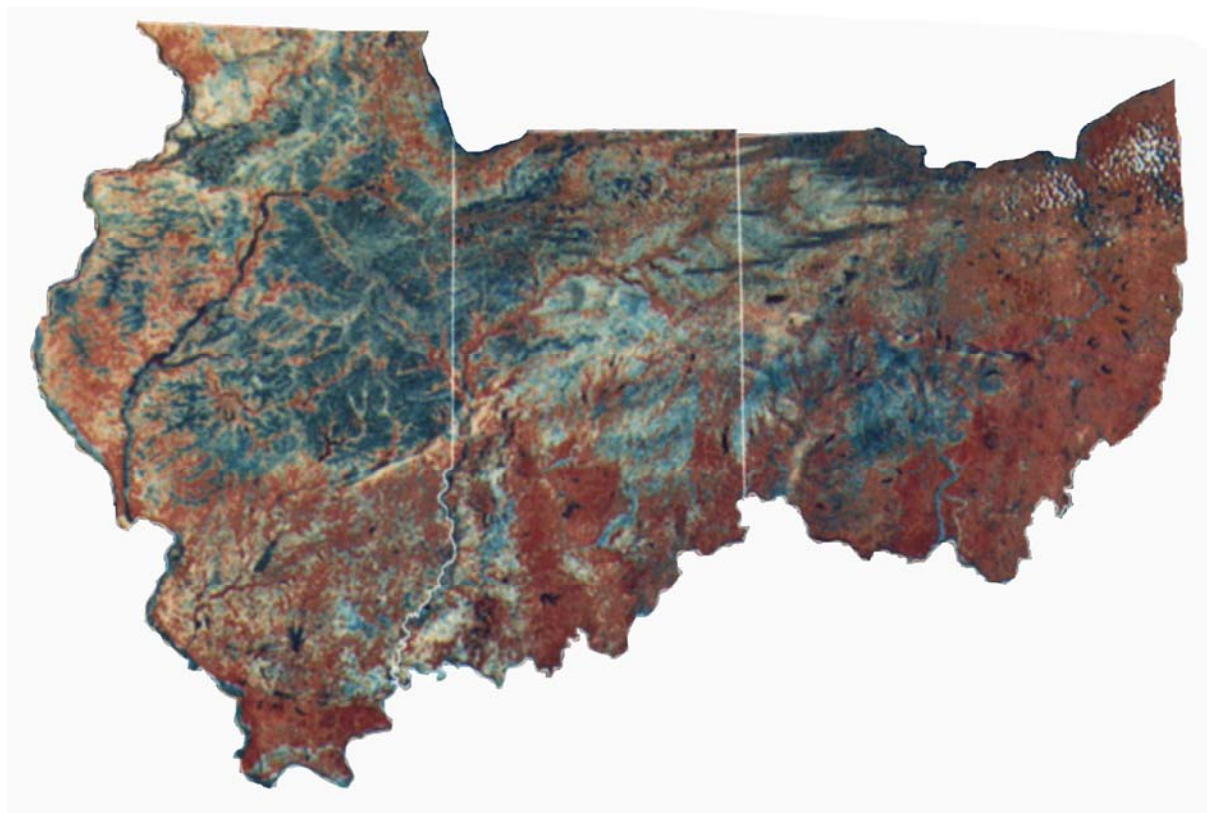


# **PERFORMANCE OBJECTIVES**

**FOR THE  
TRI-STATE  
CERTIFIED CROP ADVISER  
PROGRAM**



**2008**

# Tri-State Certified Crop Adviser Performance Objectives

## CONTENTS

<b>INTRODUCTION.....</b>	<b>1</b>
<b><u>NUTRIENT MANAGEMENT COMPETENCY AREAS</u> .....</b>	<b>2</b>
1 - Nutrient Movement in Soil and Water .....	3
2 - Nutrient Application, Availability, and Uptake .....	3
3 - Crop Nutrient Deficiencies .....	4
4 - Soil Test Interpretation.....	5
5 - Lime Application and Soil pH.....	5
6 - Manures and Biosolids.....	5
7 - Nutrient Management Planning .....	6
<b><u>SOIL AND WATER MANAGEMENT COMPETENCY AREAS</u> .....</b>	<b>7</b>
1 - Natural Resource Conservation Issues .....	8
2 - Soil Productivity and Environmental Management.....	8
3 - Water Quality .....	9
4 - Soil Erosion.....	10
<b><u>INTEGRATED PEST MANAGEMENT (IPM) COMPETENCY AREAS</u> .....</b>	<b>12</b>
1 - IPM Principles and Concepts.....	13
2 - Insect Management .....	13
3 - Crop Disease Management .....	14
4 - Weed Management .....	15
5 - Health, Safety, and Environmental Stewardship of Pesticides .....	16
6 - Pesticide Performance and Application .....	17
<b><u>CROP MANAGEMENT COMPETENCY AREAS</u> .....</b>	<b>19</b>
1 - Cropping Decisions.....	20
2 - Hybrid and Variety Selection.....	20
3 - Crop Growth, Development, and Diagnostics .....	21
4 - Crop Harvesting, Handling, and Storage .....	22
5 - Managing Agronomic Information .....	22
<b>RESOURCE MATERIAL INFORMATION .....</b>	<b>23</b>

**PERFORMANCE OBJECTIVES  
FOR THE  
TRI-STATE CERTIFIED CROP ADVISER PROGRAM  
ILLINOIS--INDIANA--OHIO**

**INTRODUCTION**

The Certified Crop Adviser (CCA) Program is an educational program with two main goals: to certify individuals who have passed a minimum competency examination and to establish a mechanism of continuing education for those already certified.

At the core of this program are the Competency Areas and Performance Objectives (P.O.'s). These describe the knowledge and skills that crop advisers consider important in order to carry out their duties.

The Competency Areas and P.O.'s outlined in this publication are the result of a cooperative effort by the Ohio, Indiana, and Illinois CCA Boards. The purpose of this Tri-State CCA initiative is to eliminate unnecessary duplication of time, effort, and expense spent on managing the minimum competency exam, and to coordinate mutual continuing education efforts. This document contains the Competency Areas and Performance Objectives that are common to the tri-state region.

