

# **Pennsylvania**

## **Certified Crop Advisor Exam**

### **Performance Objectives**

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## **I. Soil Fertility Competency Area (20% of exam questions)**

### **A. Basic Concepts of Soil Fertility**

1. List the forms of macronutrients that are available to plants.
2. List the forms of the macronutrients that are susceptible to loss.
3. Recognize how the processes of mass flow, diffusion, and root interception affect nutrient uptake.
4. Distinguish between point and non-point sources of entry into the environment.
5. Recognize how soil climatic, and nutrient properties affect movement of a nutrient in soil or water.

### **B. Liming and N, P, K Plant Requirements**

#### **Liming**

6. List processes or practices that cause soil pH to change.
7. Describe how liming material characteristics influence lime rate.
8. Calculate the amount of liming material that should be applied to achieve a recommended lime requirement on a soil test report.
9. Describe the neutralizing value, physical properties, and handling precautions of liming materials.

#### **Nitrogen**

10. Describe the N uptake pattern for crops grown in Pennsylvania.
11. Describe symbiotic nitrogen fixation.
12. Describe ways nitrogen may be lost from the soil.
13. Describe the analysis, physical form and handling precautions of nitrogen fertilizer sources.

#### **Phosphorus**

14. Describe how soil properties affect phosphorus fertilization.
15. Recognize how soil holds phosphorus.
16. Recognize how soil properties, erosion, runoff, and amount, type, and method of application affect P loss.
17. List the analysis, physical form and handling precautions of phosphorus fertilizer sources:

#### **Potassium**

18. Recognize how soil retains potassium.
19. Recognize the role of potassium in animal health.
20. Recognize the general conditions where there is the potential for deficiency of micronutrients.

### **C. Soil Test Reports and Fertilizer Recommendations**

21. Describe soil sampling and handling procedures.
22. Describe how to sample and submit plant samples for tissue analysis.

23. Interpret the items on a soil test report.
24. List the soil test interpretations categories and their definitions.
25. Recognize the economic and environmental factors involved in making fertilizer recommendations.
26. Given soil test results and recommendation information make/modify a soil test recommendation.

#### ***D. Manure Management***

27. Describe how animal density on a farm affects manure management.
28. Calculate manure production from animal inventories.
29. Interpret the items on a manure analysis report.
30. Calculate manure nutrient availability based on handling and application.
31. Calculate manure application rates.
32. Describe how to calibrate a manure spreader.
33. Describe areas that may be environmentally sensitive to manure applications.
34. List options for dealing with excess manure.
35. Recognize how conservation practices and manure management practices are integrated in a nutrient management plan.
36. Recognize barnyard management problems.
37. List the roles of the public and private organizations that provide manure management assistance.
38. List the publications containing manure management information.
39. Recognize the provisions of the Nutrient Management Act in Pennsylvania.

#### ***E. Fertilizer Forms and Application***

40. Recognize how fertilizer placement and time of application affect nutrient availability.

## **II. Soil and Water Competency Area (5% of exam questions)**

### ***A. Basic Physical Properties***

1. Know the most primary processes of soil formation in Pennsylvania and where examples can be found illustrating each.
2. Know what is soil health (= soil quality).
3. Understand soil consistency.
4. List characteristics of gravel, sand, silt and clay.
5. Use a textural triangle to determine textural classification of a soil if given the percents of two of the soil separates.
6. Identify prismlike, blocklike, platelike and spheroidal structural units.
7. Describe benefits of well-developed soil aggregation.
8. Describe how each of the following factors affects soil structure.
9. List sources of soil organic matter.
10. Define humus.
11. Describe the relationship between soil organic matter and soil color and structure.
12. Describe how the carbon:nitrogen ratio of soil organic materials may affect soil nitrogen availability to plants.
13. Describe advantages and disadvantages of green manuring.
14. List ways to maintain the organic matter content of an agricultural soil.

