach (any variety), and occasionally Myrobalan (cherry plum), although the latter is not very satisfactory.

*Apricots.*—The chief stock for the apricot is seedlings of apricot varieties. Apricots are also grown on Myrobalan and *Prunus mume* (Japanese apricot), and occasionally on peach, although the last named does not often make a good union.

*Cherries.*—Mazzard cherry is the common stock for sweet cherries, and Mahaleb for sour varieties. All seeds are imported from France. A sour cherry seedling, known as the Stockton Morello, is coming into favor for adapting sweet cherries to heavy or even wet soils where the stock has a decidedly dwarfing influence.

*Peaches.*—The peach is chiefly propagated on peach seedlings. In California the seeds come mainly from the Salwey and Muir varieties, although it is probable that any variety would do. The Strawberry, an old discarded variety, seems to give the highest percentage of

germination and the greatest uniformity of seedlings. Almond seedlings may be used. Apricot seedlings are occasionally employed in sandy soils to resist nematode injury, but the union is not often successful and can be remedied only by double-working, using Sugar prune as the intermediate stock. The peach does well on *Prunus davidiana* (wild Chinese peach), which is distinctly tolerant of alkali.

*Pears.*—The chief stock for pears is grown from a native seedling of Europe known as the French pear. The Chinese sand pear, known to the trade as “Japanese pear,” has been a failure in California, because it does not thrive in heavy or wet soils. The Manchurian species, *Pyrus ussuriensis* and *Pyrus calleryana*, are sparingly used as blight-resistant stocks, as the seeds which come from Japan are apt to be mixed with other species which are not resistant to blight. Two blight-resistant varieties, the Old Home and Surprise, may be bench-grafted on French seedling roots and later top-worked to Bartlett or any other desired variety. This makes it impossible for blight to do more than kill the branches, which may again be top-grafted. The French root is the only pear stock known to be highly resistant to oak fungus.

*Plums and Prunes.*—Plums and prunes are grown principally on Myrobalan seedlings. The seeds are imported from Italy by way of France, although scattering trees from which seeds might be procured may be found in any old prune or plum orchard in California. Peach seedlings are also a common stock. The almond is used especially in the Sierra foothills.

*Walnuts.*—Seedlings of the wild Northern California black walnut are used almost exclusively as stock for walnuts because they answer every purpose including resistance to oak fungus. Seedling English walnuts may be used, though they are less hardy and are readily attacked by oak fungus. Hybrids between the California and Eastern black walnuts, or between either of these and the English walnut are unusually vigorous growers, if selected stock is used. They are, however, rarely utilized because of the difficulty in obtaining the nuts or seedlings for planting.

The principal methods of propagating deciduous fruits are by budding, grafting, hardwood cuttings, layering, root suckers, and seeds.

#### BUDDING

Budding is the operation of inserting a single detached bud under the bark of the stock or seedling. Buds are taken from the current season's growth of the tree desired and placed on seedlings in the nursery. Only wood buds are used, since flower buds would only

blossom and die. Wood buds are always smaller and sharper-pointed than flower buds. Where they occur in clusters the center one is practically always a wood bud. Single buds are preferred for budding. Where clusters are used the outside buds are rubbed off. The budding knife should be of good steel and with a thin blade having an upward curve to the cutting edge.

Apples, pears, and quinces may be either budded or grafted. On the Pacific Coast, they are usually budded, while in the East they are often bench-grafted, the work being done in a grafting cellar in winter (January and February). Stone fruits, such as almonds, apricots, cherries, peaches, and plums, are commonly budded.

The operation of budding is simple and easily learned, but skill is acquired only after much practice. Budding is usually done in the latter part of July or August when the bark peels readily, but may be continued through September or until the bark refuses to peel. When the nursery trees are  $\frac{3}{16}$  to  $\frac{1}{4}$  inch in diameter all leaves and branches within six inches of the ground are rubbed off. This operation should not be performed within a week or ten days of budding as the wounds must have time to heal. Buds from the variety desired are secured by cutting "whips" or twigs of last season's wood. For convenience in handling, these whips are trimmed from the sticks with a sharp knife, cutting the stem from the underside. Beginners will find it desirable to cut the leaf stems to stubs a quarter of an inch long for ease in handling.

Bud sticks should be kept moist from the time they are taken from the tree until budding is done. They may be wrapped in wet burlap and kept standing in a pail with a few inches of water. In nursery practice, buds are usually placed on the north side of the seedlings for protection against the sun and as near the ground as it is convenient to work. In parts of California where summer north winds are hot, some propagators prefer to bud on the south side of the nursery tree, believing that exposure to the sun is less harmful to the bud than the hot north wind.

*Modified Shield Bud.*—A modified shield bud is most commonly used. The bud with half an inch of bark and a thin layer of wood is sliced from the bud stick with a sharp knife and immediately placed beneath the bark in contact with the cambium or growing layer (fig. 1.) The matrix for receiving the bud is usually made ready before the bud is cut from the stick. Two slits are made on the trunk of the seedling about two inches from the ground. One of the slits is cut across the stem and the other up and down at right angles to the first, either above or below it, thus forming the letter T upright or inverted.

Expert budders make the final vertical slit and throw open the bark ready to receive the bud all at one stroke or with a single movement and without removing the knife blade.



Fig. 1.—Bud sticks and buds. The buds are partially cut away but not entirely removed from the sticks until actually needed.

To set the bud, place it point up under the flaps of the bark in the T. Tie firmly with a twelve-inch piece of cotton wrapping twine or wet raffia. Wrap it at least twice around both below and above the bud. The loose ends may be tied in a single knot, or if wrapping is done from one end only, as is customary with skillful operators, the other may be made secure at the finish by a half hitch. In ten days

or two weeks the string should be cut so that the bark will not be constricted. Nothing more need be done until spring (fig. 2).