To become certified, an individual must be competent in areas addressed in both the International and Tri-State P.O. documents. The Tri-State P.O.'s are intended to complement, not duplicate, the International P.O.'s. The Tri-State P.O.'s address areas of crop advising that are specific to the tri-state region.

The P.O.'s are dynamic and will be upgraded, changed and modified as the needs of crop advisers in the tri-state region evolve. While this is a cooperative effort, the authority and management of each state's CCA program remains with the state CCA boards.

J.J. Vorst  
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2007

## **Tri-State Certified Crop Adviser**

### **NUTRIENT MANAGEMENT COMPETENCY AREAS**

1. Nutrient Movement in Soil and Water
2. Nutrient Application, Availability, and Uptake
3. Crop Nutrient Deficiencies
4. Soil Test Interpretation
5. Lime Application and Soil pH
6. Manures and Biosolids
7. Nutrient Management Planning

# **NUTRIENT MANAGEMENT**

## **COMPETENCY AREA 1. NUTRIENT MOVEMENT IN SOIL AND WATER**

1. Recognize how the following affect nutrient movement in soil and water
  - a. temperature and precipitation
  - b. soil physical, chemical, and biological properties
  - c. tillage
  - d. nutrient form
  - e. rate of application
  - f. time of application
  - g. method of application

## **COMPETENCY AREA 2. NUTRIENT APPLICATION, AVAILABILITY, AND UPTAKE**

2. Recognize how the following affect nitrogen fertilization practices
  - a. soil texture
  - b. soil organic matter
  - c. crop rotation and crop grown
  - d. soil moisture
  - e. soil temperature
  - f. time and method of application
3. Describe how soil pH and soil nitrogen levels affect nitrogen fixation
4. Describe how to apply the following nitrogen fertilizers
  - a. anhydrous ammonia
  - b. urea
  - c. Urea/Ammonium-Nitrate (UAN) solutions
  - d. ammonium sulfate
  - e. manure/biosolids
5. Recognize how the following affect phosphorus fertilization and uptake
  - a. soil texture
  - b. soil pH
  - c. soil test results
  - d. soil moisture
  - e. soil temperature
  - f. tillage system
  - g. crop rotation and crop grown
  - h. source of P
  - i. band vs. broadcast application

