Lecture-7

Factors influencing rooting of cutting and Layering

Learning objectives

- Influence of different factors on rooting of cutting and layering

The ability of rooting in different plant species varies widely. The rooting of cuttings is influenced by several internal and external factors, which include:

1. **Physiological condition of the mother plant**
   - Physiological condition of the mother plant can exert great influence on the rooting of cuttings. For example, cuttings taken from the plants deficient in water often show reduced rooting.
   - Cuttings root better if taken in early morning hours, when plants are in turgid condition, than the one taken from water deficient plants.
   - Similarly, the nutrient status of stock plant also exerts a strong influence on the development of roots in cuttings. It has been reported in apple and raspberry that their cuttings root and sprout better when taken in fall when carbohydrate content was the highest and survival was very poor in summer, the time when carbohydrate storage was less.
   - Plants supplied with excessive nitrogen have luxuriant growth but cuttings taken from such plants produce poor roots. Thus, low N and high CHO balance in stock plant is necessary for better rooting. To obtain better rooting, blocking of CHO reserves by girdling has been found very useful as it blocks the downward movement of CHO, hormones and other root-promoting factors.
   - Internal factors of plant such as, auxin level, rooting co-factors and CHO etc. also affect the root initiation process of cuttings. Thus, the girdling of shoots prior to their use as cuttings is useful for stimulation of rooting.
2. **Juvenility factors**
   - In most plant species, the cuttings taken from juvenile (young) growth phase often root better than from adult phase. It implies that the ability of cuttings to form adventitious roots decrease with the increase in the age of the plant.

- In fruit plants like mango, apple, apricot, olive, citrus, pear, peach etc, the cuttings often root better if they are taken in juvenile phase. Cuttings taken from old non-bearing plants rarely root better.
- It is proven fact that plants produce more rooting inhibitors with the growing age and thus inhibit root initiation process in the cuttings taken from them.
- The phenolic level also decreases with the increase in the age of plant.
- The juvenility in mature plants can be induced artificially by heading back, spraying GA_3, forcing of *sphaeroblasts*, by rooting, grafting adult forms on to juvenile from and /or through dis-budding.

3. Type of the wood

- A proper choice of wood is an important factor because the wrong choice may be quite harmful as it may result in complete failure of rooting of cuttings. In general, the capacity of the cuttings to root depends upon the type of wood taken by the propagator.
- Usually, the cutting taken from the lateral shoots root better than the ones taken from terminal shoots. It is particularly true with plum, spruce and pines etc. It may be due to the reason that the lateral shoots have more stored food (CHO), which facilitates better rooting in the cuttings.
- In hardwood cutting, more roots are developed in the basal portion of the shoot than the cuttings taken from mid or top of the shoot, because accumulation of CHO and root promoting substances are in higher concentration at the basal parts.
- Similarly, formation of some root initials in the basal portions probably under the influence of root promoting substances from bud and leaves may be responsible for it.
- The cuttings taken from vegetative shoot root better than flowering shoots, perhaps due to presence of high level of rooting co-factors (hormones) in vegetative shoots.

4. Presence of leaves and buds

- In most species, the rooting process is inhibited if leaves and buds are removed from the cuttings. The promoting effect of leaves and buds in root initiation is due to the fact that these are the primary source of carbohydrate and auxin synthesis and other root promoting co-factors in the plants.
- These root promoting co-factors are transported by the leaves and buds to the basal portion of the cuttings for root initiation.

- The effect of buds on rooting may vary with the time of the year. Usually, growing buds promote rooting and dormant buds inhibit it. Presence of buds in easy-to-root species stimulates rooting but in difficult-to-root species, rooting is inhibited.
- The promoting effect of buds on rooting during dormancy period may be due to the higher auxin and low inhibitor supply to the basal portion of the cutting. However, in some species, the leaves are removed to reduce the loss of water due to transpiration.

5. **Presence of viruses**
    - The process of root initiation in cuttings taken from plants infected with viruses is inhibited or reduced as compared to those taken from virus-free stock plants. It is particularly true with apple and Chinese gooseberry, where virus-free clones have been reported to root better than the infected stocks.
    - Viruses not only reduce rooting percentage but also influence the root number.
6. **Position of the basal cut in the cutting:** In some plants, rooting is better when the cut is made just above or below the node, in others rooting is better if cut is made at the node and still in others, and position of the cut has no effect on root initiation process.
7. **Season**
    - In some cases, season of the year, when cuttings are made has significant influence on rooting of the cutting.
    - In deciduous plants, the hardwood cuttings could be made in dormant season and semi hard wood or softwood cuttings in the growing season.
    - The evergreen plants usually have one or more flushes of growth in a year and thus cuttings should be prepared at various times in relation to growth flush but more especially in spring or later fall, depending upon the species. For examples, the leafy cuttings of olive root better under mist if produced during late spring and summer but rooting is completely inhibited if taken in mid-winter.
    - For softwood cuttings of deciduas plants, the best rooting is obtained if the cuttings are prepared in spring, when leaves are fully expanded and shoots have attained some degree of maturity.
    - For best results in broad-leaved evergreen plants, cuttings should be prepared after a flush of growth has been completed and wood is partially matured, particularly during spring to late fall.

- Similarly, in narrow-leaved evergreen plants, the results are better if cuttings are prepared during late fall to late winter.

