GIBBERELLIN

Physiological Roles

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PLANT HORMONE

Phytohormones

- Organic compounds produced in low concentrations
- Produced in one part of plant (i.e. source)
- Transported to another part of plant (i.e. target)
- Cause physiological or developmental responses (stimulatory or inhibitory)

Also called as " plant growth regulators "

Types Of Plant Hormones

Major types of plant hormones:

- Auxins
- Cytokinins
- Gibberellins
- Ethylene
- Abscisic acid

Gibberella fujikuroi

***Gibberella fujikuroi* is a fungal plant pathogen. It causes bakanae disease in rice seedlings, by overloading them with the phytohormone gibberellin as its own metabolic byproduct.**

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Gibberellin was first recognized in 1926 by a Japanese scientist, Eiichi Kurosawa, studying bakanae, the "foolish seedling" disease in rice. It was first isolated in 1935 by Teijiro Yabuta and Sumuki, from fungal strains (*Gibberella fujikuroi*) provided by Kurosawa. Yabuta named the isolate as gibberellin.

- **There are 126 compounds belonging to the class of Gibberellins have been isolated from a wide variety of plants (24 occur in *Gibberella fujikuroi* and 101 in other higher plants)**
- **They are found in all parts of the plant body**
- **Highest concentrations of gibberellins are found in developing seeds**
- **Different gibberellins differ in structure and biological activity**

“Foolish seedling disease” in rice

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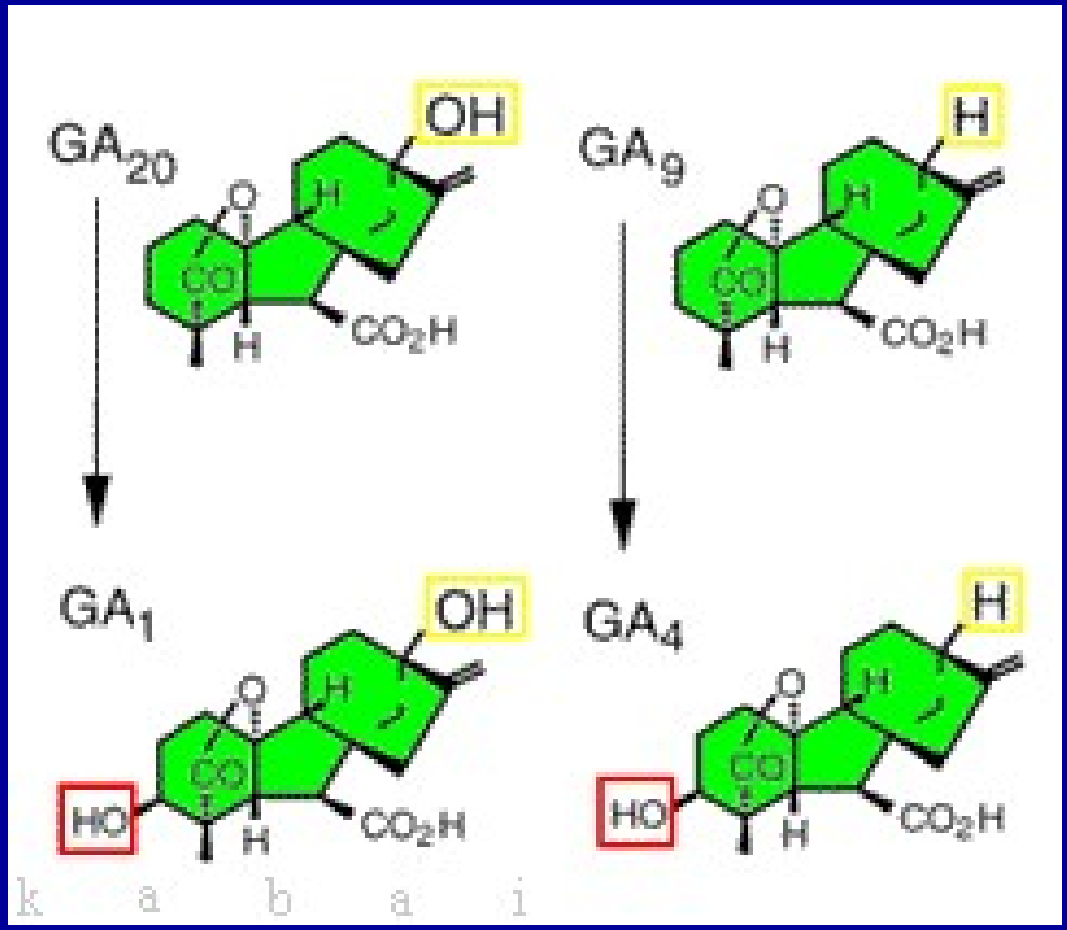
- All known gibberellins are diterpenoid acids that are synthesized by the terpenoid pathway in plastids and then modified in the endoplasmic reticulum and cytosol until they reach their biologically-active form.
- All gibberellins are derived via the ent-gibberellane skeleton, but are synthesised via ent-kaurene.
- The gibberellins are named GA_1 through GAn in order of discovery.
- Gibberellic acid, which was the first gibberellin to be structurally characterized, is GA_3.
- As of 2003, there were 126 GAs identified from plants, fungi, and bacteria

