Practical - 23

STUDYING THE USE OF GIBBERELLIC ACID AND OTHER GROWTH REGULATORS IN FRUIT CROPS

Exercise

Studying the use of gibberellic acid and other plant growth regulators in fruit crops.

Objectives

- To know about different kinds of growth regulators used in fruit crops
- To study the use of gibberellic acid and other growth promoting substances

Delivery schedule: 01 period

Student expectations/learning objectives

- To know about different growth regulators used in fruit crops
- To know about Gibberellic acid and its uses in fruit crops
- To learn different methods of application of gibberellic acid

Handouts / material / equipment's & tools required: Paper sheet and pen to note down the use of different plant growth regulators and to note the methods of applicationsin fruit crops. Volumetric flask of different size beaker, precision balance, spatula, stirring glass rod etc.

Pre-learning required: Pre-requisite knowledge of plant growth regulators and their use in fruit crops.

Introduction

For teachers…

- Explain the uses of different PGRs in fruit production.
- Practically, show different

Chemical substances other than vitamins and nutrients having potential to regulate the plant growth when used in small quantities are known as plant growth regulators. The term plant growth regulator is broad in sense and used for endogenous as well as synthetic growth regulators. However, the term plant hormone is used for growth regulating substances produced endogenously. Different types of growth regulators like auxin, gibberellin, cytokin in, ethylene, retardants and inhibitors are useful in fruit production.

The stock solutions of auxins, gibberellins, cytokinins etc. should be prepared and can be stored in a refrigerator at near freezing temperature. Stock solution of auxin and other organic materials deteriorate with time. Some organic compounds are relatively insoluble in water. A small quantity of organic solvent (not more than 0.5 per cent of the final volume) is effective in dissolving most of the organic substances. Cytokinins are weak bases and can be dissolved in a dilute acid, whereas, auxins are weak acids and can be dissolved in a dilute base or in alchohol. Use of small quantity (0.3 to 0.5ml) of 1N HCl for cytokinin and NaOH/ KOH for auxin for each 10 mg of the compound is satisfactory.

S. No.	Plant growth regulator	Examples
1	Auxins	• Indole Acetic Acid (IAA) • Indole Butyric Acid (IBA) • Naphthalene Acetic Acid (NAA) • 2, 4 – Dichlorophenoxy Acetic Acid (2, 4-D) • 4-Chloropenoxy Acetic Acid (4-CPA)
2	Gibberellic acid (GA)	• Gibberellic acid 3 (Ga_3) • Gibberellic acid 4 (GA_4) • Gibberellic acid 7 (GA_7)
3	Cytokinin	• Kinetin • Zeatin • Adenin • 6- benzyle amino purine (6-BAP) • Benzyle adenine (BA) • N-(2-chloro-4-pyriyl)-N-phenyl urea(4-CPPU)
4	Ethylene	• 2-chloro ethyl phosphonic acid (Ethrel, Ethephon) • Chloroethyl phosphoric acid (CEPA)
5	Growth retardants	• 2,4 Dichlorobenzyl (2,4 DNC) • Cycocel (CCC) • Alar • Paclobutrazol (PBZ)
6	Growth inhibitors	• Abscissic acid (ABA) • Maleic hydrazide (MH) • Tri- iodobenzoic acid (TIBA)

Gibberellic acid

Gibberellic acid (gibberellins) is a group of naturally occurring growth regulators stimulate the growth of many plants, promote flowering in some cases and cause a variety of other interesting morphological and physiological responses. Gibberellin was first discovered by late Elichi Kurosawa in 1926 in Japan from a rice diseased plant caused by a fungus (*Gibberella fujikuroi*). It produced taller plant than healthy ones. The first pure Gibberellin was called gibberellic acid (GA) named by Imperial Chemical Industries group. It is gibberellic acid (GA_3) produced and used in nearly all the horticultural crops.

Methods of application of gibberellins

Liquid sprays: This is the most convenient method,which is generally practiced. Gibberrellic acid is soluble in water only to the extent of 6000 parts per million (ppm). Therefore, a stock solution is prepared by dissolving one gram in 95 per cent ethyl alcohol with 0.1 per cent tween 20 (wetting agent) and diluting with water to make one litre of solutions. Desired further dilutions can be prepared from this stock solution as and when required.

Liquid dip: This is mostly used in case when the whole bunch has to be dipped. For example, in grapes the berry bunches are dipped in a beaker containing desired concentration of GA_3 solutions for seedlessness and elongation of berry.

Lanolin paste: This is an easy way to obtain a systematic application. One percent paste is prepared by placing 12.5 mg of the gibberellic acid into a small vial, then dissolving the acid with drops of a spreader and finally mixing it with one gram of melted lanolin.

Aerosols: Aerosols produce a dry spray over the entire plant leaving no powdery residue. The advantage of this method is that gibberellin is stable in the solvent used in aerosols, while it loses its activity when stored in contact with water. This method is also economical in case of a limited number of plants to be treated.

Preparation of gibberellins solution

Steps 1. Stock solution preparation

- Weigh 1.0 g of Ga_3 accurately on precision balance.
- Dissolve GA_3 in small quantity of 1N KOH / NaOH (generally 3 to 5 ml of solvent is sufficient for each 1000 mg quantity).
- Make volume to 1000 ml in a volumetric flask by adding double distilled water.
- Shake the volumetric flask gently for uniform dissolution.
- This will give 1000 ppm solution of GA_3.

Step 2. Dilution of stock solution

- As per requirement dilution may be done. For example, if students want to prepare 1000 ml solution of 50 ppm GA_3. Then calculation should be done by using the following formula, $N1 \times V1 = N2 \times V2$

  Where,

Calculation for preparation of 1.0 L (1000 ml) solution of 50 ppm GA_3

N1 = Concentration of stock solution

V1 = Volume of stock solution required

N2 = Concentration of solution has to be prepared

V2 = Volume of solution has to be prepared

1000 ppm (*N1*) x *V1* = 50 ppm (*N2*) x 1000 ml (*V2*)

V1 = (50 x 1000) /1000

$V1 = 50$ ml

Result: For preparing 1000 ml solution of 50 ppm GA_3. Students should take 50 ml of 1000 ppm Ga_3 stock solution and dilute it to make 1000 ml by adding double distilled water.

Students Activities

1. Visit to nearby orchards and note down about different plant growth regulators used in the orchards.
2. Prepare stocks solution (1000 ppm) of gibberellin and cytokinin. Dilute stock solution to a desired concentration and practice spray on fruit plants.
3. Practice different methods of GA_3 application on fruit plants.
4. Visit agro-chemical shops in the locality and note down different types of plant growth regulators sold there.

Study Material

- Kumar, N. (2010). Introduction to Horticulture, Oxford & IBH Publishing Company Pvt Ltd. New Delhi.
- Randhawa, G. S. (1971). Use of plant growth regulators & gibberellins in horticulture, ICAR Technical bulletin (Agric.) No. ICAR,New Delhi