

# CLASS-VII

- Lesson 4 Grafting
- Lesson 5 Event Management
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## 4

# GRAFTING

Grafting is a form of plant propagation that consists of joining two separate plant parts together to create a new plant. The two parts to a graft include the scion, or the top branch, and the understock, also called the rootstock, which is the bottom portion with the roots. Grafting is common on trees, but also works on shrubs, perennials and even some vegetables. Grafting is a horticultural technique whereby tissues of plants are joined so as to continue their growth together. Japan, Korea and Spain are the main producers of grafted plants. In this lesson we shall learn about the basic principles and techniques of grafting.



## OBJECTIVES

After studying this lesson, you will be able to:

- explain the meaning of grafting;
- enumerate the reasons for grafting;
- explain the principles of grafting ;
- list the special terminology of grafting;



- explain the general procedure of grafting;
- identify and use the tools of grafting; and
- describe the different procedures of grafting.

## 4.1 MEANING OF GRAFTING

Graft, in horticulture, is the joining together of plant parts by means of tissue regeneration. Grafting is the act of placing a portion of one plant (bud or scion) into or on a stem, root, or branch of another (stock) in such a way that a union will be formed and the partners will continue to grow. The part of the combination that provides the root is called the stock while the added piece is called the scion. When more than two parts are involved, the middle piece is called the interstock. When the scion consists of a single bud, the process is called budding. Grafting and budding are the most widely used vegetative propagation methods. In crop agriculture, grafting is most commonly referred to as an artificial, vegetative method of plant propagation. However, as a technique or procedure, it has many other uses. Plant grafting is a procedure in which parts of plants are joined together to unite and continue growing as one plant. A grafted plant, therefore, is a composite of parts derived from two or more plants.

Most varieties of a particular fruit species are interchangeable and can be grafted. Because of differences in level of activity, some are better able to support others as understocks. Plants of the same genus and species can usually be grafted even though they are a different variety. Plants with the same genus but of a



different species can often be grafted. But the result may be weak, short-lived, or they may not unite at all. Plants of different genera are less successfully grafted although there are some cases where this is possible. Plants of different families cannot be grafted successfully.

## 4.2 REASONS FOR GRAFTING

In modern horticulture grafting is used for a variety of purposes like to repair injured trees, to produce dwarf trees and shrubs, to strengthen plants' resistance to certain diseases, to retain varietal characteristics, to adapt varieties to adverse soil or climatic conditions, to ensure pollination, to produce better quality etc.

### Reasons for Grafting and Budding

- Change varieties
- Optimize cross-pollination and pollination.
- Take advantage of particular rootstocks.
- Benefit from interstocks.
- Perpetuate clones.
- Produce certain plant forms.
- Repair damaged plants.
- Increase the growth rate of seedlings.

## 4.3 TERMINOLOGY OF GRAFTING

**Adventitious buds** - buds that can produce roots or shoots at an unusual location on the plant if environmental conditions are favorable.



**Bark** - all tissues lying outward from the vascular cambium.

**Bud** - an immature or embryonic shoot, flower, or inflorescence.

**Budding rubber** - a strip of pliable rubber 3/16- to 3/8-inch wide by 4 to 8 inches long and 0.01 inch thick used to hold a bud in proper position until the plant tissue has knitted together.

**Callus** - undifferentiated (parenchyma) tissue formed at a wounded surface.

**Cambium** - a thin layer of living cells between the xylem (outer sapwood) and phloem (inner bark) that is responsible for secondary growth. Because cambium cells divide and make new cells, the cambia of two different but related plant will grow together if they are fixed and held firmly in contact.

**Compatible** - plant parts (scion and rootstock) that are capable of forming a permanent union when grafted together.

**Double-worked plant** - a plant that has been grafted twice, usually to overcome incompatibility between scion and root stock; it consists of a rootstock, interstock, and scion.

**Graft** - a finished plant that comes from joining a scion and a rootstock.

**Graft or bud union** - the junction between a scion or bud and its supporting rootstock.

**Grafting paint** - A mixture used like warm grafting wax to cover wounds and prevent drying. It requires no heating before use



and dries to a moisture-proof seal when exposed to air. Unlike conventional paints, it does not damage plant tissue.

