

PLANT GROWTH REGULATORS

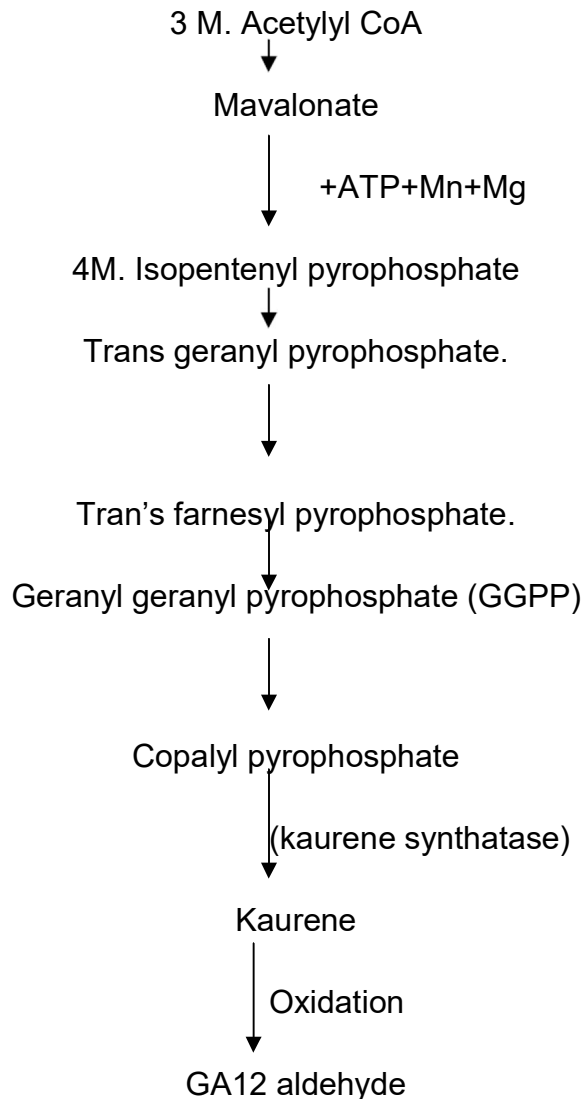
GIBBERELLINS

The discovery of Gibberellins was quite accidental. Japanese worker Kurosawa (1926) in Japan while conducting experiments on rice disease caused by *Gibberella fujikuroi* (causal organism for foolish seedling of rice or bakane disease) observed that the fungus caused excessive growth in rice. He applied the fungal extracts to intact healthy plants and observed enhanced growth. Later Yabuta and Sumuki (1938) named the active principle as gibberellin. Further it was purified, crystallized and named as gibberellic acid (Curtis and Cross 1954). Now gibberellins are designated as GA₁, GA₂ and so on. The common gibberellic acid is GA₃. At present 112 types of gibberellins are known.

25.1 Occurrence and Site of synthesis:

Gibberellins are synthesized in the young leaves (major site), shoot tip, root tip and the developing seeds.

25.2 Bio synthesis:



Acetyl co A is the precursor for the biosynthesis of gibberellins. Three molecules of acetyl co A are linked together to form a molecule of mevalonic acid. Mevalonic acid in turn is activated in the presence of ATP, Mn and Mg and is converted to isopentenyl phosphate (IPP). This is a 5 carbon compound. Four molecules of IPP undergo stepwise condensation, first to Trans geranyl pyrophosphate (GPP) then to trans farnesyl pyrophosphate (FPP) and finally to form a diterpene called geranyl geranyl pyrophosphate (GGPP). This is 20 carbon compound. This GGPP is converted to kaurene. The conversion of GGPP to kaurene is carried out by the enzyme kaurene synthetase in two steps.

First GGPP is converted to copalyl pyrophosphate. In the second step copalyl pyrophosphate in turn is converted to kaurene. Kaurene undergoes oxidation and a series of reactions resulting in the formation of gibberellins.

Transport

Transport of gibberellins is passive and non polar. Gibberellins move both in xylem and phloem and vice versa through vascular ray cells.

25.3 Mode of action:

There are several hypotheses to explain the mechanism of GA in the plants.

