

**TENNESSEE  
CERTIFIED CROP ADVISER**

**PERFORMANCE OBJECTIVES**

**Prepared by the  
Tennessee Certified Crop Adviser Board**

**Effective October 2018**

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## INTRODUCTION

The Certified Crop Adviser (CCA) Program is coordinated at the international level by the American Society of Agronomy. A local board administers the CCA Program in each respective state or region including the state of Tennessee which is administered by the Tennessee Certified Crop Adviser Board. The board is responsible for developing the performance objectives and the local board examination.

The performance objectives are divided into five competency areas 1) Nutrient Management; 2) Soil and Water Management; 3) Pest Management; 4) Crop Management. Each section is further divided into several categories. The performance objectives will be evaluated and upgraded by the Tennessee Certified Crop Adviser Board as needed.

These performance objectives were developed from modifications of those developed by the Iowa and Kentucky CCA Boards.

These performance objectives were originally printed in October 1994. First revisions were made September 1995. Revisions are made every 4 to 5 years to ensure that the performance objectives are up to date and reflect the state of the science and practice in the State of Tennessee.

<b>Crops of Agronomic Importance in Tennessee</b>	
Corn	Cotton
Forage Crops	Soybean
Tobacco	Wheat

## **NUTRIENT MANAGEMENT COMPETENCY AREAS**

1. Basics of Soil Fertility
2. Soil pH and Liming
3. Tennessee Liming Materials Act
4. Nitrogen
5. Phosphorus
6. Potassium
7. Secondary and Micronutrients
8. Soil and Plant Sampling Analysis
9. Tennessee Commercial Fertilizer Act

## **NUTRIENT MANAGEMENT PERFORMANCE OBJECTIVES**

### **COMPETENCY AREA 1 – Basics of Soil Fertility**

1. List the ionic form in which essential elements are taken up by plants from the soil.
2. Define cation exchange capacity (CEC) and understand its units of measure.
3. Recognize the soil properties which affect the CEC and the relationship of CEC to the following:
  - a. mobility of nutrients in the soil
  - b. soil availability of nutrients
4. Understand the principles of the mineralization process and recognize the nutrients (listed below) and nutrient forms involved in the process.
  - a. nitrogen
  - b. phosphorus
  - c. sulfur
  - d. boron
5. Understand nutrient movement in soil and water as affected by the following properties:
  - a. cation exchange capacity
  - b. soil texture, structure and bulk density
  - c. drainage, both surface and subsurface
  - d. nutrient form, both cations and anions
  - e. rate of nutrient application
  - f. time of nutrient application
  - g. precipitation, both amount and distribution
  - h. irrigation
  - i. soil slope and crop residue cover
  - j. season
6. Identify advantages and disadvantages of broadcast, banded, foliar, and incorporated fertilizer applications and determine the effect of the following on each method of application:
  - a. tillage system
  - b. soil test level
7. Interpret the management of and determine the nutrients available from the following alternative fertilizer sources:
  - a. manures
  - b. legumes/cover crops
  - c. sludges
  - d. by-products
8. Calculate fertilizer product needs based on nutrient rate recommendations and fertilizer analysis.

## **COMPETENCY AREA 2 – Soil pH and Liming**

1. Define soil pH and interpret each of the following:
  - a. pH scale
  - b. effect of soil pH on availability of plant nutrients
  - c. effect of soil pH on plant toxicity from elements in the soil
  - d. effect of soil pH on soil microorganisms
  - e. effect of fertilizer materials on soil pH
  - f. suggest pH ranges for crops of agronomic importance in Tennessee
2. Understand the difference between soil water pH and buffer pH and what each measures.
3. Determine the effect of each of the following factors on limestone application rate:
  - a. soil organic matter, clay content, texture and CEC
  - b. liming material and quality
  - c. cropping system

## **COMPETENCY AREA 3 – Tennessee Liming Materials Act**

1. Define an agricultural liming material.
2. List minimum required labeling for an agricultural liming material.
3. Define calcium carbonate equivalent, relative neutralizing value (RNV) and be able to calculate RNV.
4. Describe the requirements for fineness of grind of agricultural limestone before it can be sold in Tennessee.