**Grafting strip** - a rubber strip used to hold scions in place until knitting has occurred. Grafting strips are thicker and less pliable than budding rubber.

**Grafting twine** - treated jute or raffia used to wrap graft junctions to keep scions in place and cambia properly aligned.

**Incompatible** - plants whose parts will not form a permanent union when grafted together.

**Interstock** - an intermediate plant part that is compatible with both the scion and the rootstock. Used in cases where the scion and rootstock are not directly compatible with each other or where additional dwarfing and cold or disease resistance is desired.

**Parafilm** - registered trade name for a nonsticky, self-adhering parafin film. Can be stretched over a bud or graft to hold the bud or scion in position as well as to seal the junction. Used in place of a rubber strip or twine.

**Polarity** - a condition where stems grow shoots at the apical or terminal end and roots at the basal end.

**Rootstock** - the portion of a grafted plant that has (or will develop) the root system onto which the scion is grafted.

**Scion** - a plant part that is grafted onto the interstock or the rootstock. The scion usually has two or more buds.



Notes

**Single-worked plant** - a plant that has been grafted once; it consists of a rootstock and a scion.

**Standard** - a single-stemmed understock used for the production of weeping forms of woody plants. One or more scions are usually grafted relatively high on the understock (2 to 6 feet).

**Top-worked plant** - an established tree or mature plant whose upper portion has been removed back to the main limbs or trunk and then grafted with new scions.

**Understock** - same as rootstock.

**Union** - the point where the scion and rootstock are joined.

**Warm grafting wax** - a mixture, usually consisting of beeswax, resin, and tallow plus a fungicide, that is applied warm over a bud or graft junction to prevent drying and to serve as a topical dressing.

Two terms are common in grafting are Rootstock and Scion

1. Rootstock is the lower part having roots and usually consists also of a stem that is to become the lowermost part of the shoot of the grafted plant. The rootstock provides anchorage as well as support to the upper parts of the plant.
2. Scion is the upper part that is joined to the rootstock and is the main component of the plant shoot when the plant is fully developed. It usually consists of the primary stem (trunk) and branches except the portion that belongs to the rootstock. The scion determines the characteristics of the plant such as its leaves, flowers, fruits and seeds and thus needs to be chosen with care.



**INTEXT QUESTIONS 4.1**

Explain the following in one sentence only.

1. Bark
2. Callus
3. Cambium
4. Rootstock
5. Scion
6. Graft
7. Graft or bud union
8. Single-worked plant
9. Double-worked plant
10. Union

**4.4 PRINCIPLES OF GRAFTING**

The establishment of union between grafted components is effected through the formation of a loose growth of cells (callus) contributed by both elements. These cells fuse into a mass so continuous in compatible grafts that the precise location of the line of union is frequently impossible to determine, even microscopically. Just as in wound healing, union proceeds more rapidly if the wounded areas are protected against drying out; and, in most forms of grafting, rapid knitting is essential to maintenance of life in the scion.

**Notes**



In grafting and budding, the rootstock can be grown from seed or propagated asexually. Within a year a small amount of scion material from one plant can produce hundreds of plants.

## 4.5 GENERAL PROCEDURE OF GRAFTING

### 1. Vertical Incisions

Make four 3-inch vertical incisions through the rootstock's bark, starting at the top. Slip a small rubber band on the rootstock, stopping just below these vertical cuts. With the point of a knife, separate the bark from the wood at the tip of the rootstock. Peel the bark down in four 3-inch-long flaps. Cut off an equal-sized piece of rootstock with shears after peeling back the bark.

### 2. Prepare the Scion

Prepare the scion by trimming 1/2 inch off the bottom to show fresh, green wood. Slice a shallow, 2-inch cut into the wood at the bottom end of the scion. This cut exposes the cambium tissue, which carries sap through the tree. Repeat this in order to create four evenly-spaced cuts.

### 3. Connect Scion and Rootstock

Place the cut end of the scion inside the four flaps, lining up each cut surface with a flap.

