**MODERN TECHNIQUES OF CULTIVATION: HYBRIDISATION, BUDDING, LAYERING**

**INTRODUCTION**

The onset of human civilization can be traced back to the beginning of agriculture. Agriculture began when plants and animals required for man were transplanted from their wild habitats to the human surroundings where they were nurtured with special attention. The strides made in the field of science and technology brought about great changes in the agricultural scenario too.

In agriculture and horticulture the methods of vegetative reproduction has been exploited in the development of specialized techniques for artificial propagation. The common methods of artificial propagations are

1. Hybridisation
2. Budding
3. Layering
4. Grafting
5. Cutting
6. Tissue culture and
7. Cloning.

**HYBRIDISATION**

The process of cross breeding varieties of crop plants, each having a specific and better characteristics, to obtain a totally “new crop plant” having the desired characteristics of both, is called **hybridisation.** Hybrid variety is the result of crossing of two varieties of species having desired genes, and bringing together the useful characters of both of these into one progeny. They are also known as High Yielding Varieties (HYV). The introduction of high yielding varieties of crops has brought about the increase in food production, because these varieties are strong, high yielding, early maturing, and better responsive to fertilizers.

The process of hybridization is done by,

1. Selection of parents, both possessing good characteristics, height, vigour, resistance to disease, etc.
2. Cross breeding the two parents in order to incorporate the good characteristics of both into one variety.

**Reason for the improvement of a hybrid:**

Suppose we want to obtain an improved variety of a crop, which is highly yielding as well as disease resistant. We should select two existing varieties of that crop, one of which is high-yielding; while the other is disease resistant. When the high yielding parent plant is cross bred with the disease resistant parent plant, then the daughter plant produced is high yielding as well as disease resistant.

**HIGH YIELDING VARIETIES OF CROPS**

1. WHEAT: Larma, Rojo-64 A, Sonara-64, Hira-moti, Kalyan sona, Sarbati sonara, Pusa larma, Arjun.
2. PADDY: Jaya, Padma, Pusa-205, IR-8, T-141.
3. MAIZE: Ganga-101, Deccan hybrid, Rankit.

**PROCEDURE OF HYBRIDISATION**

1. Selection of parent plants with different qualities.The parent plants should belongs to the same species.
2. Self pollination can be prevented by removing the stamens.
3. Pollination is done by artificial methods.
4. The female flower should be covered well to prevent external pollination.
5. The seeds are germinated and those having desired qualities are selected and grown.

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 Selected female plant Selected male plant

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 Remove stamens from female flower

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 Collect pollen grains from the male flower

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 Pollinates the female flower using the collected pollen grains

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 Covers the mother plant with polythene bag

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 Collect seeds Germinate the seeds

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 Select and grow better varieties of offspring

**ADVANTAGES OF HYBRIDISATION**

* Results in the production of more vigorous and better adapted varieties.
* Brings superior characters like high yield, good quality, and resistance to diseases, insects, drought, etc. into a single variety.
* Leads to the formation of hybrids, which are better responsive to fertilizers, and takes less time for ripening.
* Results in the creation of new genotypes.

**DISADVANTAGES OF HYBRIDISATION**

* Produces sterile hybrids in certain plants.
* A tedious, time consuming and expensive procedure.
* A technical procedure, which can be adapted only by experienced plant breeder.

#### LAYERING

Layering or layerage is a process by which new individual plants are produced on plants without disconnecting the plant parts from it. Usually it is produced from stems. Since the plant part to be developed into new plant is attached to the mother plant, the mother plant itself supplies Auxin (rooting hormone) and other food necessary for its rooting and growth. Thus, the artificial supply of such foods can be avoided unlike those in the case of vegetative propagation by stem cuttings. However, the limitations of this kind of propagation are that it does not produce a large number of individuals in a limited time. Moreover, a stem tip with active terminal bud is necessary for layering.

During layering, the layered stem produces roots and shoots. This is influenced by temperature, oxygen, darkness, moisture etc. Though there are different types of layering, air layering and simple layering are more common.

 **Air layering**

Air layering, a popular method of propagating houseplants, involves establishing a root system on the plant’s stem above the ground. Air layering is common in mango, mussaenda etc. The air layer may be made at any point on a stem of proper maturity. On many plants, a good location is about 12 inches from the tip.