Successful budding cannot be done unless the bark of the stock peels readily. It is not so necessary for the bark to peel on the bud stick. For this reason the modified shield bud is used rather than the

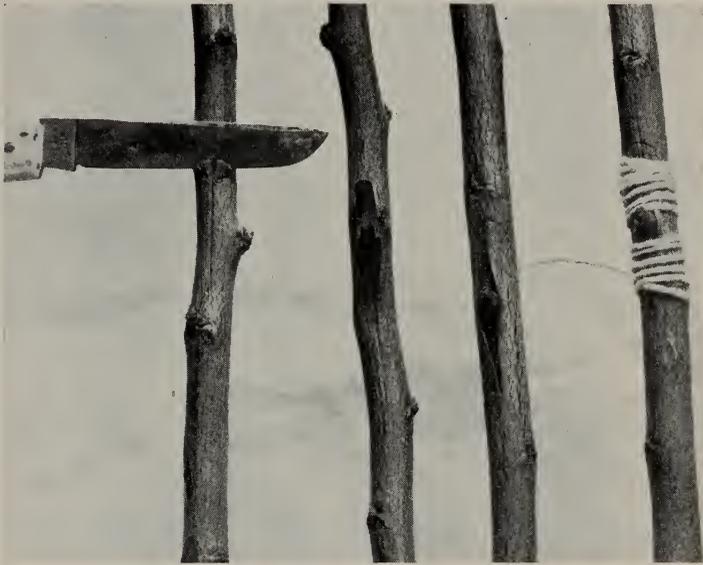


Fig. 2.—Steps in setting a shield or modified shield bud. Left, T cut made in bark; center, buds shown in place; right, bud tied.

true shield bud. To remove from the stick, a deep slice is made beneath the bud and extending just beyond it when the blade is withdrawn and a light horizontal cut made just through the bark. The bud with its shield-shaped piece of bark can then be lifted off with the thumb and finger, leaving the wood behind. This is the true shield bud with a square shouldered top and the pointed bottom.

When growth starts in the spring, the seedlings should be cut back to one-half inch above the bud, and all sprouts appearing below the bud rubbed off. One season's growth from the bud should develop a tree large enough for orchard planting.

*June Budding.*—Peach seedlings are often large enough to be budded in May or early June and set in the orchard the following spring, thus gaining a year. When this is done, it is sometimes necessary to collect the bud wood during the previous winter and hold it dormant in cold storage until needed. In California, the season is long enough to permit the budding of peaches and sometimes of other stone fruits in the usual way in May or June, just as soon as the

seedling stock is large enough and the new growth on the trees sufficiently matured for buds to be secured. June buds must be forced into quick growth by partially breaking off the tops of the little trees. As soon as the buds begin to open, the entire tops are removed.

*Flute and Ring Budding.*—Other types of budding sometimes used on the Pacific Coast are flute and ring budding. Flute budding is adapted to plants having thick bark, like the walnut or pecan, and

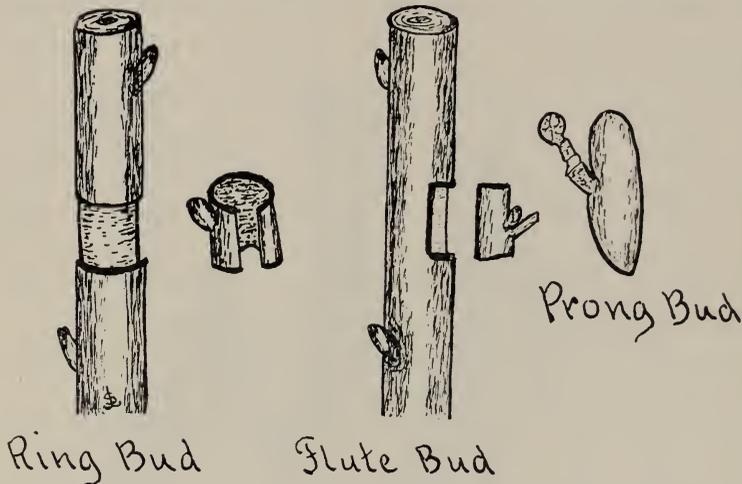


Fig. 3.—Special forms of buds. The ring and flute buds are used in propagating walnut, pecan and other thick-barked trees.

is usually done when the bark peels best. By this method, a section of bark is removed from the seedling and replaced by a similar portion including the bud desired. The bud is not held under flaps of bark as in shield budding but is tied to the stock in much the same manner. When the operation extends entirely around the stem, it is called "ring budding."

*Prong Budding.*—Another modification of shield budding is prong budding. The method is very similar to grafting. Instead of a simple bud, a short spur is used. The spur with a slice of bark is removed much like a shield bud, but only when the wood is dormant. After the operation is completed, the seedling is cut off just above the inserted bud (spur) and the wound covered with grafting wax (fig. 3).

#### GRAFTING

The different ways of grafting are usually given names according to the position of the union on the plant and the method of joining stock and scion. There are four general classes: root grafting, crown

grafting, stem grafting, and top grafting. The part that is grafted on is known as the stock and the scion is a section of a one-year-old twig that is joined to the stock.

*Root Grafting.*—In the Eastern and Central states, root grafting sometimes called “bench grafting,” is a popular method of propagating apples and pears. One-year-old seedling trees are taken up from the nursery as soon as dormant, tied in bundles of 100 each. Nurserymen carefully grade the trees according to size. Those taller than twelve inches are shortened by removing the tops to within four inches of the roots. The bundles are kept in good condition until needed by burying in sand or green sawdust in a cellar or cool room or, by selecting a moist, well-drained place out-of-doors and “heeling-in.” Scions of the desired varieties are cut after the leaves have dropped, and are stored in moist sand in a cool room; the grafting is done indoors during winter. A straight, thin blade that will hold a fine edge makes a good grafting knife. Some propagators prefer to cut down the blade of an old-fashioned steel case-knife about three inches in length and grind it sharp for a grafting knife.