## **COMPETENCY AREA 4 – Nitrogen**

1. Recognize and interpret nitrogen deficiency symptoms in the agronomic crops of importance in Tennessee.
2. Describe how the pre-sidedress nitrogen soil test is used for nitrogen management in corn.
3. Determine the relative plant availability of nitrogen from the following organic sources and interpret the effect of the C:N ratio on nitrogen availability:
  - a. legume crops/cover crops
  - b. non-legume crops
  - c. manures
  - d. sludges
  - e. by-products
4. Understand nitrogen uptake and nitrogen use efficiency by crops as influenced by:
  - a. soil properties
  - b. rate of nitrogen fertilization
  - c. environmental conditions
  - d. availability of other nutrients
  - e. irrigation

5. Recognize how cropping systems affect the rate of nitrogen fertilization.
6. Recognize the handling precautions and their effect on soil pH of each of the following nitrogen fertilizer materials:
  - a. anhydrous ammonia
  - b. urea
  - c. ammonium nitrate
  - d. UAN solutions
  - e. ammonium sulfate
7. Distinguish between the advantages and disadvantages of each of the following nitrogen fertilizer materials in different soils, cropping systems and tillage systems:
  - a. anhydrous ammonia
  - b. urea
  - c. ammonium nitrate
  - d. UAN solutions
  - e. ammonium sulfate

#### **COMPETENCY AREA 5 – Phosphorus**

1. Recognize and interpret phosphorus deficiency symptoms in the agronomic crops of importance in TN.
2. Recognize how each of the following factors affect phosphorus fertilization:
  - a. soil properties
  - b. cropping system
  - c. soil test level
  - d. environmental concerns
3. Recognize how each of the following factors affect soil retention and fixation of phosphorus:
  - a. soil clay
  - b. soil pH
  - c. soil texture
4. Distinguish between the advantages and disadvantages of each of the following phosphorus fertilizer materials in different soils, cropping systems and placement in different tillage systems:
  - a. diammonium phosphate (DAP)
  - b. monoammonium phosphate (MAP)
  - c. triple superphosphate
  - d. ammonium phosphate
5. Understand the use of various soil tests for phosphorus and interpretation of soil test values.

#### **COMPETENCY AREA 6 – Potassium**

1. Recognize and interpret potassium deficiency symptoms in the agronomic crops of importance in TN.

2. Recognize how each of the following factors affect soil retention of potassium:
  - a. CEC
  - b. soil texture
  - c. soil mineralogy
3. Recognize how each of the following factors affect potassium fertilization:
  - a. soil properties
  - b. soil test level
  - c. cropping system
  - d. crop grown
  - e. environmental concerns
4. Understand the use of soil tests for potassium and interpretation of soil test values.

### **COMPETENCY AREA 7 – Secondary and Micronutrients**

1. Identify plant deficiency symptoms and likelihood of occurrence of each of the following secondary and micronutrients in corn, wheat, cotton, soybeans, tomatoes, snapbeans, grapes, tobacco, fescue, orchardgrass and alfalfa and recognize soil properties and nutrient interactions affecting their availability to plants:
  - a. calcium
  - b. magnesium
  - c. sulfur
  - d. zinc
  - e. boron
  - f. manganese
  - g. molybdenum
2. Identify plant toxicity symptoms of each of the following elements in corn, soybeans, wheat, cotton, tobacco, fescue, orchardgrass and alfalfa and recognize soil properties and nutrient interactions affecting their availability to plants:
  - a. aluminum
  - b. manganese
  - c. boron
3. Describe the advantages and disadvantages of each of the following methods of correcting secondary and micronutrient deficiencies or toxicities:
  - a. foliar application
  - b. soil application
  - c. adjusting soil pH

### **COMPETENCY AREA 8 – Soil and Plant Sampling Analysis**

1. Understand University of Tennessee recommended soil sampling and handling procedures and the effect of the following factors on soil test results and interpretations:
  - a. type of test needed
  - b. time of sampling
  - c. depth of sampling
  - d. frequency of sampling
  - e. sampling density (number per acre)



2. Interpret laboratory reports from soil, plant and manure test results including:
  - a. degree of nutrient deficiency or adequacy
  - b. expected crop response to applied nutrients
  - c. units of measure and conversion between units
  - d. reliability
3. Understand the limitations and advantages of plant analysis as a diagnostic tool.

