Unit C: Maintaining the Fruit and Nut Tree

Lesson 2: Plant Propagation Techniques Utilized in Fruit and Nut Production

Terms

- Air layering
- Cambium layer
- Cleft graft
- Compound layering
- Distal end
- Division
- Hardwood
- Inarching
- Interstock
- Mound layering
- Node
- Perlite
- Proximal end
- Rootstock
- Runner
- Scion
- Side graft
- Simple layering
- Softwood
- Stolon
- Tip layering
- Topworking
- Vermiculite
- Whip and tongue graft

I. **Cuttings** are the most common method of vegetative propagation.

A. A cutting is any vegetative plant part such as stem, leaves, or roots that, when detached from the parent plan is capable of reproducing a plant exactly like the parent.

1. Cuttings for fruit and nut trees will be **softwood** or **hardwood**.
    a. Softwood cuttings are normally from woody plants and come from the new growth before it hardens.
    b. Hardwood cuttings come from a woody plant after the stem has hardened.

B. Propagation by cuttings are less commonly used by fruit and nut trees.

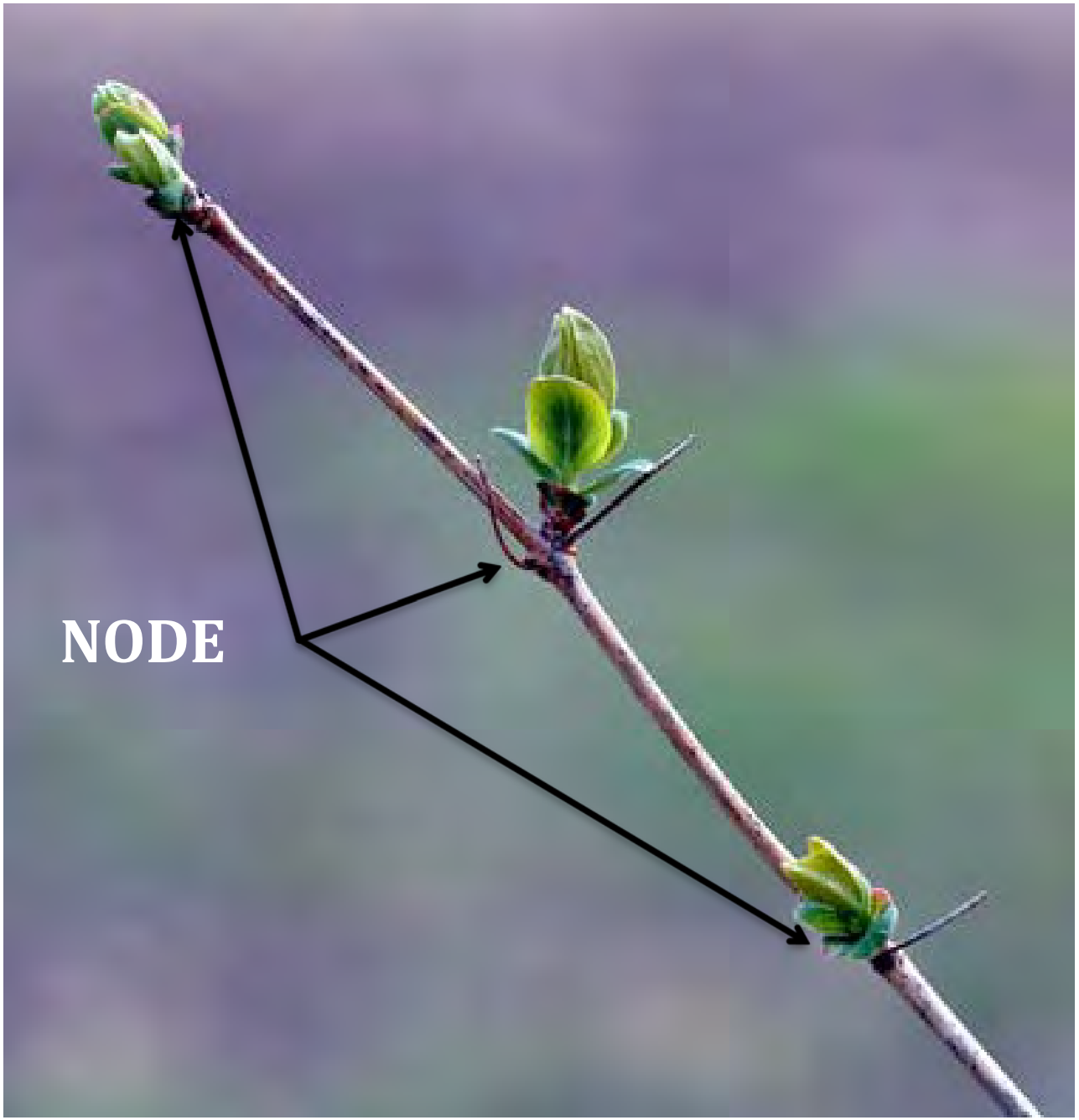
1. Grapes are the main fruit which can be successfully propagated by cuttings.
   a. This is one reason that some of our grape cultivars are so ancient.
2. Fig and pomegranate can be propagated by stem cuttings.
3. Traditional fruit trees such as pears and apples can be propagated by stem cuttings but not without great trouble and sometimes little success.


Pomegranate
Cuttings

C. The procedure for stem cuttings of fruit and nut trees depends upon the species.

1. Stem cuttings should be 15 centimeters long with five to six buds.
    a. Avoid using cuttings from the tip of the cane. This wood will be younger and more prone to cold damage.

2. Cut the stem at a forty-five-degree angle immediately below a **node.**
    a. a node is the area of a stem where one or more leaves are attached
    b. roots commonly initiate from the node in some species of plants.


NODE

3. Only healthy, insect-free cuttings should be selected.
4. Early morning is the best time to take cuttings
5. Keep the cut end moist until it is rooted.

6. Cuttings should be taken with a sharp knife or razor blade to reduce injury to the parent plant.
   a. Dipping the tool in rubbing alcohol or a mixture of one part bleach and nine parts water prevents the transmission of disease from infected plant parts to healthy ones.

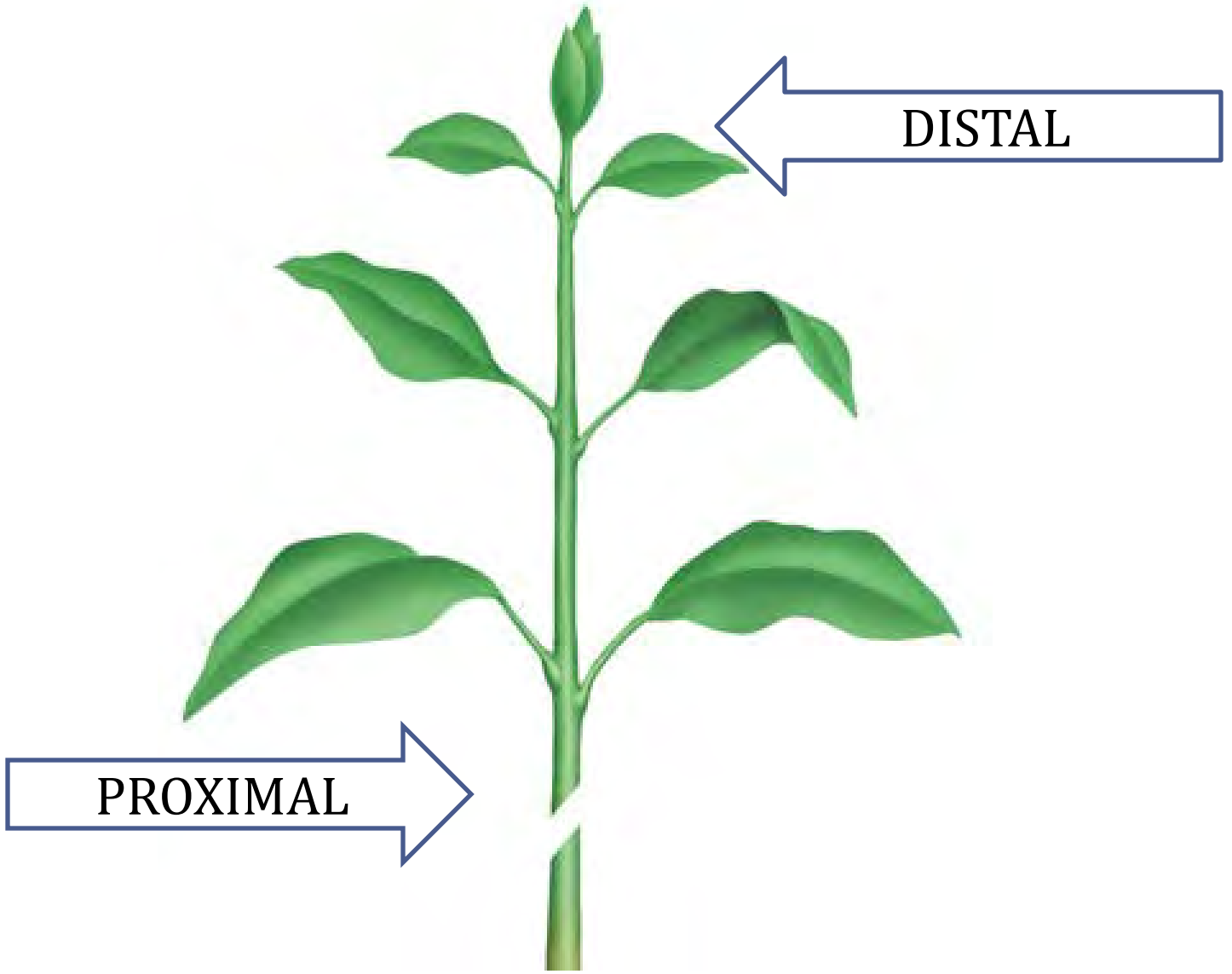
7. Flowers should be removed from the stem in order to conserve energy and stored carbohydrates for root and shoot formation rather than flowering and fruiting.