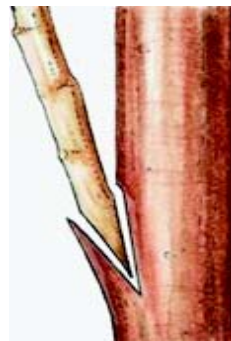


Fig. 4.1 Procedure of Grafting



#### 4. Secure the Graft

Now use the rubber band to hold the flaps in place. Make sure the cambium tissue of the scion is placed against the cambium tissue of the rootstock.

#### 5. Protect the Graft

Protect the graft by wrapping it with a piece of heavy-duty aluminum foil, then covering it with a piece of plastic.

#### 6. Secure the Plastic

Tape the plastic lightly around the graft using masking tape.

New buds should appear in 15 to 30 days. You may want to write the date and tree variety on the tape to keep track of multiple trees.

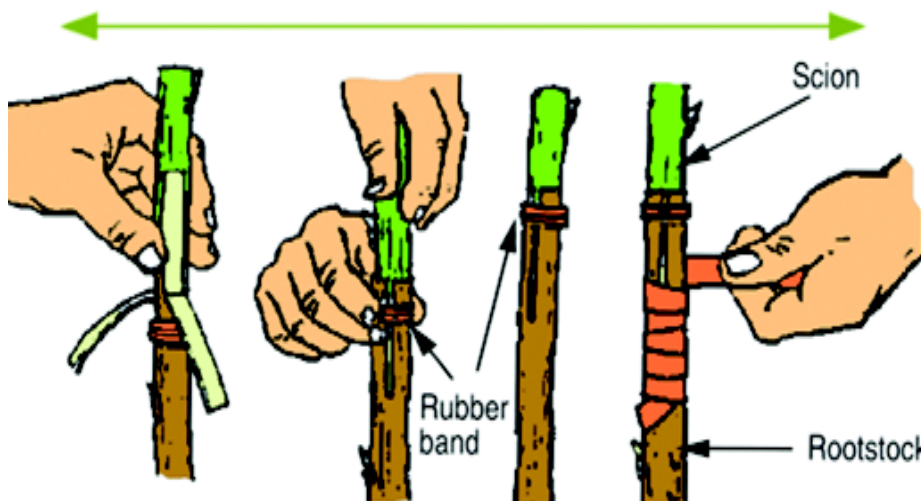


Fig. 4.2 Secure the Plastic

To have an almost 100% of success, you have to follow these rules:

**Notes**

- 1) Cut branches from which you will get the scions at the end of the dormant season, i.e. when the buds begin to move but are still fully closed.
- 2) The scion must be young - one years old - and must have buds
- 3) Put the branch in a cold and humid place. You can wrap them in wet newspaper paper and can be left, in the refrigerator vegetable drawer.
- 4) After few weeks (two or three typically), when the buds of the rootstock begins to open, remember this is the best moment to do the grafting.
- 5) You should always graft a scion to a rootstock in the spring.
- 6) In the dormant season (late winter), cut the new growth scions that have buds on them. Place the newly cut scions in plastic bags and store in the refrigerator until spring.
- 7) Both scions and rootstocks should be about the same diameter.

**Reasons for Graft Failure**

- The stock and the scion were not compatible.
- The cambiums did not meet properly.
- The scion was upside down.



- Grafting was done at the wrong time of the year.
- Either the scion or the rootstock was not healthy.
- The scions were dried out or injured by cold.
- The scions were not dormant when grafted.
- The graft was not properly covered.
- The scion was displaced by some means.
- The graft was too shaded by other growth to grow.
- The graft was attacked by insects or disease.
- The graft union was disturbed because the tape was left on too long.

**ACTIVITY 4.1**

Visit your neighborhood Nursery /Farm to see and learn/practice the basic procedure of grafting.

**4.6 TOOLS OF GRAFTING****a. Knives**

Grafting and budding knives are designed specifically for these purposes and should not be used for carving and whittling wood. They are available in either left- or right-handed models. The

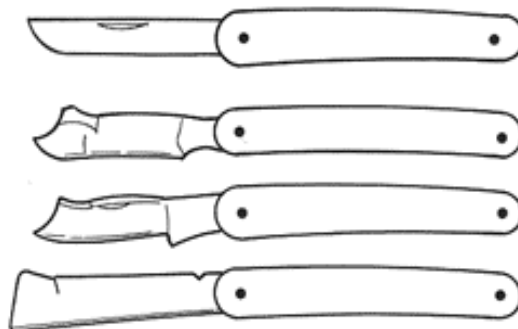


Fig. 4.3 Knives



Notes

blade is beveled on only one side, unlike conventional knives, which have blades that bevel on both sides down to the cutting edge. Grafting and budding knives must be kept razor sharp so they will cut smoothly.

