WELCOME

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COURSE SEMINAR ON

ROLE OF PLANT GROWTH REGULATORS IN PROPOGATION OF HORTICULTURAL CROPS

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INTRODUCTION

- Plant Growth Regulators (PGR) known as bio-stimulants or bio-inhibitors modify physiological processes in plant.
- In earlier literature, these substances were referred as Hormones.
- **Thimann (1948)** suggested to use term phytohormones for naturally occurring plant hormones.
- According to **Phillips (1971)** growth hormones are the organic substances which are synthesized in particular cells and transferred to other cells where in extremely small quantities influence developmental processes.
- PGR are such organic compounds occuring naturally in plants as well as synthetic other than nutrients which in small amounts promote, inhibit or modify any physiological process **(Van Overbeek *et. al.*, 1941)**.

- **The PGR are of two types:-**
  i. Growth promoter: Auxins, Gibberellins and Cytokinin
  ii. Growth regulators: Abscisic acid and ethylene
- The major areas where growth regulators have successfully played their roles in plants are:
  1. In vegetative propagation
  2. Inhibition of abscission
  3. Prevention of bud dormancy
  4. Growth control
  5. Promotion of flowering
  6. Prolonging the post harvest life
  7. Retarding senescence. …………..**(Sabagh *et. al.*, 2021)**

CLASSIFICATION

PLANT GROWTH REGULATORS

Growth promoting

- Natural occurring
  E.g. IAA, Zeatin, Kinetin, etc.
- Synthetic
  E.g. Adenine, Benzimidazole, etc.

Growth inhibitor

- Natural occurring
  E.g. Abscissic acid
- Synthetic
  E.g. Morphactins, MH, CCC, etc.

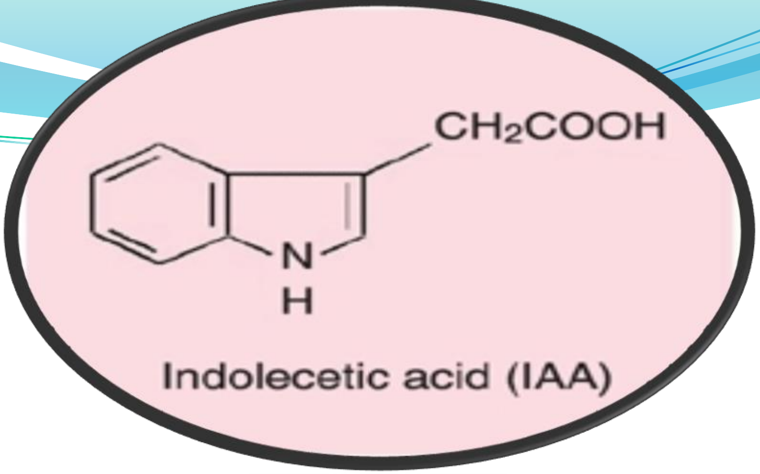
MODE OF ACTION

Auxin	Increase cell division in cambium but inhibit the growth of lateral buds.
Gibberlin	Also influence cambial growth and promote cell division in sub apical (inter node)region of shoots.
Cytokinin	Promote cell division in callus tissue and growth of lateral buds.
Abscissic acid	Prevent cell division but their effect can be over come exogenous application of auxin, gibberlin and cytokinin.
Ethylene	Little effect of cell division but strong effect on cell enlargement.

Common Growth Regulators are-

1. Auxin	Indole-3-Acetic Acid (IAA), Indole-3-Butyric Acid (IBA), 2,4-D, Naphthalene Acetic Acid (NAA)
2. Gibberellins	Gibberellic Acid GA_1 to GA_{130}
3. Cytokinins	Kinetin, Zeatin etc.
4. Dormins/ Growth inhibitors	Absisic Acid, Phasic acid, Xanthoxin etc.
5. Ethylene	Ethephon
6. Synthetic Growth Retardants	Cycocel, Phosphon D, Morphactins, Maleic Hydrazide (MH)
7. Flowering Hormones	Florigen, Vernalin, Anthesin etc

Auxin



- Auxins play an important role in rooting and apical dominance.

- It Produced in apical and root meristems, young leaves, seeds of developing fruits.