8. An artificial rooting hormone can be used to promote quicker rooting.
    a. Rooting hormone is not required but will improve the success and speed of rooting in cuttings.

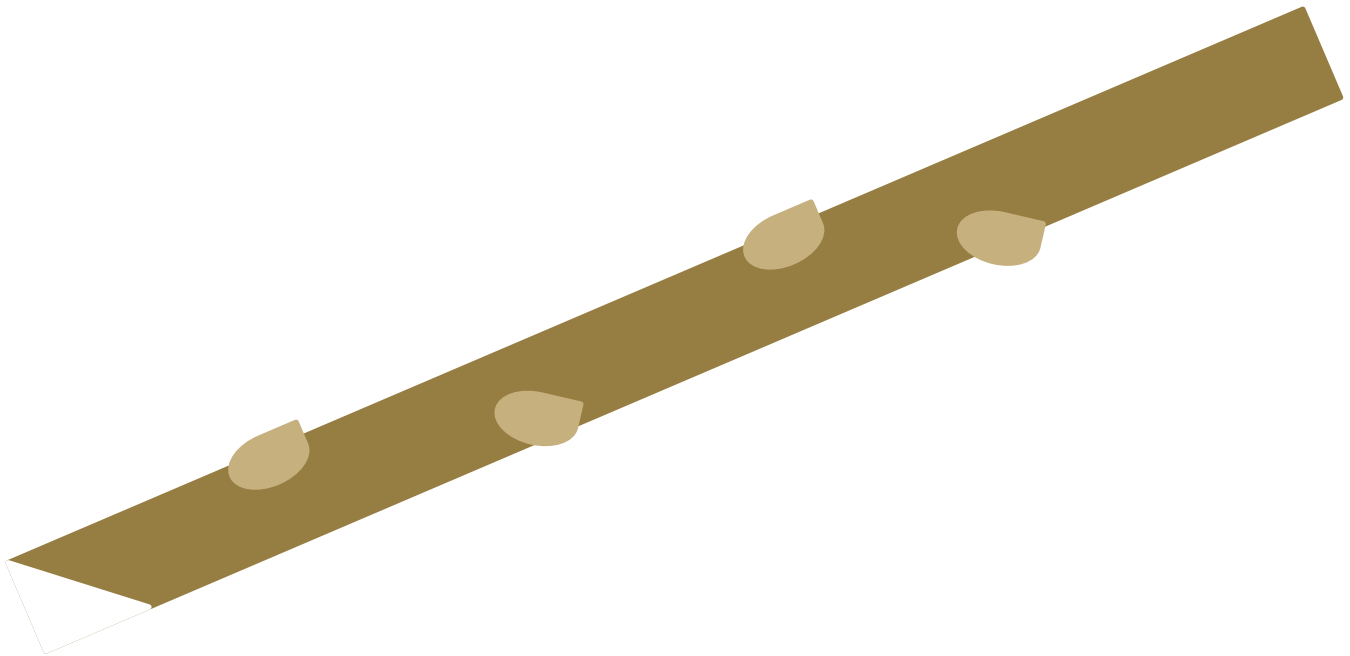
D. After taking the cutting be sure to maintain the vertical orientation of the cutting.

1. The end of the cutting that was closest to the roots, **proximal end**, should go into the growing medium and the end closest to the tip, **distal end**, should be pointing out of the growing medium

   a. Roots will only form from the proximal end and inserting the distal end of a cutting into the growing media will not succeed.


DISTAL
PROXIMAL

2. Remembering which end is which can be done by always cutting the proximal end at an angle and the distal end straight.



E. After cuttings are taken they should be placed in a moist rooting medium such as coarse sand, **vermiculite**, soil, water or mixture of peat and **perlite**.

1. Selection of the correct rooting medium is important to get optimum rooting in the shortest time.
2. The rooting medium should be sterile, low in fertility, drain well enough to provide oxygen, and retain enough moisture to prevent water stress.
    a. The medium should be moist before inserting cuttings and kept evenly moist while cuttings are rooting and forming new shorts.

F. Stem cuttings can be placed in bright but indirect light so they do not dry out.

II. Layering is another very simple method of asexual propagation.

A. Layering is commonly done on bramble fruits and can also be done with grapes.

B. Stems still attached to their parent plants may form roots where they touch rooting medium or soil.

C. Severed from the parent plant, the rooted stem becomes a new plant.

D. Layering promotes a high success rate because it prevents the water stress and carbohydrate shortage that plague cuttings.

E. Some plants, especially brambles, layer themselves naturally.

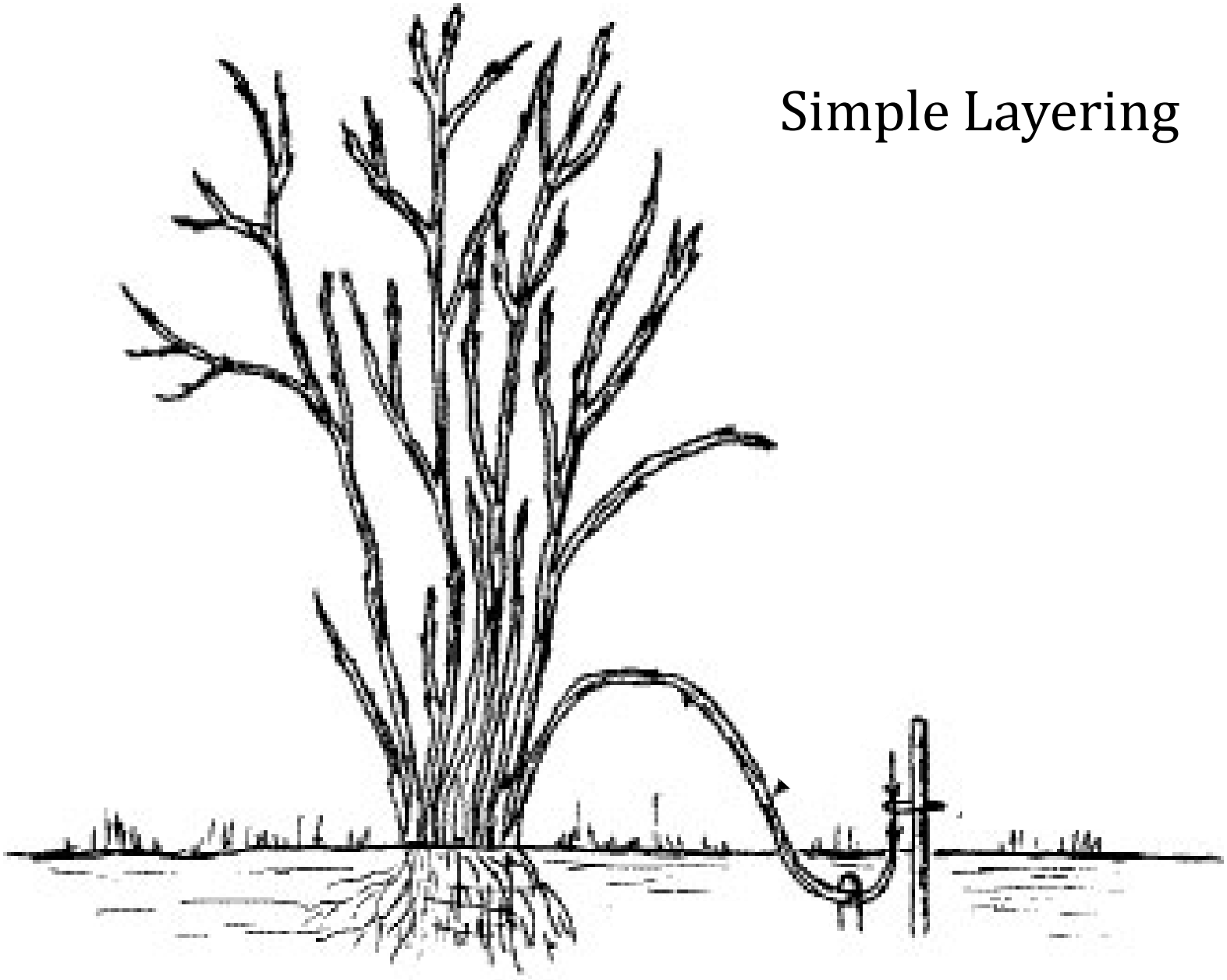
F. There are various methods of layering.