### b. Pruning and Lopping Shears

Pruning and lopping shears should be the scissors or sliding blade type rather than the blade and anvil type. If used to harvest scion wood or bud sticks, blade and anvil pruner will crush plant tissue. As with knives, pruning and lopping shears should be kept razor sharp to give clean, close cuts.



Fig. 4.5 Shears

### c. Grafting Tool/Clefting tool

A special device known as a grafting tool has been designed for making the cleft graft. It is used when the rootstock's diameter is

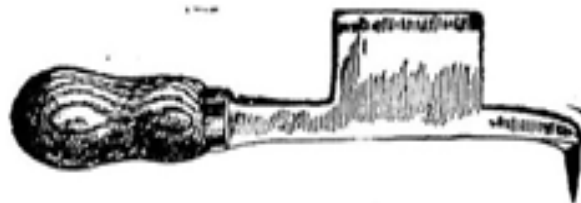


Fig. 4.6 Clefting tool

greater than 1 inch. The wedge-shaped blade is used to split the stock, and the flat pick opens the cleft so that the scions can be inserted. Once in place, the flat pick is removed and the cleft comes together to hold the scions in position.

**Notes**

#### **d. Wax Melter**

Wax melters are used to heat the wax for sealing graft and bud junctions. They are usually made by modifying kerosene lanterns. The chimney is replaced by a small tin pot that serves as a receptacle for the wax. When the flame is kept low, the wax is melted without burning and can be kept at a suitable temperature.

#### **e. Safety Gloves**

To protect hand from cuts and injuries



Fig. 4.7 Gloves

#### **f. Grafting Wax**

This is usually a paraffin-based wax that can be softened in the palm of your hand and applied to a new graft to prevent



desiccation. Grafting wax. Grafting wax is a composition of rosin, beeswax, tallow, and similar materials, used in gluing and sealing the wounds of newly grafted trees or shrubs to protect them from infection.

### **g. Tape**

Electrical tape can be used (as long as it's cut later to ensure it falls off before girdling the branch). There is also a cloth-backed grafting tape that will decompose.

### **h. Budding rubbers**

These are elastic bands, typically 8 inches long, that do a fine job of maintaining adequate pressure.

### **i. Grafting compound**

This is often an asphalt-based tree wound dressing that prevents moisture loss from the graft.

## **4.7 TECHNIQUES OF GRAFTING**

### **i. Cleft Graft**

One of the simplest and most popular forms of grafting, cleft grafting is a method for top working both flowering and fruiting trees (apples, cherries, pears, and peaches) in order to change varieties. Cleft grafting is also used to propagate varieties of plants that are difficult to root. This type of grafting is usually done during the winter and early spring, while both scion and rootstock are still dormant. Cleft grafting may be performed on main stems or on lateral or scaffold branches.



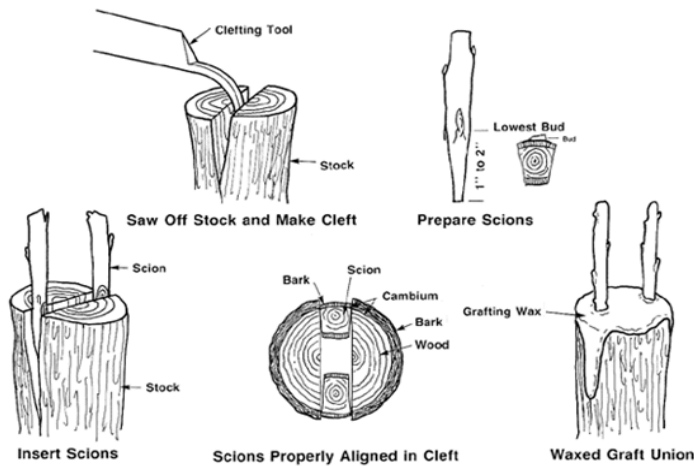


Fig. 4.8 Cleft Graft

The rootstock used for cleft grafting should range from 1 to 4 inches in diameter and should be straight grained. The scion should be about 1 1/4-inch in diameter, straight, and long enough to have at least three buds. Scions that are between 6 and 8 inches long are usually the easiest to use.