The entire root may be grafted or it may be cut into several pieces and each portion grafted to a scion. Whole roots do not require scions of more than two buds but the scions are usually about four inches long. Piece roots may be from one to four inches in length. Where stock is scarce and scion wood plentiful, a short piece root and a long scion are often used. The union is then set deeper in the soil. A 3-inch piece root is usually joined to a 6 or 7-inch scion, giving grafts 8 or 9 inches in length or more.

The “whip graft” is commonly used. At the base of the scion and top of the root, sloping cuts 1 to 1 $\frac{3}{4}$  inches are made. On each of these cuts, starting at a point about one-third from the tip, a reverse cut is made, slightly curved and parallel to the first cut. A thin tongue of wood in both root and scion is thus formed, which, when skillfully made, will interlock and fit snugly together (fig. 4). Care should be taken to see that the cambium layers (inner bark) of the scion and root fit together on at least one side. If one piece is larger than the other, they will coincide or fit only on one side but, fortunately, this is sufficient.

The parts are held in place with a few wraps of waxed string. A good wrapping thread is made by dropping a ball of No. 18 knitting cotton into melted grafting wax, afterwards allowing it to drain and cool. No tying is needed with waxed string. Heavy cord which does not rot readily in the soil might constrict the growing graft. After being joined and tied, the grafts are placed in moist sand, sawdust,

or moss and kept cool until planting time. Growth at the juncture of scion and root has then started and a strong union soon results.

In large nurseries a furrow may be plowed six or eight inches deep and the grafts set six to eight inches apart. Small plantings may be made with a spade. The soil should be firmed well around each graft, especially around the root part.

*Crown Grafting.*—Some propagators bud all of their apple and pear seedlings and “whip graft” or “cleft graft” wherever the buds fail to unite. The latter is done in the early spring as the trees stand in the nursery row.

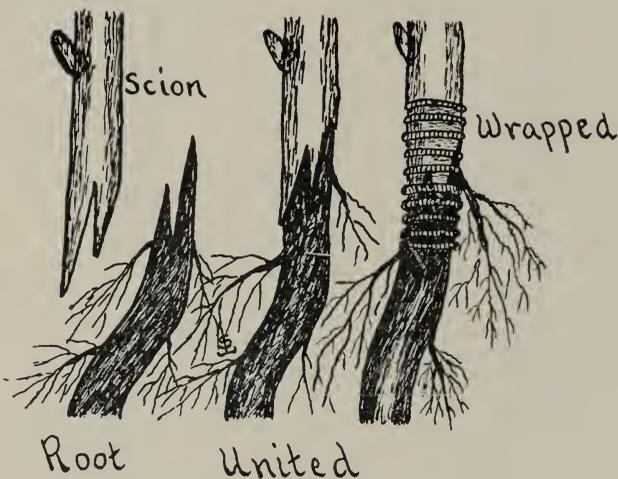


Fig. 4.—Root-graft. This manner of uniting scion and stock is often known as the “whip” or “tongue” graft. It is not much used in California but is extensively employed in cold climates where work is done indoors during the winter.

In-laying, a special form of crown grafting, is sometimes done at or just above the surface of the ground. The stock is cut off and on the stump a V-shaped groove made either with a sharp knife or with a special tool, which will cut both the groove and a triangular-shaped wedge at the base of the scion to fit the groove. The scion is held in place with a waxed cloth or string.

*Stem Grafting.*—A common method of inserting a scion in the trunk or stem below the framework branches is known as “stem grafting,” and is accomplished by making use of a side graft. With a sharp chisel an oblique cut about an inch deep is made in the stock and the scion cut wedge-shaped to fit. The wound is covered with wax or waxed cloth (fig. 5).

*Inarching.*—Another method of stem grafting is that known as “grafting by approach” or “inarching.” One plant can be made

to unite with another while both are growing on their own roots. This is often practiced with pear trees on undesirable roots or where the trunk has been injured by blight or rodents.

A seedling of the favored stock is planted by the side of the tree and grafted into the latter four to six inches (or as low as possible) from the ground. The seedling is whittled to a wedge-shape and inserted in a cut made with a knife point or thin chisel. The parts are firmly wrapped and waxed until they unite. Several seedlings may



Fig. 5.—Side-graft. Left, scion set in stock; center, the scion; right, graft wrapped with waxed cloth.

be thus grafted around a tree and serve either to bridge over a crown wound or to revive the tree by providing a more congenial stock. It is easier to do the grafting and waxing before planting the seedlings. The seedlings should be planted as closely to the trees as possible (much closer than those shown in the illustration) to avoid injury in cultivating. Oftentimes valuable trees can be saved by inarching with very little setback in their growth (fig. 6).

*Bridge Grafting.*—Each year many orchard trees on the Pacific Coast are severely injured or killed by rodents or through mechanical injuries which result in the girdling of the trunk. Fortunately such injuries usually occur in winter when the trees suffer least. By bridging over the injured area, the tree can be made to function normally. Scions two or three inches apart are inserted into the live tissues above and below the wound.

The operation is quite simple. Dead and loose bark should be cut away, and the wound smoothed and treated with a good antiseptic. The scions for the bridge should be of the previous season's growth and of the same species as the tree to be treated. The two ends of the scion are whittled to a long, thin wedge on the same side. A single shallow stroke of the knife will give the necessary flat surfaces to the other side. The wedge-shaped ends are slipped into slits made in the bark, or under the edges of the bark, above and below the girdle, so that the cambium layers of scion and stock are in contact. The



Fig. 6. Inarching. These young trees, girdled by gophers at the ground, were saved by inarching with seedling trees. The seedlings were planted unnecessarily far from the trees and are likely to be in the way of cultivation.

scions should be slightly longer than the space to be bridged, so that when forced into place the tension will hold them in place (fig. 7). It is a good plan to wrap waxed cloth over the edges of the bark covering the scions or to drive a small nail through the ends of each scion to hold them firmly in position. If the girdle is near the ground, it is well to bank soil over the bridge grafts to keep them from drying out.

