

## Lecture:7

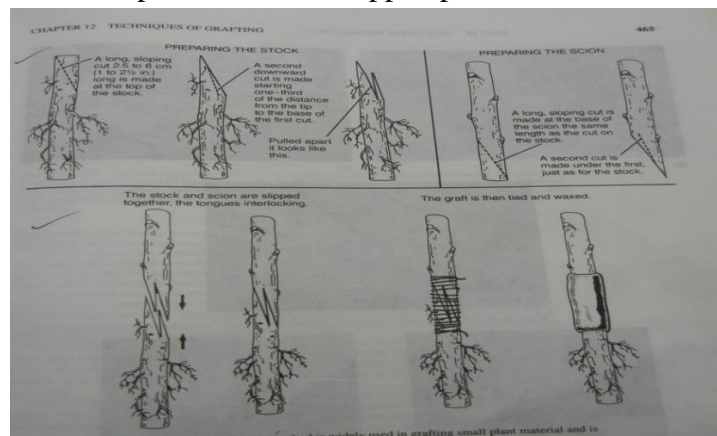
### Grafting

#### Detached scion grafting- Apical graftage

**a. Tongue grafting:** Useful for grafting relatively small material of about 6-13 mm in diameter. It is highly successful if done properly because there is considerable vascular cambium connection. It heals quickly and makes a strong union. Scion and rootstock of equal diameter is preferable for this technique for better graft union formation. The scion should contain 2 or more buds. It is done mainly during the dormant season of the plant.

For this, after heading back the stock, 1<sup>st</sup> a smooth cut is made at 2.5-6 cm long. Then a reverse cut is made downward from the point about one third of the distance from the tip and should be one half of the length of the 1<sup>st</sup> cut. Similar technique should be followed for the preparation of scion at its base. After that the rootstock and scion are inserted into each other, with the tongue interlocking. The lower tip of the scion should not overhang the stock as there is a likelihood of the formation of large callus knots. The use of scions larger than the rootstock should be avoided for the same.

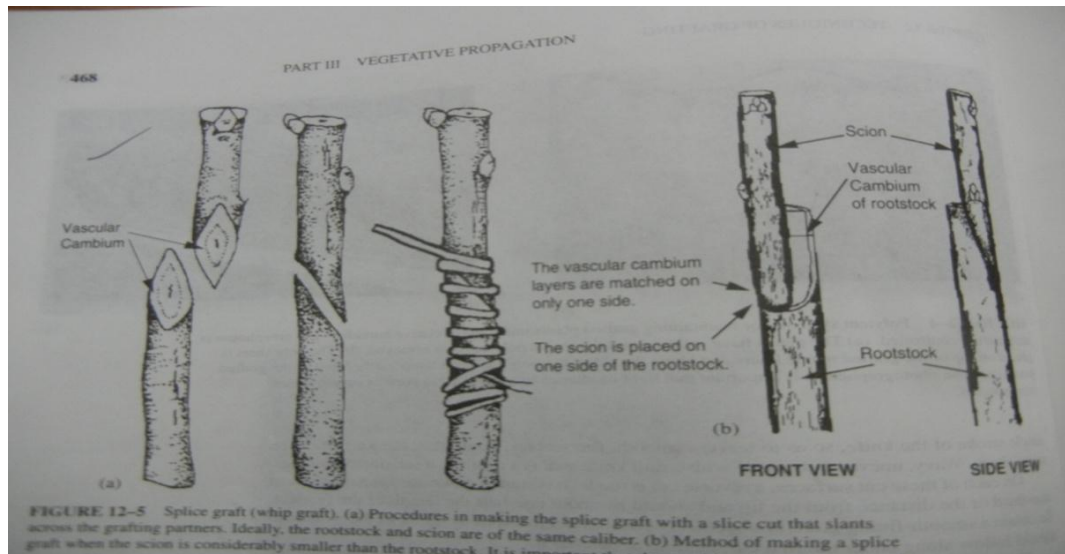
It is commercially used in temperate fruits like apple, pear *etc.*



**b. Whip grafting (Splice grafting):** It is the same as the tongue grafting, except that the second or tongue cut is not made in either the stock or scion. A simple slanting cut of the same length and angle is made in both the stock and scion. These are placed together and wrapped or tied in such a way so that there should be no space in between stock and scion.