- Naturally occurring auxins in plants are Indole-3-acetic acid, 2-Indolyl L-acetic acid etc (Zhao 2010).

- Synthetic auxins are Indole-3-butyric acid (IBA), 2,4-dichlorphenoxyacetic acid, 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) etc.

ROLE OF AUXIN

1. Rooting:

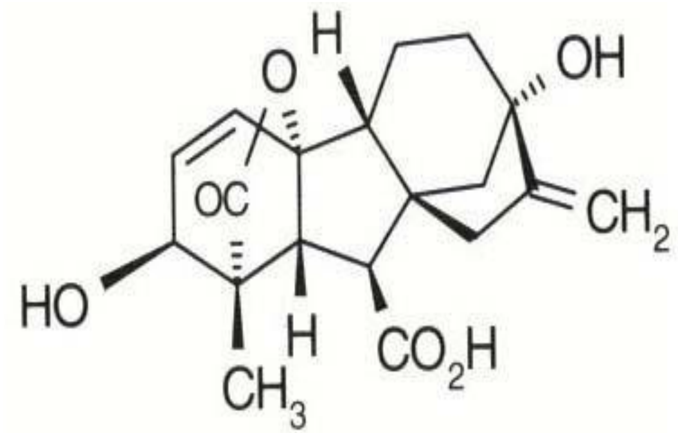
NAA and IBA are used for inducing rooting in cuttings of plants.

2. Shoot and root growth:

Auxin promotes growth of shoot at a higher concentration and that of root at a very low concentration.

GIBBERELLIN

- Gibberellins are named after the fungus *gibberella fujikuroi* which causes rice plants to grow abnormally tall.

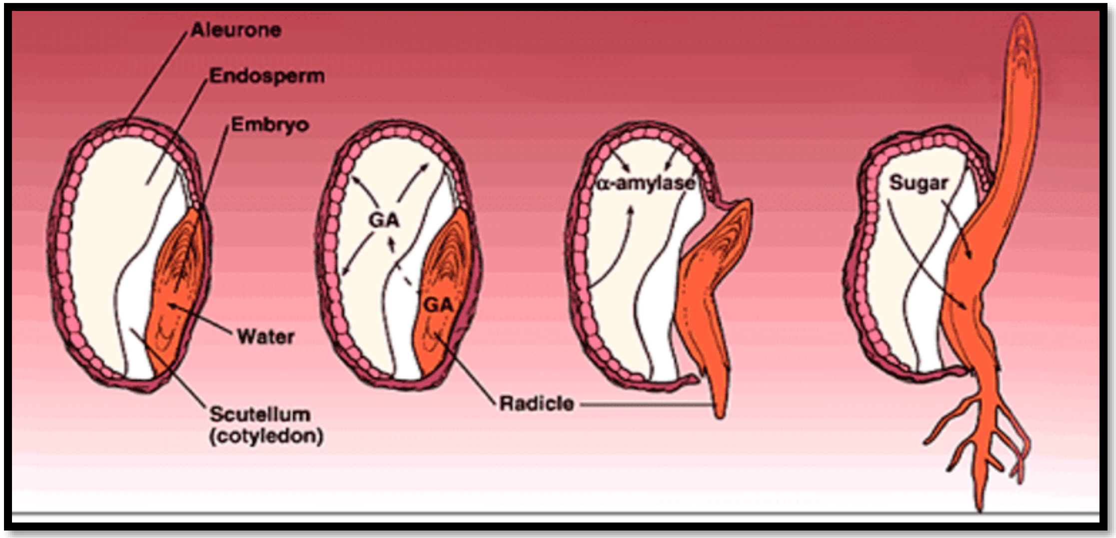


- Produced in shoot tips (young leaf and bud primordia), root tips and immature seeds.

ROLE OF GIBBERELLIN

1. Seed germination:

Involve in synthesis of amylase and other hydrolytic enzymes.