1. In **tip layering** the shoot tips is inserted in a hole three to four inches deep and covered with soil.
   a. The tip grows down first and then bends sharply and grows upward.
   b. Roots from at the bend and the recurved tip becomes a new plant.
   c. Tip layering can be used on purple and black raspberries and trailing blackberries.

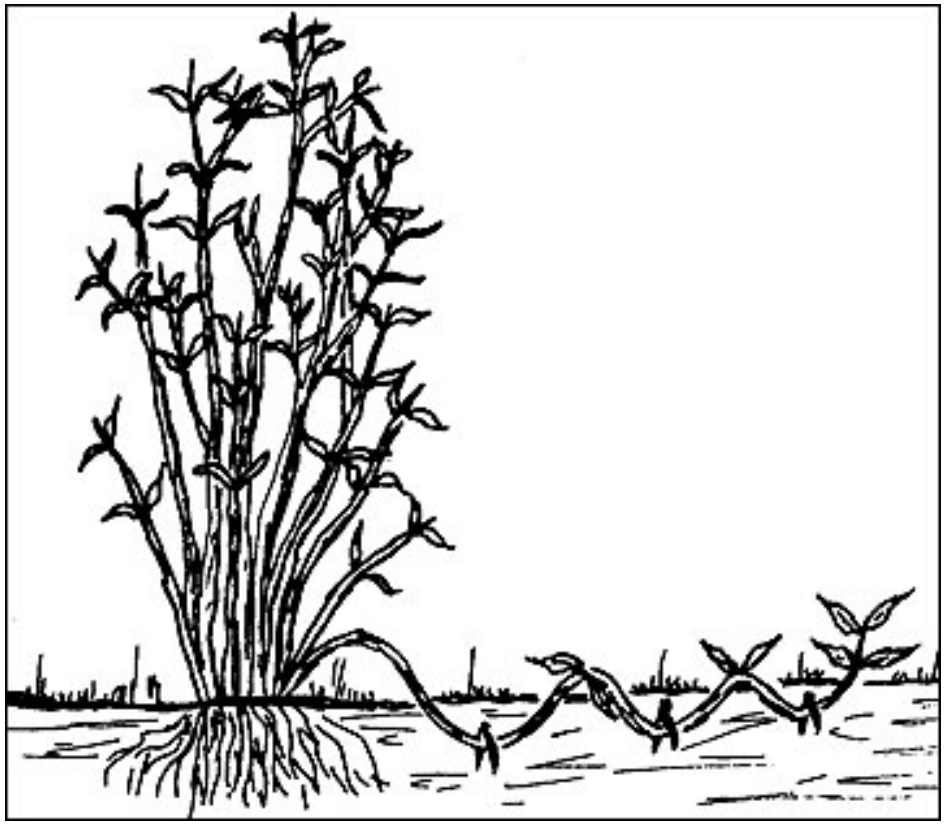
Tip Layering

2. **Simple layering** involves bending a stem to the ground and partially covering it with soil, leaving the last 15 to 30 centimeters exposed.
   a. The tip is bent into a vertical position and staked in place.
   b. The sharp bend will often induce rooting, but wounding the lower side of the branch or loosening the bark by twisting the stem may help.

Simple Layering

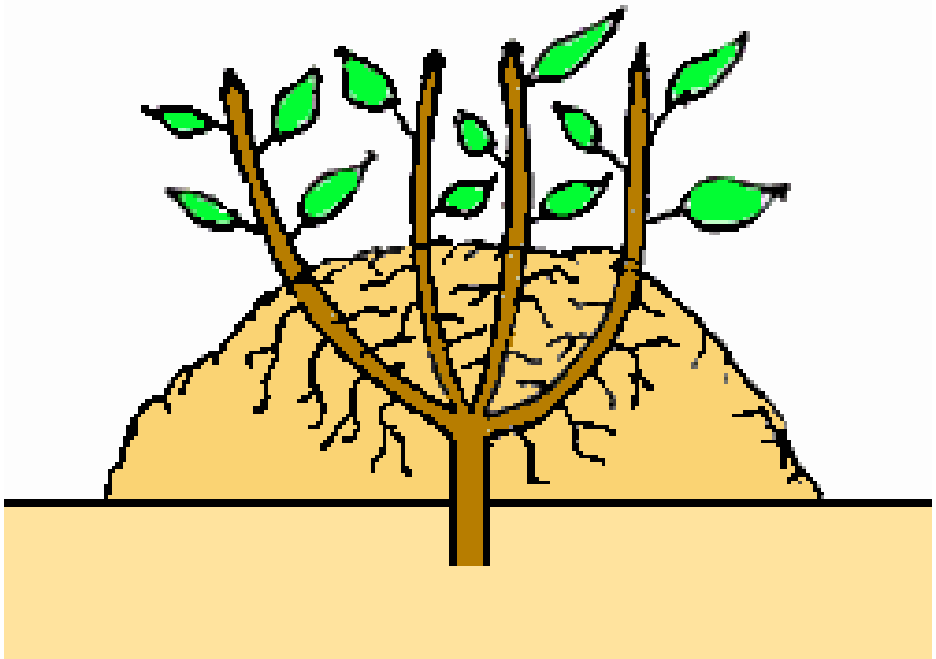


3. **Compound layering** is just like simple layering except multiple sections of the same stem are alternately covered and exposed.

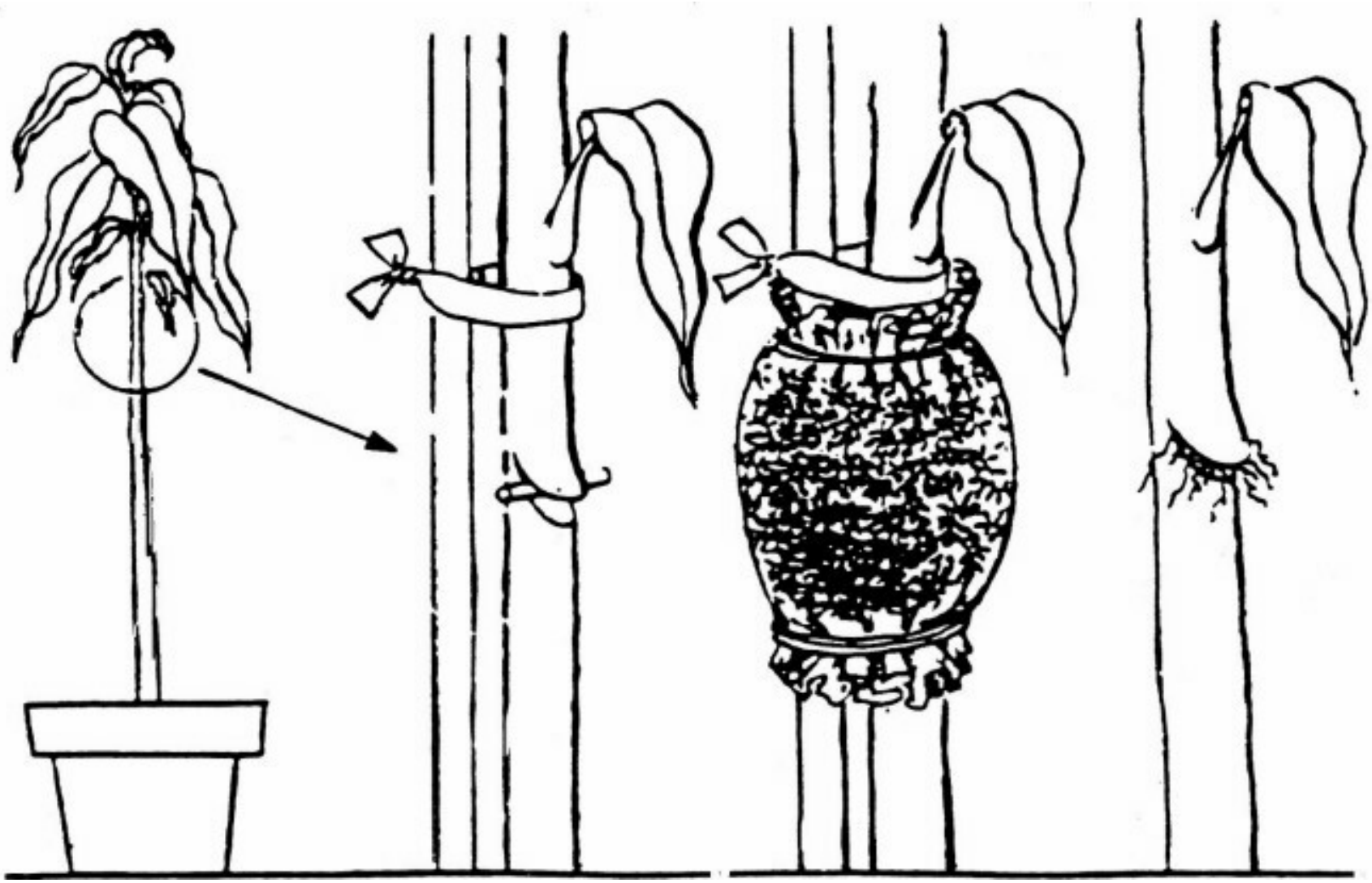


4. **Mound layering** consists of cutting back the plant to once about the ground in the dormant season and then piling soil around it in the Spring to induce root production from the new shoots.

   a. This type of layering works for apple rootstocks.