6. Recognize how the following factors affect potassium fertilization and availability to crops
  - a. soil texture
  - b. soil test results
  - c. soil moisture
  - d. tillage system
  - e. crop rotation and crop grown
  - f. cation exchange capacity (CEC)
  - g. fall, winter, or spring application
7. List advantages and limitations of in-row and pop-up methods of applying K
8. Describe environmental and economic impacts of the following on applying N, P, and K
  - a. time
  - b. method
  - c. form
  - d. use of stabilizers

### **COMPETENCY AREA 3. CROP NUTRIENT DEFICIENCIES**

9. Recognize nitrogen deficiency symptoms in corn, soybeans, wheat, and alfalfa
10. Recognize phosphorus deficiency symptoms in corn, soybeans, wheat, and alfalfa
11. Recognize potassium deficiency symptoms in corn, soybeans, wheat, and alfalfa
12. Identify plant deficiency symptoms for the following
  - a. magnesium in corn
  - b. sulfur in corn
  - c. zinc in corn
  - d. boron in alfalfa
  - e. iron or manganese in soybeans
13. Describe how to apply nutrients for correcting deficiencies listed in #9-12
14. List soil characteristics and cropping systems that contribute to causing nutrient deficiencies listed #9-12
15. Describe environmental conditions that cause deficiencies in #9-12
16. Recognize how soil pH and phosphorus levels affect zinc availability

#### **COMPETENCY AREA 4. SOIL TEST INTERPRETATION**

17. Explain how the following items on a soil test report affect nutrient recommendations
  - a. CEC
  - b. soil pH
  - c. buffer pH
  - d. organic matter
  - e. P level
  - f. K level
  - g. Ca/Mg level
18. Explain why phosphorus recommendations differ between Bray and Mehlich soil test procedures

#### **COMPETENCY AREA 5. LIME APPLICATION AND SOIL PH**

19. Recognize how the following factors affect lime application
  - a. tillage system
  - b. crop rotation
  - c. crop grown
  - d. soil type
  - e. soil pH and buffer pH
  - f. timing of P application
20. Describe how dolomitic differs from calcitic limestone
21. Describe how fineness and purity influence lime quality
22. Recognize how soil pH affects nutrient availability
23. Describe appropriate uses of liquid or pelleted lime

#### **COMPETENCY AREA 6. MANURES AND BIOSOLIDS**

24. Describe how to determine amounts of nutrients available from manure/biosolids
25. Describe advantages and limitations of using manure/biosolids as nutrient sources
26. Describe effects of applying manures and biosolids on the environment
27. Describe timing and methods of applying manures and biosolids
28. List nutrient availability rates from biosolids

## **COMPETENCY AREA 7. NUTRIENT MANAGEMENT PLANNING**

29. Name the agency responsible for overseeing Nutrient Management Plans
30. Use soil test reports to make economically and environmentally sound fertilizer recommendations
31. List the purposes of a nutrient management plan
32. Identify sources of information to meet legal requirements for nutrient management planning for your state

## **Tri-State Certified Crop Adviser**

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

1. Natural Resource Conservation Issues
2. Soil Productivity and Environmental Management
3. Water Quality
4. Soil Erosion

## **SOIL AND WATER MANAGEMENT**

### **COMPETENCY AREA 1. NATURAL RESOURCE CONSERVATION ISSUES**

1. Describe how the following affect conservation of natural resources
  - a. sedimentation
  - b. soil erosion
  - c. nutrient transport
  - d. pesticide transport
  - e. manure management
2. Describe how the following practices affect soil and water conservation
  - a. residue management
  - b. nutrient management
  - c. pest management
  - d. buffer strips, riparian areas, field borders
  - e. cropping systems
3. Describe how the following conservation practices impact wildlife habitat
  - a. crop rotation
  - b. tillage/residue management
  - c. buffer strips, riparian areas, field borders
4. Identify costs/benefits associated with implementing conservation measures
5. Identify state and federal agencies involved with soil and water management
6. Define soil erosion tolerance level (T)
7. Define highly erodible land (HEL)
8. Describe land management practices recommended for HEL
9. List factors used by USDA to define a wetland (WL)
10. Describe how planned drainage and cropping systems affect the management of wetlands

### **COMPETENCY AREA 2. SOIL PRODUCTIVITY AND ENVIRONMENTAL MANAGEMENT**

11. Explain how the following affect soil and crop productivity potential
  - a. soil nutrient level
  - b. tillage
  - c. crop rotation
  - d. soil organisms
  - e. drainage
  - f. cover crops
  - g. soil texture

