

Physiological Dynamics in Animals & Plants – Lecture 12 – Plant hormones/growth regulators

- I. There are five major classes of plant hormones: auxin, gibberellins, cytokinins, abscisic acid, and ethylene.
 - A. Other plant hormones have been discovered more recently: brassinosteroids, salicylic acid, jasmonic acid, and systemin.
- II. Auxin was the first growth hormone to be discovered in plants.
 - A. Required for plant viability.
 - B. The principal auxin in plants is IAA (indole-3-acetic acid)
 1. IAA is synthesized from tryptophan through multiple pathways.
 2. “Synthetic” auxins include: indole-3-butyric acid (IBA), 2,4-dichlorophenoxyacetic acid (2,4-D), and α -naphthalene acetic acid (α -NAA).
 - C. Auxin moves from the apex to the base of a stem or root.
 - D. Physiological effects of auxin
 1. Cell elongation, e.g. in *Avena* (oat) is stimulated by auxin (Fritz Went)
 - a. The acid-growth hypothesis of Rayle and Cleland - auxin \rightarrow
 - \rightarrow proton extrusion
 - \rightarrow activates expansin
 - \rightarrow “relaxes” cell wall
 - \rightarrow reduces turgor
 - \rightarrow reduces water potential of cell
 - \rightarrow draws in water for cell growth (volume increase)
 2. Inhibition of lateral bud formation (apical dominance)

III. Gibberellins promote shoot elongation and are involved in seed germination

- A. Structure of gibberellins
- B. Shoot elongation in intact plants
- C. Promote “bolting” and overcome dwarfism
- D. Induce enzymes and hormone synthesis during grass seed germination
 - 1. $H_2O \rightarrow$
 - \rightarrow embryo
 - $\rightarrow GA_3$
 - \rightarrow aleurone layer
 - \rightarrow hydrolytic enzymes (α -amylase, β -amylase, proteases, RNase, phosphatases)
 - \rightarrow endosperm
 - \rightarrow carbohydrates, cytokinin, and tryptophan (which becomes IAA)
- E. Promotes flowering in “long-day” plants
- F. Overcomes bud dormancy (antagonizes ABA)
- G. Inhibits organ formation
- H. Causes precocious flowering of trees

IV. Cytokinins stimulate cell division

- A. Structure of cytokinins (kinetin, zeatin); natural components of tRNA
- B. Along with auxin, promote cell division and regulate plant cell cycle
- C. Promote cell enlargement

- D. Along with auxin, promote organ formation
 - E. Release “apical dominance”
 - F. Prevent leaf senescence
 - G. Cause mobilization of nutrients
- V. Abscisic acid (ABA)
- A. Structure of ABA
 - B. Promotes bud dormancy (antagonist of gibberellin)
 - C. Involved in abscission?
 - D. Causes stomata to close/prevents stomatal opening
 - E. Can control embryonic development in conjunction with cytokinins and gibberellins
- V. Ethylene promotes fruit ripening and leaf senescence and is involved in some growth processes.
- A. Biosynthetic pathway is simple
 - B. In some tissues, ethylene synthesis is promoted by auxin
 - C. Involved in leaf senescence and abscission
 - D. Promotes fruit ripening
 - E. Involved in geotropism and epinasty