5. **Air layering** is not commonly used in fruit propagation but is possible.
    a. In air layering the stem is slit just below a node.
    b. The slit is then opened up and surrounded with wet sphagnum moss.
    c. Plastic or foil is wrapped around the moss and tied in place.
    d. When roots grow out of the moss the plant is cut off below the root ball and planted.

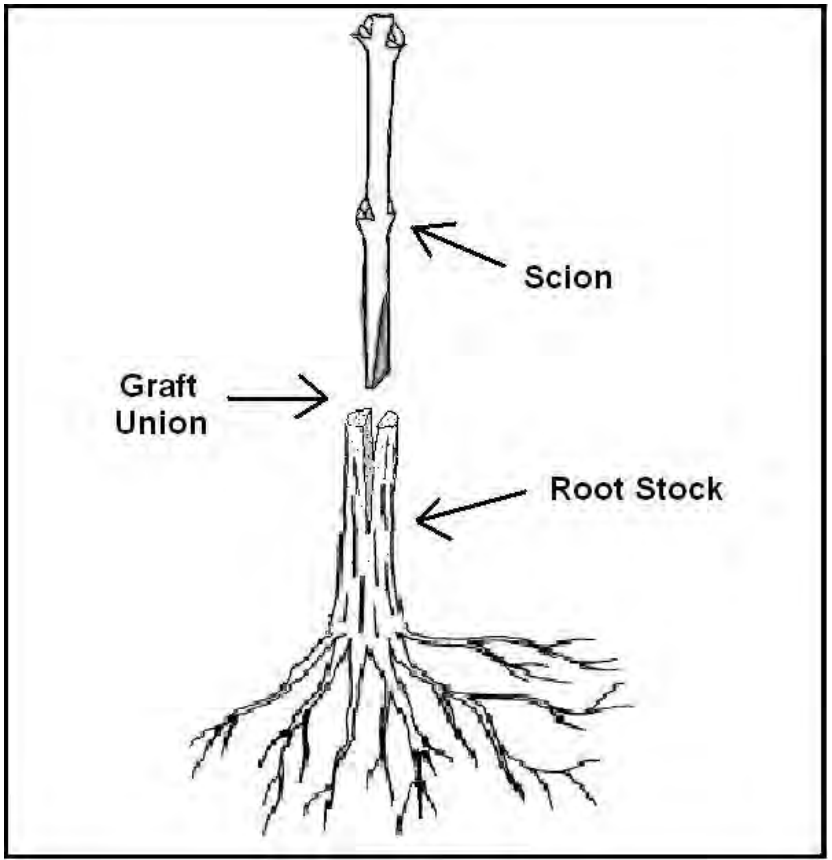


6. **Stolons** and **runners** are specialized plant structures which can be used to propagate plants.
    a. A **stolon** is a horizontal, often fleshy, stem that can root, then produce new shoots where it touches the medium.
    b. A **runner** is a slender stem that originates in a leaf axil and grows along the ground.
    c. The main fruit that is propagated by this method is strawberry.

III. Grafting and budding are the main propagation methods used in fruit and nut production.

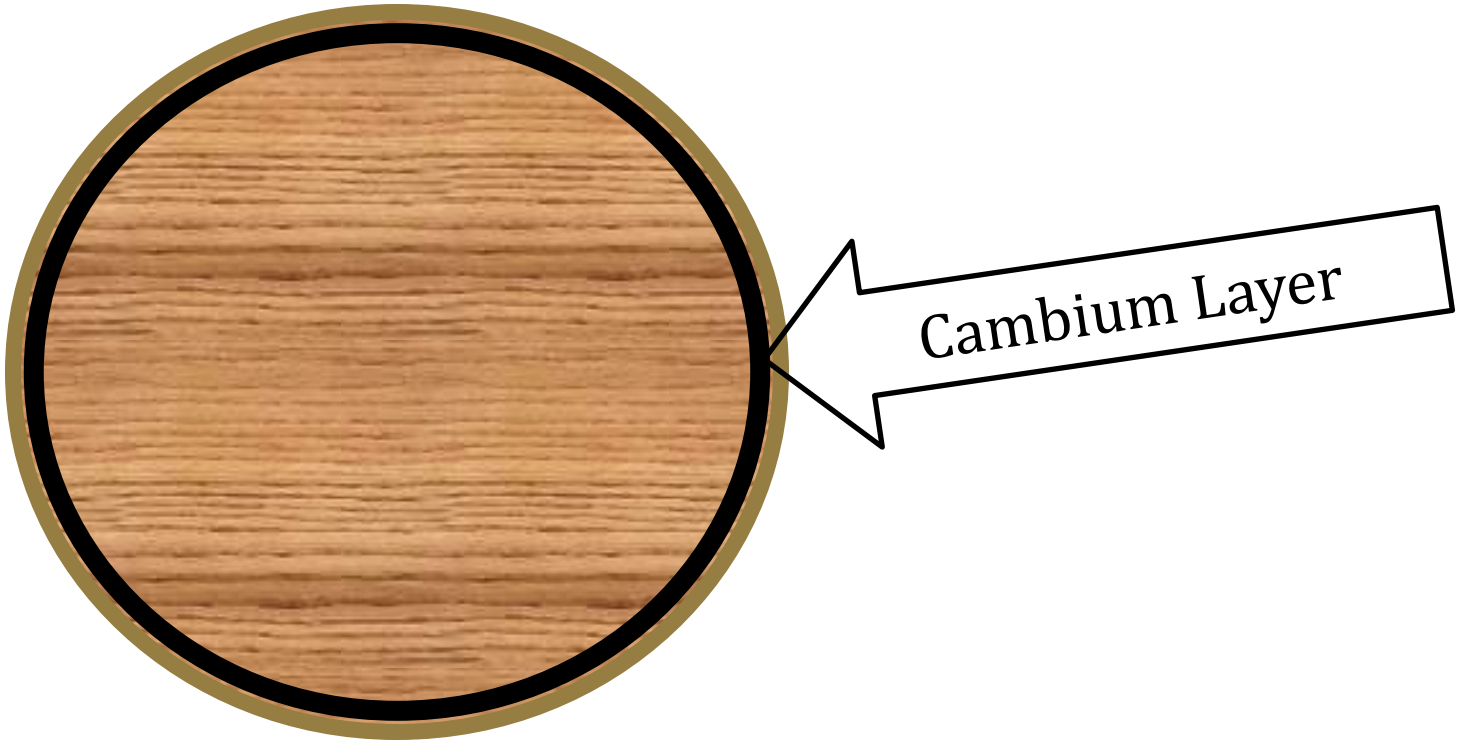
A. Grafting and budding are horticultural techniques used to join parts from two or more plants so that they appear to grow as a single plant.

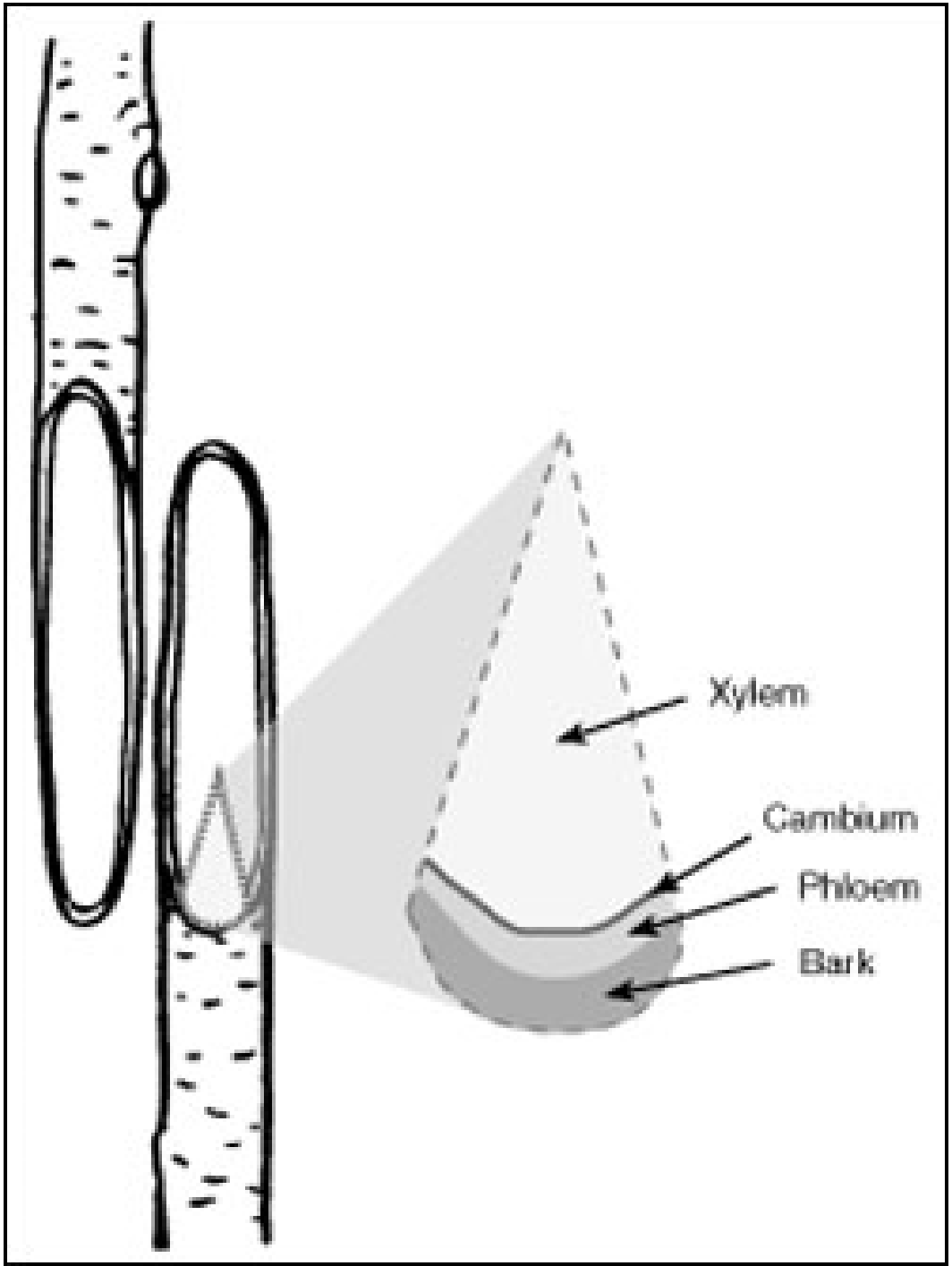
1. In grafting, the upper part (**scion**) of one plant grows on the root system (**rootstock**) of another plant.