- **Gibberellins are tetracyclic diterpene acids.**
- **There are two classes based on the presence of either 19 or 20 carbons.**
- **The 19-carbon gibberellins, such as gibberellic acid, have lost carbon 20 and, in place, possess a five-member lactone bridge that links carbons 4 and 10.**
- **The 19-carbon forms are, in general, the biologically active forms of gibberellins.**
- **Hydroxylation also has a great effect : In general, the most biologically active compounds are dihydroxylated gibberellins, which possess hydroxyl groups on both carbon 3 and carbon 13.**
- **Gibberellic acid is a dihydroxylated gibberellin.**



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PHYSIOLOGICAL EFFECT AND MECHANISM OF ACTION OF GIBBERELLIN

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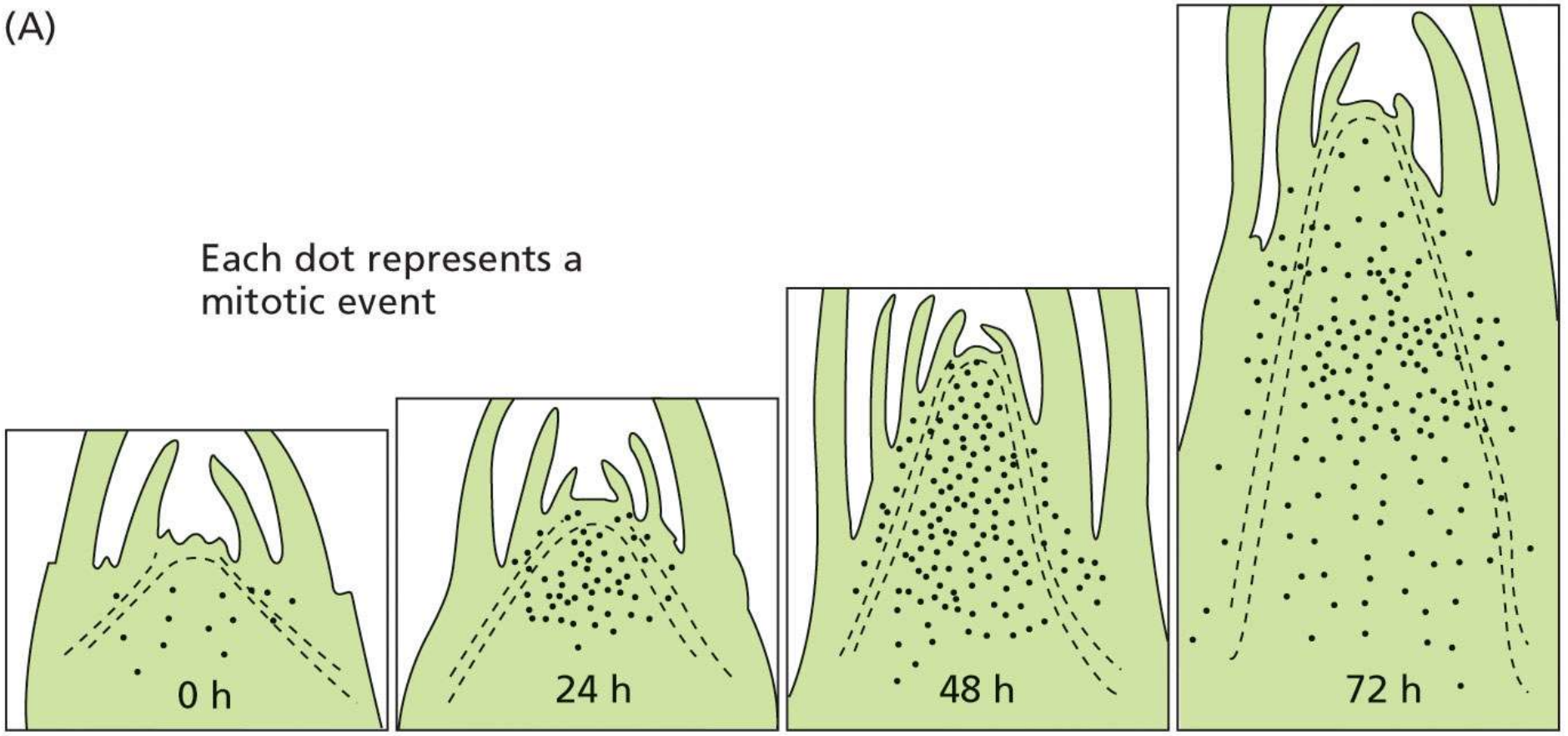
1. Gibberellins are phytohormone that have specific capabilities to spur the growth of intact plants in many species, especially in plants that are stunted in the rosette stage.