### ii. Bark Graft

Bark grafting is used primarily to top work flowering and fruiting

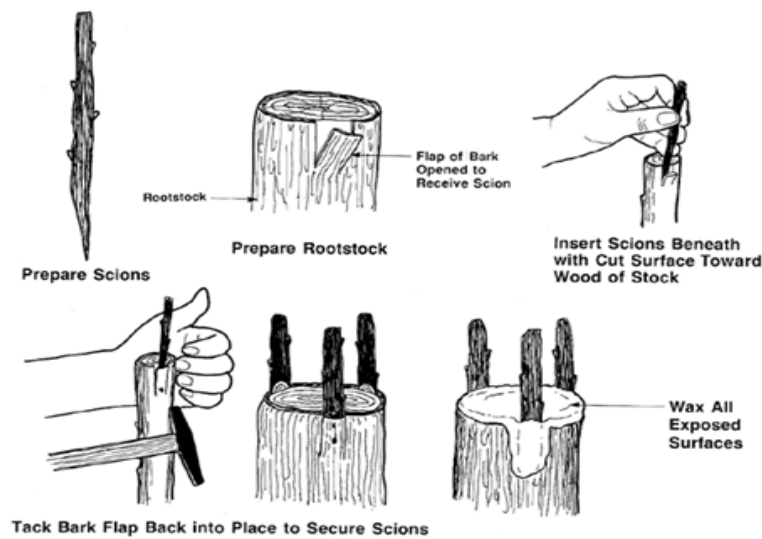


Fig. 4.9 Bark Graft



trees. In contrast to cleft grafting, this technique can be applied to rootstock of larger diameter (4 to 12 inches) and is done during early spring when the bark slips easily from the wood but before major sap flow. The rootstock is severed with a sharp saw, leaving a clean cut as with cleft grafting and the scion inserted.

### iii. Side-Veneer Graft

At one time the side-veneer graft was a popular technique for grafting varieties of flowers that are difficult to root. Currently, it is the most popular way to graft plants, especially those having a compact or dwarf form. Side-veneer grafting is usually done on potted rootstock.

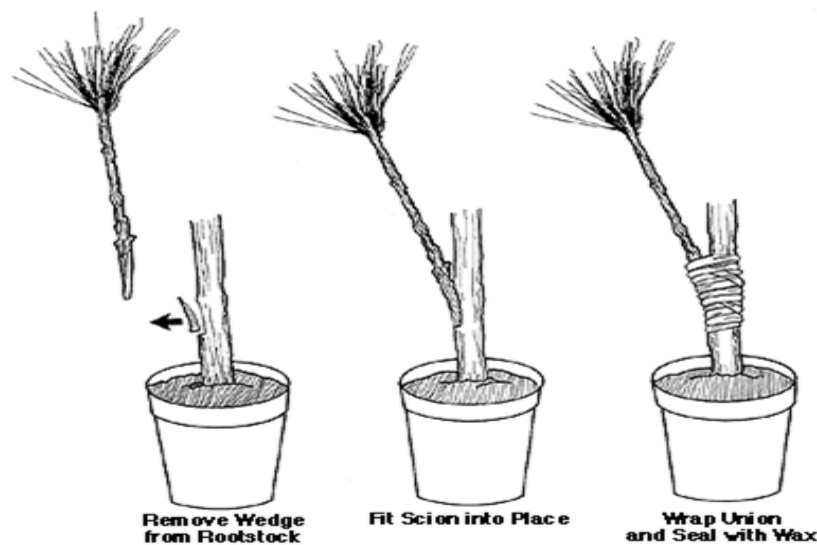


Fig. 4.10 Side Veneer Graft

### iv. Splice Graft

Splice grafting is used to join a scion onto the stem of a rootstock or onto an intact root piece. This simple method is usually