If the scion is smaller than the stock, it should be set at one side of the stock so that the vascular cambium layers will be certain to match along that side.

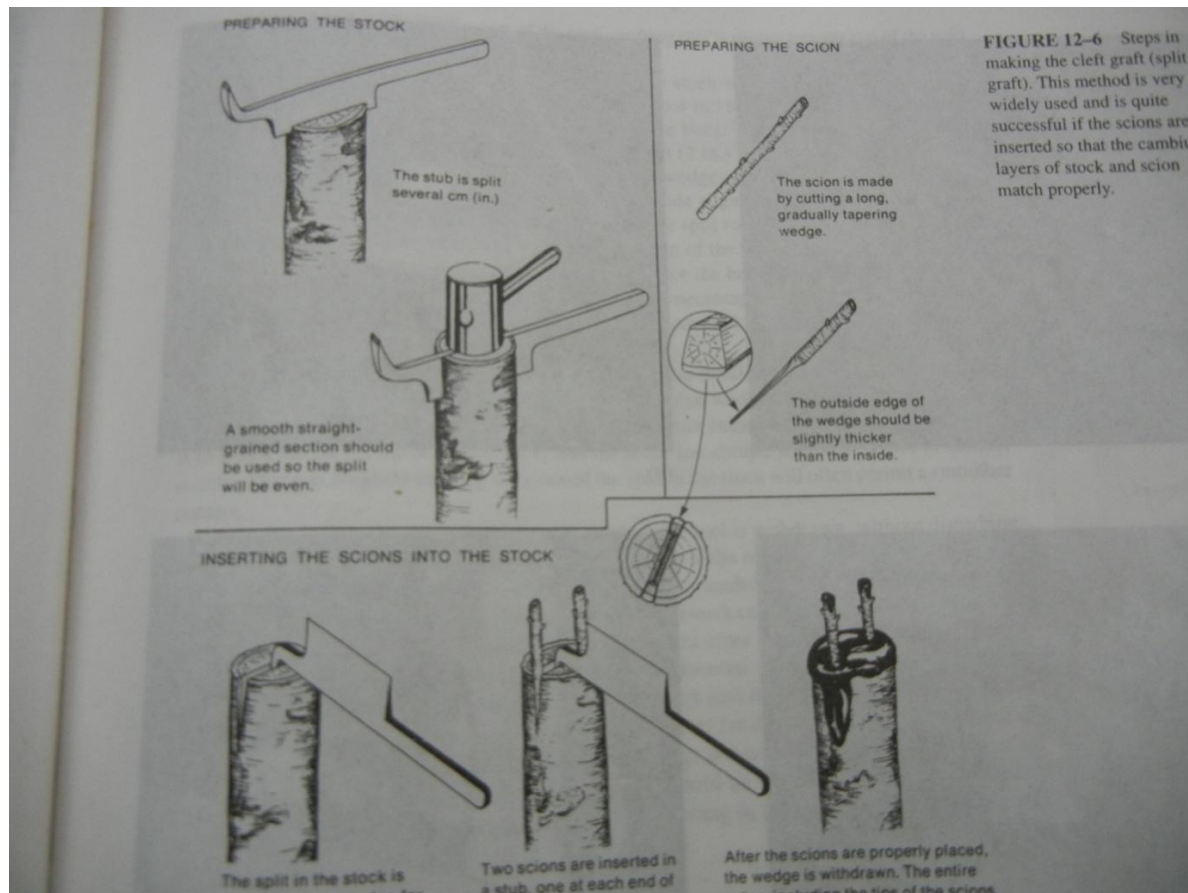
Mostly used in greenhouse production of vegetable crops for grafting on disease resistant rootstocks.