12. Describe how the following factors influence soil temperature and moisture
  - a. plant cover
  - b. surface residue
  - c. tillage system
  - d. soil organic matter
  
13. Describe how the following influence soil compaction
  - a. soil moisture
  - b. soil texture
  - c. organic matter
  - d. tillage practices
  - e. traffic patterns
  - f. livestock
  
14. Explain how the following factors influence water infiltration into soil
  - a. plant cover
  - b. surface residue
  - c. tillage system
  - d. soil organic matter and soil organisms
  - e. soil texture
  - f. time of year

### **COMPETENCY AREA 3. WATER QUALITY**

15. Define hypoxia
  
16. Define eutrophication
  
17. Describe how the following influence surface water quality
  - a. soil permeability
  - b. topography
  - c. cropping practices
  - d. drainage
  - e. pollutant characteristics
  - f. conservation buffer strips
  - g. soil test nutrient levels
  - h. tillage practices
  - i. livestock operations

18. Explain how the following influence ground water quality
  - a. pollutant characteristics
  - b. topography
  - c. nutrient type, form and time of application
  - d. water table depth
  - e. soil permeability
  - f. restrictive layers
  - g. soil test nutrient levels
  - h. sinkholes
  - i. exposed sand and gravel
  - j. abandoned wells
  - k. livestock lots
19. Describe fertilizer application practices that reduce nutrient loss from a field
20. List manure management practices that protect water quality
21. Define total maximum daily load (TMDL)
22. Describe how the following affect water quality
  - a. sediments
  - b. nutrients
  - c. pathogens
  - d. pesticides
23. Describe soil characteristics that affect rate of liquid manure application
24. Explain how application setbacks reduce the risk of water contamination

#### **COMPETENCY AREA 4. SOIL EROSION**

25. Describe how soil erosion affects the following
  - a. water quality
  - b. waterway, stream, and lake sedimentation
  - c. soil productivity potential
26. Describe how to measure soil loss from the following
  - a. sheet and rill erosion
  - b. gully erosion
  - c. wind erosion
  - d. streambank erosion
27. Describe how the following management practices affect sheet and rill erosion
  - a. tillage practices
  - b. crop rotation
  - c. cover crops
  - d. row spacing and direction

28. Describe how the following management practices affect erosion by wind
  - a. residue management
  - b. surface roughness
  - c. row direction
  - d. crop strip width
  - e. windbreak
  - f. cross wind strips
  - g. cover crops
29. Describe how water and sediment control basins, grassed waterways, and grade stabilization structures affect erosion
30. Describe how wind erosion damages growing crops
31. Describe how to use the line transect method to measure crop residue

## **Tri-State Certified Crop Adviser**

### **INTEGRATED PEST MANAGEMENT COMPETENCY AREAS**

1. Integrated Pest Management (IPM) Principles and Concepts
2. Insect Management
3. Crop Disease Management
4. Weed Management
5. Health, Safety, and Environmental Stewardship of Pesticides
6. Pesticide Performance and Application

# INTEGRATED PEST MANAGEMENT

## **COMPETENCY AREA 1. INTEGRATED PEST MANAGEMENT (IPM) PRINCIPLES AND CONCEPTS**

1. Describe characteristics of diseases, insects, and weeds that make them crop pests
2. Explain how the following factors influence field scouting
  - a. sampling pattern
  - b. pest life cycle
  - c. sampling time and frequency
  - d. field history
  - e. pest population level
3. Use crop scouting field resources to diagnose problems
4. Describe how the following environmental factors affect pest management recommendations
  - a. low temperature stress
  - b. drought
  - c. heat stress
  - d. excessive moisture
5. Describe pest problems associated with the following tillage systems
  - a. intensive
  - b. reduced
  - c. no-till
  - d. strip-till
6. List factors to consider when using transgenic, chemical, cultural, mechanical, or biological pest control methods

## **COMPETENCY AREA 2. INSECT MANAGEMENT**

7. Identify the following pests at the life stages indicated below

Adult

aphids  
bean leaf beetle  
brown stink bug  
flea beetle  
spider mites

Adult and Larval or Nymph

corn rootworms  
corn borers  
Hessian fly  
Japanese beetle  
Mexican bean beetle  
potato leafhopper  
Western bean cutworm  
white fly