2. In the budding process, a bud is taken from one plant and grown on another.

3. When the two parts are joined the **cambium layer** must match up.
   a. The cambium layer is a thin layer of cells between the bark and the inner wood where the tree grows most actively and also where most of the nutrients are transported.
   b. If the scion's cambium layer does not match with the rootstock's cambium layer the scion will die and the graft will not heal, or take.




Xylem
Cambium
Phloem
Bark

B. Since grafting and budding are asexual or vegetative methods of propagation, the new plant that grows from the scion or bud will be exactly like the plant it came from.
   1. These methods of plant reproduction are usually chosen because cuttings from the desired plant root poorly (or not at all).
   2. Also, these methods give the plant a certain characteristic of the rootstock - for example, hardiness, drought tolerance, or disease resistance.

C. The timing of grafting depends on the species and the technique used.

D. The reasons for grafting and budding are numerous and important.

1. Change varieties or cultivars.

   a. An older established orchard of fruiting trees may become obsolete as newer varieties or cultivars are developed.

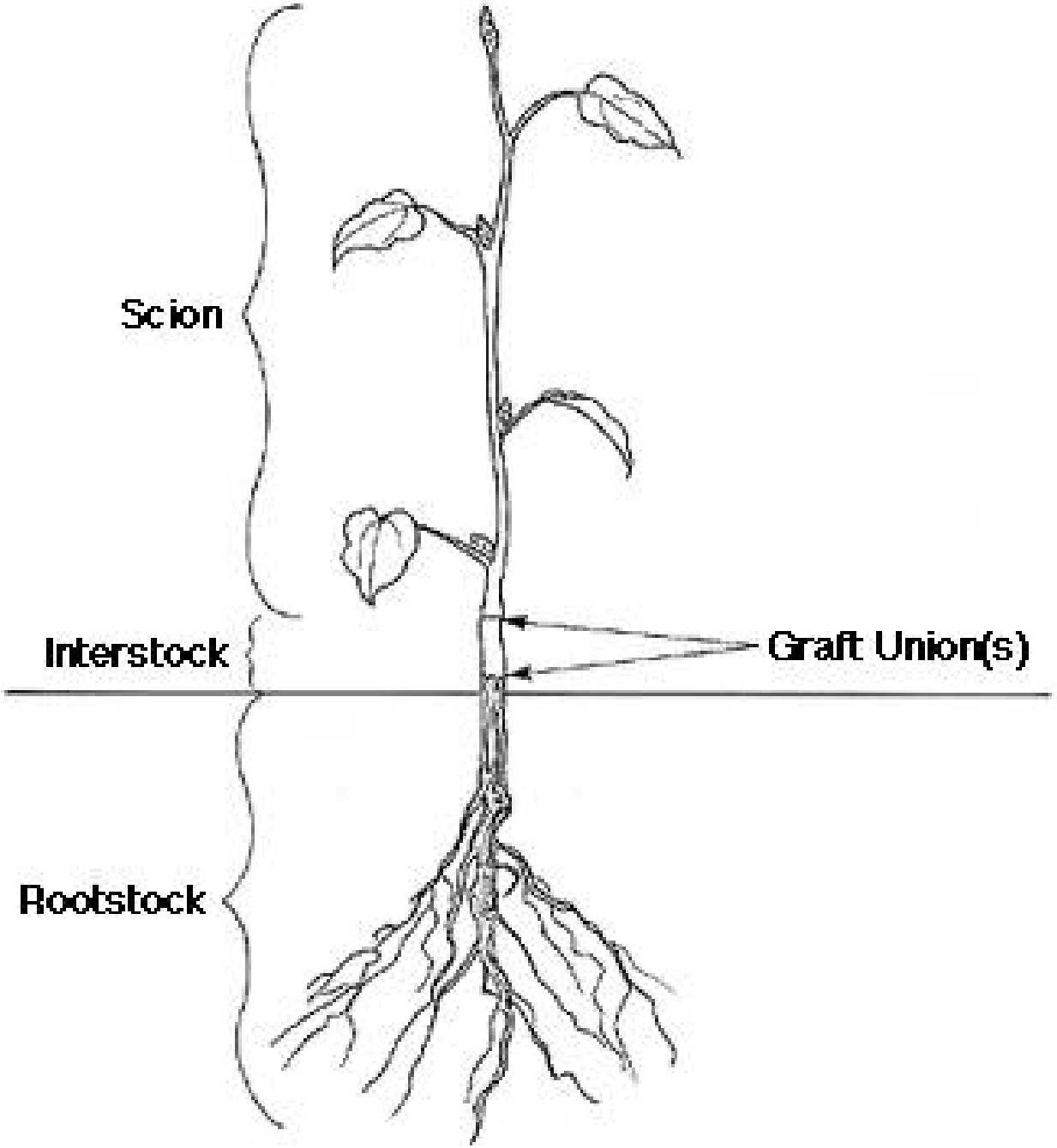
   b. The newer varieties may offer improved insect or disease resistance, better drought tolerance, or higher yields.

   c. As long as the scion is compatible with the rootstock, the older orchard may be top worked using the improved variety or cultivar.

2. Optimize cross-pollination and pollination.
   a. Certain fruit trees require cross-pollination.
   b. Portions of a tree or entire trees may be pollinated with the second variety to ensure fruit set.
   c. Where cross-pollination is not possible, the chances that cross-pollination will occur can be increased by grafting a scion from a male plant onto the female plant.

3. Take advantage of particular rootstocks.
   a. Compared to the selected scion, certain rootstocks have superior growth habits, disease and insect resistance, and drought tolerance.
   b. For example, when used as rootstock for commercial apple varieties, the French crabapple *(Malus sylvestris,* Mill.) can increase resistance to crown gall and hairy root.
   c. Malling VIII and Malling IX are used as dwarfing rootstocks for apple trees when full-sized trees are not desired, such as in the home garden.

4. Benefit from interstocks.
   a. An interstock can be particularly valuable when the scion and rootstock are incompatible.
   b. In such cases, an **interstock** that is compatible with both rootstock and scion is used.
   c. An interstock could increase the disease resistance or cold hardiness of the scion.
   d. Plants also may be double worked to impart dwarfness or influence flowering and fruiting of a scion.


Scion
Interstock
Graft Union(s)
Rootstock

5. Perpetuate clones.

a. If a fruit tree has desirable characteristics that would be beneficial throughout the orchard, such as disease resistance, grafting and budding allow that tree to be cloned.

6. Produce certain plant forms.
   a. Numerous horticultural plants owe their beauty to the fact that they are grafted or budded onto a standard, especially those that have a weeping or cascading form.
   b. In most cases, multiple scions are grafted or budded 91.4 centimeters or higher on the main stem of the rootstock.
   c. When used this way, the rootstock is referred to as a standard. It may require staking for several years until the standard is large enough to support the cascading or weeping top.

Weeping Mulberry Tree

7. Repair damaged plants.
   a. Large trees or specimen plants can be damaged easily at or slightly above the soil line.
   b. The damage may be caused by maintenance equipment (such as lawn mowers, trenchers, or construction equipment), or by disease, rodents, or winter storms.
   c. The damage can often be repaired by planting several seedlings of the same species around the injured tree and grafting them above the injury.
   d. This procedure is referred to as **inarching**, approach grafting, or bridge grafting.