**c. Cleft grafting:** Although cleft grafting can be done during the dormant season, the chances for successful healing of the graft union are best if the work is done in the early spring just when the buds of the stock are beginning to swell but well before the active growth has started. The scion should be made from dormant one-year old wood.

In making cleft grafting, a heavy knife is used to make a vertical split on the stock for a length of 5-8 cm down the centre of the previously beheaded stock. After a good and straight split is made, a screwdriver, chisel or the wedge part of the cleft-grafting tool is driven into the top of the split to hold it open. Two scions are inserted, one at each side of the stock where the vascular cambium layer is located. The scion should be 8-10 cm long, about 10-13 mm in thickness and should have 2-3 buds. The basal end of the scion should be cut into a gently sloping wedge about 5 cm long and then inserted into the split portion of the stock. A common mistake in cutting scions for this type of grafting is to make the cut on the scion too short and the slope too abrupt, so that the point of contact is only at the top. Slightly shaving of the sides of the split in the stock will permit a smoother contact. After preparation of the scion, they are inserted into the stock properly and wrapped the stock tightly with poly grafting tape or adhesive tape at the point of graft union to hold the scions in place more securely. Thereafter, thorough waxing of the completed graft is essential.

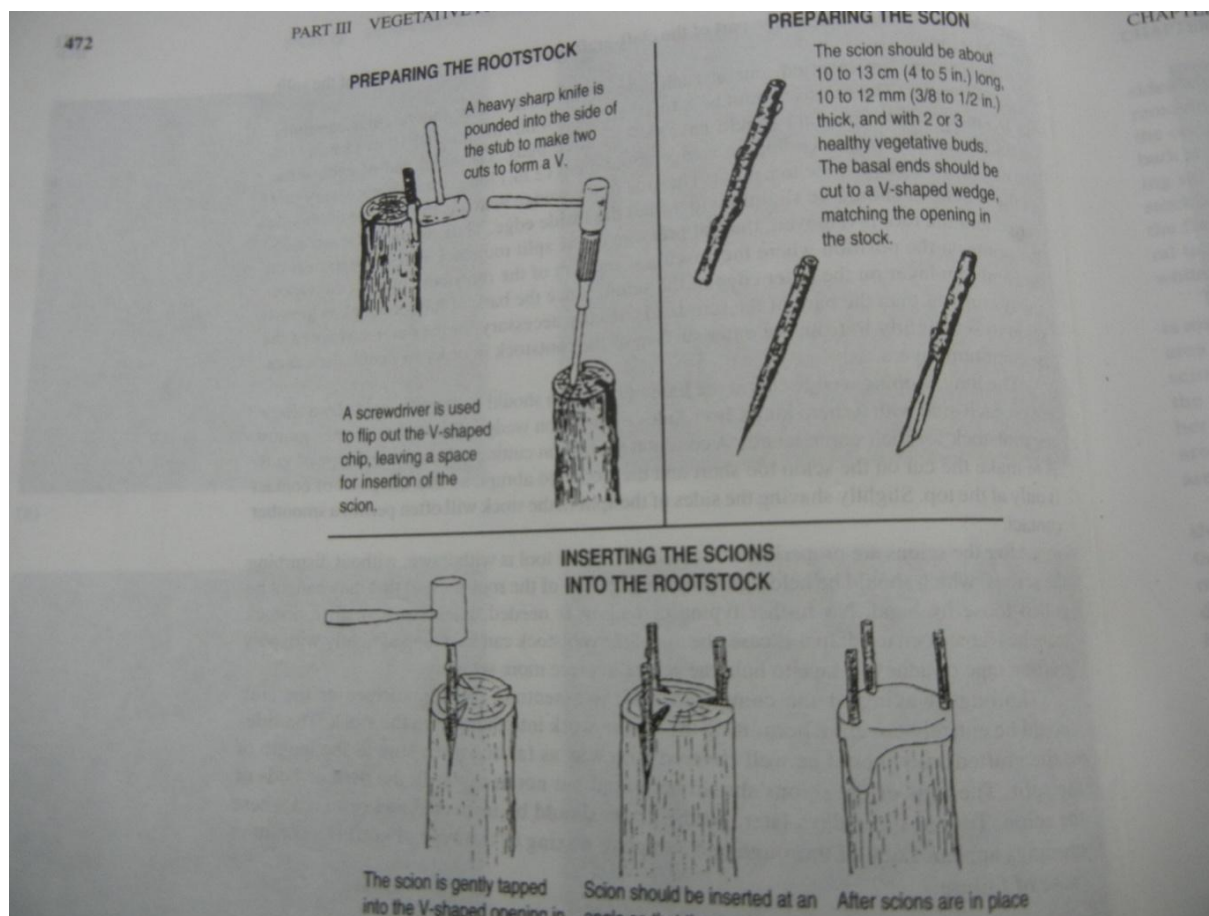
Mostly used for rejuvenating the old orchards of the temperate fruits by top working. Apart from this, Walnut, hazelnut, pecan nut, grape are also propagated by this method.