DISTRIBUTION OF CELL DIVISION FOLLOWING GA TREATMENT OF A ROSETTE PLANT, *Samolus parviflorus*



Distribution of cell division following application of GA

2. Genetic dwarfism

Genetic dwarf dwarfism is a symptom caused by the mutation. This phenomenon is visible from the shortened internode. Against this genetic dwarfism, gibberellin is able to change a dwarf plant high. GA1 Is the Biologically Active Gibberellin Controlling Stem Growth

GA synthesis mutants

Pea *na* mutant: dwarf

ent-kaurene ⟶ GA12 aldehyde

Pea *le* mutant: dwarf

exogenous GA1 ⟶ tall

exogenous GA20 ⟶ no response

cloned *Le* gene: 3β hydroxylase

GA20 ⟶ GA1

GA_1 LEVELS CORRELATE WITH INTERNODE LENGTH

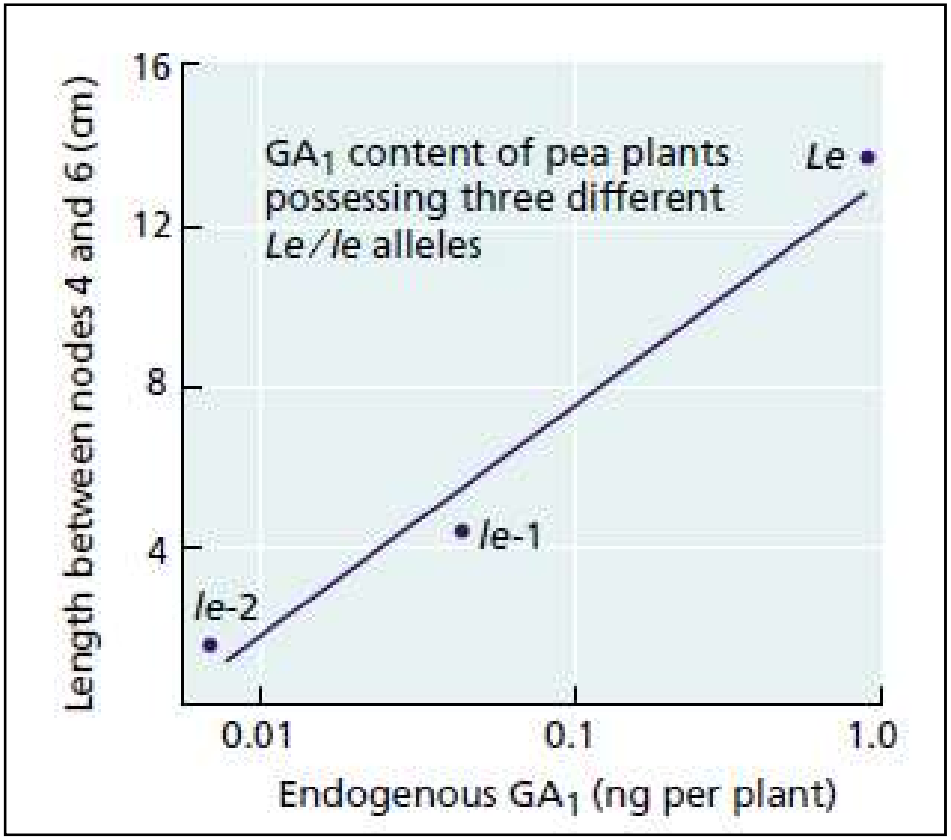
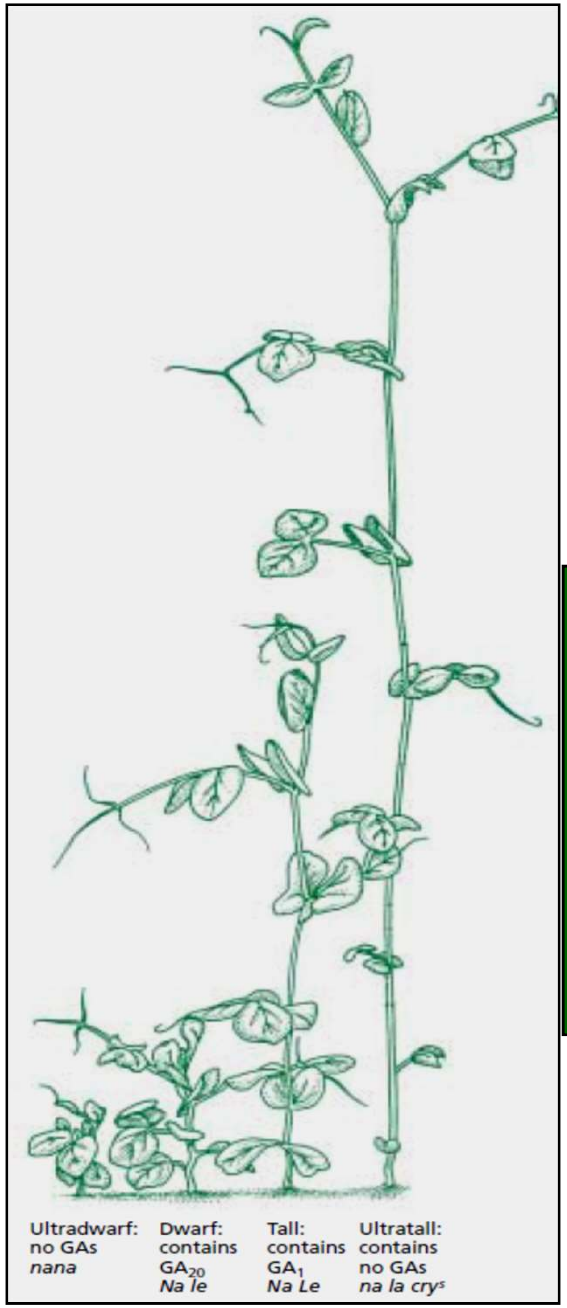


FIGURE 20.9 Stem elongation corresponds closely to the level of GA_1. Here the GA_1 content in peas with three different alleles at the *Le* locus is plotted against the internode elongation in plants with those alleles. The allele *le*-2 is a more intense dwarfing allele of *Le* than is the regular *le*-1 allele. There is a close correlation between the GA level and internode elongation. (After Ross et al. 1989.)



