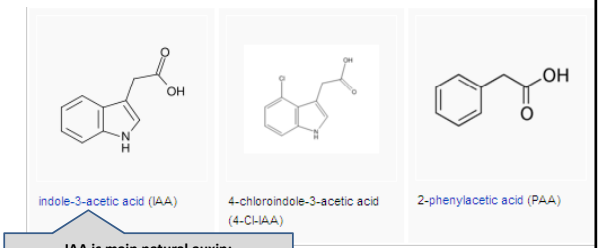
Topic 11
Hormones &
Tropisms

Stern, 12 ed., Chapter 11.

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.

A. Auxins
2. Origin

Shoot apex; young seeds

A. Auxins
3. Transport

a. Long distances:

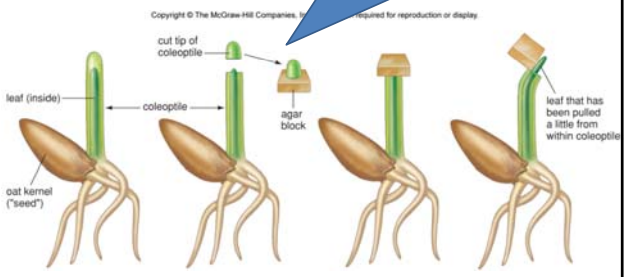
1) Phloem (mostly phloem parenchyma).
2) Polar Transport (basipetal from shoot apex; active; 5-20 cm/hr).

b. Short distances:

1) Diffusion (1 cm/hr)

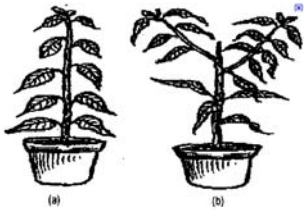
A. Auxins
4. Function
a. Tropisms:

Coleoptile experiment shows that auxin….
1. made in tip.
2. promotes cell elongation in shoot.
3. has role in tropisms.



A. Auxins
4. Function
b. Apical Dominance:

1) Auxin iInhibits axillary buds.
2) Auxin gradient from shoot apex.
2) Generally stronger in conifers.
3) Experiment: cut off apex (then apply auxin).



Generally stronger in conifers than dicots

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:

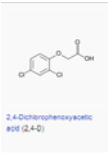
c. Rooting hormone:

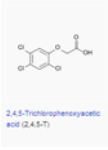
e.g., propagation by cuttings in *Gardenia* (Coffee family)

d. Pruning and shaping of plants by manipulating apical dominance:

e. Herbicides:

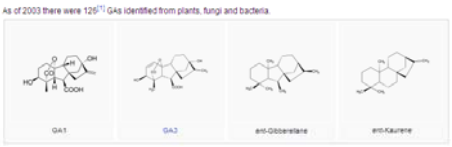
1) Large amounts disrupt growth, defoliate, and kill plants. Further, synthetics not properly metabolized (degraded)
2) Include the broadleaf (dicot) herbicides 2,4-D & 2,4,5-T
3) 2,4,5-T now banned. Manufacture makes dioxins - v. toxic to animals.





-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 fujikoroi* in study of "foolish seedling disease" of rice.

B. Gibberellins (Gibberellic Acid)
2. Origin

Young tissues of shoot & seeds.

B. Gibberellins (Gibberellic Acid)
3. Transport

a. Long-distance: xylem & phloem

b. Short-distance: diffusion.

B. Gibberellins (Gibberellic Acid)
4. Function

a. Stem elongation (via cell division & elongation)
b. Bolting

Effects of GA on Cabbage
(*Brassica oleracea*; mustard family)

B. Gibberellins (Gibberellic Acid)

4. Function

c. Seed dormancy break (mobilizes enzyme involved in starch breakdown).

5. Commercial apps

a. Sugar cane production

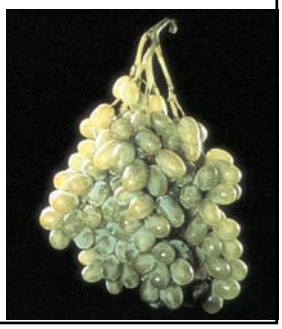
-GA application can increase this.

5. Commercial apps

b. Grapes

-enlargement of seedless grapes

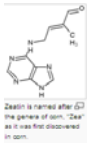
-looser clusters



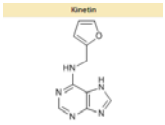
c. GA synthesis blockers

-dwarfing of plants in horticulture.

C. Cytokinins
1. Properties



Zeatin is named after the genera of corn, "Zea" as it was first discovered in corn.



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 ÷

C. Cytokinins
4. Function

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

C. Cytokinins
4. Function

c. Adventitious shoots/roots

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

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

C. Cytokinins
5. Commercial apps

a. Tissue culture (w/ auxins)

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

C. Cytokinins
5. Commercial apps

b. Delay of leaf senescence in bioengineered tobacco.

Tobacco that maintains elevated CK longer delays leaf senescence.

D. Ethylene

1. Properties

C_2H_4

gaseous

D. Ethylene

2. Origin

a. Made in most tissues, especially during stress (wounding), senescence, fruit ripening.

b. Formation requires O_2.

D. Ethylene

3. Transport

Diffusion.

D. Ethylene

4. Function

a. Fruit ripening

e.g., apples, bananas, avocados
but not grapes.

b. Leaf senescence

Ethylene regulates abscission.

D. Ethylene

5. Commercial application

a. Released by burning of fuels (such as kerosene or natural gas)

-therefore, these can be used to hasten fruit ripening.

-therefore, greenhouse growers should be wary.

b. O_2 required for formation.

This can be used to keep fruits such as apples year round.