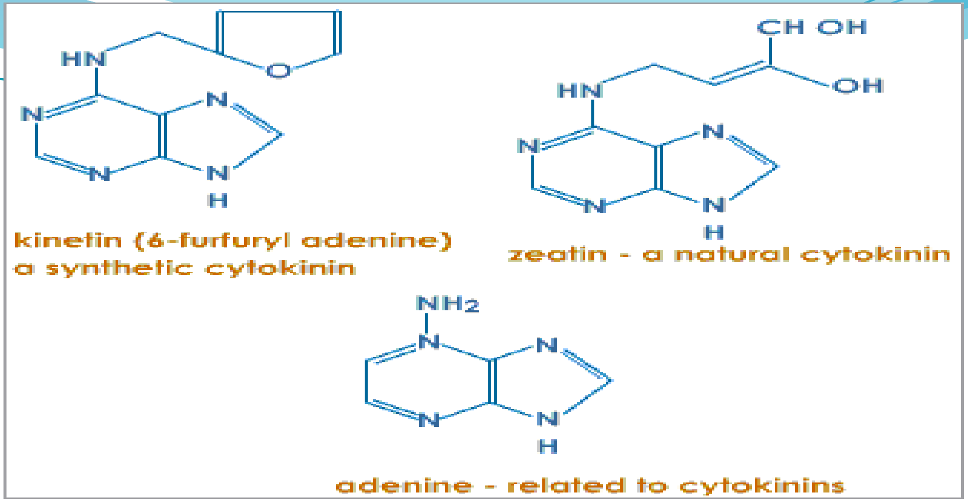
2. Breaking of Bud dormancy:

Dormancy of tree buds during winters can be broken by exo-genous application of gibberellins.

e.g.:- Apple

(Schwechheimer C., 2012)

CYTOKININ



➢In tissue culture high auxin and low cytokinin give rise to root development; low auxin and high cytokinin encourage shoot development.

➢It can be extracted from coconut milk, tomato juice, flowers and fruits of apple, peach, immature fruits of corn and *Musa spp.* **……..(Wadhwa, M., *et al.*, 2015)**

ROLE OF CYTOKININ

1.CELL DIVISION

2.CELL ENLARGEMENT

3.BREAKING DORMANCY

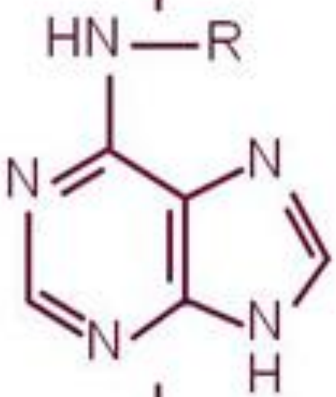
4.DELAY SENESCENCE

5.INDUCTION OF FLOWERING IN SHORT DAY PLANTS….(Kieber *et al.*, 2014)

ROLE OF CYTOKININ

Delay Senescence

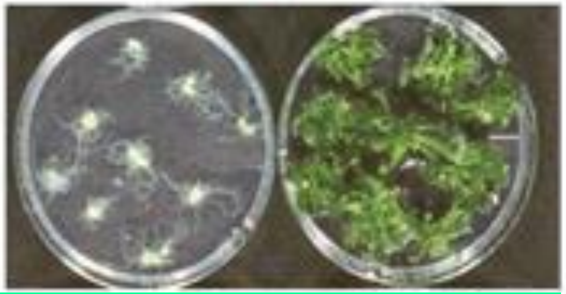
Light mediate development



Nodulation

Counteract the apical dominance

- Nutrient response
- Apical dominance
- Vascular development
- Pathogen interactions



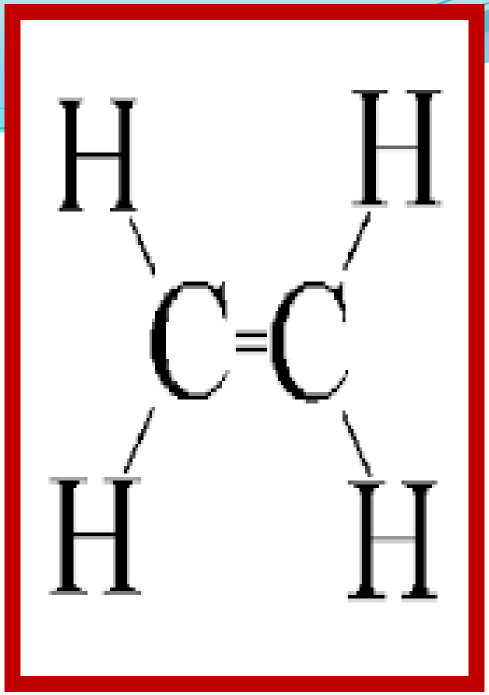
Organogenesis

Promote cell division

ETHYLENE

- Ethylene is a hydrocarbon gas commonly known as ripening hormones.

