Course – M. Sc. Botany Part 2 Paper IX

Topic – Phytohormone: GIBBERELLINS

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Phytohormones

Plant hormones are single molecules, produced within plants, that occur in extremely low concentration.it control all aspect of plant growth and development. There are five major classes of plant hormones:

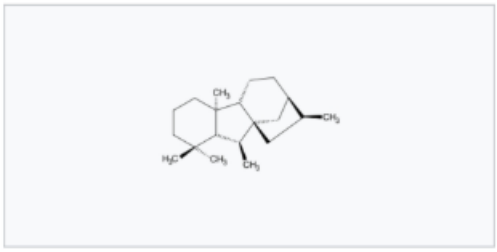
- Abscisic acid
- Auxins
- Cytokinins
- Ethylene
- Gibberellins

GIBBERELLINS

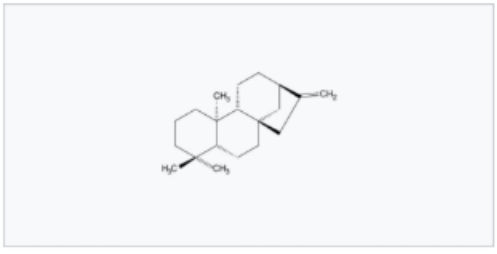
- Gibberellins [GAs] are naturally occurring tetracyclic diterpenoid carboxylic acids responsible for plant growth and various developmental processes including stem elongation, germination, dormancy, flowering, flower development and leaf and fruit senescence. GAs are one of the longest known plant hormone.
- First Gibberellin to be structurally found as GA3
- About 136 GAs identified
- Diterpenoid acids
- Weakly acidic compound
- of rice seedlings.

Chemical Structure

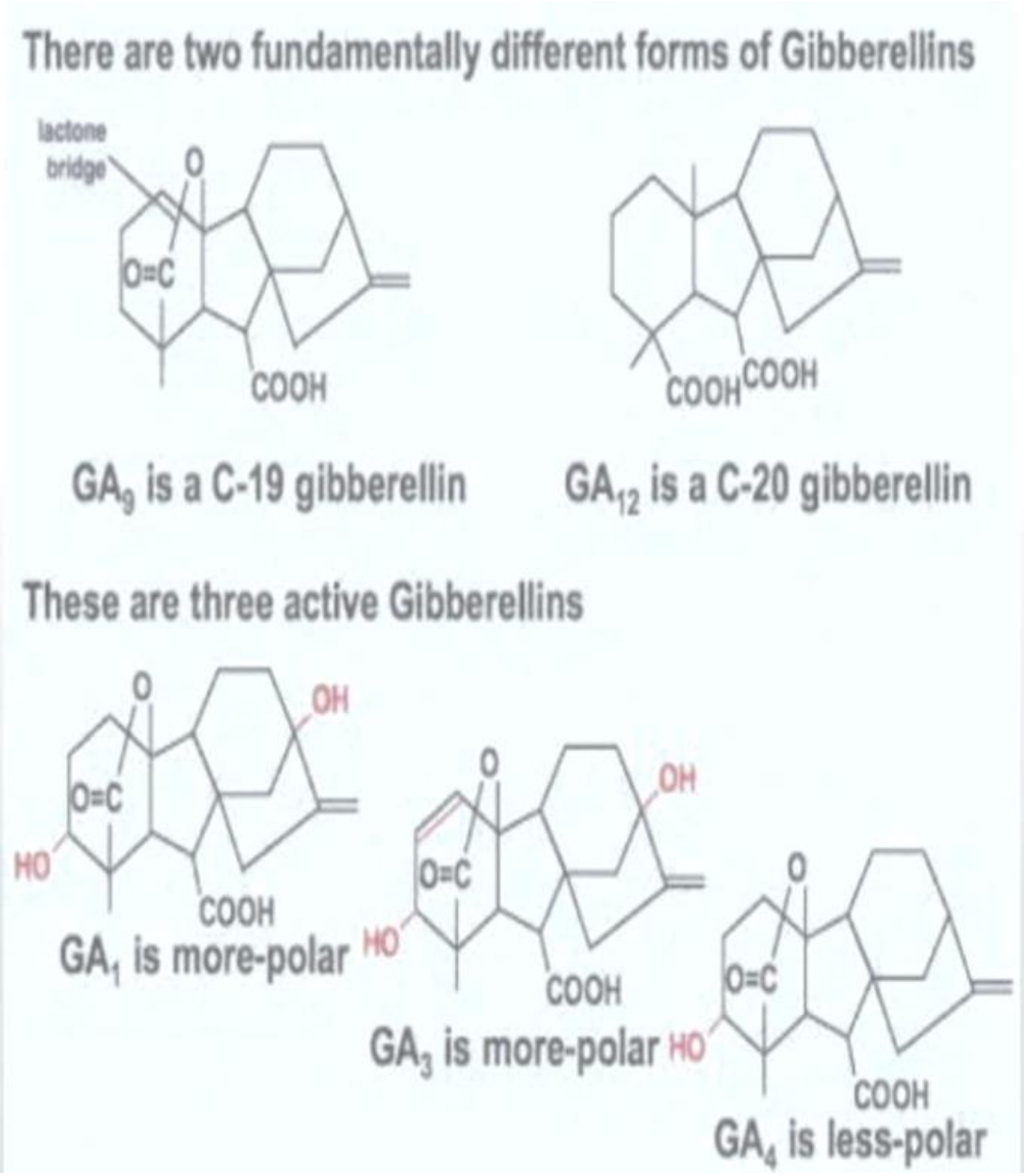
- Gibbrellins are tetracyclic diterpenes with an ent-gibbrellane structure.
- All 20 carbons of skeleton structure.
- Called as C20.
- E.g.: GA12, GA27, GA53, etc.
- GA3- practical uses in plant breeding programmes, horticulture, agronomy.