Sometimes suckers from the root inserted above a trunk would serve the same purpose as scions. When this method is possible, it is usually a very successful one (fig. 8).

*Top Grafting.*—Top grafting is a popular method of changing varieties of deciduous fruit trees. The work is usually done during

the dormant season, but with some fruits may be successfully performed as late as the blooming period, if the scions have been kept dormant in cold storage.

Tools for cleft grafting are inexpensive and simple. An old hatchet, ground sharp, a short wooden club of hardwood for a mallet, and wedges of hardwood or steel are very serviceable for a few trees. For extensive operations, a grafting tool with steel splitting blade and wedge attached to one handle is more convenient. This may be purchased from a hardware dealer. A tool less artistic in appearance, but usually more durable, can be made by a blacksmith from an old file

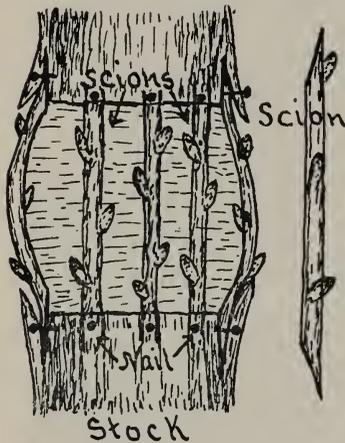


Fig 7.—Bridge grafting. If trees are wounded during the dormant season the injury may be repaired in early spring by bridging with several scions as shown in the illustration.

9). Scions three to four inches in length with two or three buds are best, as long scions are often loosened by the wind. Two sloping cuts,  $1\frac{1}{2}$  to 2 inches in length are made at the base of each scion to form a wedge which is thin on one side and thicker on the other, like a knife blade. Two scions are inserted in each cleft (one on each side) so that the thin edge fits neatly into the opening and the bark side comes in line with the inside of the bark of the stock. If the scions are pointed slightly outward and set firmly in the cleft, the cambium layer should come in direct contact with the same tissue of the stock and union should take place readily (fig. 10).

After the scions are inserted, the wedge is removed and the exposed surface covered with grafting wax, waxed cloth, or melted asphaltum. Where there is danger of crushing the scions, wads of

or rasp. The cutting edge should be concave to prevent peeling the bark when the wood is split.

*Cleft Grafting.*—A common form of top grafting is known as the cleft graft. Branches of the stock are sawed off six to twelve inches above the trunk. A sharp saw is essential for a clean cut. It is good practice to smooth the rough edges of the bark with a sharp knife to induce ready healing of the wounds.

The grafting tool is placed across the flat surface of the stub (preferably not through the exact center) and driven into it two or three inches deep with the mallet. A sharp blow from underneath will loosen the tool, and a wedge may then be driven into the cleft to hold it open while the scions are inserted (fig.

newspaper may be pushed into the cleft to relieve the side pressure or a wooden wedge may be driven in and broken off flush with the surface.

*Saw-kerf Graft.*—In some orchards the saw-kerf graft is used. The branches are cut off just as for cleft grafting, but the stub is not split. Instead, a notch is cut down the side of the stub with a saw and the edges smoothed with a sharp knife. The scion is cut to fit the notch and is set in and waxed over in a manner similar to that for cleft grafting. Some propagators slope the tip of the scions inward rather than outward, as in this position they are less liable to be



Fig. 8.—Bearing pear trees injured by blight were saved by grafting in root suckers on trunk and branches above injury.

dislodged by wind and birds (fig. 11). The saw-kerf graft is preferable to the cleft graft for branches larger than four inches in diameter as the wounds heal quicker.

A very practical modification of the saw-kerf method consists in sawing notches  $\frac{3}{4}$  of an inch deep directly into the stump by holding the saw at an angle of forty-five degrees. The saw should have coarse teeth or a heavy “set” so that the kerfs (slits) are from  $\frac{1}{8}$  to  $\frac{3}{16}$  of an inch wide. If they are made an inch apart all around the stump no time need be devoted to smoothing them with a knife as enough of the scions will grow to make the operation a success and the work is very quickly done. The scions must be flattened on both sides but

with one edge thicker than the other. A little practice will enable the operator to make them fit. Complete the operation by sealing up all wounds with grafting wax.

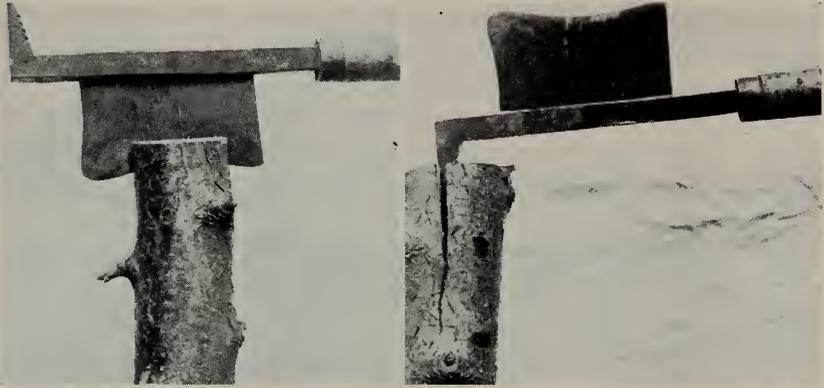


Fig. 9.—Cleft-graft. Left, stock split with grafting tool; right, cleft open ready for inserting scions.