### ***B. Erosion Processes***

15. Recognize and understand the factors used in the Revised Universal Soil Loss Equation (RUSLE).
16. Explain how diversions affect sheet, rill, and gully erosion.
17. Differentiate among the types of water and wind erosion.
18. List physical factors which affect rate of erosion.
19. Know how to estimate percent residue using the line-transect method.
20. In a given situation, make economically sound management recommendations that will result in soil conservation.

### ***C. Compaction***

21. Know effects of soil compaction on soil physical, chemical and biological properties.
22. Explain the influence of axle load and contact pressure on compaction.
23. Know the importance of soil moisture content for compaction.
24. Know strategies to reduce subsoil compaction.
25. Know strategies to reduce surface compaction.

26. Know strategies to make soil more resistant to compaction.
27. Know ways to alleviate compaction.

***D. Tillage and Residue Management***

28. Describe the components of sustainable no-tillage systems.
29. Know ways to manage manure in no-till.
30. Explain the relationship of tillage to manure, residue cover, water contamination, and nutrient loss.

***E. Regulations and Policy***

31. Explain the type of soil and water information available from the Manure Management Manual for Environmental Protection, the PA Technical Guide, Agronomy Guide, and Soil Erosion and Sediment Control Manual.

**III. Pest Management Competency Area (14% of exam is weed management, 12% is disease management, 10% is integrated pest management, 14% is insect management, and 12% relate to pesticides)**

**A. Basic Pest Management Practices**

1. Recognize examples of cultural, chemical, and biological pest management.
2. Recognize economic and environmental factors involved in making a pest management recommendation.

**B. Management of Weeds**

3. Identify weeds by common name at any stage of growth, and classify each by life cycle.
4. Recognize factors which may contribute to the success of weeds.

**C. Herbicide Application**

5. Define preplant incorporate, preemergence, and postemergence herbicide applications.
6. Define herbicide persistence.
7. Distinguish between contact and translocated type herbicides.
8. Recognize how adjuvants affect herbicide performance.
9. Recognize the importance of timing in herbicide application.
10. Recognize the relationship between plant vigor and herbicide effectiveness in postemergence applications.
11. Identify general plant symptoms caused by herbicide mode of actions groups.
12. List soil and climatic factors that affect the performance of herbicides.

**D. Management of Infectious Plant Diseases**

13. List the types of disease causing organisms.
14. Describe basic principles of disease development.
15. Corn diseases - Identify corn diseases by symptoms, study biology of the pathogen and be able to discuss management options.
16. Soybean diseases - Identify soybean diseases by symptoms, study biology of the pathogen and be able to discuss management options.
17. Wheat diseases - Identify wheat diseases by symptoms, study biology of the pathogen and be able to discuss management options.
18. Alfalfa diseases: Identify alfalfa diseases by symptoms, study biology of the pathogen and be able to discuss management options.
19. Distinguish between systemic and non-systemic fungicides.

### ***E. Management of Arthropods and Mollusks***

20. Recognize complete and gradual metamorphosis.
21. Identify arthropod and mollusk pests and classify each by feeding habits, crops attacked and type of metamorphosis. (Study tables in appendices.)
22. Identify beneficial organisms, classify them as a parasite, predator, or pathogen, and be able to discuss their importance in pest population regulation. (Study beneficial table in appendices.)
23. Understand the relationship between field characteristics and pest occurrence.
24. Distinguish between contact insecticides, stomach poisons, and systemic insecticides.
25. Recognize the importance of timing.
26. Recognize how the factors of tank, pH, weather, new plant growth, inherent molecule stability and spray coverage affect longevity and effectiveness of an insecticide application.

### ***F. Pesticide Formulations and Labels***

27. Recognize physical characteristics of various pesticide formulations.
28. Recognize the types of information found on a label.