8. Increase the growth rate of seedlings.
    a. The seedling progeny of many fruit and nut breeding programs, if left to develop naturally, may require 8 to 12 years to become fruitful.
        i. However, if these progeny are grafted onto established plants, the time required for them to flower and fruit is reduced dramatically.
    b. Another way to increase the growth rate of seedlings is to graft more than one seedling onto a mature plant.
    c. Using this procedure as a breeding tool saves time, space, and money.

IV. Grafting and budding is a practice that takes much practice but is very beneficial to the fruit and nut orchard.

A. Grafting requires different tools depending upon the graft.

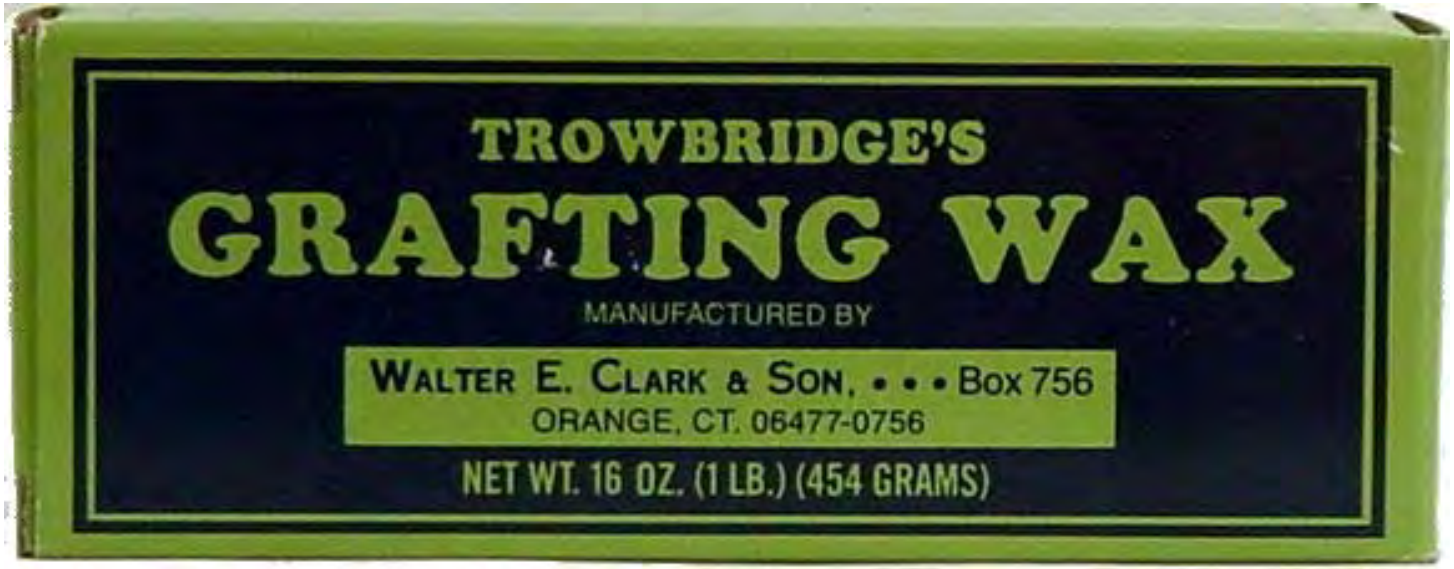
1. The most important tool is a sharp knife.
   a. A sharp knife makes cleaner cuts thus improving the quality of the graft.
   b. A sharp knife also reduces the risk of personal injury as a dull blade can cause more damage to skin than a sharp blade in the event of an accident.

2. A fine-tooth saw for cleft grafting

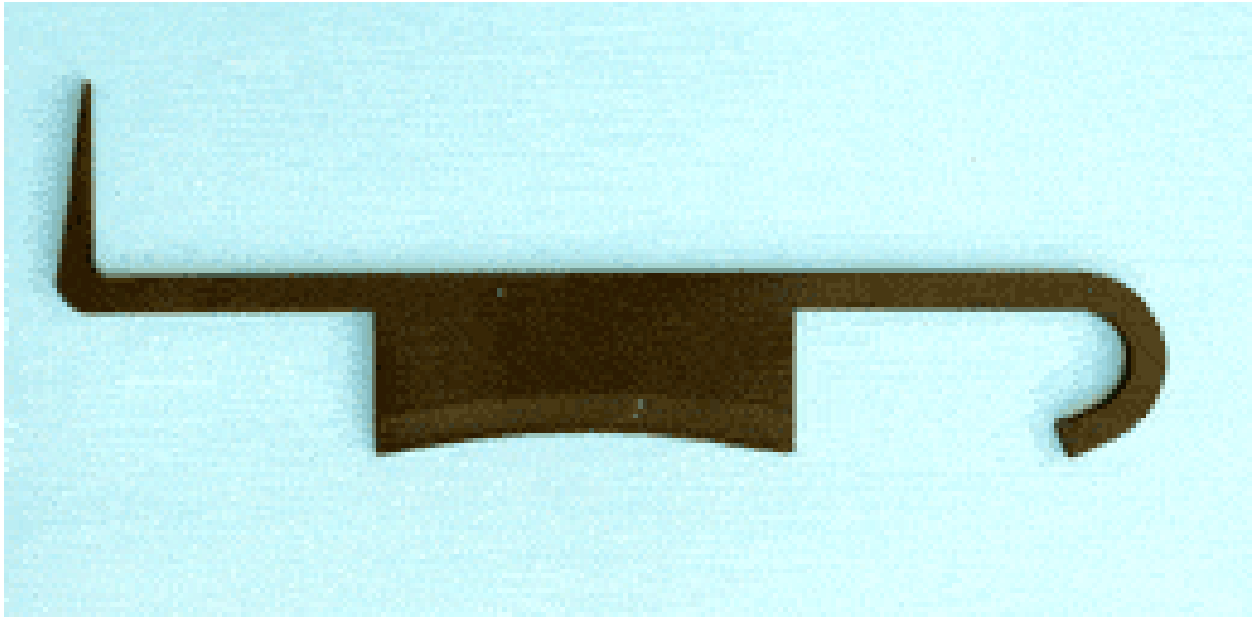
3. Pruning shears
    a. Just like the grafting knife, pruning shears should be kept

4. Tying material such as grafting tape, adhesive tape, electrician's tape or rubber strips
   a. Whatever is used for a graft covering should be resistant to sun degradation while the graft is healing and should be able to hold the graft together without girdling the tree.
   b. The tying material will be removed once the graft has healed.

5. Wax or similar substance to cover grafts
    a. All grafts should be covered with a protective coating immediately after completing the graft.