1. Increase in the endogenous auxin content:

Whenever GA causes cell enlargement, the effect is not considered to be direct. The effect is indirectly mediated through formation of auxin, in turns is held responsible for the cell elongation.

Gibberellin has been shown to cause **synthesis of amylase in barley aleurone cells**. This enzyme converts starch to reducing sugars resulting in an increase of osmotic pressure, causing entry of water into the cells and cell enlargement.

25.4 PHYSIOLOGICAL EFFECTS:

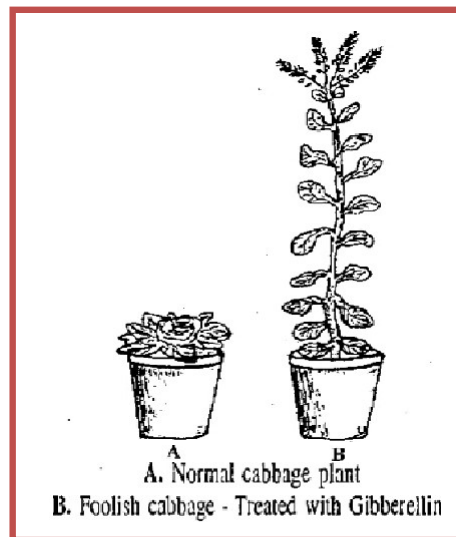
A. Stimulation of stem growth:

The most important effect of GA is the stem elongation when GA is applied the stem elongates markedly. As a result such plants grow taller. GA caused stem elongation has the following characteristic features (1) enhanced stem growth is not due to increased formation of nodes and internodes but results from rapid elongation of internodes. Therefore GA treated plants do not differ from control plants in the number of nodes and internodes. Elongation of internodes is due to both cell division and cell elongation. Younger internodes respond better than older ones and plants grown in light respond better to GA than those grown in the dark. However, not all

plants respond equally to GA application. It is only the genetic dwarf and rosette plants which show marked stem elongation.

Genetic dwarfs:

From the field grown maize four mutants were isolated. These mutants grow only up to about one fourth the heights of normal tall varieties. When gibberellin is applied, the dwarf plants respond readily and show marked stem elongation. These become comparable in height to corresponding tall varieties. Here the degree of stem elongation is proportional to the concentration of GA that is applied.



B. Bolting:

Production of floral axis is called bolting. Bolting and flowering are induced normally after photo induction or vernalisation. Bolting however can be induced without vernalisation by the treatment of the plant with gibberellins.

Many plants require a period of low temperature for flowering. Application of GA replaces the vernalization (0-5°C) requirement for the flowering of carrot, beetroot, chicory and others. Vernalization or low temperature requirement is usually met with when the plants pass through natural winter. However this low temperature requirement can be completely overcome and plants can be made to flower in high temperatures by applying GA.

Therefore low temperature requirement of plants can be replaced with GA.

C. Flowering in long day plants:

Gibberellins promote flowering in long day plants under unfavorable SD conditions. Ex: Niger.

D. Parthenocarpic fruits:

Gibberellins have been found to be more effective than auxins in causing parthenocarpic development of fruits in plants like tomatoes, apples, pears and stone fruits.

Gibberellin application promotes panicle exertion. Generally 30% of the panicle is covered by leaf sheath. Application of GA + Brassinosteroids is practically used in commercial seed production of Rice.

E. Breaking of dormancy:

Gibberellins are effective in breaking the dormancy in potato tubers and in tree buds in winter.

In potato the tubers remain dormant for weeks after harvest. However when GA is applied the buds sprout soon after the tubers are harvested. This will be useful to use the freshly harvested tuber for sowing. The seed material has to be dipped in 0.5 to 1.0 g of GA /lit of water.

ANNEXURE

Gibberellin has been shown to cause synthesis of amylase in barley aleurone cells. This enzyme converts starch to reducing sugars resulting in an increase of osmotic pressure, causing entry of water into the cells and cell enlargement. GA3 is also known to increase permeability of aleurone cells to sucrose. It increases the activity of membrane synthesizing enzymes. Synthesis of phospholipids is also increases due to GA application. The gearing up of all these metabolic activities results in cell elongation.

