

PLANT PHYSIOLOGY Lecture 23 - Plant Growth Regulation

- I. Terminology and classification
 - A. Plant growth regulator - broad category of organic substances that, in minute amounts, promote, inhibit, or otherwise modify physiological processes.
 - B. Other terms - plant hormones, phytohormones, plant growth substances, and plant growth regulators
 - 1. PGRs - usually a broad term encompassing plant hormones
 - C. Classes of PGRs (more specifically, plant hormones)
 - 1. Auxins (IAA, NAA) - cell enlargement (with cell-wall modification)
 - 2. Gibberellins (GA) - cell enlargement (less cell-wall modification)
 - 3. Cytokinins (Kinetin, BA) - cell division
 - 4. Growth inhibitors (ABA) - leaf abscission & fruit drop
 - 5. Ethylene (ethylene) - senescence & ripening
- II. Actions of the five plant hormones
 - A. Auxins (found in meristematic tissue) - from tryptophan or α -keto transamination
 - 1. Mechanism: IAA - cell-wall softening - extension - membrane RNA synthesis - cell-wall enzymes - new wall material - elongation
 - 2. Auxin moves to the cells on the lower side of a horizontal organ, stimulating cell elongation and curvature
 - 3. Actions of auxin
 - a) Apical dominance mediated by auxin
 - b) Auxin inhibits axillary buds
 - c) Auxin stimulates adventitious roots
 - d) Induction of seedless fruits by auxin (parthenocarpy)
 - e) High concentrations can lead to distortion - retardation
 - B. Gibberellins (found in fruit seeds, buds, young leaves, root tips) - from mevalonic acid (isoprene units)
 - 1. Mechanism can be synergistic - works with auxin in cell elongation
 - 2. Stimulates internode elongation
 - 3. Can assist germination, sprouting, and flowering
 - 4. Can stimulate fruit set as well as parthenocarpy
 - C. Cytokinins (found in developing fruits and seeds) - from mevalonic acid (isoprene units)
 - 1. Mechanism is generally cell division ("cytokinesis")
 - 2. With auxin, cytokinin aids growth AND differentiation of tissue culture
 - a) High IAA / low kinetin = callus; Low IAA / high kinetin = shoot
 - b) Parenchyma cells are generally used for tissue culture
 - 3. Responses to cytokinin include shoot initiation, leaf enlargement, lateral bud growth, adventitious root formation, delay of senescence, and stimulation of germination
 - D. Growth inhibitors - abscisic acid - (located near abscission layers) - from degradation of carotenoids (which are synthesized via MVA)
 - 1. Mechanism: increased RNA - enzymes - pectin hydrolysis - cellulase - organ "drop"
 - 2. Also a stress hormone - ABA triggers stomatal closure
 - 3. Abscisic acid stimulates senescence (aging) and dehiscence (splitting)
 - 4. Can be used to shorten or retard plant growth
 - E. Ethylene (present throughout the plant and especially in stressed tissue and in ripe fruits) - from degradation of methionine
 - 1. Ethylene is a gas which promotes senescence
 - 2. Ethylene can be closely associated with auxin (With high 2,4-D, high ethylene....death)
 - 3. Associated with rapid senescence in diseased and injured tissues
 - 4. Can be used to increase girth in trees
 - 5. Increases fruit ripening
- III. Important point: the growth regulators exist and work together to regulate growth & development