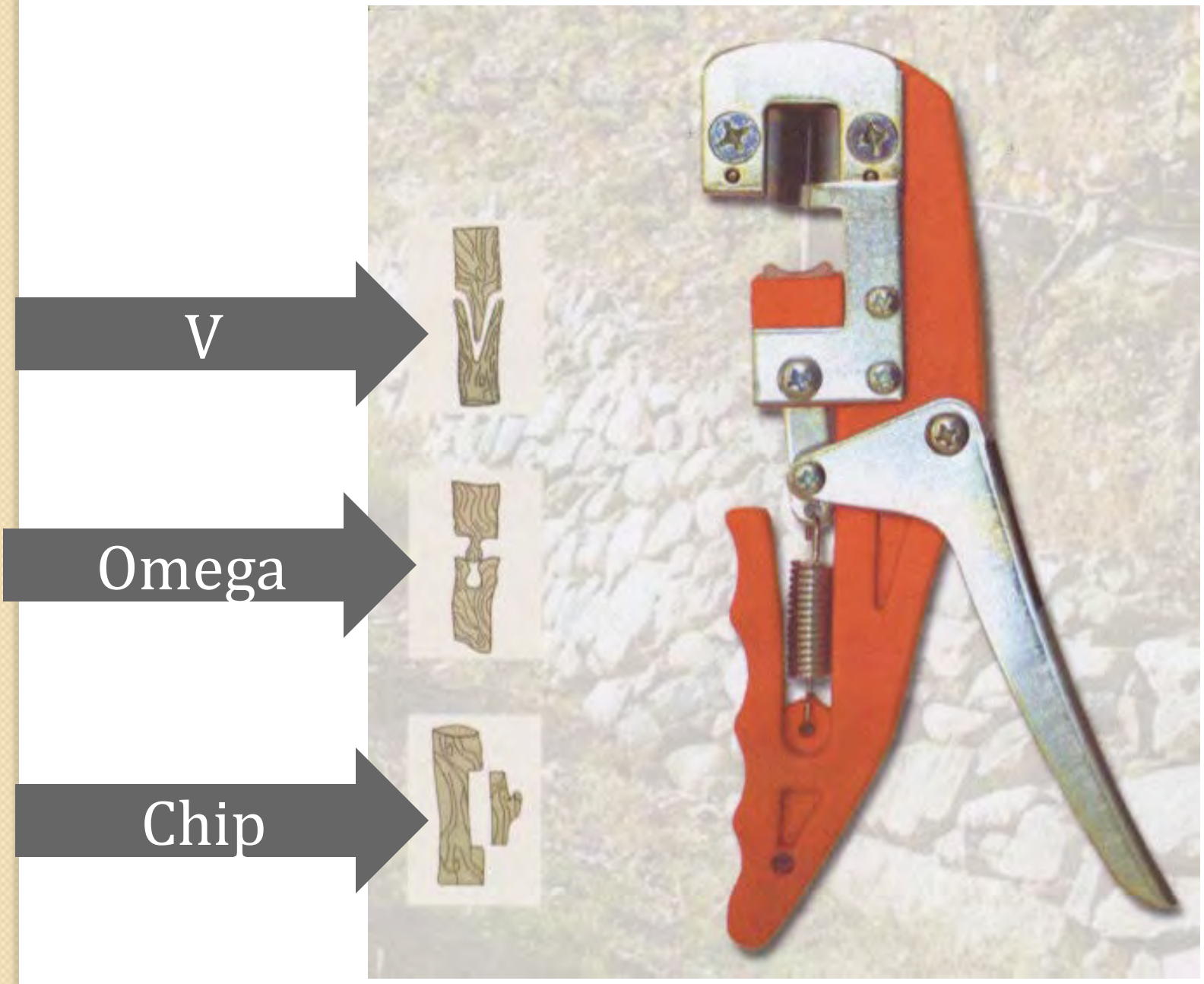


6. Grafting tool
    a. A grafting tool is not necessary as the jobs it completes can be done by individual tools, it is just convenient to only carry one tool to the orchard to complete budding and grafting.



7. Hammer
    a. A hammer is only used for cleft grafting and a few others where the rootstock may need to be pried apart or a scion may need to be nailed on to be kept in place.

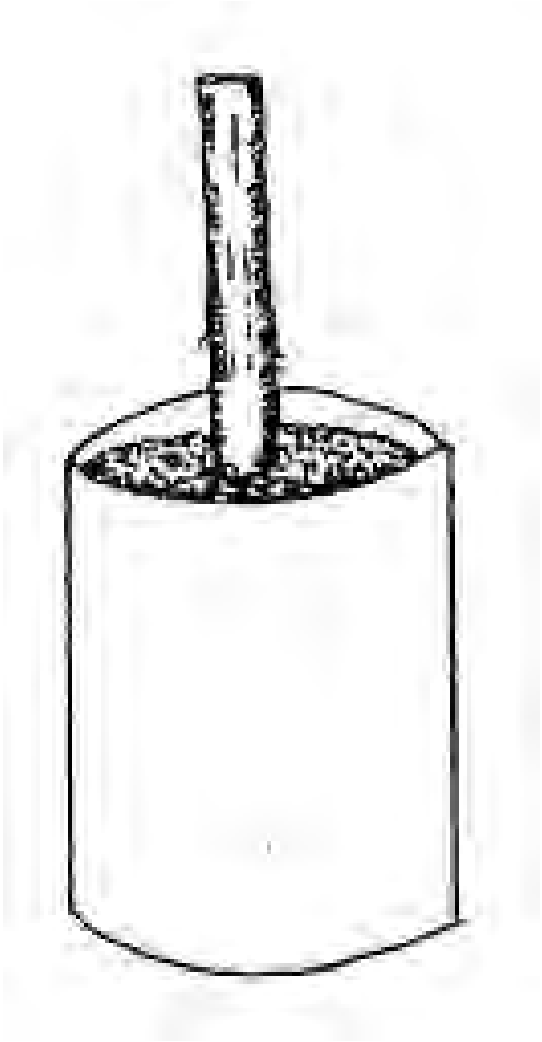
8. Some grafts can be completed with special tools.
   a. An Omega cutter creates a shape like the Greek letter omega in the scion wood and a matching tab in the rootstock.
      i. This gives a very tight fit and greatly improves the success of the graft.
   b. A chip graft machine easily creates a notch in the rootstock and the bud from the scion that will be grafted.
   c. A V-graft machine is similar to the Omega tool except it creates a wedge shape in the rootstock and complementary notch in the scion.


V
Omega
Chip

d. The Omega, chip and V grafting tools are commonly used in very large grafting operations and orchards where hundreds or thousands of grafts are done a week.

B. There are many methods of grafting. The most common is the **whip graft, or whip and tongue graft,** which is used mostly on young apple and pear trees when the branches are relatively small (not more than 1.27 centimeters in diameter) and the rootstock is about the same diameter as the scion of the new cultivar.

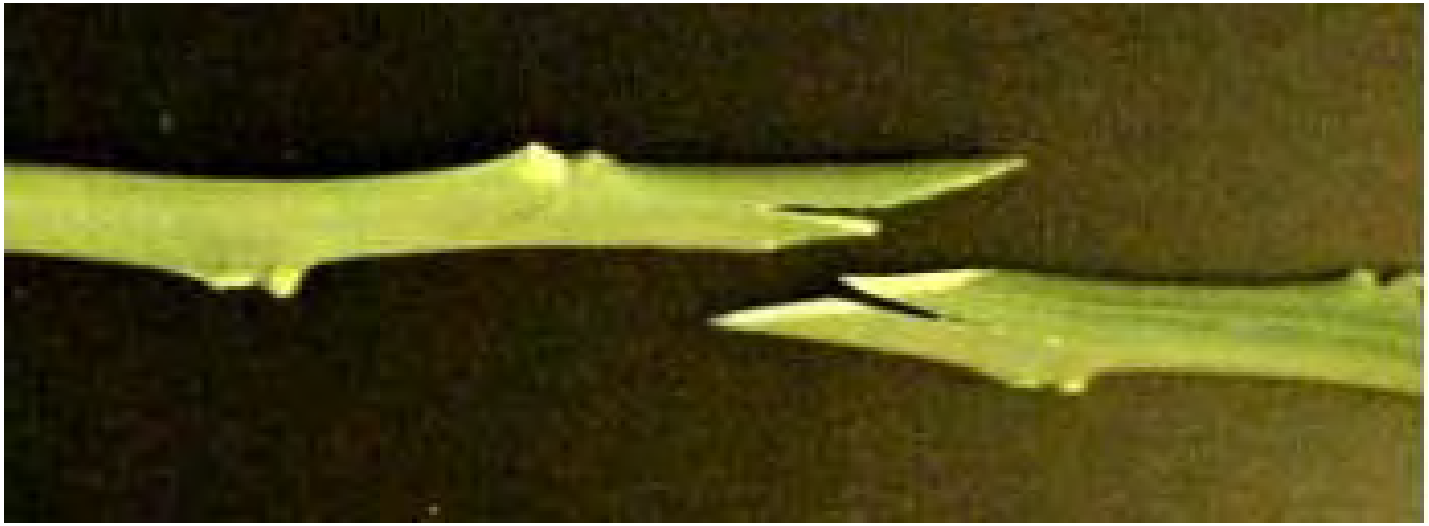
1. Cut off a branch of the rootstock, leaving a stub at least 31 centimeters long.



2. Make a straight, slanting cut about 3.81 centimeters long on both the scion and the stock.
   a. Make the cut straight and even—one stroke with a sharp knife will do it.

b. For the tongue, make a straight draw cut (not split), beginning near the top and cutting about the full length of the level.

c. Match the two parts together by sliding the tongues into each other so they interlock.



3. Bind tightly with tape, then carefully cover the union and binding material with grafting compound or wax
   a. Remove wrapping as soon as the scion has started to grow to prevent girdling of the tree.
   b. This type of graft is difficult for the beginner but is used extensively by experienced operators. It lends itself to the tape method of binding. Tape serves to seal the wound and

C. The **cleft graft** is used for **topworking** (placing a new variety on an older established tree) older established apple and pear trees, either on the trunk of a small tree or on the side branches of a larger tree.

1. It is best adapted to branches 2.54 to 5.08 centimeters in diameter.
    a. The grafts are made within 61 to 91 centimeters of the trunk or main branches and preferably not more than 1.2 to 1.8 meters from the ground, or near the top of the tree will be too high.

2. Select a place free from knots and cut off the stock with a saw.
3. Cut the cleft (avoid splitting if possible) with a grafting tool, large knife or hatchet. After a few trials you will learn the proper depth of cleft.

4. With a sloping cut about .64 centimeters above the upper bud, cut the scions to include three buds, and to a blunt wedge about 3.81 centimeters in length with one side slightly thicker than the other.
    a. If the scion wedge is cut to a sharp point there is danger of the bark peeling. Also a sharp scion wedge will not fit the cleft as well

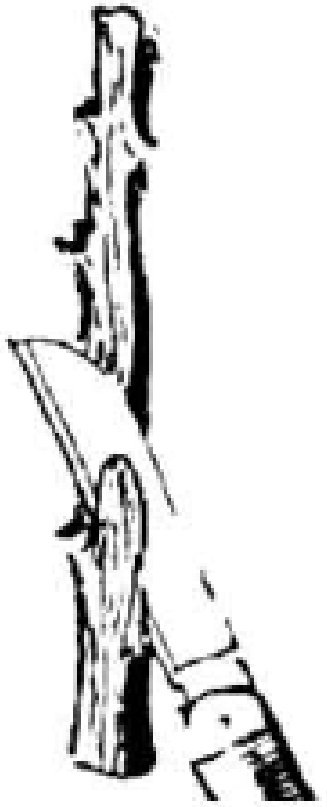
5. Open the cleft slightly with a grafting tool or screw driver. Insert a scion on each side, with the inner bark of stock and scion in contact. Have the thick side of the scion outward

6. Cover the unions with grafting compound or tape and be sure the cleft is covered its full length.

7. During the first season, let all scions and the shoot growth from below the graft grow undisturbed. However, do not permit this rootstock growth to shade out the scions.
    a. The second Spring, select the most suitable scion as the permanent branch and consider the others as spares. Leave the spare scions on to assist in healing over the stub, but cut them back to a few buds on each.
    b. The third Spring, severely cut back the spare scions again.
    c. In the fourth season, or when crowding is noted, cut off all of the spare scions as seems necessary.