Phenotypes and genotypes of peas that differ in the gibberellin content of their vegetative tissue. (All alleles are homozygous.) (After Davies 1995.)

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Genetically Engineered Dwarf Wheat Plants Overexpressing GA 2-ox, which degrades GA_1
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Flowering

Hormones that play a role in flowering is often called florigen. According Chailakhian florigen complex consisting of gibberellins that contribute to stem formation and growth, and contribute to the formation of flowers. This is evidenced by the long-day plants, which can be flowering in short day conditions, but can be stimulated by giving sort of gibberellin acid.

Parthenocarphy

Cloro research results in 1965, turned out kind of wine cluster dipping Delaware at the time before flowering (pre-bloom) and after flowering (post-bloom) in a solution of GA3 can produce berries as much as 88-96% that do not have seeds.

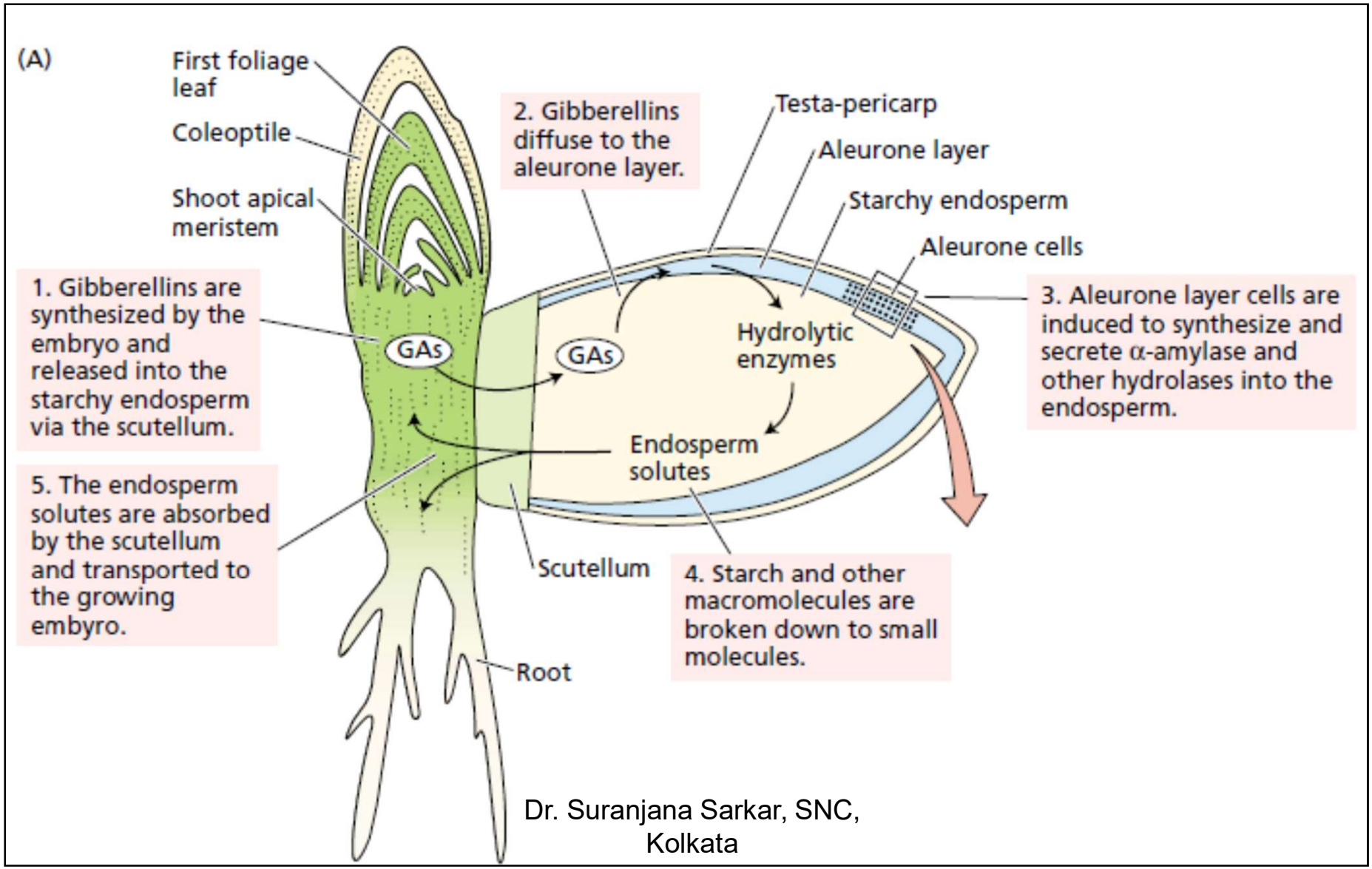
Breaking of Dormancy

The role of gibberellins in breaking seed dormancy through increased synthesis enyim-hydrolytic enzymes, will change the starch into sugar and produce useful energy for cell activity in growth.

Mechanism of action of gibberellin

