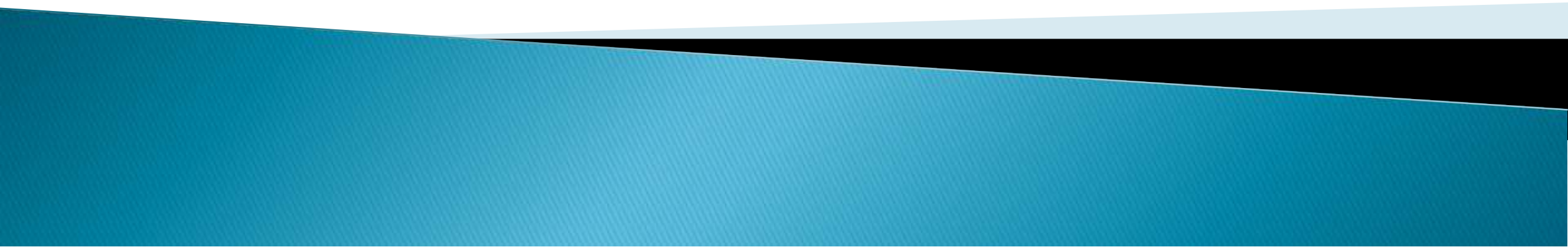


Role and mode of action of morphactins in vegetable crop production



What are morphactins.?

- ❖ Morphactins are a group of substances which act on morphogenesis and modulate the expression of plants.
- ❖ Chemically, they are the derivatives of fluorene compounds. Fluorene by itself is inactive, but the addition of COOH group in the 9th position makes it active.
- ❖ Have very diverse effects on plant growth and development.
- ❖ Morphactins have adverse effects on plant morphogenesis and this characteristic designation(morphactin) is derived from morphologically active substance.
- ❖ They are translocated in plants basipetally as well as acropetally through both sieve tubes and xylem elements.

Examples

- ▶ Chloroflurenol,
- ▶ Flurenol,
- ▶ Methyl benzilate,
- ▶ Methyl chloroflurenol,
- ▶ Methyl dichloroflurenol.

Role of morphactins

- ❖ Inhibits seed germination(particularly emergence of radicle)
- ❖ Inhibits the growth of seedling.
- ❖ Inhibits stem elongation(increased concentration produces dwarfing in plants).
- ❖ Growth of first internode and root was inhibited by both morphactins(more in light) and kinins(more in dark) in *bryophyllum tubiflorum*.


Role of morphactins

- ❖ They exercise depolarization during cell division.
(denfer and others(1969) observed random orientationof the mitotic spindle and plane of cell division).
- ❖ Increased tillering and lateral buds(number) in cereals and grasses.
- ❖ Prolonged bud dormancy in potato and crab apple
- ❖ Low concentartion promotes primary roots.
- ❖ Stimulates flowering in short day plants

SIMILARITIES BETWEEN MORPHACTIN AND ABA


- ▶ Both temporarily inhibit seed germination.
- ▶ In both retardation effect is countered by ga3.
- ▶ Both inhibit vegetative growth of apical bud.
- ▶ Retarding effect on the emergence of dormant buds.
- ▶ **Most of their effects can be reversed by ga3 treatment.**

Brassinosteroids(BRs)

- Brassino steroids are class of poly-hydroxy steroids that have been recognized as a sixth class of plant hormone.
 - BRs was first isolated in 1979 from pollen of *Brassica napus* which promote cell division and stem elongation and biologically active molecule was isolated.
 - From 230 kg of *Brassica napus* pollen yield was only 10mg.
 - Over 70 BRs compound have been isolated from plants which will promote cell elongation and cell division reported by Mitchell *etal.*
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- BRs are biosynthesized from campesterol.
- Sites for biosynthesis in plants have not been experimentally demonstrated.
- One well supported hypothesis is that all tissue of produce BRs, Since BR biosynthetic and signal transduction genes are expressed in a wide range of plant organs and short distance activity of support this.
- BRs are recognized at the cell membrane, although they are membrane soluble.
- BRs also extracted from the plants *Lycopersicon esculentum* contains relatively high amount of BRs, which increases disease resistance and used as “plant strengthening substance”

Function of BRs


- It promote cell expansion and elongation with auxin.
 - BRs also have primary role in cell division and cell wall regeneration.
 - Promotion of vascular differentiation; BR signal transduction has been studied during vascular differentiation
 - its necessary for pollen elongation for pollen tube formation.
 - BRs can provide some protection to plants during chilling and drought stress.
 - Application of brassinosteroids to cucumbers was demonstrated to increase the metabolism and removal of pesticides,
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Maleic hydrazide

- Maleic hydrazide is a synthetic compound which has a plant growth regulating action. It is used as a foliar treatment of potatoes to prevent volunteer formation and sprouting during storage.
- It can also be used pre-harvest to suppress sprout formation in onions.
- Maleic hydrazide has a mutagenic effect on the cells and prevents cell division in tubers as well as an inhibitory effect on biosynthetic activity.
- It is also used in combination with various herbicides (dicamba and MCPA) as well as fatty acids, to control unwanted vegetation in amenity turf and ornamental gardens.