Larval

alfalfa weevil  
armyworm  
cutworms  
earworms  
grape colaspis  
seedcorn maggot  
stalk borer  
white grubs  
wireworm

8. Identify crop injury symptoms caused by each pest in objective #7
9. Describe management alternatives for each pest in objective #7

10. Explain how the following insect characteristics influence pest management decisions
  - a. developmental time and period of activity
  - b. host plants for egg, larval, pupal, adult or nymph insect life stages
  - c. site of insect feeding on plant
  - d. insect mobility
11. Explain how an insect's overwintering and oversummering strategies affect pest management decisions
12. Describe how the following cropping practices affect potential crop damage from insects
  - a. planting date
  - b. harvest date
  - c. tillage method
  - d. weed control method
  - e. hybrid, variety and trait selection
  - f. crop rotation
13. Explain why refuge design in insect resistant crops varies with insect species

### COMPETENCY AREA 3. CROP DISEASE MANAGEMENT

14. Identify the symptoms of the following crop diseases

#### Corn

ear rots  
 gray leaf spot  
 corn leaf blights  
 seedling blights  
 stalk rots  
 rusts

#### Soybeans

brown stem rot  
 phytophthora root rot  
 seedling blights  
 soybean cyst nematode  
 sudden death syndrome  
 sclerotinia stem rot  
 bean pod mottle virus  
 Asian rust

#### Wheat

barley yellow dwarf virus  
 head scab  
 powdery mildews  
 rusts  
 septoria glume blotch  
 septoria leaf blotch complex

#### Alfalfa

phytophthora  
 anthracnose  
 bacterial wilt  
 leaf spots

15. Explain how the following factors affect the severity of crop disease damage
  - a. cultivar or hybrid selection
  - b. fertility practices
  - c. insect vectors
  - d. date of planting
  - e. weather events
  - f. tillage system
  - g. crop rotation
  - h. soil compaction
  - i. alternate host
  
16. Describe how the following factors affect plant disease management
  - a. time of infection
  - b. stage of crop development
  - c. environmental stresses

#### **COMPETENCY AREA 4. WEED MANAGEMENT**

##### **Weed Identification and Biology**

17. Identify the following vegetative structures of grass weeds
  - a. ligule
  - b. auricle
  - c. blade
  - d. sheath
  - e. underground structures
  - f. hairs
  
18. Identify broadleaf weeds using the following characteristics
  - a. cotyledon shape
  - b. true leaf shape
  - c. leaf arrangement
  - d. underground structures
  - e. seed
  
19. Identify the following weeds at seedling, vegetative and reproductive growth stages
 

<u>Sedges and Grasses</u>	<u>Broadleaves</u>	<u>Broadleaves</u>
barnyardgrass	bindweeds	kochia
crabgrasses	burcucumber	lambsquarters
fall panicum	Canada thistle	morningglories
giant foxtail	common chickweed	pigweeds
green foxtail	common cocklebur	poison hemlock
yellow foxtail	common milkweed	pokeweed
Johnsongrass	common ragweed	purple deadnettle
quackgrass	giant ragweed	smartweeds
shattercane	dandelion	velvetleaf
woolly cupgrass	eastern black nightshade	waterhemp
yellow nutsedge	hemp dogbane	wild carrot
	henbit	wild garlic
	horseweed (maretail)	wild mustard
	jimsonweed	wild onion

20. Classify each weed in #19 as winter annual, summer annual, biennial, or perennial
21. Explain how tillage systems affect weed populations and species

### **Weed Control**

22. Describe plant damage symptoms for corn and soybeans caused by the following herbicide mode of action groups
  - a. amino acid synthesis inhibitors
  - b. cell growth inhibitors
  - c. cell membrane disruptors
  - d. growing point disintegrators
  - e. growth regulators
  - f. photosynthesis inhibitors
  - g. pigment inhibitors
23. Describe how to use the following cultural and mechanical methods to control weeds
  - a. crop rotation
  - b. plant population and row spacing
  - c. tillage and cultivation
  - d. planting date of crop
  - e. proper soil fertility and pH
24. Describe how to manage herbicide tolerant crop systems

### **Weed Resistance Management**

25. List factors that cause weeds to develop resistance to herbicides
26. List methods that can help prevent weeds from developing herbicide resistance
27. Describe how to identify and manage herbicide resistant weed populations