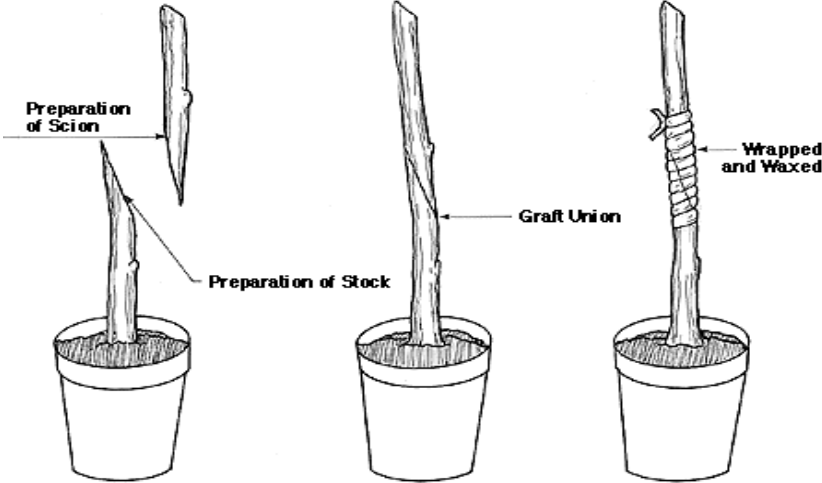


Fig. 4.11 Splice Graft

applied to herbaceous materials that callus or "knit" easily, or it is used on plants with a stem diameter of 1/2-inch or less. In splice grafting, both the stock and scion must be of the same diameter.

**v. Whip and Tongue Graft**

The whip and tongue technique is most commonly used to graft

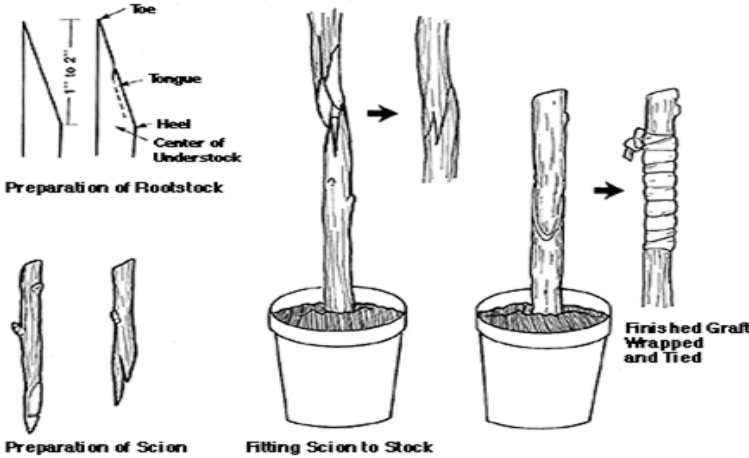


Fig.4.12 Whips Tongue Graft



Notes

nursery crops or woody ornamentals. Both the rootstock and scion should be of equal size and preferably no more than 1½-inch in diameter. The technique is similar to splice grafting except that the whip on the rootstock holds the tongue of the scion in place (and vice versa). This leaves both hands free to wrap the joint.

For the whip and tongue graft, make similar cuts on both the stock and scion. These cuts should be made with a single draw of the knife and should have a smooth surface so that the two can develop a good graft union.

### vi. Saddle Graft

Saddle grafting is a relatively easy technique to learn and once mastered can be performed quite rapidly. The stock may be either

