Cytokinins are hormones with a structure close to adenine that play a central role in the regulation of the plant cell cycle and numerous developmental processes.

Cytokinins are present in all plant tissues. They are abundant in the root tip, the shoot apex and immature seeds.

Cytokinin transport: Cytokinins from the root are transported to the shoot via the xylem. Root apical meristems are major sites of synthesis of the free cytokinins in whole plants. The cytokinins synthesized in roots appear to move through the xylem into the shoot, along with the water and minerals taken up by the roots.

Discovery of cytokinin

The first common natural cytokinin identified was purified from immature maize kernels and named **zeatin.** Coconut milk contains substance/s that stimulate/s mature cells to enter and remain in cell division cycle. Coconut milk was shown to contain the cytokinin **zeatin.** Kinetin was the first artificial cytokinin to be discovered. Today there are more than 200 natural and synthetic cytokinins. Cytokinins occur in free form or in tRNA.

Physiological role:

1. **Promotion of cell division:** The major physiological role of naturally occurring cytokinins is to promote cell division. Exogenous applications of CKs induce cell division in tissue culture in the presence of auxin. Evidence showed that cytokinins are involved in the regulation of the cell cycle. They control the activity of cyclin-dependent kinases (CDKs).

2. **Control of Apical Dominance and lateral buds-release:** Cytokinins and auxin contribute to apical dominance through an antagonistic mechanism; Auxin restrains axillary bud growth causing the shoot to lengthen and Cytokinins (from the root) stimulate axillary bud growth.

3. **Cytokinins as anti-aging hormones**: Cytokinins can retard aging of some plant organs or delay leaf senescence, perhaps by inhibiting protein breakdown, stimulating RNA and protein synthesis, and mobilizing nutrients.

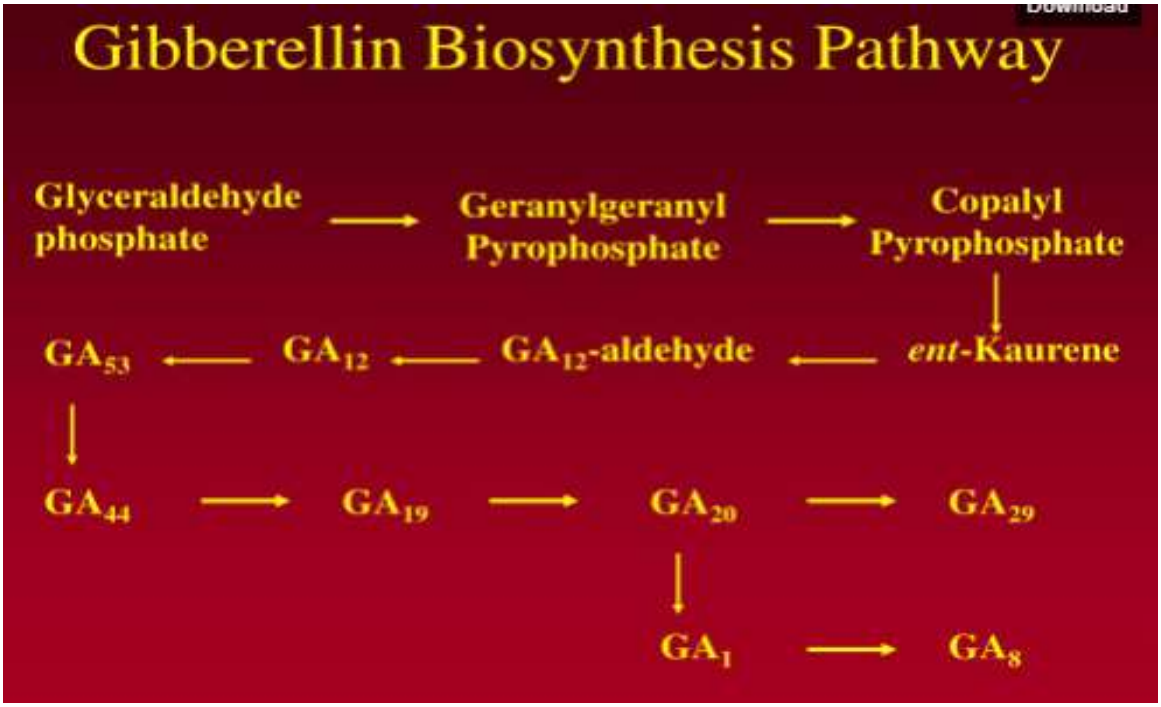
4. **Breaking the dormancy:** Cytokinins can stimulate germination and break dormancy.

