III. Hormones

• Regulate growth & development (stimulate or repress).
• May act far from source.
• Potent.
• Often act in concert w/ (or in opposition to) others.

A. Auxins

1. Properties

IAA is main natural auxin:
1. Indol ring
2. Acetic acid side group.

2. Origin

Shoot apex; young seeds
A. Auxins

3. Transport

   a. Long distances:
      1) Phloem (mostly phloem parenchyma).
      2) Polar Transport (basipetal from shoot apex; active; 5-20 cm/hr).

   b. Short distances:
      1) Diffusion (1 cm/hr)


A. Auxins

4. Function

   a. Tropisms:
      1) Coleoptile experiment shows that auxin:
         1. made in tip.
         2. promotes cell elongation in shoot.
         3. has role in tropisms.

   b. Apical Dominance:
      1) Auxin inhibits axillary buds.
      2) Auxin gradient from shoot apex.
      3) Generally stronger in conifers.
      4) Experiment: cut off apex (then apply auxin).
A. Auxins
4. Function

c. Cell expansion/elongation:
1) Acidifies walls, makes them plastic.

d. Spring activation of vascular cambium & differentiation of phloem & xylem:

e. Adventitious roots:

f. Fruit development (from seeds):
1) Pericarp is typically sensitive.

A. Auxins
5. Commercial applications
(mostly via synthetics)

a. Some seedless fruits:
1) e.g., tomatoes

b. Orchard fruit ripening uniformity/delaying drop:

c. Rooting hormone:

E.g., propagation by cuttings in Gardenia (Coffee family)
d. Pruning and shaping of plants by manipulating apical dominance:

e. Herbicides:
1) Large amounts disrupt growth, defoliate, and kill plants. Further, synthetics not properly metabolized (degraded)
2) Include the broadleaf (dicot) herbicides 2,4-D & 2,4,5-T
3) 2,4,5-T now banned. Manufacture makes dioxins - v. toxic to animals.

-Agent orange = 1:1 mixture
-Use against Vietcong & N Vietnamese, 1961-1971
-Collateral damage:
  -Destroyed hardwood industry, forests, and mangroves
  -Birth defects, Cancer, etc., etc. due to 2,4,5-T.
B. Gibberellins (Gibberellic Acid)

1. Properties

First isolated from Gibberella fujikori in study of “foolish seedling disease” of rice.

2. Origin

Young tissues of shoot & seeds.

3. Transport

a. Long-distance: xylem & phloem

4. Function

a. Stem elongation (via cell division & elongation)
b. Bolting
B. Gibberellins (Gibberellic Acid)
   4. Function
      c. Seed dormancy break (mobilizes enzyme involved in starch breakdown).

5. Commercial apps
   a. Sugar cane production
      - GA application can increase this.
   b. Grapes
      - enlargement of seedless grapes
      - looser clusters
   c. GA synthesis blockers
      - dwarfing of plants in horticulture.
C. Cytokinins
1. Properties

C. Cytokinins
2. Origin

Root apex (& radicle of germinating seed)

C. Cytokinins
3. Transport

a. Long-dist. (xylem, phloem)

b. Short-dist. (diffusion)

C. Cytokinins
4. Function

a. Cell division (with auxin)
   -auxin w/o CK = cell enlargement but no ÷
Cytokinin: Function

4. Function

b. Negative regulator of apical dominance (auxin/ck ratio determines dormancy or break of buds; application to lateral buds can cause them to break)

c. Adventitious shoots/roots

Auxin/CK High (e.g., stem cutting):
parenchyma diff. into roots.

Auxin/CK low (e.g., decapitated root):
parenchyma diff. into shoots

5. Commercial apps

a. Tissue culture (w/ auxins)

Auxin = CK (undiff. growth)
Auxin > CK (roots diff.)
Auxin < CK (shoots diff.)

b. Delay of leaf senescence in bioengineered tobacco.

Tobacco that maintains elevated CK longer delays leaf senescence.