**The procedure for air layering is as follows:**

* Remove all leaves several inches on either side of the point where the layer is to be made.
* From the center of the layering area, make a slanting cut upward an inch or more in length and about halfway through the branch.
* An alternate method of wounding is to remove a strip of bark 1/2 inch to 1 inch wide around the branch.
* Apply a rooting hormone to the cut or wounded surface.
* Insert a small piece of wood such as a toothpick in the cut to keep the wound open.
* Pack about a handful of moist, sphagnum moss around the branch to cover the wound.
* Cover the ball of moist moss with plastic wrap. Wrap it around the moss so that the plastic overlaps to keep the moss from drying out. Clear plastic permits you to see when roots have developed. Secure the plastic at each end with tape, string, plant ties or other convenient fasteners. It will usually take a month or more for roots to appear.



**Simple layering**

Simple layering is the easiest for the homeowner and may be performed whenever a plant has a branch low enough to be pulled down to the ground. Bury the branch several inches deep in the soil, making sure the shoot tip protrudes from the soil.

**Procedure for simple layering:**

* Many plants root when a branch is bent sharply upward. However, it can speed the process to make a wound or cut on the stem at the point where it curves upward. Make a slanting cut about 2 inches long either above or below the bend and about 12 inches from the tip.
* Dust the cut with a rooting hormone. Place the prepared branch or stem into a hole or trench 3 to 4 inches deep and secure it with a wooden peg or wire wicket.
* After the branch has been pinned down close to the point of wounding, bend the tip upward. If the cut was made on the topside, give the branch a half twist. If the branch is stiff, insert a stake next to the shoot to hold the tip in an upright position
* Fill the trench and mound the soil slightly so that thewounded portion of the stem will be 4 to 6 inches below the soil surface.
* Choose flexible branches that bend easily. Keep the soil around the layer moist at all times, and cover with straw, leaves or sawdust.
* The layer may form roots during the first season, but it should not be cut from the parent plant until the following spring. Some hard-to-root plants may take two years to produce roots.
* The following spring, after the layer is well rooted, cut off the branch where it enters the soil. Don’t disturb the roots of the layer for two to three weeks after the branch has been ready to give the new plant,time to recover.
* It can then be transplanted to a convenient protected spot or container where it can be tended carefully for one year before moving it to a permanent location.Foliage plants such as Philodendron, Diffenbackia, etc. are propagated by simple layering.



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 **SIMPLE LAYERING (A) BRANCH(B) WOUNDED AREA(C) STALKED TIP**

**ADVANTAGES OF LAYERING**

* It is relatively simple.
* Usually very successful.

**LIMITATIONS OF LAYERING**

* It does not produce large number of individual plants within a limited time.
* Moreover, a stem tip with active terminal bud is necessary for layering.

**BUDDING**

Budding is a method of grafting in which the scion is a single bud rather than a piece of stem or twig. It is most frequently used to multiply a variety that cannot be produced from seed. It may also be used for top working trees that cannot be easily grafted with cleft or whip grafts. There are two important methods of budding, such as T-budding (shield budding) and patch (chip) budding.

**T budding**

Budding, particularly T-budding, is faster than any other grafting technique and produces a high percentage of successful unions. Budding is also well adapted to plant shoots less than an inch in diameter. In larger branches, buds may be inserted in vigorously growing twigs near the upper part of the plant. Besides ease and success, budding usually produces a stronger union than those made with other grafting techniques, because by inserting a single bud we can produce several new plants even when scion wood of a new variety is limited. (E.g.: Hibiscus)

T-budding can be done almost any time that the bark of the stock slips (easily separates from the wood) and buds are fully developed. Most budding is done from late July to early September. Buds set at this time normally remain dormant until the following spring, which is desirable because young shoots produced during this period would be subject to winter injury. Spring budding (in March and April) is possible but is less desirable than fall budding. (July- September)