## **COMPETENCY AREA 5. HEALTH, SAFETY, AND ENVIRONMENTAL STEWARDSHIP OF PESTICIDES**

28. Explain how the following chemical factors influence the persistence and carryover of pesticides within a field environment
  - a. microbial degradation
  - b. photodegradation
  - c. chemical breakdown
  - d. volatility
  - e. sorption

29. Explain how the following environmental factors influence the persistence and carryover of pesticides within a field environment
  - a. soil pH
  - b. moisture
  - c. temperature
  - d. leaching
  - e. soil erosion
30. Explain how the pesticide signal words Caution, Warning, and Danger relate to toxicity
31. List sources of information about your state's pesticide laws
32. List record keeping requirements related to pesticides
33. Using information on a label or Material Safety Data Sheet (MSDS), determine the following
  - a. toxicity
  - b. handling precautions
  - c. first aid procedures
  - d. safety information
  - e. environmental hazards
  - f. dosage or use rate
  - g. application restrictions
  - h. Re-Entry Interval (REI)

## **COMPETENCY AREA 6. PESTICIDE PERFORMANCE AND APPLICATION**

### **Pesticide Performance**

34. Recognize how soil and environmental factors affect pesticide performance
35. Explain how timing of application affects pesticide performance
36. Describe how to use the following information to develop a pest management program
  - a. field pest history
  - b. severity of infestation
  - c. crop growth stage
  - d. application method
  - e. economic threshold
  - f. previous pesticide applications
  - g. non-pesticide alternatives

37. Describe how the following factors affect liquid pesticide performance
- a. spray pattern
  - b. spray pressure
  - c. application rate
  - d. application speed
  - e. adjuvants
  - f. pesticide compatibility
  - g. carrier
  - h. mixing order
  - i. wind speed
  - j. water characteristics

### **Pesticide Application**

38. Describe how the following pesticide formulations differ
- a. water soluble liquids
  - b. water soluble powders
  - c. wettable powders
  - d. emulsifiable concentrates
  - e. water dispersible granules
  - f. pellets
  - g. granules
39. Describe the pattern form, relative droplet size, proper pattern overlap, operating pressure, and primary uses of the following nozzle types
- a. standard flat fan
  - b. even flat fan
  - c. flood tip
  - d. air injection
  - e. twin jet
40. List consequences of inadequate spray equipment
41. Explain why frequency of cleaning spray equipment is important
42. Distinguish spray particle drift from volatilization

## **Tri-State Certified Crop Adviser**

### **CROP MANAGEMENT COMPETENCY AREAS:**

1. Cropping Decisions
2. Hybrid and Variety Selection
3. Crop Growth, Development, and Diagnostics
4. Crop Harvesting, Handling, and Storage
5. Managing Agronomic Information

# **CROP MANAGEMENT**

## **COMPETENCY AREA 1. CROPPING DECISIONS**

1. Compare and contrast continuous and rotational crop systems
2. Describe how the following affect management decisions within a rotational system
  - a. pest resistance
  - b. pest persistence
  - c. crop traits
3. Describe environmental and economic factors which influence selection of a tillage system
4. List advantages and limitations of intensive, reduced, strip-till, and no-till systems
5. Describe consequences of planting corn, soybeans, or wheat earlier or later than optimum
6. Describe how row spacing affects the following
  - a. weed control
  - b. disease control
  - c. crop yield
  - d. interplant competition
  - e. lodging
7. Describe how the following factors influence optimum population
  - a. soil type
  - b. planting date
  - c. hybrid and variety
  - d. row spacing
8. List advantages and limitations of growing pure grass or legume stands versus mixed stands

## **COMPETENCY AREA 2. HYBRID AND VARIETY SELECTION**

9. Describe how the following characteristics influence hybrid and variety selection:
  - a. maturity rating for corn, soybeans, and wheat
  - b. lodging resistance in corn, soybeans, and wheat
  - c. pest resistance in corn, soybeans, wheat, and alfalfa
  - d. winter hardiness of wheat and alfalfa
  - e. intended end use of corn, soybeans, wheat, and alfalfa
10. Describe how planting date affects hybrid and variety selection
11. Describe how tillage systems affect hybrid and variety selection

12. Describe the advantages and limitations of growing the following:
  - a. herbicide resistant crops
  - b. insect resistant crops
  - c. disease resistant crops
  - d. non-GM crops
13. Describe the agronomic and economic advantages and limitations of growing value-added crops

