KNOWLEDGE EXPECTATIONS FOR PEST CONTROL ADVISERS:
DEFOLIATION AND OTHER HARVEST AID PRACTICES

I. INTRODUCTION

1. Define:
    a. defoliation;
    b. desiccation;
    c. harvest aid chemical.

A. The Purpose of Harvest Aids in California Cotton

1. List the reasons for using harvest aids.
2. List the advantages of manipulating harvest timing.
3. Describe how harvest aids sustain quality.

II. PHYSIOLOGICAL PROCESSES INVOLVED IN DEFOLIATION AND DESICCATION

1. Recognize that defoliation is a natural process.
2. Describe how the following plant hormones affect senescence and/or abscission:
    a. cytokinin;
    b. auxin;
    c. ethylene;
    d. abscisic acid.
3. Identify, on a cotton plant, the
    a. leaf abscission zone;
    b. petiole;
    c. leaf blade;
    d. main stem;
    e. vascular tissue.
4. Recognize where leaf abscission takes place on cotton.
5. Describe the differences between the leaf cuticle of an old leaf and a young leaf and how this affects the use of harvest aids.
6. Describe how plant water stress can affect penetration of harvest aid chemicals through the leaf cuticle.
7. Distinguish the difference in plant response to application of chemicals classified as defoliants versus desiccants.
8. List conditions that affect the rate and degree of natural defoliation occurring in late season cotton. [insects, leaf age, disease, water stress, fruit load, nitrogen level]

III. COTTON

1. Describe the crop cycle of cotton in California. (typical planting dates, plant growth regulator applications, primary flowering period timing, harvest dates)
2. Describe the stages of cotton growth and how long each takes.
3. Describe the approximate amount of time after flowering it takes a boll to
    a. reach final fiber length;

b. develop a high viability seed;
c. reach fiber maturity;
d. mature to a cracked, open, harvestable boll.

4. Describe how conditions during flowering and boll development can affect boll quality and maturation.
5. Describe how defoliant efficacy is impacted by the perennial nature of the cotton plant.
6. List some differences between growth habits and lint quality of California Upland/Acala and Pima varieties of cotton.
7. Define:
    a. boll;
    b. cracked boll;
    c. cutout;
    d. first-position boll;
    e. module;
    f. nodes above crack boll (NACB);
    g. rank growth;
    h. square.

IV. HARVEST AIDS AND THEIR USES

A. Preparing for Harvest Aid Applications

1. Describe how to determine the need for use and most appropriate application timing for
    a. defoliants;
    b. desiccants;
    c. boll openers;
    d. other materials used as harvest aids.
2. Describe how the following factors can alter the choice and effectiveness of harvest aids:
    a. air temperature at application;
    b. arthropod pests—aphids, whiteflies, and spider mites;
    c. humidity/precipitation;
    d. plant nitrogen status;
    e. plant vegetative vigor/leaf canopy density;
    f. plant water status;
    g. plant/fruit maturity;
    h. weed infestations.
3. Describe how the presence of johnsongrass, pigweed, nightshade, and annual and perennial morningglory can affect harvest aid use decisions.
4. Identify how target harvest dates are determined.
5. Describe how to determine boll maturity and uppermost harvestable bolls using the following methods:
    a. nodes above cracked boll (NACB);
    b. sharp knife technique;
    c. percent open bolls;
    d. seed coat color change.

6. Describe how to measure nodes above cracked boll (NACB).
7. Describe the relationship between harvest aid application timing based on Nodes Above Cracked Boll (NACB) and yield and fiber quality.

B. Environmental and Plant Factors Affecting Defoliation

1. Describe the general effects of the following factors on the ease of cotton defoliation:
    a. boll load;
    b. difficulty in chemical penetration of plant cover;
    c. humidity;
    d. insects;
    e. plant size and vigor;
    f. plant water stress;
    g. soil water availability;
    h. soil and plant nitrogen;
    i. temperature;
    j. weeds.
2. Recognize the general differences in response to harvest aid material choices and timing in the Pima versus Upland/Acala varieties of cotton.
3. Describe how vegetative growth is affected by:
    a. early or mid-season boll retention;
    b. lygus damage;
    c. nitrogen levels;
    d. soil water levels;
    e. temperature.
4. Describe how the relative level of plant vigor affects defoliation.
5. Explain why regrowth can occur and how to manage it.
6. List plant and cultural management factors important in assessing regrowth potential.
7. Describe how incomplete leaf drop increases gin trash, which reduces the quality and successful module storage of lint.

C. Types of Harvest Aids

1. Recognize that harvest aids can
    a. have herbicidal activity
    b. have hormonal activity
    c. act as boll openers
    d. act as defoliants and/or desiccants
2. Understand that the results of harvest aid use can depend upon many factors including water and nitrogen status and plant vigor, environmental conditions, and application rates.

- **Defoliants**

3. Recognize that the following materials are defoliants and can be used at certain rates and environmental conditions:
    a. dimethipin;

b. sodium chlorate;
c. thidiazuron;
d. tribufos;
e. thidiazuron plus diuron.

4. List the conditions that favor the use of defoliants and how an appropriate defoliant and application rate is determined.
5. Recognize that defoliants induce plant stress to help initiate defoliation but do not kill plants.

- **Desiccants**

6. Recognize that the following materials can be used as desiccants at certain rates and environmental conditions:
    a. paraquat;
    b. sodium chlorate.
7. Describe how desiccants affect plant cells.
8. Describe how the following factors affect the efficacy of desiccants:
    a. air temperature;
    b. humidity;
    c. plant-water status;
    d. plant canopy density;
    e. prior use of harvest aids;
    f. rate of desiccant application;
    g. soil residual moisture.

- **Boll Openers**

9. Recognize that the following materials are boll openers:
    a. ethephon;
    b. ethephon plus AMADS;
    c. ethephon plus cyclanilide;
    d. dimethipin.
10. Describe the use of boll openers as harvest aids.
11. Recognize the proper application timing for boll openers.
12. Describe conditions in which the application of a boll opener would reduce quality and yield.

- **Other Harvest Aid Materials**

13. Recognize the following materials and understand how they are used on cotton in California:
    a. endothall;
    b. glyphosate.
14. Recognize the benefits of using glyphosate as a harvest aid. [enhanced defoliation; weed control; regrowth control]

- **Harvest Aids for Organic Cotton**

15. Recognize that the following materials can be used as harvest aids for organically grown cotton:

a. magnesium chloride;
b. zinc sulfate;
c. zinc sulfate plus Chilean nitrate;
d. zinc plus citric acid.

16. Describe a problem associated with the use of magnesium chloride in organically grown cotton.
17. Explain why organically grown cotton typically cannot be stored in modules even when machined harvested.

- **Adjuvants**

18. Describe the function of adjuvants when using harvest aids.
19. Recognize that defoliant labels list required or recommended adjuvants.

D. Application Methods and Considerations for Harvest Aid Use

1. Describe some environmental, safety, and coverage problems associated with harvest aid application by aircraft.
2. Describe situations in which applications of harvest aids using ground equipment would be advantageous.
3. Describe the importance of leaf coverage for desiccant or defoliant effectiveness.
4. Explain how droplet size is adjusted and how, under certain conditions, it can impact harvest aid effectiveness.
5. Describe regulations that apply to the use of harvest aids.
6. Recognize the most appropriate combination of harvest aids for the following situations:
    a. Condition 1: fields with uniform or heavy boll load, abrupt cutout, and warm temperatures (>80°F) at and following application.
    b. Condition 2: late plantings, low boll retention, rank growth and/or cool temperatures (<80°F) at application.