### ***G. Pesticide Application Equipment***

29. Identify and describe the function granular applicator components.
30. Identify and describe the function of sprayer components.
31. Describe pattern form, relative droplet size, proper pattern, overlap, and primary uses of the following nozzle types.
32. Describe how to determine nozzle wear.
33. List physical factors affecting output during granular spraying of pesticides.
34. List physical factors affecting output during spraying of pesticides, and define when conditions are favorable for spray drift.
35. Describe method to estimate ground speed during pesticide application.
36. Recognize relationship between spray boom ht. and nozzle spacing.
37. Describe procedure used to adjust output of a granular applicator or sprayer.
38. Use calibration factors of gallons per acre, gallons per minute, width of nozzle spacing, and ground speed to demonstrate how to set up and calibrate a sprayer.

### ***H. Pesticide Resistance***

39. List factors influencing development of pesticide resistance and define cross resistance.
40. List ways to prevent the occurrence of pesticide resistant insects and weeds.
41. List ways to manage pesticide resistant insects and weeds once they have occurred.

### ***I. Using Pesticides in an Environmentally Sound Way***

42. Recognize how movement of a pesticide in soil or into water may be affected by various factors.
43. Know which soil property or pesticide characteristic would most likely retard or restrict the movement or leaching of a pesticide.
44. Be able to identify conditions that affect pesticide volatilization.
45. Describe how pesticide degradation is affected by soil moisture and soil temperature.
46. Describe the purpose of FIFRA.
47. Recognize general provisions of FIFRA.
48. List penalties for violation of FIFRA provisions.
49. Know which types of records must be kept by private pesticide applicators in Pennsylvania.
50. Know to whom restricted use pesticides can be sold.
51. Be able to explain the restricted entry interval (REI) associated with the Worker Protection Standard.
52. List SARA regulations that pertain to pesticide dealers.

### ***J. Protecting Humans Against Pesticide Exposure***

53. List pesticide modes of entry into the human system.
54. Distinguish between chronic and acute poisoning effects.
55. Recognize general symptoms of acute poisoning.
56. List possible chronic effects of poisoning.
57. Recognize general procedures to follow if pesticide gets on skin, in eyes, in mouth or stomach, or if inhaled.
58. What is the best source of information concerning level of pesticide toxicity, handling precautions, first aid procedures, and other pesticide safety information?
59. Describe protective gear used during mixing and application of pesticides.
60. Describe proper cleanup procedures for PPE and application equipment.
61. Recognize proper ways to dispose of pesticides and containers.
62. Describe safe storage.
63. Recognize procedures to follow when a spill occurs.

### ***K. Integrated Pest Management***

64. Understand the philosophy of integrated pest management.
65. Understand the relation between the economic injury level, economic threshold, and general equilibrium position of an organism's population.
66. List steps in carrying out an IPM program.



67. Understand why it is important to sample pest populations and the need for using an adequate sample size to estimate an organism's population level.
68. List types of pest monitoring methods and the advantages and disadvantages of each.
69. Understand the types and significance of plant injury/plant response relationship.
70. List the variables used to calculate the economic injury level (EIL) and understand how the EIL varies when any one variable value changes.
71. Understand the term pest status, the types of pest status, and how pest status influences the form of an IPM program.
72. Understand the limitations and strengths of the integrated pest management approach.

#### **IV. Crop Management Competency Area (13% of exam is related to crop management)**

##### ***A. Identification of seed and vegetative states***

1. Be able to identify the seed and mature plant of each crop.
2. Describe how crops respond to soil fertility, pH, and soil drainage.
3. List the recommended soil pH ranges for agronomically important crops.
4. Describe how extremes of temperature generally affect the growth and development of a crop.
5. Describe how the water needs of a crop typically change during growth and development.
6. Describe the adaptation of agronomically important crops to extremes of precipitation.
7. Recognize the affects of daylength (photoperiod) and temperature (vernalization) on flowering.
8. Define the term growing degree day (GDD) and describe how it is used in crop production systems.