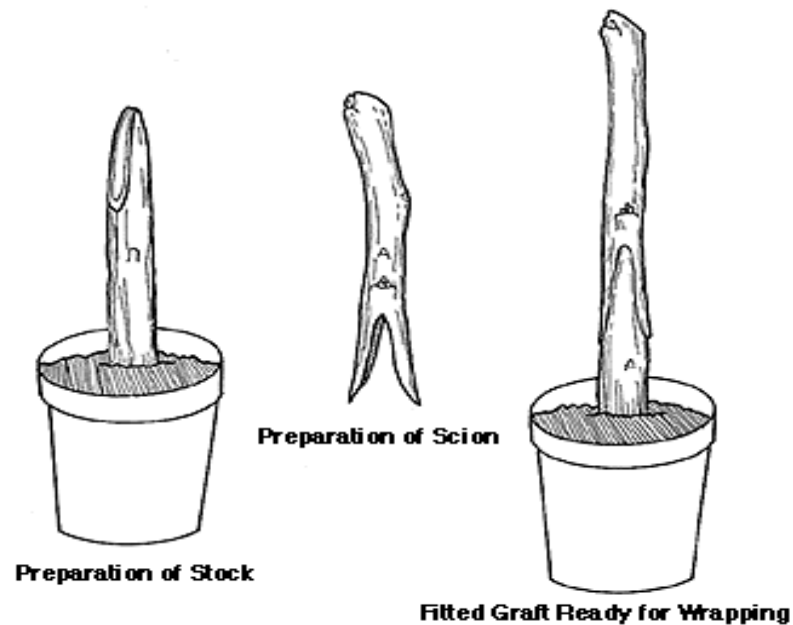


Fig. 4.13 Saddle Graft

field-grown or potted. Both rootstock and scion should be the same diameter. For best results, use saddle grafting on dormant stock in mid- to late winter. Stock should not be more than 1 inch in diameter.

**Notes**

### vii. Bridge Graft

Bridge grafting is used to "bridge" a diseased or damaged area of a plant, usually at or near the base of the trunk. Such damage commonly results from contact with grading or lawn maintenance equipment, or it may be caused by rodents, cold temperatures, or disease organisms. The bridge graft provides support as well as a pipeline that allows water and nutrients to move across the damaged area.

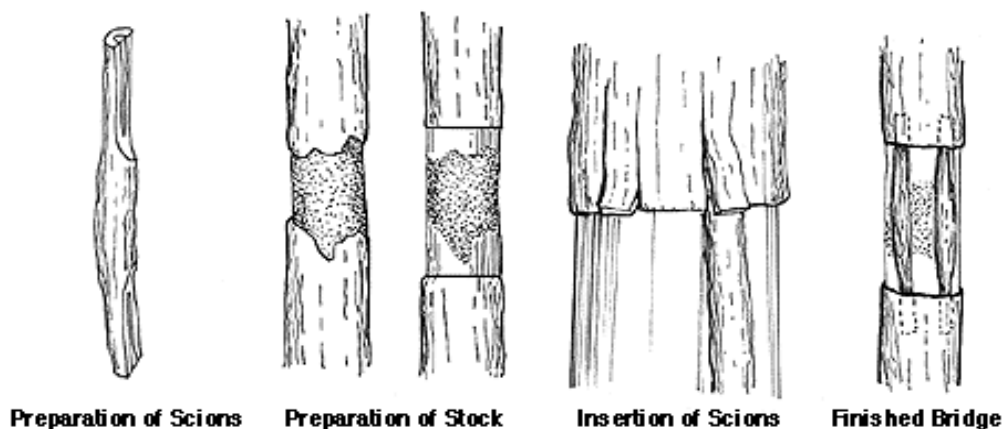


Fig. 4.14 Bridge Graft

Bridge grafts are usually done in early spring just before active plant growth begins. They may be performed any time the bark on the injured plant "slips."



