BI 103: Plant Responses: Tropism & Hormones

Announcements
1. Field trip: Sunday 1pm
2. Lab report: Germination experiment
   - Due: June 6th
   - Midterm Exam: next Friday!

Today:
- Lecture: Tropism & Hormones
- Activities: Seasonal hormone graphs
- Film: Private Life of Plants

Tropism
- from Greek: trope “to turn”
- Plants turn toward (positive) or against (negative) environmental stimuli
- Gravity, Light, Touch, Water

Tropism from Greek: trope “to turn”
Plants turn toward (positive) or against (negative) environmental stimuli
Gravity, Light, Touch, Water

Auxins
Made in:
- Apical meristem of shoot system.
- Move from tip downward.

Affects:
- Cell elongation

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<thead>
<tr>
<th>Hormone</th>
<th>Some Major Effects</th>
<th>Major Sites of Synthesis</th>
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<tbody>
<tr>
<td>Auxins</td>
<td>Hormone cell elongation is shown</td>
<td>Shoot apical meristem</td>
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<td>Positive growth of heteroblastic (shoot tip damaged)</td>
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<td>Positive root branching</td>
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<td>Cell enlargement and rapid expansion in shoots and roots</td>
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<td>Calcium Ions</td>
<td>Induced stem elongation by promoting cell division and cell elongation</td>
<td>Seed apical meristem</td>
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<td>Stimulates cell division and cell elongation</td>
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Auxin, produced in the shoot tip, is distributed evenly across the shoot and root as it travels downward. Auxin from the shoot tip travels down and collects in the root tip. (a) The shoot and root are oriented vertically. (b) The shoot and root are oriented horizontally.

AUXIN IS TRANSPORTED TO THE LOWER SIDE OF THE SHOOT, WHERE IT STIMULATES CELL ELONGATION AND CAUSES THE STEM TO BEND UPWARD.

AUXIN IS TRANSPORTED TO THE LOWER SIDE OF THE ROOT, WHERE IT INHIBITS CELL ELONGATION AND CAUSES THE ROOT TO BEND DOWNWARD.
Auxin and Elongation

Cut tip off, no growth

Place agar on cut shoot, it grows like normal

Cut tip on agar block, auxin diffuses into agar

Auxins

Made in:
Apical meristem of shoot system.
Move from tip downward.
Affects:
Cell elongation
Apical dominance

Several Forms:
Indoleacetic acid (IAA)
Phenylacetic acid (PAA)
4-chloroindoleacetic acid (4-chloroIAA)
Indolebutyric acid (IBA)

Auxins

Made in:
Apical meristem of shoot system.
Move from tip downward.
Affects:
Cell elongation
Apical dominance
Lateral root development—adventitious roots
Development of vascular tissue
Fruit development
Retards senescence in leaves & fruits
Tropisms

Several Forms:
Indoleacetic acid (IAA)
Phenylacetic acid (PAA)
4-chloroindoleacetic acid (4-chloroIAA)
Indolebutyric acid (IBA)

Phototropism

Auxin migrates away from light, and accumulates in greater amounts on opposite side, promoting greater elongation of cells on dark side.
Phototropism and Auxin Continued

Asymmetric distribution of auxin causes cell elongation!

Gravitropism

Gravity may be perceived by statoliths (aka amyloplasts) in root cap

Amyloplasts: organelles in plant cells which synthesize starch & store it

Q: Where might amyloplasts be in the root?

Growth Responses - Gravity

Statoliths: specialized amyloplasts with lots of dense starch

Time: 0 hr

Time: 1 hr

Cytokinins

Made in: roots

Affects:
lateral shoot growth
Stimulates embryo development
Development of chloroplasts
Stimulation of the onset of fruits
Stimulate plant metabolism
Delays the aging of plant parts especially leaves

Apical Dominance: the maintenance of a single top

Gibberellins

Made in:
- shoot apical meristem
- young leaves
- embryos

Affects:
Germination
Sprouting of buds-responsible for ‘bolting’
Elongation of stems & leaves
Stimulates flowering
Affects the development of fruit
Gibberellins (commercial uses)
- Stem growth enhancer (e.g., rice, cotton)
- Fruit growth enhancer (e.g., apples, pears, grapes)
  - Gibberelin spray for grapes

Gibberellins and Germination
- Water moves into seed
- Embryo releases gibberelin
- Aleurone cells release amylase
  - Amylase digest starch into sugar
  - Sugar fuels growth!

Abscistic Acid
- Synthesized throughout plant body especially when stressed
  - Affects:
    - Promotes seed & bud dormancy
    - Reduces lateral root formation
    - Closes stomata

Ethylene
- Made in: throughout the plant
  - Affects:
    - Ripening of fruits
    - Maturation of flowers
    - Scenecense of fruits & leaves
    - Thigmotropism

Ethylene and Thigmotropism
- Where plant touches object, ethylene inhibits cell elongation (auxin).
- Cells not touching object grow normally, causing bending around object.

Growth Responses - Touch
- Thigmotropism – movement in response to touch
Florigens: Stimulates flowering

- Synthesized in mature leaves: information sent to apical buds.
- Activity of hormone strongly associated with day length.
- Why?

Flowering

- Night interrupted by light! (red)
  - Both act as if short night
- Light followed by night again (dark red)
  - Both act as if long night

Photoperiodism

- Biological response to length of day and night
  - Phytochrome – pigment that detects light
- Circadian cycles (24 hours) are biological clocks
  - Helps tell plants when to do things