**FIGURE 12-6** Steps in making the cleft graft (split graft). This method is very widely used and is quite successful if the scions are inserted so that the cambium layers of stock and scion match properly.

**d. Wedge grafting:** A heavy, short bladed knife is used for making a V-wedge in the side of the stub, about 5 cm long. For this two cuts are made, coming together at the bottom and as far apart at the top according to the diameter of the scion. These cuts extend about 2 cm deep into the side of the stub towards the centre. The diameter of the stock to be grafted is the same as cleft grafting- 5-10 cm and the scions are also the same size- 10-13 cm long and 10-13 mm thick. After preparation of the stock, the scions are prepared by trimming the base to a wedge shape, exactly the same size and shape of the V- wedge on the stock. In a stock of 5 cm diameter, 2 scions should be inserted while in stock of 10 cm diameter, 3 scions should be inserted. After all the scions are firmly inserted into the place, all cut surfaces including the tip of the scion should be waxed thoroughly. Like cleft grafting, it can be made in late winter or in early spring before the bark begins to slip.

Mainly use to topwork the old orchards.



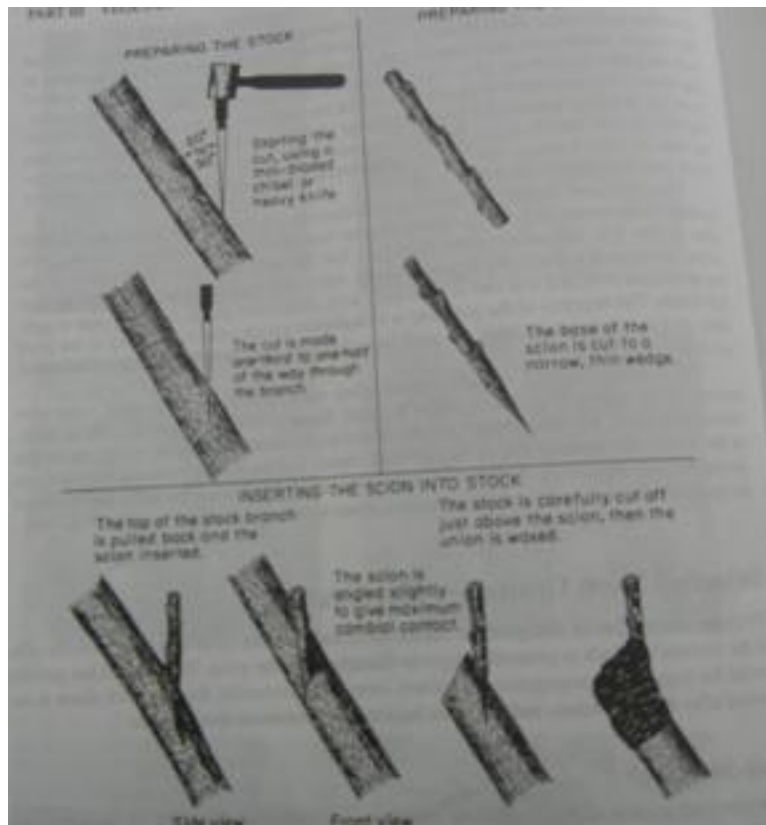
### Detached scion grafting- Side graftage