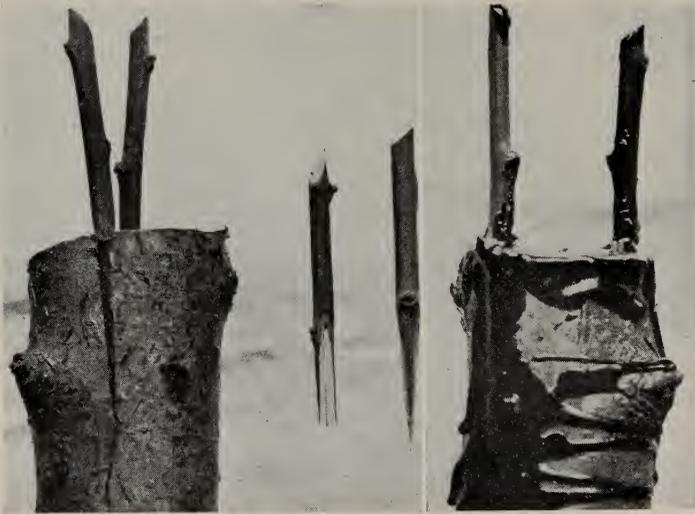


Fig. 10.—Cleft-graft. Left, scions set; center, the scions; right, completed graft covered with grafting wax.

*Bark Graft.*—Bark grafting is a form of top grafting often used with old trees. The top is cut off as for cleft grafting, and the edge of the stub smoothed with a knife. Instead of splitting or notching the stock, the bark is loosened with a thin chisel or knife blade and wedge-shaped scions forced beneath the bark and wood. Sometimes a shoulder is cut on the scions to hold them in place. Either grafting

wax or waxed cloth is used to cover and seal wounds until union takes place (fig. 12).

With some fruits, bark grafting is often more successful than cleft grafting. Some propagators like best to top graft only part of the branches one year, leaving the remainder uncut to provide shade for the scions and foliage for the manufacture of plant food for the tree while the scions are uniting and putting out new leaves. Others graft the entire top at one time, allowing a few water sprouts to form on the trunk the first season to produce foliage until the scions are established.



Fig. 11.—Saw-kerf graft. Left, scion set; center, notch smoothed with a knife; right, shows position of saw. A modification of this method consists of making a single cut into the wood an inch deep with a coarse-toothed saw.

*Top Budding.*—This form of top-working is convenient for changing over undesirable trees of peaches as all peach trees are difficult to graft. The top is cut back severely when dormant and the resultant new growth is budded the following summer. The T-bud form, as for shield budding in the nursery, is commonly used. Buds of the desired variety are cut from well hardened wood of the current season's growth. The method of setting and wrapping the buds is similar to that used in shield budding.

**GRAFTING WAXES AND WRAPPING.**—A much used grafting wax is made by melting together four parts of resin, two parts of beeswax, and one part of tallow. While warm this may be applied with a brush to the cut surfaces of the stock, or if made by the process of cooling the molten mass by pouring into cold water, the wax may be

pulled like taffy until smooth and tough and then rolled into balls and laid away on oiled paper until needed. Before handling in this way, the hands should be greased with tallow or lard. This makes a soft wax which can be warmed by simply working with the hands or if needed in a hurry may be heated over a fire. The wax should be carefully spread over all cuts, cracks, and exposed places on the graft.

Waxed cloth is made in the same manner as waxed thread (p. 9). Strips of old sheeting or similar cloth are rolled loosely, dropped in hot wax for a few minutes, and then set away on greased paper to drain. Waxed string or cloth may be kept indefinitely. It is easily

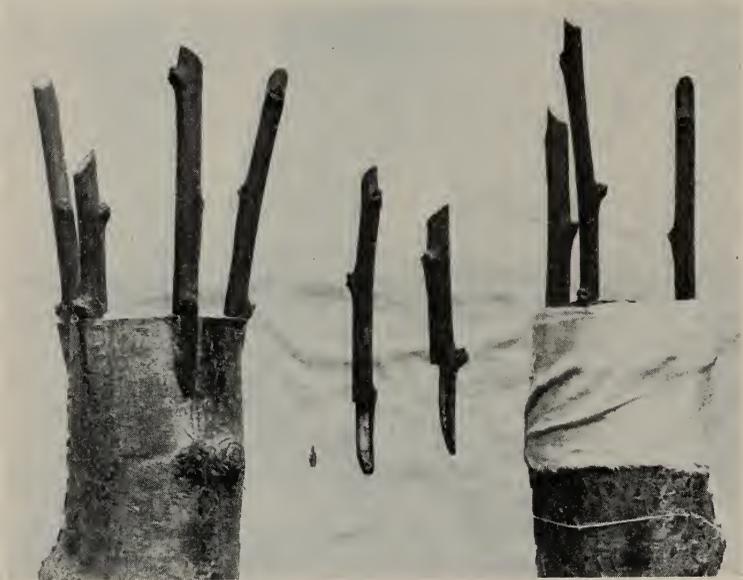


Fig. 12.—Bark graft. Left, scions set; center, the scions; right, graft wrapped with waxed cloth.

softened if the wax becomes hard, by dipping in warm water. During the past few years many orchardists have successfully substituted asphaltum Grade D for grafting wax. It is much less expensive and, when melted, is as easily applied with a brush.

Grafting pots or portable hand stoves for heating the wax may be secured through dealers in hardware and orchard supplies. For grafting a few trees the wax may be poured into a tin can and kept soft by placing it in a pail half-filled with hot coals.

#### HARDWOOD CUTTINGS

A hardwood cutting is a portion of the ripened wood of a plant of the previous season's growth. Such fruits as grape, currant, goose-

berry, fig, and quince are ordinarily propagated by this simple method.

It is impossible to lay down a hard and fast rule for the length of cuttings or the number of nodes, that is, buds or joints, on each. A cutting of currant and gooseberry six or eight inches in length will contain several nodes, while one of grape of the same length may have only two. Cuttings are usually about six inches in length and contain two or more nodes. Grape propagators prefer a 10 or 12-inch cutting with three nodes. As roots generally develop best from the vicinity of the buds, it is the usual practice in preparing cuttings to make the lower cut just below a node or bud (fig. 13).