5. **Promote Chloroplast maturation**: Promotes the conversion of etioplasts into chloroplasts via stimulation of chlorophyll synthesis (Etioplasts are photosynthetically inactive plastids that accumulate when light levels are too low for chloroplast maturation) .

6. **Stimulates morphogenesis** Cytokinins play a vital role in the morphpgenins in plants (shoot initiation/bud formation) in tissue culture.

Gibberellins

Gibberillic acid discovered as a fungal compound that enhances rice growth but reduce seed production—"folish seedling disease infected by fungi *Gibberella fukikuori*. Later on similar compounds were identified in plants and defined as a growth hormone with many functions such as promoting stem growth, seed germination, flowering etc. Now over 125 members exist. While the most widely available compound is GA3 or gibberellic acid, the most important in plants is GA1, which is the GA primarily responsible for stem elongation.



Transport:

GAs are probably transported in the phloem and xylem. It moves from one part to the other in the phloem similar to the transport of carbohydrates and other substances.

Physiological role:

1. **Stem elongation:** The most important effect of gibberellins is elongation of stem and leaf sheaths in intact plants. Lack of gibberellins causes shortening of internodes and reduced height. It has been observed in several plants like, Pea, bean cucumber, lettuce, pepper, cabbage, etc. The elongation of stem results due to cell division and cell elongation induced by gibberellins.

2. **Reversal of dwarfism:** One of the most prominent effects of gibberellins is the elongation of genetically dwarf (mutant) varieties of plants like corn and pea. It is believed that dwarfism (shortening of internodes and reduced height) in mutant a variety of plants is due to the absence of endogenous gibberellins or presence of

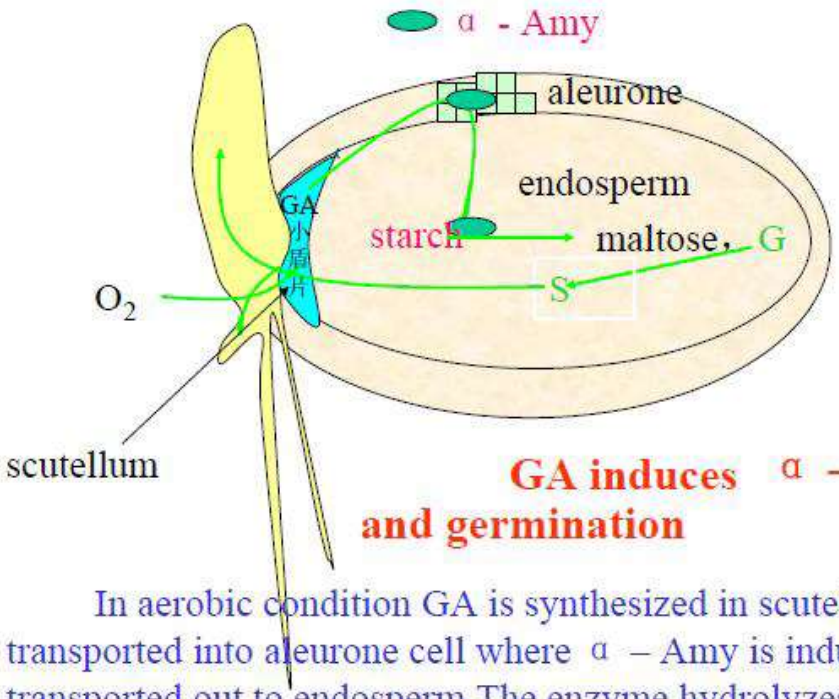
natural inhibitors. When the gibberellins are applied exogenously, the dwarf plants show rapid elongation of internodes and normal growth.

3. **Bolting** (rapid growth of floral stems, which elevates flowers) in long day plants. GAs causes stem elongation in response to long days. Usually such plants require specific long day photoperiods or specific cold requirements to bolt and flower. The rosette habit is due to the deficiency of gibberellins which inhibit cell division at sub-apical meristem and stem remains very short at internodes. If such plants are treated with gibberellins during condition of rosette growth, the plants bolt and flower.

4. **Induction of maleness in dioecious flowers.**

5. **Fruit setting and growth**: This can be induced by exogenous applications in some fruit (e.g., grapes).

6. Seed germination:



In aerobic condition GA is synthesized in scutellum and transported into aleurone cell where α – Amy is induced and transported out to endosperm. The enzyme hydrolyzes starch into maltose and then glucose and sucrose which is transported into embryo for seedling growth.