a. **Side-Stub grafting:** It is useful for the trees that are too large for the whip or tongue grafting but not large enough for cleft or wedge grafting. The best rootstock for this type of grafting is about 2.5 cm in diameter. For this type of grafting, an oblique type of cut is made into the rootstock at an angle of about 20-30°. The cut should be 2.5 cm deep, so that when the branches are pulled back the cut will open slightly but will close when the pull is released.

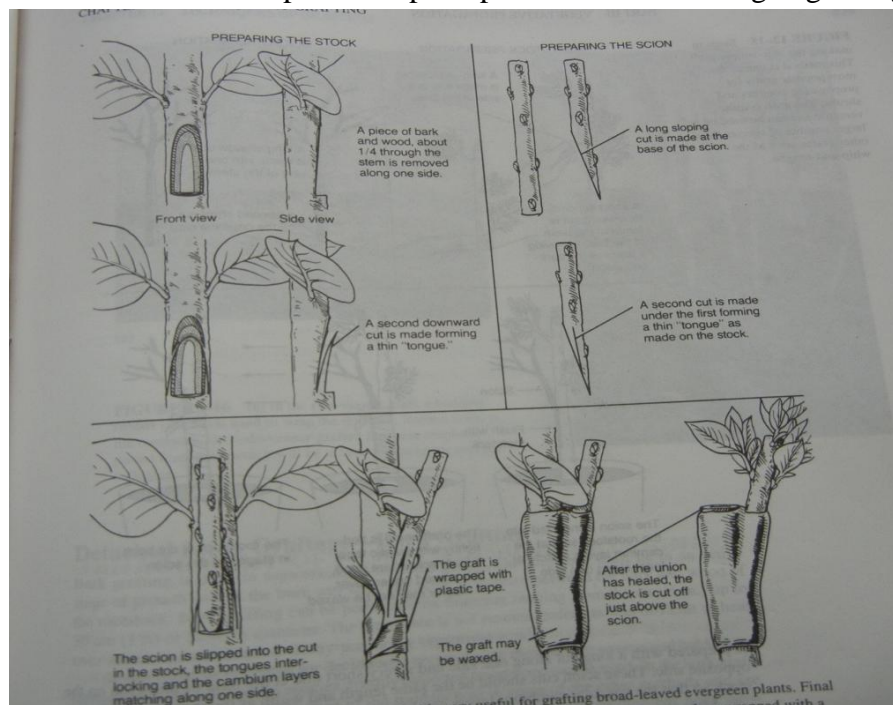
The scion should be about 7.5 cm long and relatively thin and should contain 2-3 buds. At the base of the scion, a wedge of about 2.5 cm long is made. The cut on both the sides of the scion should be very smooth. The grafter inserts the scion into the cut while the upper part of the rootstock is pulled backward, using care to obtain the best cambium contact. Then the rootstock is released. The pressure of the rootstock should grip the scion tightly. The wrapping the scion and rootstock at the point of union with grafting tape is done to prevent the union from any type of injury or damage. After the formation of successful union, the rootstock may be cut off just above the union. This must be done very carefully otherwise scion may become dislodged. The entire graft union must be covered with grafting wax, sealing all opening.

Mainly use to topwork the old orchards.