The study with barley seeds showed that embryos of barley provides a phytohormone namely gibberellin acid that diffuses to the aleurone layer, and the spur phytohormone aleurone cells to make a hydrolytic enzyme (amylase, protease b glucase, phosphatase, etc.). Hydrolytic enzymes are then diffuses into the endosperm and the changing macro-molecules that are stored in the endosperm into sugars, amino acids, nucleotides, and others.

Gibberellin from the Embryo Induces α-Amylase Production by Aleurone Layers



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RECAP

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Physiological Roles of Gibberellins

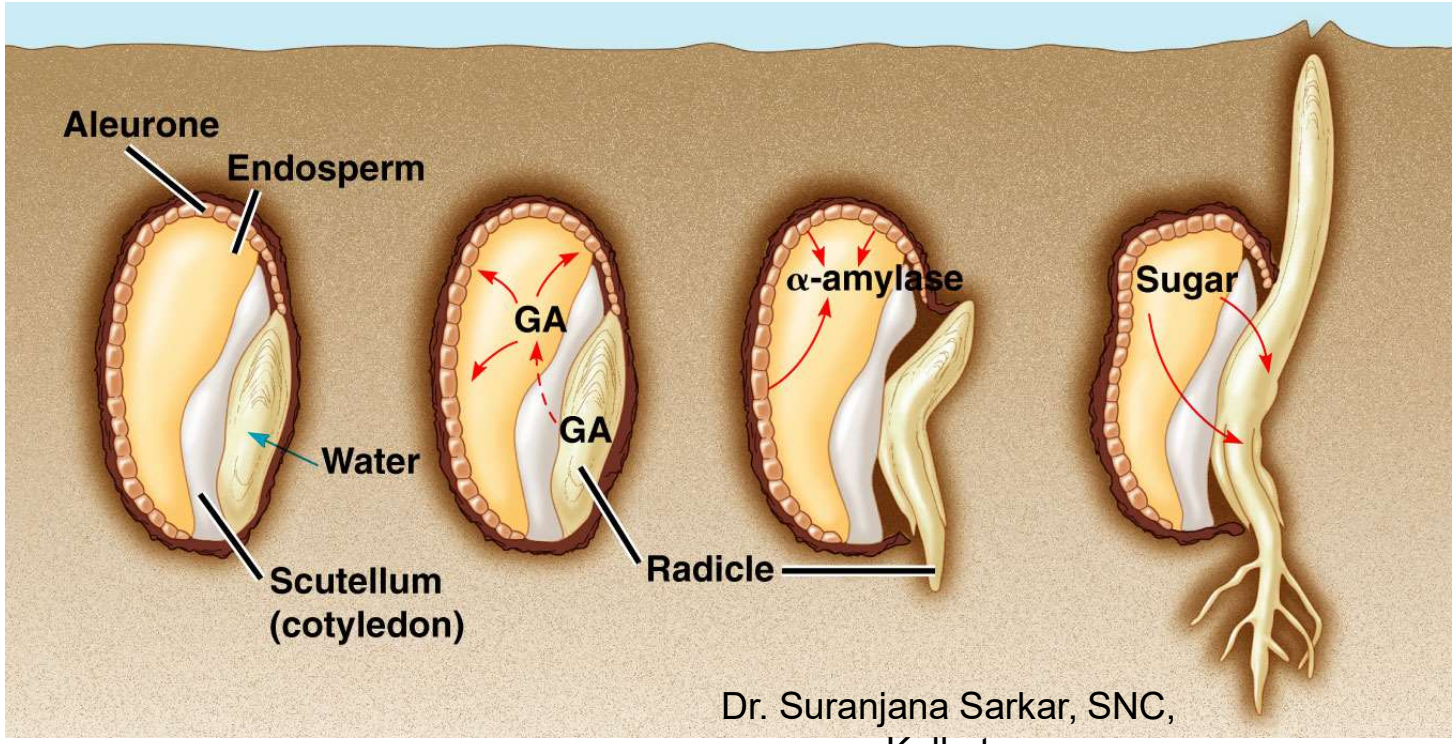
- **Seed Germination-Barley de novo amylase synthesis (Varner 1964)**
- **When applied externally, they can reverse the effect of certain dwarfing mutations**
- **Studies with such mutants have shown that although the application of mall gibberellins can cause this effect, they have to be converted to a particular form (gibberellin A1) before they can have any biological effect.**
- **Gibberellins can substitute for the dormancy breaking treatments (cold or light) in certain seeds like lettuce tobacco and wild oats.**
- **Gibberellins promotes in germination and radicle growth in malting barley seeds.**
- **External application of gibberellins can promote development of seedless fruits (parthenocarpy) in some species (e.g. Currants, apples cucumbers**
- **Flower induction**
- **Control of sex expression**
- **Delays Senescence**