- The source of ethylene are internal combustion of automobiles, engines, ripening fruits, vegetables, pollinated flower, diseased decayed materials.



ROLE OF ETHYLENE

❑ Abscission:

The reduce auxin along with the increased ethylene results in the formation of an abscission layer, which is a thin region where the cells slowly break down forming a thin line which eventually breaks and shedding occurs.

Cont..

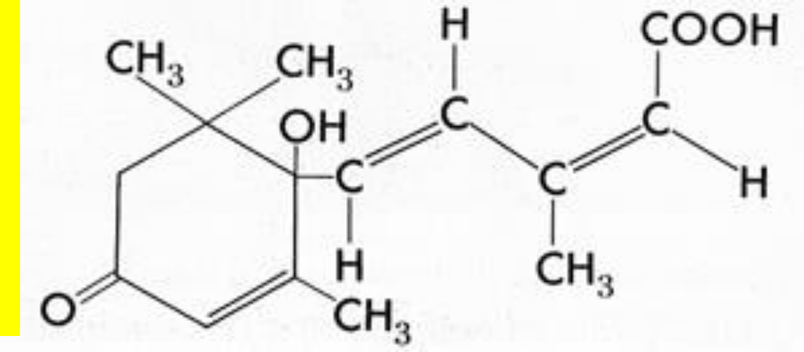
- **Break down of dormancy**

  E.g. seeds of peca nut, apple, strawberry etc.

- **Exudation of sap and latex**

  E.g. rubber

Abscissic Acid
(Stress Hormone)



- Found in old leaves, dormant seeds, dormant buds.
- ABA was originally believed to play a major role in leaf abscission and dormancy. It is now known that ethylene is more directly involved with leaf abscission.
- ABA plays important role in movement of guard cell and stomata opening **(Lim *et. al.*, 2015).**

ROLE OF ABSCISSIC ACID

- **ABA is known to be a major factor in seed dormancy. Applications of ABA will inhibit seed germination.**

- **Applications of ABA to the leaves of well watered plants will result in stomata closure.**

- **Counteract GA.**

- **Stimulates release of ethylene. …… (Chen *et al.*, 2020)**

FLOWERING HORMONES

- **1.Florigen: These hormones are synthesized in the older leaves and then transferred to the growing region where it initiates the floral and bud initiation. It is mainly responsible for flowering in plants (Higuchi 2018).**
- **2.Anthesins: It is newly discovered hormone responsible for flower formation which horticulturists use to induce early flowering in some plants.**

  Example: Chrysanthemum
- **3.Vernalin: It is used to undergo and bring vernalisation in some plants.**

MORPHACTINS

It is synthetic growth regulators. It bring about fundamental action on morphogenesis and hence these are called morphactins.

THE MAJORE ROLES ARE:

1. Inhibit germination of seed.
2. Inhibit the growth of seedlings.
3. Inhibit the stem elongation.
4. Prolong the bud dormancy.
5. Preventing flowering

Commercial Use
of
Plant Growth Regulators
in

S. No	Fruits	Growth regulators	Effect	Features
1.	**Mango**	**NAA @ 200 ppm**	**Reduction of fruit drop**	**Pea stage**
		NAA @ 200 ppm	**Reduce the floral malformation**	**Time of fruit bud differention (october)**
		2,4- D @ 10 ppm	**To control pre harvest fruit drops**	**-**
		Paclobutrazol @ 10 g a.i /tree	**Control of vegetative flush during Oct- Nov**	**-**
2.	**citrus**	**2,4 –D @ 20 ppm**	**To control pre harvest fruit drops**	**-**
		NAA @ 100-500 ppm	**Fruit thinning**	**-**
3.	**Banana**	**2,4 –D @ 20 ppm**	**Removal of seedling**	**Poovan variety**
		Etherel @ 500 ppm	**Accelerate the ripening**	**-**
4.	**Sapota**	**NAA @ 120 ppm**	**Increase the fruit set and yeild**	**-**