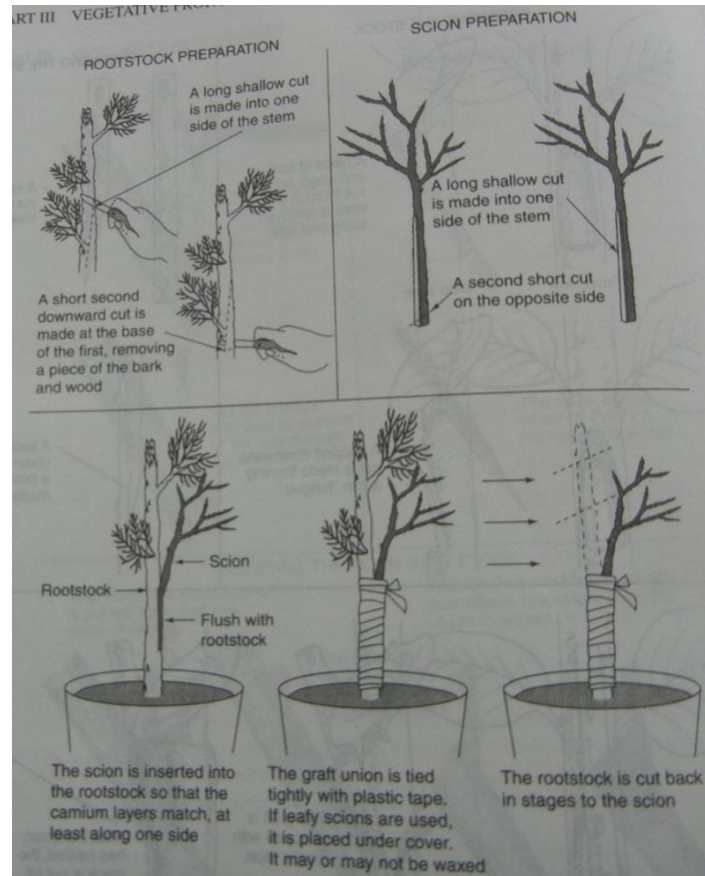


b. **Side tongue grafting:** The technique of side tongue grafting is similar to that of tongue grafting. The main difference between these two techniques is that side tongue grafting is done at the side portion of the shoot as compared to apical portion in case of tongue grafting.



c. **Side- veneer grafting:** It is one of the most popular grafting techniques, commercially adopted for mass multiplication of mango. In this case, rootstock is selected by when they have a diameter of about 1-1.5 cm. normally 1 year old seedlings a selected for that purpose. After

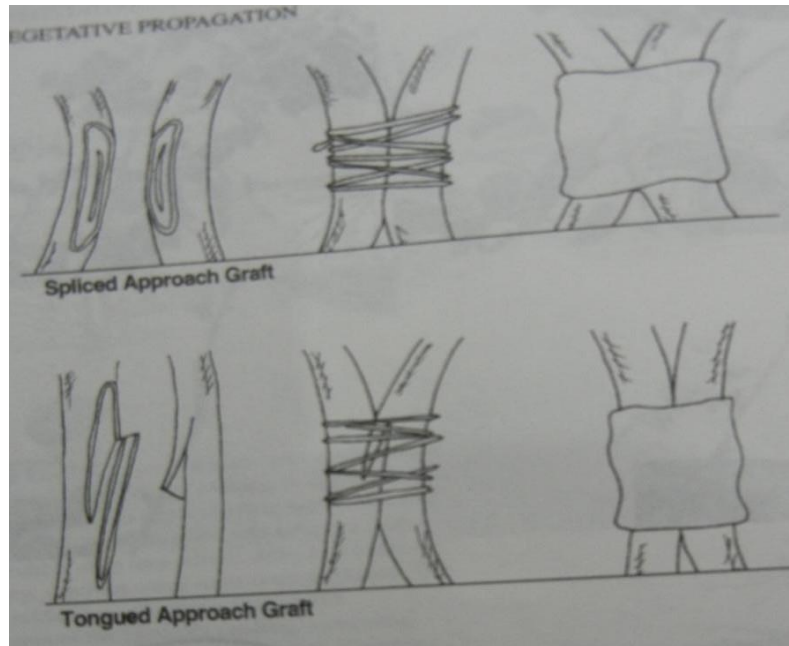
selection a shallow downward and inward cut of 3-5 cm length is given on one side of the stock just above the crown. At the base of this cut, a second short inward and downward cut is made, intersecting the 1<sup>st</sup> cut, so as to remove the piece of wood and bark. The scion is prepared with a long cut along one side and a very short one at the base on opposite side. These scion cut should be same in length as those made on the rootstock, so that the vascular cambium layers of both stock and scion can match as closely as possible. After inserting the scion, the graft is tightly wrapped with grafting tape. After the formation of successful union, the rootstock may be cut back just above the union.