**PROCEDURE FOR T-BUDDING**

* **Selecting the stock**
Young plants selected for the stock must have new, vigorous growth. In early summer, remove the branches on the lower 6 inches of the trunk. This results in a smooth surface to work on. Most budding of young plants is done 2 to 3 inches above the ground; however, it is possible to bud higher.
* **Obtaining bud sticks**
The bud stick is a twig, usually from the current season’s growth, that is taken from the plant that is to be propagated. It should be vigorous and healthy with plump, well-developed buds. Buds on the center of the twig are generally better than those near the tip or the base.
* **Preparing the stock**
A T-cut is the most common and successful cut to make in the stock for budding. Select a smooth, branch-free location on the stock. Make a vertical cut about 1-1/2 inches long by drawing the knife upward. After making the vertical cut, make a crosscut to form a T at the top of the vertical cut, giving the crosscut a downward angle to make insertion of the bud piece easier. Cut through the bark but not into the wood. Once inserted, the bud should be placed in about the center of this vertical slit.
* **Inserting the bud**
After making the two cuts to form the T, gently lift the bark at the junction of the two cuts with the knife. To insert, place the base of the bud into the slit at the top of the T cut. Slide the bud down into the vertical slit until the top of the shield is even with or below the cross cut. Leaving the 1/2 inch of leafstalk as a handle can make insertion easier. It is important to insert the buds promptly as soon as they have been cut from the bud stick.
* **Wrapping the bud**
After the bud has been placed in the T-cut, it should be wrapped. Rubber budding strips are easy to use. String or twine may also be used. When wrapping, it is best to start above and wrap downward to keep from pushing the bud out if the bark is loose. Make three or four wraps above the bud and three or four below. Finish with a self-binding loop. Try to cover the horizontal cut of the T with one loop of the wrap. Never cover the bud. As the bud begins growing, buds from the rootstock may develop shoots. These should be removed as soon as they appear before they are more than 2 to 3 inches long. Do not prune the new branch that has developed from the grafted bud during the first summer. If there is danger of it being broken by wind, it would be better to tie it to a stake or devise other means of support rather than pruning it.

**Patch budding**

Patch budding is a technique that uses a bud with attached bark, instead of a bud stick. Patch budding is slower and more difficult than T-budding, but it is used on thick-barked trees (e.g., walnuts and pecans) that can’t be T-budded. For a successful patch bud, it is essential that the size of the bud and its attached bark be the same size as the patch cut on the under stock. For this reason, double-bladed knives and other special tools have been devised to make perfectly parallel, horizontal cuts. These cuts are usually done about an inch apart.

**STEPS OF PATCH BUDDING**

* **Preparation of bud sticks**
When preparing for patch budding in late summer, select wood for bud sticks about two to three weeks in advance. At that time, cut the leaf blades from the areas to be used, but allow the petioles to remain. Do not cut the bud sticks from the tree. The petioles will have dropped by the time the bud sticks are used and the leaf scars will have healed over. Then, cut bud sticks as needed and keep them moist and protected from direct sun or intense heat.
* **Removal of the bud patch**
To remove the bud from the bud stick, use a double-bladed knife to make parallel horizontal cuts equal distances , above and below the bud. Then, make vertical cuts about an inch apart at each end of the horizontal cuts. This makes a patch about 1 inch square. Remove this patch from the bud stick by pushing sideways. Pulling it from the stick may result in pulling out the center of the bud. If the core of the bud stays on the bud stick, the patch bud will not grow.
* **Preparing the stock**
A patch similar to that made for the bud must also be made in a clean, straight-grained portion of the stock. Remove the bark from the stock and promptly insert the patch with the bud. Neither do both operations quickly, so the bud nor the stock has a chance to dry out. While the inserted patch should fit on all four sides, a snug fit is especially important at the top and bottom.
* **Wrapping the bud patch**
Immediately after insertion, wrap the patch. If the bark of the stock is thicker than that of the bud, pare (to cut off) it down so that the bud will not be loose after wrapping. Do not cover the bud during wrapping, but all four cuts must be covered. To hold the bud tight, use heavy cotton string, nursery adhesive tape or masking tape. The edges of the patch must be waxed. Do not allow the wrapping to constrict the bud union. About 10 days after budding, check the buds and release the wrapping by making a single vertical cut on the backside of the stock, away from the bud. Do not try to pull off the wrapping if it sticks to the bud or stock.
* **Cutting back the stock**
As with other forms of budding, do not cut the stock back until the bud union is completed. When the budding is done in fall (fall budding: july-sep), do not cut the stock back until growth starts in the spring. If the budding is done in the spring, cut the stock back about 10 days after it has formed a union.

**ADVANTAGES OF BUDDING**

* It maintains the genotype in successive generations.
* It is one of the easiest and successful methods of artificial propagation.

**DISADVANTAGES OF BUDDING**

* Single buds are not as strong as stem sections; they are more susceptible to environmental pressures.
* Even birds may interfere with successful budding by breaking off buds as they land on stems.
* Even insects may interfere with successful budding by feeding on tender buds.
* Wrapping a single bud union with budding tape requires precision.