#### **COMPETENCY AREA 9 – Tennessee Commercial Fertilizer Act**

1. Define a commercial fertilizer and list exceptions.
2. List minimum required labeling for fertilizer.
3. Define a soil conditioner.
4. Define bulk fertilizer.
5. Other references:
  - a. See effective rules of the Tennessee Department of Agriculture:  
<http://publications.tnsosfiles.com/rules/0080/0080.htm>
  - b. Also see Lawserver: [http://www.lawserver.com/law/state/tennessee/tn-code/tennessee\\_code\\_title\\_43\\_chapter\\_11\\_part\\_1](http://www.lawserver.com/law/state/tennessee/tn-code/tennessee_code_title_43_chapter_11_part_1)

## **SOIL AND WATER MANAGEMENT COMPETENCY AREAS**

1. Soils and Landscapes
2. Soil Properties
3. Soil Erosion
4. Tillage
5. Residue Cover

## **SOIL AND WATER MANAGEMENT PERFORMANCE OBJECTIVES**

### **COMPETENCY AREA 1 – Soils and Landscapes**

1. Be able to use a county soil survey to:
  - a. identify the soil mapping unit of an area
  - b. locate the agronomic interpretations for a mapping unit
  - c. determine the properties of the principle soils of the mapping unit
2. Understand the relationship between:
  - a. soil series
  - b. soil associations
  - c. soil mapping unit
3. Understand the limitations of map scale in delineating soil variability.
4. Understand the crops and conditions under which tile drainage may be needed in Tennessee.

### **COMPETENCY AREA 2 – Soil Properties**

1. Understand the factors affecting crop rooting depth.
2. Be familiar with soil drainage classes and the use of soil color in determining drainage.
3. Define a fragipan, understand its effects on soil drainage and rooting depth.
4. Recognize the difference between natural and management-induced compaction and its implications.
5. Understand the effect of soil texture, soil water content and management on the potential for soil compaction.
6. Understand the concept of soil available water capacity and its relation to soil productivity.
7. Understand the role of soil organic matter in:
  - a. soil fertility
  - b. soil herbicide interactions
  - c. soil structure
8. Understand the natural and cultural managerial factors affecting soil organic matter content.
9. Understand the influence of management and soil properties on infiltration and permeability.
10. Understand the effects of soil texture, soil structure, organic matter content and soil depth on the potential for nitrate and pesticide leaching.

### **COMPETENCY AREA 3 – Soil Erosion**

1. Understand the soil, landscape, climatic and management factors affecting soil erosion.
2. Understand the effect of erosion on soil productivity and the concept of soil loss tolerance.
3. Be familiar with the factors in the Revised Universal Soil Loss Equation (RUSLE2) and Water Erosion Prediction Project (WEPP).
4. Relate soil erosion to water pollution.
5. Be familiar with common soil conservation practices in Tennessee, including
  - a. tillage practices
  - b. crop rotation
  - c. cover crops
  - d. contouring
  - e. residue management
  - f. terracing
  - g. grass waterways
  - h. filter strips
  - i. strip cropping
6. Understand the relationships among tillage, residue cover, cropping systems, soil structure, infiltration and erosion.
7. Describe the components of an approved conservation plan and its relationship to crop management decisions.
8. Understand the role of drainage practice in relation to the potential for increased production and government policy on wetlands.

### **COMPETENCY AREA 4 – Tillage**

1. Understand the factors affecting choice of tillage systems, including:
  - a. crop rotation
  - b. soil properties
  - c. weed species
  - d. erosion potential
2. Define intensive tillage, conservation tillage and no-tillage and know the advantages and limitations of each.
3. Understand the effects of tillage systems on:
  - a. soil erosion
  - b. soil structure
  - c. soil organic matter
  - d. residue cover
  - e. incorporation of fertilizer, lime and pesticides
  - f. soil compaction
  - g. infiltration
  - h. water quality

4. Understand the crops and conditions under which subsoiling may be needed in Tennessee.

#### **COMPETENCY AREA 5 – Residue Cover**

1. Recognize how each of the following factors affect soil residue cover:
  - a. cropping rotation
  - b. crop yield
  - c. harvesting methods
  - d. weather
  - e. tillage system
  - f. fertilizer and manure methods
2. Know how to measure soil residue cover.