ent-Gibberellane



ent-Kaurene



Discovery:

- Japanese scientist Eiichi Kurosawa identified on Bakanae (foolish seedlings) in 1926
- Caused by "Gibberella fujikuroi"
- In 1934, Yabuta discovered compound Fusaric acid, known as Gibberellins.

Production:

These are found in the;

- Young tissues of Roots,
- Germinating seeds,

- Developing shoot tissues,
- Embryo,
- Production increases in the dark.

Biosynthesis:

- Occurs in 3 stages
- In 3 distinct subcellular locations.
- 1st stage- geranylgeranyl diphodphate is converted in a two-step process to *ent*-kaurene. This occurs in plastids, and the first enzymically diphosphate synthase, provides the committing step.
- 2nd stage- ent-kaurene is translocated to cytoplasm, where it is oxidized and hydroxylated to give GA12-aldehyde by a series of ER- bound P450 monooxygenases.
- 3rd stage-GA12- aldehyde is further oxidized, hydroxylated, and in some cases, desaturated by soluble enzymes in the cytosol to yield the bioactive C19-Gas.

Mechanism of action

- Acts by inducing activity of gluconeogenic enzymes during early stages of seed germination.
- Gibberellins also induces the synthesis of a– amylase & other hydrolytic enzymes during germination of monocot seeds.
- Gibberellins also mobilizes seed storage reserves during germination & seedling emergence.

Functions of Gibberellins:

- Bolting and flowering:
  - Induce bolting i.e. shoot elongation and flowering.
  - Promote the growth of short-day condition.
- Elongation of Internode:
  - The loosening of cell wall for stretching.
  -The target of the gibberellin is at intercalary meristem.
- Break seed dormancy – light sensitive seeds treated with gibberellin in dark, e.g. Lettuce and Tobacco.
- Breaking of bud dormancy e.g. potato tubers.
- Parthenocarpy -seedless and fleshy fruits development e.g. Tomato, grapes.
- Substituting cold treatment – Induce flowering in the biennials in a single year.
- Stimulates germination of pollen
- Stimulate root growth
- Stimulates a-amylase production in germinating seeds.
- Induction of flowering:
  -GA2 andGA7 are effective in inducing early flowering.
  -Induces many pistillate flowers.
  -Engender helix [English ivy].
- Fruit set:
  -Initiation of fruit growth following fertilization.

- E.g. apple, stone fruits.

Applications of Gibberellins:

1.Fast growth of seedlings.

2. Breaking of seed and bud dormancy.

3. Control of plant growth.

4. Modification of sex expression.

5. Malting of barley.

6. High sugar yield – e.g. sugarcane.

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