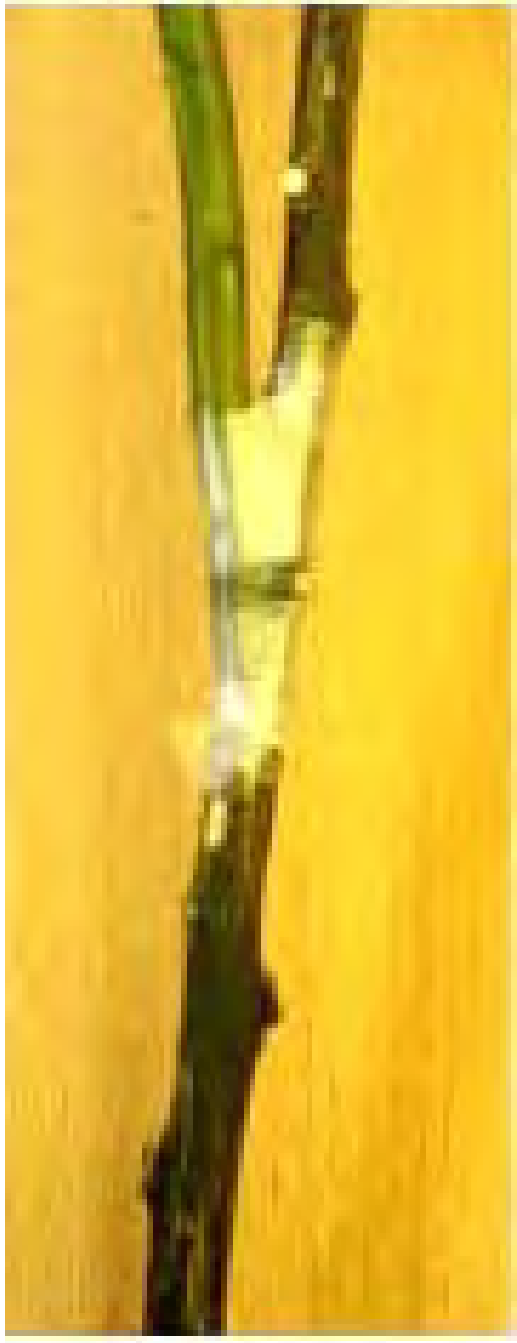
D. The **side graft** is adapted to a wide range of branch sizes (.64 to 1.9 centimeter diameter). Its use is generally restricted to branches that are too large for the whip graft yet not large enough for the cleft graft. As the name suggests, the scion is inserted into the side of the stock, which is generally larger in diameter than the scion.

1. Select a smooth place on the rootstock branch at least a foot from the trunk.
2. Make a slanting cut at a narrow angle almost to the pith (core of the branch).



3. Cut the scion to a short, sharp wedge (about 2.54 centimeter) with one side thicker than the other.
4. Bend the branch slightly to open the cut. Press the scion in so the cambium layers of the stock and scion meet at one side.

5. Tying is unnecessary if the stock binds well, but you may have to tie small materials if the scion is not held firmly. Cut surfaces should then be covered with grafting compound or tape.



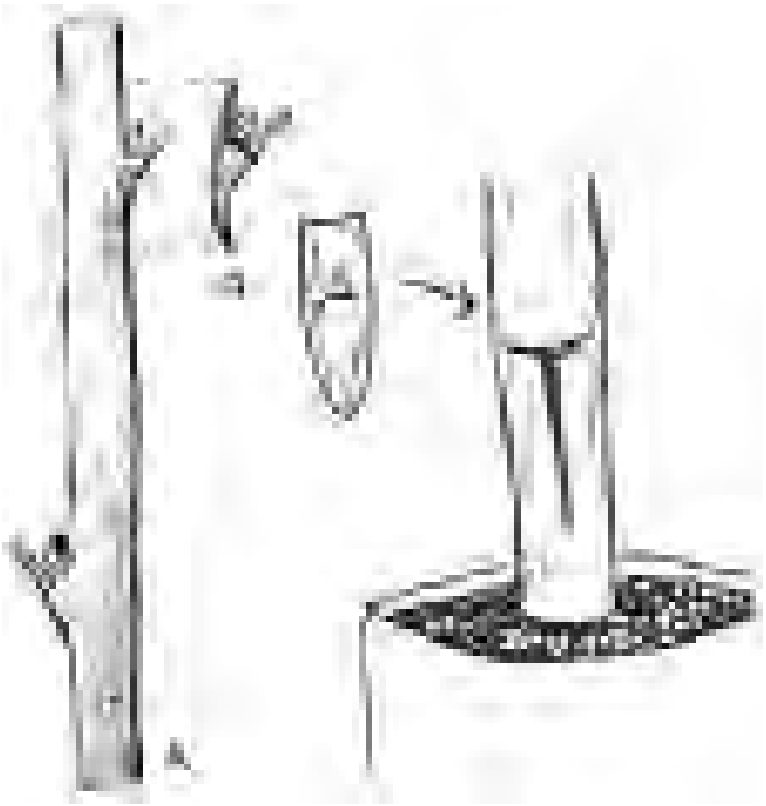
6. In about two weeks, cut off the stock above the union using sharp shears in order to avoid disturbing the scion, then cover the cut surface with grafting compound.

E. **Budding** is a form of grafting in which a single bud is used as the scion rather than a section of stem. It is the most commonly used method for fruit tree production in the nursery, but can also be used for topworking plum, cherry, apricots, and peach as well as young apple and pear trees. (Cherry, plum, apricot, and peach are not easily cleft grafted or whip grafted.)

1. Budding is done in when the bark of the stock slips easily and when there are well-grown buds.
2. The first step is to cut bud sticks of the desired cultivar from strong shoots of the present season's growth. These buds should be mature, as indicated by a slightly brownish color.
3. Clip off the leaves as soon as the bud sticks are cut, leaving about 1.27 centimeter of the leafstalk for a handle. Discard the soft tips of the bud sticks. Wrap the bud sticks in moist burlap, moss or paper to prevent drying out.

4. Branches from the size of a pencil up to 1.27 centimeter diameter may be worked by this method. The bark of larger branches is too thick for satisfactory budding.

5. On the branches of the stock, about 40 centimeters or more from the trunk, make a T cut just across the bark. Then, with a knife blade or bark separator, lift the corners and carefully loosen the bark.



6. Remove the bud from the scion by shallowly whittling it off leaving enough surrounding bark and cambium to fit into the T cut just made in the stock.
7. Use rubber strips, electrician's tape, or adhesive tape to tie the bud. Wrap and tie tightly, but be sure you do not cover the bud.

8. Cut the tie before it binds too tightly—that is, in two or three weeks. Cut on the side away from the bud. Rubber strips need not be cut. The bud should remain dormant until the following Spring. Cut off the stock above the bud as soon as the bud starts growing.
9. Do not permit any shoot growth.
10. After the second year remove any growth from the stock and leave only growth from the buds.

F. Grafts are not always successful and even a successful orchardist will rarely have 100 percent success. There are many reasons why a graft may fail.

1. The scion and stock were incompatible.
   a. The process of wound healing between the scion and stock is necessary.
   b. In the healing process new plant tissues form, including the cambium which allow the transport of water, nutrients and hormones to the scion.
   c. If the plant materials are rejected the scion will die so the correct genus and species must be chosen.
   d. For example peach cannot be grafted onto plum rootsocks but plum can be grafted to peach.
   e. There are many sources available which suggest the best scion rootstock combination but most times compatibility can only be discovered by testing.
   f. In general, plants of the same species are genetically more similar and more likely to be compatible.

2. The grafting was done at the wrong season.
3. The rootstock was not healthy.
4. The scions were not vigorous.
5. The scions were dry or injured by cold temperatures.
6. The scions were not dormant.
7. The cambium of scion and stock were not meeting properly.

8. The scions were upside down.
9. The graft was improperly covered with grafting compound.
10. The scions were displaced by wind, birds or storms.
11. The graft was shaded too much after growth began.
12. New growth was damaged by aphids or other insects.
13. The union girdled because the bindings or label were not released in time.

Review/Summary

1. What is the proper procedure for propagating cuttings?
2. What is the proper procedure for the asexual propagation methods of layering?
3. What are the asexual propagation methods of budding and grafting?
4. What are the procedures for grafting and budding in the fruit and nut orchard?