## **PEST MANAGEMENT COMPETENCY AREAS**

1. Integrated Pest Management (IPM) Concepts
2. Weed Pest Characteristics
3. Insects and Mites
4. Disease Pests
5. Non-pest Factors that Injure Crops
6. Non-pesticide Pest Management Tactics
7. Pesticide Pest Management Tactics
8. Laws and Regulations Governing Pest Control Operators and Applicators of Restricted-Use Pesticides
9. State and Federal Agencies

## PEST MANAGEMENT PERFORMANCE OBJECTIVES

### **COMPETENCY AREA 1 – Integrated Pest Management (IPM) Concepts**

1. Explain the components of an integrated pest management system.
2. Recognize, in general terms, how environmental and cultural factors influence pest populations.
3. List correct pest monitoring procedures based on behavior and/or biology of the pest.
4. Recognize the necessity for correct pest identification in making pest management decisions; describe the consequences if pest management decisions are based on incorrect pest identification.
5. Recognize the benefits of developing a list of major weed species and a weed map of each field.
6. Describe the use of pheromone trapping and degree day predictions of insect activity.

### **COMPETENCY AREA 2 – Weed Pest Characteristics**

1. Identify the following weeds during seedling and mature growth stages:

#### ANNUALS

##### Grasses

- a. Italian ryegrass
- b. cheat
- c. large crabgrass
- d. barnyardgrass
- e. fall panicum
- f. foxtail
- g. goosegrass
- h. broadleaf signalgrass

##### Broadleaf

- a. morningglories
- b. smartweed
- c. velvetleaf
- d. sicklepod
- e. Palmer amaranth
- f. common lambsquarters
- g. prickly sida
- h. giant ragweed
- i. henbit
- j. marestail (horseweed)
- k. musk thistle

#### PERENNIALS

- a. johnson grass
- b. yellow nutsedge
- c. trumpetcreeper

- d. bigroot morningglory
  - e. horsenettle
  - f. wild garlic
  - g. curly dock
  - h. balloonvine
2. Describe the types of reproductive methods of weeds and why it is important to know them when designing a weed management process.
  3. Describe where to find management recommendations for weed control.
  4. Recognize the importance of the following factors affecting weed-crop competition:
    - a. row spacing
    - b. plant population (crop/weed)
    - c. duration of competition
    - d. weed distribution
  5. Explain the concept of scouting for weeds, when/how it is done and why it is important.
  6. Discuss issues with contaminated equipment and how to properly manage equipment.

### **COMPETENCY AREA 3 – Insects and Mites**

1. Identify the list below, know their life cycles and recognize characteristic damage.

#### **ADULT STAGES ONLY**

- a. bean leaf beetle
- b. grape colaspis
- c. japanese beetle
- d. striped and margined blister beetles
- e. sugarcane beetle
- f. sorghum midge
- g. kudzu bug
- h. stink bug (for example red-banded stink bug, green stink bug, brown stink bug, brown marmorated stink bug)

#### **ADULT AND IMMATURE STAGES**

- a. stink bugs (for example red banded stink bug, green stink bug, brown stink bug, brown marmorated stink bug)
- b. southern and western corn rootworm
- c. european corn borer
- d. southwestern corn borer
- e. kudzu bug
- f. tarnished plant bug
- g. spider mites
- h. aphids (for example greenbug, cotton aphid, soybean aphid, bird-cherry oat aphid, sugarcane aphid, etc.)
- i. corn earworm
- j. budworm, bollworm
- k. three cornered alfalfa hopper
- l. banded winged whitefly
- m. thrips



#### LARVAL STAGES ONLY

- a. hessian fly
  - b. alfalfa weevil
  - c. fall armyworm
  - d. armyworm (true armyworm)
  - e. cutworms
  - f. seedcorn maggot
  - g. white grubs
  - h. wireworms
  - i. cabbage and soybean loopers
  - j. green cloverworm
  - k. bermudagrass stem maggot
2. Describe how insect biology and behavior affect pest management practices and decisions.
  3. Describe how crop growth stage affects severity of insect damage.
  4. Describe where to find management recommendations for insect and mite control.
  5. Explain the concept of scouting for insects and mites, when/how it is done and why it is important.