### Attached scion grafting

**a. Spliced approach grafting/Inarching:** Here the rootstock and the scion should be of same size. An exception of this is the inarching of mango in India, where the scion is considerably smaller than the field grown rootstock. The scion in a pot is hung from the branch of the larger rootstock. At the point of union, a slice of bark and wood of 2.5-5 cm long is cut from both stock and scion. This cut should be the same size on each so that identical cambium patterns are made. After splicing or removing the slice of bark and wood from stock and scion, the cut surface are bound tightly together with poly grafting tape. After the formation of successful union, the rootstock may be cut back just above the union and scion below the union.

**b. Tongue approach grafting:** It is the same as of spliced approached grafting except that after the 1<sup>st</sup> cut is made in each stem to be joined, a second cut- downward on the stock and upward on the scion is made thus providing a thin tongue on each piece. By interlocking these tongues a very tight closely fitting graft union can be obtained.

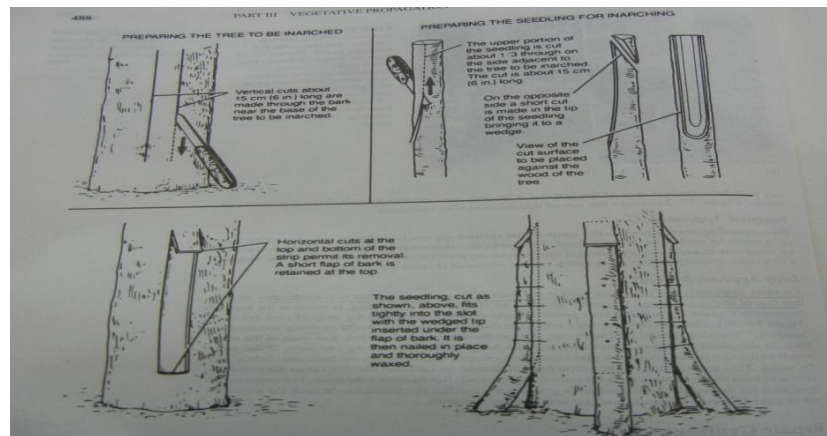


### **To overcome the problem of root damage by grafting technique**

Inarching is the technique through which we can overcome the problem of root damage of any well established plant by replacing the damaged root system. It is similar to that of spliced approach grafting. However, it differs in that the top of the new rootstock plants are usually does not extend above the point of graft union as it does in spliced approach grafting.

Here, seedlings planted surrounding the damaged tree are grafted into the trunk of the tree to provide a new root system and replaced the damaged root system. The seedling to be inarched into the tree should be spaced about 13-15 cm apart around the circumferences of the tree if damage is extensive and grafting is done in spring when the plants are in active growth stage.