##### ***B. Crop Staging, Growth and Development***

9. Use staging systems of corn, soybeans, and small grains to identify stage of growth at any time between emergence and physiological maturity.
10. Use staging system to identify growth stages of forage legumes.
11. Describe how frequency of harvest is related to forage yield and quality.
12. Describe how frequency and timing of harvest affects stand longevity, food reserves, and stand persistence.
13. Describe the locations and functions of meristems used for regrowth in forage legumes and forage grasses.
14. Relate anatomical features of major crops to developmental stages.
15. Recognize relationships between the growth and development of major crops and management factors.

##### ***C. Tillage systems***

16. Recognize how environmental and management factors influence the selection of a tillage system.
17. Identify tillage implements and describe their functions in a tillage system.
18. Describe the timing and sequence of tillage operations in an intensive tillage system.
19. Compare and contrast fall and spring tillage.
20. Describe the advantages and limitations of an intensive tillage system.
21. Describe the timing and sequence of tillage operations in a reduced tillage system.
22. Describe the advantages and limitations of a reduced tillage system.
23. Identify the tillage implements and describe their function in a ridge-till system.
24. Describe the timing and sequence of tillage operations in a ridge-till system.
25. Describe the advantages and limitations of a ridge-till system.
26. Describe the functions and operation of a no-till planter.

27. Describe the timing and sequence of operations in a no-till system.
28. List the advantages and limitations of a no-till system.

#### ***D. Hybrid vs. Cultivar and Crop Seed***

29. Distinguish between a hybrid and a cultivar.
30. List the characteristics used in selecting a hybrid or cultivar.
31. Recognize how storage time, handling, and storage conditions may affect seed quality.
32. Define seed dormancy and hard seed.
33. Describe seed tests used to determine seed viability (germination) and vigor.
34. Define PLS.
35. Calculate % PLS values for seedlots when given percentage purity and percentage germination.
36. Calculate the amount of seed needed for a field when given the seeding rate and the %PLS value of a seedlot.

#### ***E. Seeding Date Factors***

37. Describe factors which determine when to seed corn, soybeans, small grains and forages.
38. Recognize consequences of seeding too early or too late.

#### ***F. Seeding Rates and Pattern Factors***

39. List factors that influence the seeding rate of major crops.
40. List factors that influence the planting pattern of major crops and understand characteristics that make them adapted to high or low density.
41. List methods to seed small grains and forage crops.
42. Explain why forage crop establishment is more difficult than the establishment of grain crops.
43. List recommended seeding rates for major crops.
44. List advantages and disadvantages of seeding pure grass or legume stands vs. mixed stands.

#### ***G. Seeding Depth Factors***

45. List recommended seeding depths for major crops.
46. Recognize how crops respond to depth of planting.
47. Recognize conditions which would cause recommended seeding depth to be altered.

#### ***H. Crop Damage, Mortality and Factors Influencing Replanting Decisions***

48. Describe the type of damage hail, frost, flooding, drought, and wind can cause in corn, soybean, small grain and forage crops.
49. Recognize when major crops are most susceptible to specific environmental stresses.

50. Describe climatic and plant factors which influence a plant's ability to resume growth after being damaged.
51. Determine when crop damage would justify replanting.

### ***I. Cropping Systems***

52. Recognize how fallow is used in crop production.
53. List advantages and limitations of growing cover crops and companion crops in a cropping system.
54. Compare and contrast single crop systems and crop rotations.
55. Describe double cropping.

### ***J. Forage Harvesting Factors - Perennial Crops***

56. Describe how frequency of harvest is related to forage yield and quality.
57. Describe how frequency and timing of harvest affects food reserves and stand longevity.

### ***K. Pasture Systems***

58. Recognize the advantages and disadvantages of forage grass and legume species for pasture.
59. List factors that influence the selection of grass and legume species for pastures.
60. Recognize the difference between continuous and rotational grazing.
61. Describe animal unit.
62. List the management factors that influence the productivity of continuous and rotational grazed pastures.
63. Estimate the area required for pasturing various classes of livestock on pastures with varying productivity.