

**KNOWLEDGE EXPECTATIONS FOR PEST CONTROL ADVISERS:
PLANT GROWTH REGULATORS**

1. Be familiar with the general uses and classification of the following plant growth regulators:
 - a. Auxins:
 - i. 1-naphthalenacetic acid (NAA)
 - ii. 2,4-D
 - iii. 3-indoleacetaldehyde acid (IAld)
 - iv. 3-indoleacetic acid (IAA)
 - v. 3-indolepyruvic acid (IPA)
 - vi. indolebutanoic acid (IBA)
 - b. Gibberellins (GA):
 - i. GA₄GA₇
 - ii. GA₃
 - c. Cytokinins:
 - i. CPPU
 - ii. kinetin
 - d. Ethylene/Ethylene releasers
 - i. ethephon
 - ii. ethylene
 - e. Inhibitors/Retardants:
 - i. abscisic acid (ABA)
 - ii. ancymidol
 - iii. carbaryl
 - iv. chlormequat
 - v. chloro IPC
 - vi. daminozide
 - vii. flurprimidol
 - viii. hydrogen cyanamide (H₂CN₂)
 - ix. mefluidide
 - x. mepiquat chloride
 - xi. paclobutrozol
 - xii. prohexadione calcium
 - xiii. succinic acid (SADH)

I. PLANT GROWTH REGULATORS

1. Define plant growth regulator.
2. List the common classes of plant growth regulators. (auxins, gibberellins, cytokinins, growth retardants/inhibitors, ethylene, others)
3. List the plant growth regulators that play a major role in:
 - a. abscission;
 - b. dormancy;
 - c. fruit abscission;
 - d. fruit ripening;
 - e. fruit set;

- f. leaf expansion [ethylene];
 - g. plant senescence;
 - h. root initiation;
 - i. seed germination;
 - j. stem elongation.
4. Recognize that plant growth regulators can act at low concentrations.
 5. Recognize that plant growth regulators can have undesirable effects when applied at improper rates or times.
 6. Describe how environmental conditions, the plant developmental stage, and plant condition (e.g., stress, fruit load), on their own or in combination, can affect the activity of plant growth regulators.
 7. Compare/contrast the ability of a plant growth regulator or plant hormone to stimulate growth and retard growth in different situations.
 8. Differentiate between a plant growth regulator and a plant hormone (plant growth substance).
 9. Define:
 - a. plant hormone;
 - b. abscisic acid (ABA).
 10. List the "classical" five naturally occurring plant hormone groups. (auxins, cytokinins, ethylene, the gibberellins, abscisic acid)
 11. Describe how each type of plant growth regulator affects:
 - a. seed dormancy;
 - b. seed growth;
 - c. vegetative growth;
 - d. flower and fruit growth;
 - e. organ abscission.
 12. Describe the primary physiological processes in plants that are regulated by:
 - a. auxins;
 - b. cytokinins;
 - c. ethylene;
 - d. gibberellins;
 - e. growth retardants/inhibitors.
 13. Recognize that plant growth regulators interact with other organic compounds (hormones and other growth regulating substances) in plants.

- **Auxins**

14. Define:
 - a. auxin;
 - b. 3-indoleacetic acid (IAA).
15. Describe the effect of auxins on plant growth.
16. List the primary uses of auxins as plant growth regulators and identify the crops on which they are used. (Reduces fruit drop, increases fruit drop, delays maturation, blossom thinning agent, sets fruit, enhances adventitious root formation, delays color development)