#### COMPETENCY AREAS 4 – Disease Pests

1. Describe where to find management recommendations for disease control.
2. Describe how environment, host plant and pathogen interact for the following disease groupings:
  - a. wind/rain dispersed fungal diseases
  - b. insect transmitted viral diseases
  - c. bacterial diseases
  - d. soil-borne fungal diseases
  - e. diseases caused by nematodes
  - f. contaminated equipment
3. Identify the symptoms of the following crop diseases:  
CORN
  - a. gray leaf spot
  - b. northern corn leaf blight
  - c. seedling blights
  - d. stalk rots
  - e. rusts
  - f. fusarium ear rot  
SOYBEANS
  - a. phytophthora root rot
  - b. Pythium root rot
  - c. Fusarium rot
  - d. Rhizoctonia root rot

- e. septoria brown spot
- f. seedling blights
- g. frog-eye leaf spot
- h. soybean cyst nematode
- i. sudden death syndrome
- j. asian soybean rust
- k. target spot
- l. cercospora leaf blight
- m. downy mildew

#### WHEAT

- a. barley yellow dwarf virus
- b. head scab
- c. powdery mildews
- d. rusts
- e. septoria leaf blotch
- f. stagonospora glume blotch
- g. stagonospora leaf blotch

#### ALFALFA

- a. phytophthora root rot
- b. anthracnose
- c. bacterial wilt

#### COTTON

- a. seedling diseases
- b. verticillium wilt
- c. alternaria leaf spot
- d. reniform nematode
- e. target spot
- f. boll rots

#### TOBACCO

- a. black shank
- b. target spot
- c. frog-eye leaf spot

4. Describe how the following types of diseases affect plant health and productivity:
  - a. root rots
  - b. stem rots
  - c. leaf spots
  - d. seedling disease
  - e. vascular wilts
  - f. viral diseases
  - g. nematode root feeding

5. Explain the concept of scouting for diseases, when/how it is done and why it is important.

## **COMPETENCY AREA 5 – Non-pest Factors that Injure Crops**

1. Describe how corn, soybeans, wheat, cotton, tobacco and forages can be injured by the following environmental factors:
  - a. wind and air quality
  - b. temperature extremes
  - c. moisture extremes
  - d. hail
  - e. sunlight duration and intensity
  - f. soil pH and nutrient extremes
2. Recognize how the following factors influence crop injury caused by pesticides and fertilizer in Tennessee:
  - a. crop sensitivity
  - b. weather
  - c. carryover potential
  - d. rate and formulation
  - e. correct method (timing and placement) of application
  - f. incompatibilities of pesticides
3. Explain resistance management strategies
  - a. Weed management
  - b. Bt / insect management
  - c. Disease management

## **COMPETENCY AREA 6 – Non-pesticide Pest Management Tactics**

1. Recognize the importance of the following factors in managing pests of corn, soybeans, wheat, cotton, tobacco and forages in Tennessee:
  - a. field history
  - b. variety selection
  - c. seed/plant source
  - d. site preparation/tillage type
  - e. planting date and method
  - f. plant density
  - g. soil/plant fertility
  - h. water management
  - i. timeliness of harvest
  - j. sanitation
  - k. storage
  - l. neighboring fields/borders
2. Describe the advantages and disadvantages of genetic, cultural, biological and chemical management of pests.
3. Recognize the role of tillage and crop rotation in weed, insect, and disease control.