5.	Grapes	GA_3 @ 10-40 ppm	Enlargement of panical growth	-
		GA_3 @ 10 ppm	Rachis elonation	One month after forward pruuning
		GA_3 @ 30-40 ppm	Berry elongation	Bajra grain size berry stage
		4 CPA @ 10 ppm	Increase the pedicel thickness	-
		CCC @ 250-500 ppm	Suppresion of vine growth and increase the fruitfullness of buds	After back prunning (5 leaf stage)
		GA_3 @ 50 ppm	Berry thinnig	50% bloom stage
		GA_3 @ 30-40 +Cytokinin	Bunch elongation	Bunch dipping at 6-7 mm berry size
		NAA @ 20-50 ppm	Control post harvest berry drop	-

6.	guava	IBA @ 300 ppm	Promote the roots (air layering)	-
		NAA@ 80-100 ppm	To reduce the rainy season fruits drop	-
		NAA@ 800 ppm+ Deblossoming	Maximum yeild in winter season	-
7.	Pineapple	Ethephone @100 ppm	Uniform flowering	All month
		Ethephone combination with (2% urea+ Ca+ Na Carbonate 0.04%)	Uniform flowering	March- May
8.	Apple	NAA @2-10 ppm	Effective thinnig agent	-
		NAA + sevin	Heavy thinning	-
		NAA @ 10 ppm	Prevent the pre harvest fruit drop	-

COMMERCIAL USE OF PLANT GROWTH REGULATORS

SL. No.	CROP	PGR	EFFECT
1.	Bougainvillea	IBA @ 10,000 ppm	Rooting in hard wood cutting
2.	Croton	IBA @500-2500 ppm	Rooting in air layering
3.	Chrysanthemum	IBA @ 100-200 ppm	Rooting in soft wood cutting
4.	Orchids	NAA @ 10 ppm	Increase vase life of flower
5.	Chrysanthemum	NAA @ 10 ppm	Increase vase life of flower
6.	Anthurium	BA @20 ppm	Delaying senescence
7.	Zerbera	BA @ 15 ppm	Delaying senescence
8.	Tulip	BA @10 ppm	Delaying senescence
9.	Rose	Cytokinin @20 ppm	Accelerate the opening of bud
10.	Chrysanthemum	Cytokinin @ 20 ppm	Accelerate the opening of bud

COMMERCIAL USE OF PLANT GROWTH REGULATORS IN

SL.No	CROP	PGR	EFFECTS	REMARK
1.	Tomato	2,4-D@2-5 ppm	Increase the fruit set, earliness and parthenocarpy	Seed treatment
		PCPA@50-100ppm	Fruit set at high and low temperature condition	-
2.	Brinjal	2,4-D@2 ppm	Improve the fruit set and early yield	Spray at first flower appearance
3.	Chilli	NAA@ 40 ppm	Enhance the flower and fruit set	-
4.		GA_3 10-100ppm	Enhance the flower and fruit set	-
5.	Okra	IAA @20 ppm+NAA20ppm	Enhance the seed germination	-
6.	Bottle gourd	MH@50-150 ppm	Induction of more female flower	-

12.	Bitter gourd	CCC @100-500 ppm	Increase the female male ratio	-
13.		MH @150-200 ppm	Increase the female flower	-
14.	Bitter gourd (gynoecious line)	Silver nitrate @200-300 ppm	Induce male flower	-
15.	Summer squash	ethophone@250 ppm	Temporary suppression of male flowers	1st true leaf stage repeated spray up to 2-3 weeks
.		ethephone@600 ppm	Complete suppression of male flowers	2 & 4 true leaf stage spray up to 2-3 weeks
16.	Pumpkin	ethophone@250 ppm	High female flower production	-
17.	Garden pea	CCC@50 ppm	Increase the yield, drought tolerant	-

CONCLUSION

The plant growth regulators either synthetic or natural have been found great and wide applications in agriculture and horticulture.

These growth regulators which in minute quantity can have ability to promote and modify a physiological process in plants and have been found greater applications and economic importance for farmers and horticulturists.

Beside their major roles there are many other minor roles.

The knowledge of these growth regulators have been advantages and boon to many agriculturists and horticulturists globally.

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