8. Treatment of cuttings: Various treatments have been demonstrated to treat cuttings before planting for root initiation. These treatments include use of growth regulators, mineral nutrient, fungicides, wounding, etiolation and girdling.

i) Use of growth regulators: Among growth regulators, IBA has been found to be the most ideal compound for promoting rooting in cuttings in most of the plant species. The concentration varies from plant-to-plant and type of cuttings used. In addition NAA, 2, 4-D and 2, 4, 5-T are the other root promoting auxin. However, 2, 4-D and 2,4, 5-T are potent weed killers and may inhibit shoot-development in certain species. Their concentration and degree of success also depend upon species and type of cuttings used. IAA is highly sensitive to light and is destroyed by strong sunlight, though NAA and 2, 4-D are stable.

ii) Mineral nutrients: Treatment of cuttings with nitrogenous compounds (organic and inorganic) usually promotes rooting of cuttings in several plants. Among different organic forms of nitrogen, asparagines and adenine are most effective. Boron also plays important role in rooting process of certain plant species. It promotes root growth rather than root initiation. The combination of nutrients (N, B) with auxin (IBA) is the most effective treatment for root initiation and development process in many plant species.

iii) Fungicides: In some instances, the rooting of cuttings initiate at better rate but their survival is low because these are attacked by pathogens. Thus, treatment of cuttings before planting with fungicides like captan and benomyl, gives better results. The fungicides may be used as powder dip, following IBA treatment or these may be mixed with IBA powder before treatment. Captan is more suitable, because it does not decompose easily and has long residual effect.

iv) Wounding: Wounding is helpful in cuttings having old wood at the base. Wounding promotes rooting in cuttings in several ways:

a) It tears sclerenchyma rings of tough cells in cortex, exterior to the point of origin.
b) It helps in better absorption of moisture, growth substances from the rooting medium.
c) Due to higher excretion of hormones in the wounded area, respiration rate is increased.
d) Division of cells in the wounded area and adjacent cells is faster
e) Wounded cells release ethylene, which act as root promoting hormone

All these conditions induced by wounding help in better root-initiation process.

v) **Etiolation treatment**: Etiolating is the oldest horticultural practice in which light is excluded from the plant or its part for sometime during the growing season. It is believed that exclusion of light reduces the photodecomposition of naturally occurring auxins and resulting in accumulation of auxins which ultimately synergies the root-initiation process. In etiolation,

the basal portion of the newly emerged shoots is kept under complete darkness by covering them with a black polythene cover and the terminal portion is allowed to grow in normal condition. After sufficient time, depending upon the species, the shoot is cut down, its basal portion is treated with auxin (IBA) and cuttings so prepared are planted in the nursery. The trench, mound and stool methods of propagation in which basal portion of the shoots are kept in darkness by soil cover are based on the principle of etiolation. Etiolation is useful in difficult-to-root plant spices like mango, jackfruit and avocado.

vi) Girdling: In case of girdling a ring of bark 2.5 to 3.0 cm is removed from the base of the shoot, which is to be used for the preparation of cuttings. It can also be done by making a notch or tying a wire around the shoot. This process helps to initiate the rooting process much early in some plant species. Girdling basically blocks the downward movement of carbohydrates, hormones and other root promoting factors. When to girdle and from where to girdle, differs widely with different plant species. However, cuttings of mango, litchi, guava, citrus root-better if the shoots are girdled 10-15 days before preparing of cuttings from them.

9. Environmental conditions: Environmental conditions like availability of water, light, temperature and rooting media may also affect the root initiation process in cuttings. Effect of different environmental factors is summarized as under:

i) Water condition: Loss of water through leaves need to be regulated by keeping optimum number of leaves in leafy cuttings. Similarly, loss of water from the leaves should be reduced by placing the cuttings in covered propagation frames having automatic humidifiers and ventilation system, laying thin layer of polyethylene cover over the beds of leafy cuttings by using mist propagation.

ii) Temperature: Temperature is considered as one of the most important environmental factors which govern the physiological processes occurring in plant system. A day temperature of 21-24^{0}C and night temperature of 13-15^{0}C are considered quite satisfactory for rooting of cuttings in most plant species. Very high or low temperature may inhibit root initiation process in the cuttings.

iii) Light: Light effects in rooting of cuttings may be due to its intensity, day length or light quality. Usually, the rooting is better in cuttings taken from stock plants grown at a low light intensity than the ones obtained from plants grown at a higher light intensity. The photoperiod under which the stock plants are grown, may also exert an influence on the rooting of cuttings taken from them. Some plants manufacture better carbohydrates under short-day conditions and others at long-day or day-neutral conditions. The orange red light of spectrum seems to favour rooting of cutting than the blue region. Further, red light (680nm) has more inhibitory influence on rooting than the blue or far red light spectrum.

iv) Rooting medium: An ideal medium must provide sufficient porosity to allow air and, should have better water holding capacity. It should be well drained and free from pathogens. Medium must perform three important functions

- It should hold the cutting properly.
- It should provide adequate moisture to the cuttings.
- It should permit free air passage to the base of the cuttings.

Some cuttings when rooted in sand produce long, un-branched and brittle roots but produce well branched, slender and flexible roots in perlite or peat mixtures. Generally pH near 7.0 is considered ideal for rooting process in the cuttings. The level of exchangeable calcium in the rooting medium, especially peat moss should not be high as it may also affect rooting process adversely.