## COMPETENCY AREA 7 – Pesticide Pest Management Tactics

1. Describe the role of the following adjuvants/additives in pesticide applications:
  - a. surfactants
  - b. fertilizer additives
  - c. drift control agents
2. Recognize how the following factors affect spray delivery and spray coverage:
  - a. spray pressure
  - b. application speed
  - c. air vs ground application
  - d. nozzle type
  - e. nozzle spacing
  - f. boom/nozzle height
3. Define the following types of pesticide interactions when two or more pesticides are used:
  - a. additive
  - b. synergistic
  - c. antagonistic/mixing order
4. Distinguish pesticide resistance and pesticide tolerance.
  - a. Understand the causes of resistance
    - i. Natural selection
    - ii. Improper use of technology
  - b. Explain how tolerance is achieved
    - i. breeding programs
5. Describe methods to avoid development of and/or manage pesticide resistant pests.
6. Define the role the following factors play in herbicide persistence in the soil:
  - a. soil moisture
  - b. soil temperature
  - c. soil pH
  - d. soil microbes
  - e. application rate
7. Recognize the role that persistence plays in the potential carryover problems for the following herbicides
  - a. atrazine
  - b. metolachlor
  - c. fomesafen
  - d. sulfonyl urea
8. Describe the benefits and limitations of the following methods of herbicide application in different tillage systems:
  - a. early preplant/burn down
  - b. preplant incorporated
  - c. preemergence
  - d. postemergence
  - e. postemergence directed

9. Recognize how growth stage and environmental factors affect weed control and herbicide injury to crops.
  - a. crop growth stage vs weed growth stage
  - b. possible weather factors influencing off-target chemical movement
  - c. interaction between crop and/or weed growth stage and weather factors
10. Describe modes of action of the following insecticide groups:
  - a. synthetic pyrethroids
  - b. neonicotinoids
  - c. organophosphates
  - d. diamides
  - e. bacillus thuringiensis
11. Describe modes of action of the following fungicide groups:
  - a. Reference: <http://iwilltakeaction.com/uploads/files/55620-27-ta-fm-fungicideclassification-poster-fnl-lr.pdf>
  - b. mitosis disrupters
  - c. cell membrane disrupters
  - d. respiration inhibitors
  - e. oxidative phosphorylation uncouplers
  - f. unknown
  - g. multi-site contact activity
12. Describe modes of action of the following herbicide groups:
  - a. Reference: [http://iwilltakeaction.com/uploads/55620-1\\_TA\\_HRM\\_2017Poster.pdf](http://iwilltakeaction.com/uploads/55620-1_TA_HRM_2017Poster.pdf)

### **COMPETENCY AREA 8 – Laws and Regulations Governing Pest Control Operators and Applicators of Restricted-Use Pesticides**

1. Know the certification requirements for private or commercial applicators using a restricted use pesticide in Tennessee.
2. Be able to list the facts that must be recorded and kept by all applicators and commercial pest control operators in Tennessee for a period of two (2) years.

### **COMPETENCY AREA 9 – State and Federal Agencies**

1. Recognize the responsibilities of and the assistance available through the following state and federal agencies:
  - a. Tennessee Extension
  - b. Tennessee Department of Agriculture
  - c. Farm Services
  - d. National Resource Conservation Service
  - e. Environmental Protection Agency
  - f. United States Department of Agriculture

## **CROP MANAGEMENT COMPETENCY AREAS**

1. Seeding
2. Growth and Development
3. Harvest

## **CROP MANAGEMENT PERFORMANCE OBJECTIVES**

### **COMPETENCY AREA 1 – Seeding**

1. Know recommended seeding depths for crops of agronomic importance and the factors that affect seeding depth such as:
  - a. weather/temperature
  - b. tillage system
  - c. soil type
2. Describe crop responses to planting patterns and plant population (seeding rate).
3. Explain the effect of seed quality on crop growth and development.
4. Determine pure live seed (PLS) from seed sample analyses.
5. Recognize the following terms from the Tennessee Seed Law of 1972:
  - a. hard seeds
  - b. weed seeds
  - c. variety
  - d. treated
  - e. mixed or mixture
  - f. germination percent

### **COMPETENCY AREA 2 – Growth and Development**

1. Describe how the water and nutrient needs of crops change during growth and development and how soil type and climate influence water availability during the growing season.
2. Distinguish the growth states during which crops are most susceptible to environmental stress.
3. Identify damage to agronomic crops from hail, frost, flooding, drought and wind.
4. Identify stages of crop development for crops of agronomic importance in Tennessee.

### **COMPETENCY AREA 3 – Harvest**

1. Outline harvest timings or schedules for achieving best quality in crops of agronomic importance in Tennessee.
2. Describe the use of growth regulator and harvest aid chemicals for crop production in Tennessee.