Some propagators use a heel or mallet cutting. The former is made with a slice of the old wood adhering to the base, and the latter with a short section (one-half to one inch) of the parent stem left intact. Roots develop readily on such cuttings, but they are more wasteful of wood, since only the base of the shoot is used for each cutting. Other propagators prefer "single eye" cuttings with only one bud and an inch of wood above and below it. Though this method gives a large number of cuttings from a limited supply of wood, it is usually necessary to start them in a greenhouse or hotbed with bottom heat. The bud is placed in either an upright or a horizontal position about an inch below the surface of the soil or sand and kept moist (fig. 14).

The cuttings are usually made in late fall before heavy frosts. They are tied in bundles, packed in sand, moss, or green sawdust and stored in a cool cellar or pit during the winter. In the early spring the bundles are opened and the cuttings set two or three inches apart in the nursery row. Cuttings difficult to root should be placed in a coldframe or sand bed in an upright but inverted position, and the upper end of the bundles covered with an inch of sand. Leaves or manure spread over the cuttings will protect them from freezing. Early in the spring the litter may be taken off and the sand bed or frame covered with a glass sash. This method keeps the tops of the cuttings cool and dormant while the butts, being nearer the surface of the sand, receive more warmth. These callus quickly and roots start before the leaves appear. The cuttings are then in ideal condition for setting in the open ground.

In milder localities of the Pacific Coast, hardwood cuttings of many plants may be made and set directly in the nursery row in the late fall or winter after the wood is ripened. Roots will form during the early spring, and strong young plants will be ready for field setting the next fall or the following spring. Care should be taken to place the cuttings in soil which is not apt to heave by freezing and thawing or in which

water stands for more than a day or two at a time even after heavy rains. Leaves or straw as a thin top mulch usually prevents injury from freezing. If not protected in some manner, the cuttings should be carefully watched; if the soil about them becomes displaced, they should be reset and packed firmly again in fine soil.

All cuttings should be planted two or three inches apart in the nursery row with the uppermost bud just above the ground. A furrow may be opened with a plow, the cuttings placed against the land side, and loose soil packed firmly around them, or they may be planted in an opening made with a garden dibble or spade. Very long cuttings are best set on a slant so the lower nodes, where the roots are expected

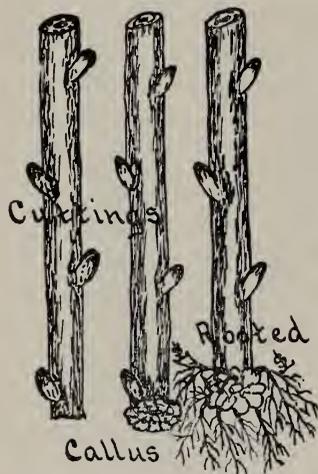


Fig. 13.—Hardwood cuttings showing callus and root formations.

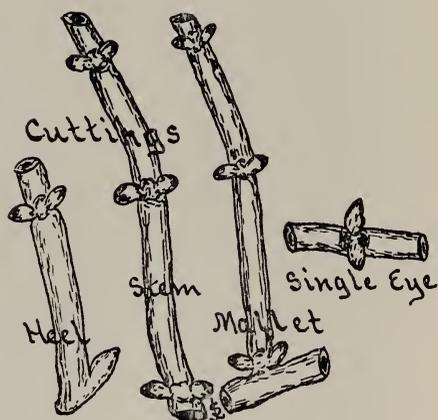


Fig. 14.—Special forms of hardwood cuttings.

to form, will be nearer the surface of the soil and receive more warmth. Care should be taken that the soil is firmed well around each cutting, especially at the base.

#### LAYERING

Layering is the operation of rooting stems while they are attached to the parent plant. This is a simple method of propagation, as the parent plant nourishes the layered parts until they are well rooted.

*Tip Layering.*—Some plants root best by layering the tips, while others seem able to strike root at any point on the new wood. In jointed plants like the grape, the roots form at the nodes or joints. By wounding the bark by scraping, cutting or sharply twisting the stem, older wood may be induced to root.

Loganberries, black raspberries (blackcaps), dewberries, and trailing blackberries are commonly propagated by bending down a cane

of the previous season's growth and covering the tip with two or three inches of fine moist soil. In windy localities it is best to dig shallow holes near the parent plant, insert the cane tips and press the soil firmly around them to insure a good root system. This is done when the young cane has stopped growth in early fall. Roots quickly develop on the buried tip, and by early winter the layers are ready for transplanting. Before digging up, the cane is severed from the parent plant, six to eight inches being left attached to the rooted tip (fig. 15). Well rooted tips can be field set any time during the dormant season. In California they move well in January or February.

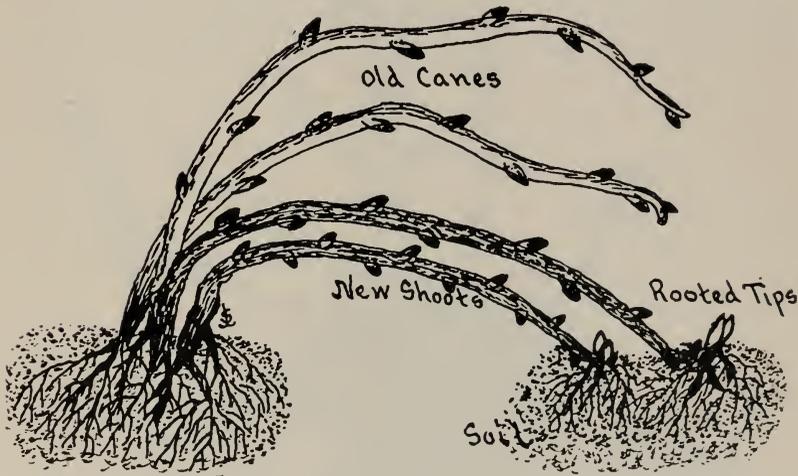


Fig. 15.—Layered loganberry. The cane tips were lightly covered with soil in early fall.