17. List the auxins contained in plant tissues. [3-indoleacetic acid (IAA), 3-indoleacetaldehyde (IAld), 3-indolepyruvic acid (IPA), 3-indoleacetoneitrile (IAN), ethyl ester of indoleacetic acid (IAE)]
 18. Describe the effect of auxin on ethylene and how leaf sensitivity changes as leaves age. [Younger leaves are less sensitive to ethylene than older leaves due in part to higher auxin levels in younger leaves.]
 19. Recognize that auxins are also used as herbicides and give an example.
- **Gibberellins**
 20. Define gibberellins (GA).
 21. Describe the effect of gibberellin on plant growth.
 22. List the primary uses of gibberellins as plant growth regulators and identify the crops on which they are used. (cell elongation, cell division, overcoming dormancy, overcoming or breaking bud dormancy, increases or reduces fruit set, affects fruit shape, fruit maturation, delay of flowering in fruit trees, stimulates flowering and bolting in biennials, delays senescence)
 23. Describe how gibberellins stimulate plants to overcome dormancy.
 24. Recognize that there are over 100 different chemical structures of gibberellins but only a few are used commercially.
 25. Compare/contrast GA₃ and GA₄GA₇.
 26. Identify the primary gibberellins used.
 27. Identify the primary crop and use of GA₄GA₇.
 28. Identify the primary use of GA₃ in citrus.
 - **Cytokinins**
 29. Define cytokinins.
 30. Describe the effects of cytokinins on plant growth.
 - **Ethylene and ethylene releasers**
 31. Define ethylene.
 32. Recognize that ethylene is a gas.
 33. Understand the relationship of ethephon to ethylene.
 34. Describe the effect of ethylene and ethephon on plant growth.
 35. List the primary uses of ethylene and ethephon for the crops on which they are used.
 - a. citrus (fruit elimination, thinning agent, and postharvest degreening of fruit)
 - b. cotton (increases lint strength, hybrid seed production, and boll opening)
 - c. grain crops (induces fruit ripening, induces flowering, accelerates fruit and leaf abscission, promotes lateral branching, promotes shortened stems)
 - d. pome fruit trees
 - e. tomato and table grapes (advances ripening and accelerates pigment development or color accumulation)
 - f. walnuts
 - **Growth retardants and inhibitors**
 36. Define plant growth inhibitor (retardant).

37. List the materials that are primarily used as growth retardants and inhibitors, identify the crops on which they are used, and describe how they inhibit plant growth. (paclobutrazol, flurprimidol, prohexadione calcium, ancymidol, chlormequat, mepiquat chloride, mefluidide, AVG–aminoethoxyvinylglycine) [AVG is used on apples—delays fruit maturity to reduce preharvest fruit drop and improved fruit quality; pears—help maintain fruit firmness; and ornamentals—reduce flower senescence and flower bud abscission during shipping]
38. Describe the use of carbaryl as a plant growth regulator.

II. PLANT GROWTH CONCEPTS

1. Define:
 - a. abscission;
 - b. apical dominance;
 - c. apical meristem;
 - d. bioassay;
 - e. cambium;
 - f. cultivars;
 - g. dormancy;
 - h. endogenous;
 - i. locules;
 - j. meristem;
 - k. parthenocarpy;
 - l. phenotypic;
 - m. phloem;
 - n. rachis;
 - o. rest period;
 - p. senescence;
 - q. xylem.

III. APPLICATION TECHNOLOGY

1. Define the following terms and describe their importance when using plant growth regulators:
 - a. calibration;
 - b. parts per million.
2. Describe the relationship between dosage, volume and efficacy when applying plant growth regulators.
3. Describe the importance of the solution's pH when using plant growth regulators.
4. Describe how to determine the need for a surfactant when using plant growth regulators.
5. Describe how to avoid drift in the application of plant growth regulators.
6. Recognize that plant growth regulators can be incompatible with other chemicals when combined in a tank mix.
7. Describe how the following factors affect the appropriate dosage when using plant growth regulators:
 - a. humidity;
 - b. pH;

- c. plant growth stage;
 - d. plant condition (e.g., fruit load, water or disease stress);
 - e. rainfall;
 - f. sunlight;
 - g. temperature.
8. Recognize the importance of reading and understanding the language on the label of a plant growth regulator.
 9. Be able to interpret all terms and concepts on a plant growth regulator label.
 10. Recognize that specific hazards are associated with some formulations of the following plant growth regulators:
 - a. corrosive – ethephon;
 - b. flammable – ethephon, gibberellin;
 - c. eye injury – ethephon, gibberellin;
 - d. skin irritant, may be fatal if swallowed or through contact with skin – hydrogen cyanamide;
 - e. hazard to bees – carbaryl;
 - f. potential to drift and undesirably harm target and nontarget plants – all.