Gibberellins

1) Function in seed germination

- Embryo releases gibberellins

- Causes aleurone layer (in seed coat) to release enzymes (alpha-amylase): break down starch in endosperm to sugars (e.g., maltose)



E.g., germination of barley (beer production)

Gibberellins

2) Fruit development

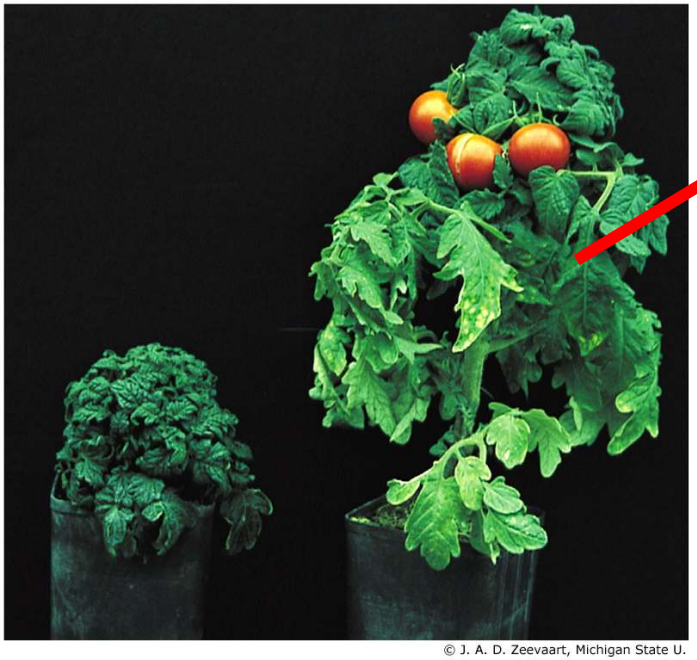
Seedless fruit crops (e.g., grapes) may be artificially sprayed with gibberellins - make fruits bigger

Gibberellins

3) Stem growth (elongation)

Induce “bolting”

- elongation of flowering stem of some plants



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Rice leaf sheath bioassay for gibberellin

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GA inhibitors

Inhibit ent-kaurene synthesis

- AMO1618
- Cycocel

Inhibit ent-kaurene oxidation

- Paclobutrazol
- Uniconazol
- Ancymidol
- Tetcyclasis

Inhibit later steps by dioxygenases

- Bx-1112
- LAB1988999


Thank You