*Mound Layerage.*—Plants, like currants and gooseberries, which “stool” are often propagated by mound layering. In the fall after the growing season, new shoots are bent outward and moist soil mounded over the crown of the parent plant at the base of the shoots, the latter being wounded by scraping with the spade at points where roots are desired. When well rooted, the shoots may be severed from the parent plant, saving as much of the new root system as possible (fig. 16).

This method of propagation is more expensive than that by hardwood cuttings, since only one new plant can be secured from each shoot, but it is a sure method of propagating gooseberries, which are sometimes difficult to root from cuttings.

*Vine Layering.*—The grape can easily be propagated by laying down a young shoot and covering one or more buds with soil. During late fall or winter when the vines are dormant, a shallow trench is

dug where a new plant is desired and in it is laid a shoot from a plant nearby. Two or three buds are covered with moist soil, and when a good root system is developed, the shoot is severed from the parent vine. A wire twisted around the shoot just below the buried bud nearest the parent plant will constrict the backward movement of sap and often aid in root formation (fig. 17).

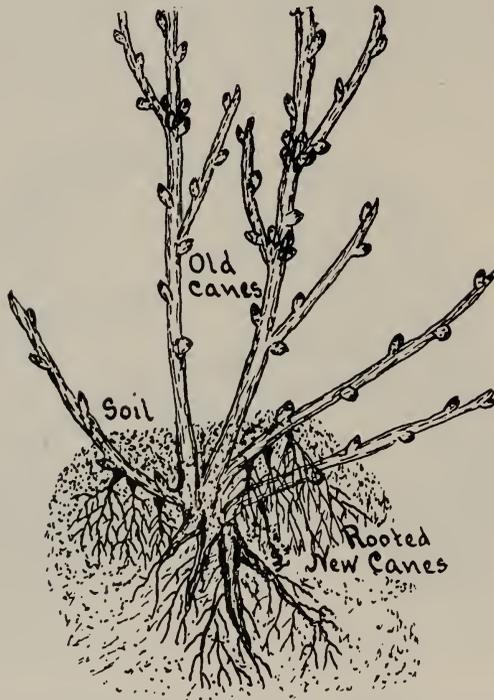


Fig. 16.—Sprouts from a currant being caused to root by means of mound layerage.

Shrubby plants of all kinds with branches or sprouts long enough to reach the ground may be layered in like manner. The tips must not be covered but the layered part should be buried deeply enough to be in contact with moist soil all summer.

*Runners.*—Quite similar to vine layering is the method by which the strawberry is propagated. Runners develop from the mother plant; at each second joint new plants will form. Most strawberry varieties produce an abundance of runner plants without assistance. Small mounds of soil or clods placed on the second and fourth joints will hold down the runners and aid in the formation of new plants. Those nearest the mother plants are strongest and are, therefore, the most desirable for field setting. Plants of the previous season are

preferable to older plants for planting. It is better to set a field with runner plants from a young plantation than from an old field, as the runners are usually strong and the plants not likely to be diseased or infested with insects (fig. 18).

### ROOT SUCKERS

Red raspberries and bush (upright) blackberries are commonly propagated by underground shoots or root suckers on which upright stems with roots are formed. Cutting through the sprouted root with a sharp spade separates the new plant from the mother plant. Young fields produce more and stronger plants than old fields (fig. 19).

*Root Cuttings.*—Berries or other fruits that sprout readily usually may be propagated by root cuttings. The roots are dug up, cut into

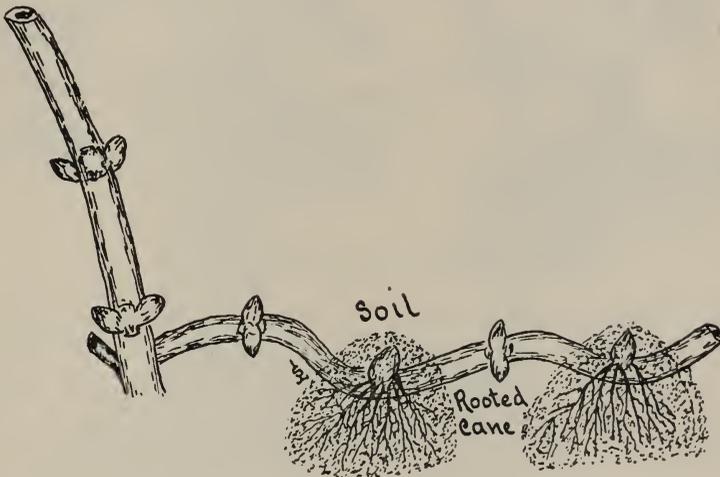


Fig. 17.—Layerage. A convenient way to propagate grapes, roses and shrubbery.

pieces two or three inches in length, and planted in early spring; but it requires a year longer to secure good plants by this method than by setting sucker plants. Root cuttings are placed in a nursery row in a trench three or four inches deep and covered with fine moist soil. After a year's growth, they may be reset in a permanent field.

### SEEDS

One method of starting seeds for budding or grafting is to sow the pits or seeds from ripe fruits directly in the nursery row or garden after the flesh has been removed and the surface moisture dried. The soil is kept moist and sometimes covered with a mulch of leaves to prevent baking the surface. This method is successful only where

the soil is well drained and the moisture is controlled. Field mice are fond of some fruit seeds, especially apple, and may destroy much of the seed bed during the winter (fig. 20).