Notes

### viii. Inarch Graft

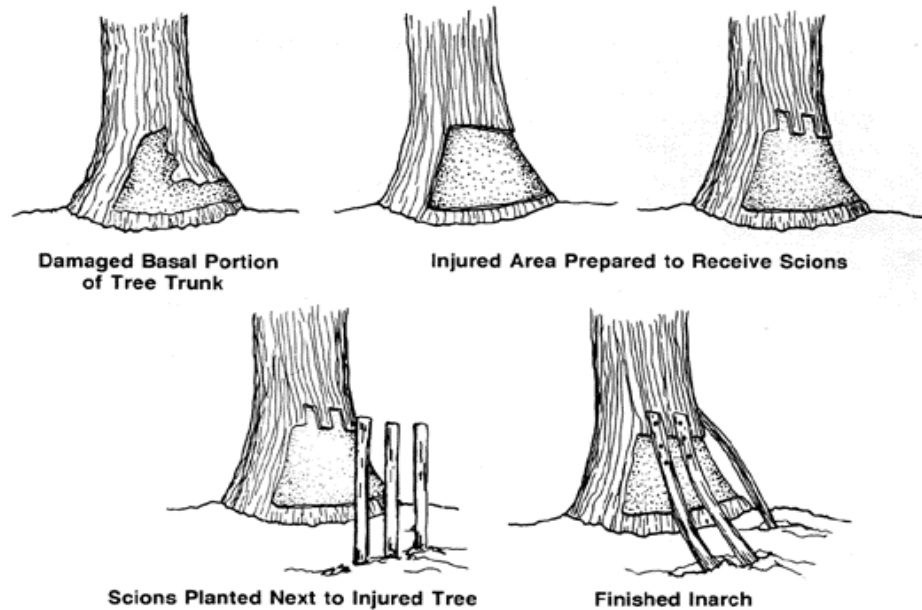


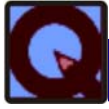
Fig. 4.15 Inarch Graft

Inarching, like bridge grafting, is used to bypass or support a damaged or weakened area of a plant stem. Unlike bridge grafting, the scion can be an existing shoot, sucker, or water sprout that is already growing below and extending above the injury. The scion may also be a shoot of the same species as the injured plant growing on its own root system next to the main trunk of the damaged tree. With the inarching technique, the tip of the scion is grafted in above the injury using the same method as for bark or bridge grafting.



### ACTIVITY 4.2

Visit your neighborhood Nursery/Farm to observe and learn about the different methods of Grafting.

**INTEXT QUESTIONS 4.2**

Match column A with column B

<b>A</b>	<b>B</b>
1. Cleft Graft	(i) carving and whittling wood
2. Inarch Graft	(ii) materials that callus or "knit" easily
3. Whip and Tongue Graft	(iii) flowers that are difficult to root.
4. Splice Graft	(iv) to harvest scion wood
5. Saddle Graft	(v) to melt wax
6. Side-Veneer Graft	(vi) scion is grafted in above the injury
7. Wax Melter	(vii) in 15 to 30 days
8. Pruning Shears	(viii) to graft nursery crops
9. Grafting knives	(ix) The stock may be either field-grown or potted
10. New buds appear	(x) simplest and most popular forms of grafting

**WHAT HAVE YOU LEARNT**

- Meaning of grafting;
- The reasons for grafting;

**Notes**



Notes

- The principles of grafting ;
- Special terminology of grafting;
- The general procedure of grafting;
- The tools of grafting; and
- Different procedures of grafting.



## TERMINAL QUESTIONS

1. What do you understand by Grafting?
2. List 4 reasons for grafting.
3. Describe the basic principles of Grafting.
4. Step wise explain the procedure of Grafting.
5. List and briefly describe the tools of grafting.
6. Briefly explain the procedure for the following techniques of grafting:
  - i. Saddle grafting
  - ii. Inarch grafting
  - iii. Cleft grafting
  - iv. Splice grafting
  - v. Whip and Tongue Grafting



**ANSWERS TO INTEXT QUESTIONS****Notes****4.1**

1. Bark - all tissues lying outward from the vascular cambium.
2. Callus - undifferentiated (parenchyma) tissue formed at a wounded surface.
3. Cambium - a thin layer of living cells between the xylem (outer sapwood) and phloem (inner bark) that is responsible for secondary growth.
4. Rootstock - the portion of a grafted plant that has (or will develop) the root system onto which the scion is grafted.
5. Scion - a plant part that is grafted onto the interstock or the rootstock. The scion usually has two or more buds.
6. Graft - a finished plant that comes from joining a scion and a rootstock.
7. Graft or bud union - the junction between a scion or bud and its supporting rootstock.
8. Single-worked plant - a plant that has been grafted once; it consists of a rootstock and a scion.
9. Double-worked plant - a plant that has been grafted twice, usually to overcome incompatibility between scion and rootstock; it consists of a rootstock, interstock, and scion.
10. Union - the point where the scion and rootstock are joined.

## CLASS-VII



Notes

## 4.2

1. - (x)
2. - (vi)
3. - (vii)
4. - (ii)
5. - (ix)
6. - (iii)
7. - (v)
8. - (iv)
9. - (i)
10. - (vii)