### **COMPETENCY AREA 3. CROP GROWTH, DEVELOPMENT, AND DIAGNOSTICS**

14. Use the Iowa State system to identify corn and soybean growth stages
15. Identify the location of growing points through V6 stage of corn and soybeans
16. Identify the soybean growth stage when nitrogen fixation begins
17. Use the Feeke's scale to identify each of the following growth stages in wheat
  - a. emergence
  - b. tillering
  - c. jointing
  - d. boot
  - e. flag leaf emergence
  - f. physiological maturity
18. Describe how corn, soybeans, and wheat respond to row spacing, population, and in-row plant spacing variation
19. Describe physical damage to corn, soybeans, wheat, and alfalfa from
  - a. hail
  - b. frost
  - c. flooding
  - d. drought
20. Identify the most susceptible growth stage of corn, soybeans, wheat, and alfalfa for each type of damage in #19
21. Use the following factors to make a replant decision
  - a. type and level of crop damage
  - b. crop growth stage
  - c. date
  - d. potential yield
  - e. weather

22. Identify the following growth stages of alfalfa
  - a. vegetative
  - b. flowering
  - c. one-tenth bloom
  - d. full bloom
23. Identify wheat and alfalfa frost heaving damage

#### **COMPETENCY AREA 4. CROP HARVESTING, HANDLING, AND STORAGE**

24. Describe how the following factors affect harvest practices and timing
  - a. crop moisture
  - b. drying cost
  - c. weather forecast
  - d. forage growth stage
  - e. pest population and activity
  - f. susceptibility to lodging
25. Identify the following causes of harvest loss in corn, soybeans, wheat, and forages due to
  - a. machine operation
  - b. environmental conditions
  - c. nutrient deficiencies
  - d. pest infestations
26. Describe how storage moisture, temperature, and pests affect grain quality and marketability
27. Describe harvest, handling, and storage practices for identity-preserved (IP) crops
28. Describe how timing and frequency of perennial forage harvest affects
  - a. legume/grass mix
  - b. stand longevity
  - c. forage quality
  - d. annual yield

#### **COMPETENCY AREA 5. MANAGING AGRONOMIC INFORMATION**

29. Describe how the following affect reliability of agronomic trials:
  - a. weather variability
  - b. field variability
  - c. number of locations
  - d. number of treatments
  - e. number of replications
30. Develop an agronomic trial to compare treatment effects
31. Relate site specific information to yield map variability

# RESOURCE MATERIALS FOR THE TRI-STATE CERTIFIED CROP ADVISER PROGRAM

The Certified Crop Adviser (CCA) Program is an educational program with two main goals: to certify individuals who have passed a minimum competency examination, and to establish a mechanism of continuing education for those already certified. More information can be found about the program by visiting the CCA homepage at [www.agronomy.org/cca/](http://www.agronomy.org/cca/)

This document contains resource materials that address the competency areas and performance objectives of the Tri-State Certified Crop Adviser Program. It is intended to provide guidance, for those seeking certification, on where to obtain information about knowledge and skills used by CCA's.

## Resources for the Tri-State Certified Crop Adviser Program

### Nutrient Management and Soil and Water Management

1. *Soil Science & Management* by Edward J. Plaster, 3rd ed., ©1997, Delmar Publishers: Albany NY
2. *Fundamentals of Soil Science* by Henry D. Foth, 8th ed., ©1990, John Wiley & Sons Publishing: NYC NY
3. *The Nature and Properties of Soils* by Nyle C. Brady & Ray R. Weil, 12th ed., ©1999, Prentice Hall: Upper Saddle River NJ
4. *Soils in our Environment* by Roy L. Donahue & Raymond W. Miller, 7th ed., ©1995, Prentice Hall: Englewood Cliffs NJ
5. *Soil Fertility* by Boyd G. Ellis & Henry D. Foth, 2nd ed., ©1997, CRC Press: Boca Raton FL
6. *Soils in our Environment* by Duane T. Gardiner & Raymond W. Miller, 8th ed., ©1998, Prentice Hall: Upper Saddle River NJ
7. *Soils and Soil Fertility* by Louis M. Thompson & Frederick R. Troeh, 5th ed., ©1993, Oxford University Press: NYC NY
8. *Natural Resource Conservation* by D. D. Chiras & Oliver S. Owen, 6th ed., ©1995, Prentice Hall: Upper Saddle River NJ