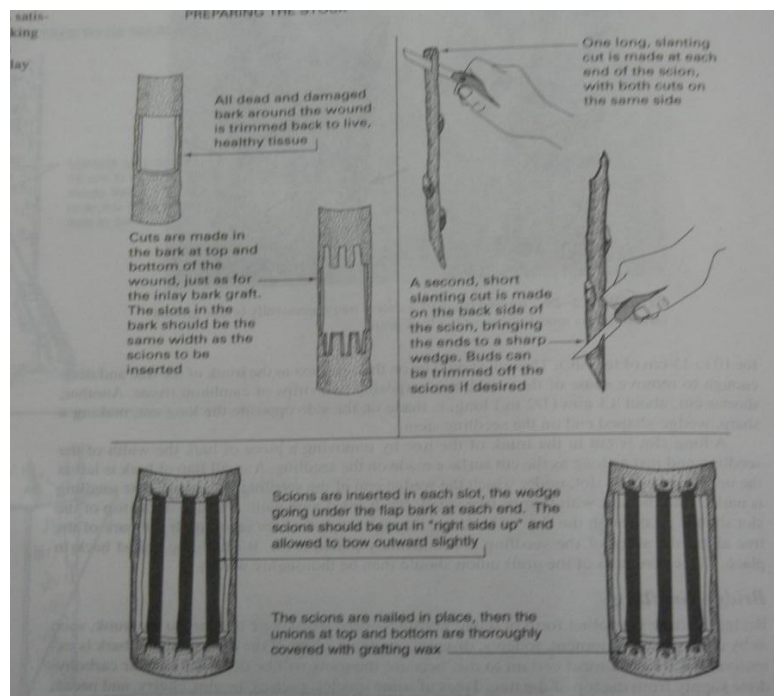
For this, two parallel vertical cut about 15 cm long are made through the bark near the base of the tree to be inarched or the damaged tree. Then a horizontal cut at the bottom is given to separate the bark portion and remove it leaving a short piece of flap intact on the top. The seedling plants surrounding the damaged plants are also prepared in same pattern by removing a splice of bark and wood from one side at a length of 15 cm. however, on opposite side a short cut is made in the tip by giving a wedge shaped cut. Then the seedlings are tightly fitted in the cut portion of the damaged plant and nailed in place and thoroughly waxed.



### To overcome the problem of trunk injury by grafting technique

Bridge grafting is the technique, used when there is any injury to the trunk of any tree. It is performed in early spring as active growth of the tree is beginning and bark is slipping easily. However, scion should be taken from dormant one year old growth with 6-13 mm thickness.

For this, the 1<sup>st</sup> step in the bridge grafting is to trim the wounded area back to healthy, undamaged tissue by removing dead bark. A scion is inserted every 45-7.5 cm around the injured section and attached at both the upper and lower ends into live, undamaged bark. It is important that the scions are right up side. If reversed, a union may form but the scions will not enlarge in diameter as they would if inserted correctly. After all the scions have been inserted, the cut surface must be thoroughly covered with grafting wax.





## Lecture 8. Micropropagation in fruit crops

It refers to the production of plants from very small plant parts, tissue or cells under aseptic (*in vitro*) condition. It is mainly based on the principle of *totipotency*. Strawberry was 1<sup>st</sup> commercially propagated by micropropagation technique

### Advantages:

1. large scale multiplication of virus free planting materials in limited time & space
2. Through out the year production
3. Beneficial in plants where vegetative propagation is not easy like papaya
4. Production of secondary metabolites
5. Long term storage in lesser space
6. Production of seedless variety through embryo rescue (Grape)
7. Shortening of breeding cycle
8. Homozygous plant production

### Methods of micropropagations

- **Meristem tip culture:** It consists of 1 or 2 pairs of leaf primordia. Helpful for the elimination of virus from infected plant.
- **Callus culture:** Unorganised mass of parenchymatous cells. Organogenesis in two steps- 1<sup>st</sup> formation of meristem and 2<sup>nd</sup> active growth of stem bud and root
- **Anther culture:** produce homozygous plants. 1<sup>st</sup> time reported by Guha & Maheshwari (1959) in *Datura*. Stage- near microscopic mitosis, when pollen grain pass through uninucleate to binucleate condition.
- **Cell suspension culture:** Homogenizing a piece of callus into liquid medium and shaking with shaker until medium become cloudy with suspended cells.
- **Ovule culture:** Unfertilized or just fertilized ovule excised and cultured. Helpful to obtain plant in self compatible species
- **Embryo culture:** Embryo excised at immature stage but before their degeneration

### Applications

- In India, the technique has been perfected in banana, grape and papaya
- Banana: Shoot tip excised from rhizomes of sword suckers
- Grape: Shoot tip with two nodal micro cutting, embryo rescue
- Papaya: Shoot tip

### Limitations:

- Costly
- Require technical skill
- Chances of contamination

- Plants having high level of phenols (mango, datepalm, coconut) not responds properly
- Laboratory establishment- difficult task.