- MH severely inhibited growth and this inhibition was not reduced either by GA or by IAA.
 - At low doses MH broke apical dominance and side branches developed; extension of these was stimulated by GA and IAA and extension of the main axis correspondingly still further reduced. The results show that MH prevents the response to GA of GA-sensitive plants.
 - It is suggested that the rapid growth of tall peas, as compared with that of dwarfs, and their lack of response to GA, are due to a greater capacity to synthesize a 'GA-like hormone'. Growth of tall peas is much more drastically inhibited by MH than that of dwarf peas and the suggestion is made that the inhibition of shoot growth induced by MH is due primarily to blocking the activity of the postulated 'GA-like hormone'.
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Jasmonate (JA)

- Jasmonate (JA) and its derivatives are lipid-based hormone signals that regulate a wide range of processes in plants, ranging from growth and photosynthesis to reproductive development.
 - Jasmonate include Jasmonic acid and its esters such as methyl jasmonate..
 - JAs are critical for plant defense against herbivory and plant responses to poor environmental conditions and other kinds of abiotic and biotic challenges.
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- Jasmonates (JA) are an oxylipin, i.e. a derivative of oxygenated fatty acid.
- It is biosynthesized from linolenic acid in chloroplast membranes.
- Synthesis is initiated with the conversion of linolenic acid to 12-oxo-phytodienoic acid (OPDA), which then undergoes a reduction and three rounds of oxidation to form (+)-~~7-epi~~7-epi-JA, jasmonic acid.
- Only the conversion of linolenic acid to OPDA occurs in the chloroplast; all subsequent reactions occur in the peroxisome.
- JA itself can be further metabolized into active or inactive derivatives.

Function of JAs


- In the plant, its role in wound response is best understood.
 - JA biosynthesis is rapidly activated, leading to expression of the appropriate response genes.
 - JA signaling is the volatile emission of JA-derived compounds.
 - JAs have also been implicated in cell death and leaf senescence.
 - JA can also induce mitochondrial death by inducing the accumulation of reactive oxygen species (ROSs).
 - JA inhibits root growth. The mechanism behind this event is still not understood.
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- JA plays many roles in flower development.
 - JA and MeJA inhibit the germination of nondormant seeds and stimulate the germination of dormant seeds.
 - High levels of JA encourage the accumulation of storage proteins; genes encoding vegetative storage proteins are JA responsive. Specifically, tuberonic acid, a JA derivative, induces the formation of tubers.
 - JAs also play a role in symbiosis between plants and microorganisms
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Salicylates

- Salicylates and related compounds are produced by plants as part of their defence systems against pathogen attack and environmental stress.
- Salicylates are derivatives of salicylic acid that occur naturally in plants and serve as a natural immune hormone and preservative, protecting the plants against diseases, insects, fungi, and harmful bacteria.


Effects

- Thermogenesis in aurum flower.
 - Plant pathogen resistance-stimulates plant pathogen protein production.
 - Reported to enhance longevity of flower.
 - Reported to inhibit ethylene biosynthesis.
 - Inhibit seed germination.
 - Block the wound response.
 - Reverse the effect of ABA.
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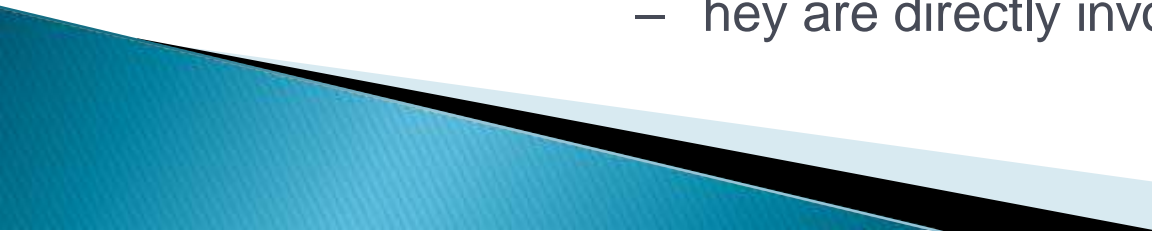
Plant peptide hormone