A common method of sprouting the seeds or breaking their seed coats is to stratify them for two or three months during the fall and winter before planting in the nursery. About November alternate layers of moist sand and seeds from ripe fruits are placed in shallow boxes and kept in a cool place until late winter. It is often necessary to cover the box or seed pit with screen wire for protection against

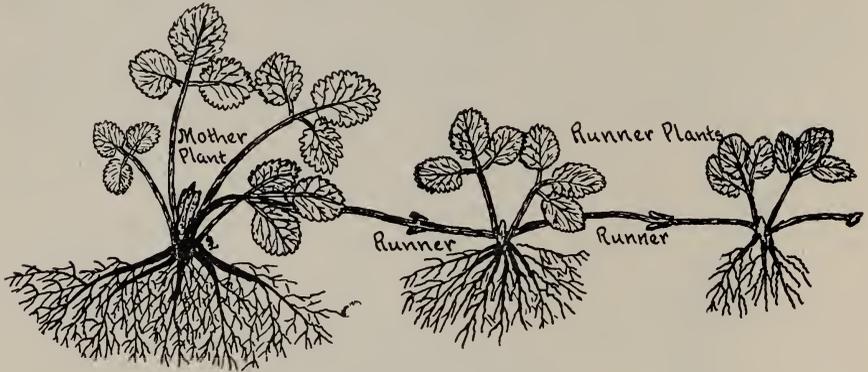


Fig. 18.—Strawberry and runner plants.

birds or squirrels. In January or February the seeds are examined from time to time and when they begin to crack or start to sprout they are planted in the nursery row to be budded the following summer. When large quantities of peach or other large seeds are stratified a pit may be dug twelve or eighteen inches deep in well drained soil. The pit is filled with seeds and covered with a few inches of moist sand (fig. 21).

Peach and apricot pits on the Pacific Coast are usually secured from canneries or dry yards and are in a more or less dried condition when they reach the propagator. Drying of the outer hard seed coat does not interfere with germination. The kernel, however, should not become too dry.

Cherry seeds should dry only in the shade before being stratified. Some successful propagators bury the cherry pits in a trench at harvest time and keep them covered with moist soil until late fall, then stratify them in the usual method.

Apple and pear seeds should be carefully watched in the stratifying box and planted *before* the sprouts appear. Peaches can be planted and will grow after the sprouts have started but apples and pears will not.

Seeds that are not apt to be molested by mice, such as the peach, apricot and walnut, may be planted in the late fall, but in general it is preferable to stratify all seeds over winter, and plant them in late January and February according to the needs of the various seeds. In a small way seeds are best mixed with sand in "flats" (shallow boxes) with open tops and kept on the ground in a shady place out in the open all winter. Rains are frequent enough to keep the sand moist.

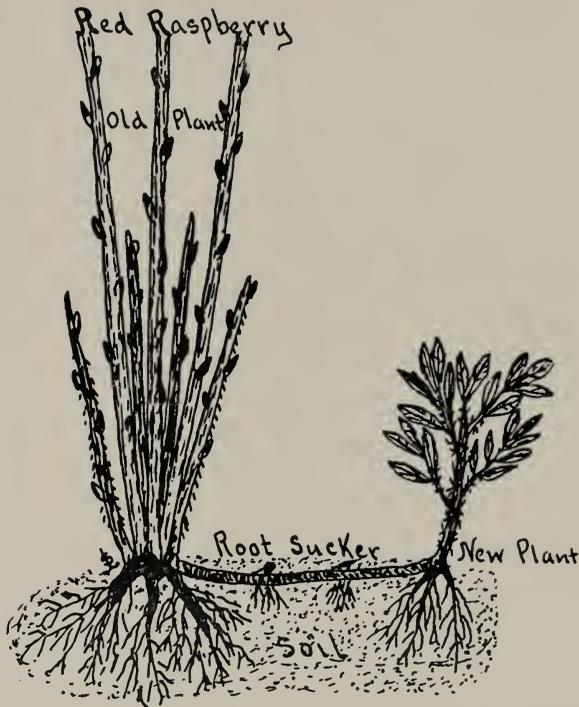


Fig. 19.—Root suckers. New plants spring up from the roots of red raspberries, blackberries and many other plants.

There are two plans for planting; in seed beds, and in nursery rows. Nurserymen usually prefer to grow apples, pears, and cherries in a seed bed for one season and then cut the seedlings back and transplant them to the nursery where they are grown another season and are budded during late summer of that season. The other plan, which is generally followed by beginners, is to plant the seed directly in the nursery rows with the idea of giving the seedlings extra good care as to irrigation and cultivation so they will be large enough to bud the same season.

Under the first plan the seeds may be planted in low raised beds six to eight feet wide and any length desired. Apple, pear, plum and

cherry seeds are planted thickly, as crowding is desirable to prevent the seedlings from becoming too large. For lining out in the nursery row, they are cut back to five or six inches, set eight to ten inches

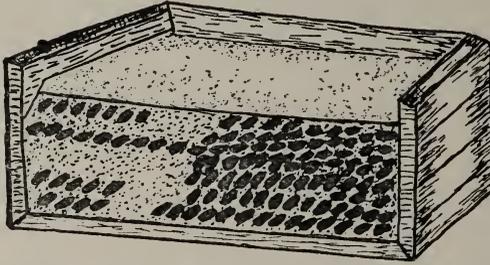


Fig. 20.—Seed stratified in sand box. Any seeds, in a small way, may be treated in this manner.

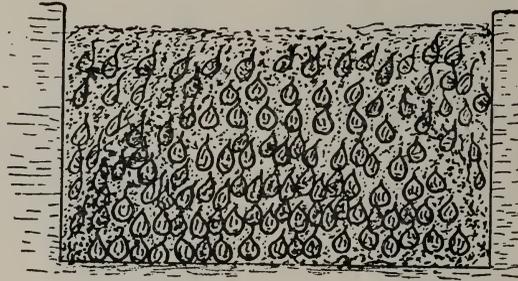


Fig. 21.—Peach seed stratified in pit.

apart, and budded the following July or August. Peaches, apricots, and almonds are rarely ever transplanted, as they grow large enough to be budded the first season. They are, therefore, always planted in the nursery row in the first place. If not crowded in the row it is quite possible to treat apple, pear and cherry seedlings in the same manner.

To grow seedlings to budding size in one season requires that the nursery soil be put in the finest state of tilth possible before the seeds are sown. During the growing season, the nursery will have to be watered according to its needs. Sandy soils may require irrigating as often as every ten days or two weeks. The seedlings should not be allowed to stop growing.

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