Lecture-12

Use of growth regulators in plant propagation

Learning objective

- Role of growth regulators in plant propagation
- Methods of application of growth regulators

Introduction

Plant growth regulators (PGR) usually are defined as organic compounds, other than nutrients, that affect the physiological processes of growth and development in plants when applied in low concentration. Practically, plant growth regulators can be defined as either natural or synthetic compounds that are applied directly to a target plant to alter its life processes or its structure to improve quality, increase yields or to facilitate harvesting. The term plant hormone, when correctly used is restricted to naturally occurring plant substances. This fall into five classes: auxins, gibberellins, cytokinins, inhibitors and ethylene (gas). The term plant growth regulators include synthetic as well as naturally occurring hormones.

Main functions

Auxins: Cause enlargement of plant cell.

Giberellins: Stimulate cell division, cell elongation or both.

Cytokinins: Stimulate cell division in plants

Inhibitors: Plant hormones that inhibit or retard a physiological or biochemical process in plants.

Rooting and plant propagation

- One of the oldest uses of plant growth regulators has been to initiate or accelerate the rooting of cuttings .
- The best and most commonly used chemical for this purpose is indole butyric acid (IBA), which is decomposed relatively slowly by the auxin-destroying enzyme system in plants. Because this compound also moves very slowly in the plant, much of it is retained near the site of application.
- Another highly active auxin frequently used for root promotion is naphthalene acetic acid (NAA). As NAA is more toxic than IBA, there is a greater danger of injury to treated plants. The amides of both compounds are also effective rooting agents.
- Many phenoxy compounds, including 2,4-D, 2,4,5-T (trichlorophenoxy acetic acid) promote root formation if used at low concentrations. The type of root systems

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produced varies with the growth regulators used. These phenoxy acids tend to produce bushy, stunted and thickened roots systems.

- IBA is commercially used as rooting hormone in many horticultural and forest plants including apple, peach ,plum, poplar ,*ficus*, grapes, kiwifruit, pomegranate, rose, tea, winged bean, rhododendron, egg plant etc.

Methods of application: There are three major methods of applying growth regulators to stem cuttings for the induction of roots:

1. Quick dip method

2. Prolonged soaking method (Dilute solution soaking method)

3. Powder method

4. Lanolin paste method

1. Quick dip method (**Concentrated solution dip)**

- In the quick dip method, a concentrated solution varying from 500 to 10,000 ppm (0.05 to 1.0 percent) of auxin in aqueous solution or 50 percent alcohol is prepared, and the basal end (0.5 to 1cm) of the cutting is dipped in it for a short time (usually 3 to 5 seconds sometimes longer).
- The cuttings are then inserted into the rooting medium. Cuttings are most efficiently dipped as a bundle, not one-by-one.
- Many propagators prefer the quick dip compared to a talc application because of consistency of results and application ease.
- Greater rooting and more consistent rooting response have been reported with quick dip method than with talc. Change the solution after use at the end of the day, rather than pouring it back into stock solution.
- On extreme hot days in open areas where evaporation is high, it is best to discard the old solution and add fresh solution several times during the day.
- Stock solution that contains a high percentage of alcohol will retain their activity almost indefinitely if kept clean. One should use rubber or plastic gloves when working with these rooting compounds.

2. Prolonged soaking method

- In this method, the basal end of cuttings are soaked in dilute solution (10 to 500 ppm) for up to 24 hrs just before they are inserted into the rooting medium. The concentration varies from about 20 ppm for easily rooted cuttings to about 200 ppm for the difficult-to-root species.
- During the soaking period, the cuttings should be held at about 20^0 C, but not placed in the sun.

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- This is generally a slow, cumbersome technique and is not commercially popular.
- Due to long duration, there are chances of variability of results, with environmental changes occurring during the soaking period.

3. Powder method

- In this method, the basal ends of cutting are treated with the growth regulators in a carrier-usually a clay or a talc. The concentration of active ingredients in the inert carrier is between 500 to 1000 ppm.
- Talc preparations have the advantage of being easy-to-use. However, uniform rooting may be difficult to obtain, due to variability in the amount of the talc adhering to the base of cutting, the amount of moisture at the base of the cutting, the texture of the stem (i.e. coarse or smooth) and loss of the talc during insertion of the cutting into the propagation medium.
- Talc formulations are generally less effective than IBA in solution at comparable concentration. Seradax-A, B and Rootone are such formulations, which are still popular among the nurserymen.

4. Lanolin paste method

- For preparing hormonal pastes, the required quantity of hormone is weighed accurately and dissolved in a few drops of alcohol.
- The required quantity of lanolin is weighed and heated slightly in a beaker under gentle flame. When the lanolin is slightly liquidified, the dissolved hormone is poured in it.
- The contents are dissolved and mixed thoroughly and allowed to cool down. The paste is ready to use.
- The growth regulators are applied to the girdled portion of a layer or stool in lanolin paste for inducing rooting.

Germination and dormancy

Giberellic acid is the most potent germination promoter, by breaking seed dormancy in a wide range of species like peach, wild mustard, citrus, rough lemon, trifoliate orange, sweet orange, beans, peach, chinese cabbage etc. Giberellin occurs at a relatively high concentration in developing seeds but usually drop to a lower level in mature dormant seeds. Giberellins play an important role in the initial enzyme induction, activation of reserve food and certain types of dormancy, including physiological dormancy, photo dormancy and thermo dormancy.

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Cytokinin is believed to offset the effect of inhibitors like ABA in germination. It allows giberellic acid to function. Applied cytokinin can also be effective in overcoming thermo dormancy.

Ethylene has been effective in overcoming seed dormancy in snowberry (S*ymphoricarops*), honey suckle (*Lonicera*), corn and other cereals, germinating bean and pea seeds produce ethylene. Ethylene is a natural germination promoting agent for certain kinds of seeds, but has limited role in germination of seeds.

Other Nutrients: Use of potassium nitrate has been an important seed treatment in seed testing laboratories. Thiourea overcomes certain types of dormancy, such as the seed coat deep embryo-dormancy. *Prunus* seeds as well as high temperature inhibition of lettuce seeds. The effect of thiourea may be due to its cytokinin activity in overcoming inhibition.

Hormonal changes during stratification

A triphasic change in endogenous hormones is typical for many seeds; generally there is:

I. A reduction of ABA

II. Increased synthesis of cytokinin and gibberellins

III. Reduction in hormone synthesis in preparation for germination.

In general, gibberellins promote germination in dormant seeds, while ABA inhibits germination. Pre-sowing treatments with certain seeds not only reduce the stratification requirement and improve the seed germination but also enhances seedling growth in a number of temperate fruits.

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