- Plants have evolved highly complex intercellular communication systems and plant peptide hormone signaling plays a greater than anticipated role in various aspects of plant growth and development.
 - A substantial proportion of these peptides are secretory and act as local signals mediating cell-to-cell communication.
 - Peptide hormones are transcribed from the genome and translated into peptides.
 - However, these peptides generally undergo further post-translational modifications to enable them to exert their function.
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Function of Plant peptide hormone

- Peptide hormones are expressed in and secreted from specific cells or tissues.
 - Apoplastic peptides are perceived by specialized receptors that are located at the surface of target cells.
 - Peptide hormone-receptor complexes activate intracellular signalling through downstream molecules, including kinases and transcription factors, which then trigger cellular events.
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Polyamines

- Polyamine is an organic compound having two or more primary amino groups – NH_2 .
 - These are strongly basic molecules with low molecular weight that have been found in all organisms studied.
 - Essential for plant growth and development and affect the process of mitosis and meiosis.
 - they are involved in modulating senescence of organs in plants and are therefore considered as plant hormone.
 - they are directly involved in regulation of programmed cell death.
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Nitric oxide


- Nitric oxide one of several oxides of nitrogen, it is a colorless gas under standard conditions.
- NO is one of the few gaseous signalling molecules known and is additionally exceptional due to the fact that it is a radical gas.
- It is a signaling molecule, acts mainly against oxidative stress and also plays a role in plant pathogen interactions.
- Treating cut flowers and other plants with nitric oxide has been shown to lengthen the time before wilting.

- Nitric oxide, known as the 'endothelium-derived relaxing factor', or 'EDRF', is biosynthesized endogenously from L-arginine, oxygen, and NADPH by various nitric oxide synthase(NOS) enzymes. Reduction of inorganic nitrate may also serve to make nitric oxide.
- In plants, nitric oxide can be produced by any of four routes:
 - (i)L-arginine-dependent nitric oxide synthase,(although the existence homologs in plant). of animal NOS
 - (ii) plasma membrane-bound nitrate reductase.
 - (iii) mitochondrial electron transport chain.
 - (iv) non-enzymatic reactions.

Strigolactones

- Strigolactones are plant hormones that stimulate the branching and growth of symbiotic arbuscular mycorrhizal fungi, increasing the probability of contact and establishment of a symbiotic association between the plant and fungus.
- Strigolactones also inhibit plant shoot branching and trigger germination of parasitic plant seeds (for example *Striga*, from which they gained their name).

Cont....

- Strigolactones are carotenoid-derived and contain a labile ether bond that is easily hydrolyzed in the rhizosphere, meaning that there is a large concentration gradient between areas near the root and those further away.
 - In 2009, strigolactone biosynthesis was found to be DWARF27-dependent.
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APPLICATION

- ▶ Okra pods (*Abelmoschus esculentus*, L. Moench 'Pusa Sawni') were given pre- and post-harvest treatments with chlorfluorenil-methyl ester (CME 74050), a morphactin, at 2.5–500 mg l⁻¹. Weight loss, moisture percentage, chlorophyll contents, soluble sugars, starch, acidity and amino acids were determined on the initial and final day, as well as anatomical changes in the fruits.
- ▶ Pre-harvest application of 2.5 mg l⁻¹ morphactin induced anatomical changes, including lower stomatal index and more long trichomes, all of which could contribute to help water conservation by the okra pods.
- ▶ concentrations higher than 10 mg l⁻¹ caused a marked degree of blackening on the very first day, rendering the pods unmarketable. Amino acids increased with pre-harvest application and decreased with post-harvest application.

- ▶ In cauliflower (*Brassica oleracea* L. var. Botrytis cv. Snowball) morphactin applied to and absorbed by leaves was transported to roots and there, either stimulated cytokinin activity or activated its synthesis and consequently caused prolific formation of shoots on the underground part of the stem, tap root and lateral roots. This may be of importance in propagation of this plant (Ilyas 1973).
- ▶ In intact *Chrysanthemum* plants, there were indications that morphactin caused an increase in chlorophyll content (Tjia 1973).
- ▶ In ficus, black currant and sour cherry, as in heloniopsis, morphactin depressed root formation. (Kato and hongo 1975, turetiskaya et al 1976, hodge and morgan 1978).

- ▶ In brassica rape l. Morphactin at 100 and 1000 ppm, caused turmerous growth forming the spherical succulent tap root (ilyas and barma 1973).
- ▶ Foliar spray of morphactin inhibited nodule and metal root formation of cicer arietinum (rao et a l 1972).
- ▶ Parthenocarpy appeared to be induced by morphactin in cucumis sativus l (bianchi and laudi et ah 1978), capsicum (jayakaran 1973), and luffa acutangula (bisaria 1977),