### Integrated Pest Management

1. *Applied Weed Science* by Carole A. Lembi & Merrill A. Ross, 2nd ed., ©1999, Prentice Hall: Upper Saddle River NJ
2. *Seed Corn Pest Management Manual for the Midwest* by multiple authors, Rev. 4/1995, Purdue University Pest Management Program, Purdue Cooperative Extension Service, and the Department of Botany & Plant Pathology

3. *Pest Management* by G. A. Matthews, ©1984, Longman Group Ltd: NYC NY
4. *The Science of Entomology* by William S. Romoser & John G. Stoffolano Jr., 4th ed., ©1998, WCB/McGraw-Hill: NYC NY
5. *The Standard Pesticide User's Guide* by Bert L. Bohmont, 5th ed., ©2000, Prentice Hall: Upper Saddle River NJ
6. *Entomology & Pest Management* by Larry P. Pedigo, 4th ed., ©2002, Prentice Hall: Upper Saddle River NJ
7. *The Biochemistry & Uses of Pesticides* by Kenneth A. Hassall, 2nd ed., ©1990, VCH Publishers Inc: NYC NY
8. *Application Technology for Crop Protection* by G. A. Matthews & E. C. Hislop, ©1993, CAB Int'l: UK
9. *Pesticide Application Methods* by G. A. Matthews, 2nd ed., ©1992, Longman Group UK Ltd: UK
10. *Chemical Exposures: Low Levels & High Stakes* by Nicholas A. Ashford & Claudia S. Miller, ©1991, Van Nostrand Reinhold: NYC NY
11. *Pesticides: Minimizing the Risks* by Ronald J. Kuhr & Nancy N. Ragsdale, ©1987, American Chemical Society: Wash DC
12. *Pesticide Application: Principles & Practice* by P. T. Haskell, ©1985, Clarendon Press: Oxford
13. *CD-AY-3 Broadleaf Weed Seedling Identification*, Purdue University Media Distribution Center
14. *Field Crop Pest Management Manual* by multiple authors, © rev 1/2000, Purdue University Cooperative Extension Service, Purdue University Departments of Botany and Plant Pathology and Entomology.

### **Crop Management & Production Systems**

1. *Crop Science: Principles & Practice* by Russell E. Mullen, 2nd ed., ©1995, Burgess Publishing: Edina MN
2. *Modern Corn & Soybean Production* by multiple authors, 1st ed., ©2000, MSCP Publications: Champaign IL
3. *Crop Production* by James J. Vorst, 5th ed., ©1998, Stipes Publishing LLC: Champaign IL
4. *Sustainable Agriculture Systems* by J. L. Hartfield & D. L. Karlen, ©1994, Lewis Publishers: Boca Raton FL
5. *Sustainable Agricultural Systems* by several editors, ©1990, Soil & Water Conservation Society
6. *How a Corn Plant Develops: Special Report #48* by several authors, Rev. 1/1997, Iowa State University: Ames IA
7. *How a Soybean Plant Develops: Special Report #53* by several authors, Rev. 6/1997, Iowa State University: Ames IA
8. *Agry375 - Crop Production Systems* by Lee E. Schweitzer, 2001 ed., Purdue University School of Agriculture
9. *Corn & Soybean Field Guide* by multiple editors, 2004 ed., Purdue Crop Diagnostic Training & Research Center and Purdue Pest Management Program: West Lafayette IN

10. *CD-AY-1 Corn Growth, Development, & Diagnostics: Germination to Knee High*, Purdue University Media Distribution Center
11. *CD-AY-2 Corn Growth, Development, & Diagnostics: Knee High to Maturity*, Purdue University Media Distribution Center
12. *Forage Field Guide* by multiple editors, 2003 ed., Purdue Crop Diagnostic Training & Research Center: West Lafayette, IN
13. *Corn, Soybean, Wheat, and Alfalfa Field Guide* by multiple editors, 2002 ed., Ohio State University Extension

## **USEFUL WEBSITES**

1. Purdue Agronomy Extension Publications:  
[www.ces.purdue.edu/extmedia/agronomy.htm](http://www.ces.purdue.edu/extmedia/agronomy.htm)
2. Weed Science Society of America: [www.wssa.net](http://www.wssa.net)
3. National Corn Growers Association: [www.ncga.com](http://www.ncga.com)
4. Herbicide Safety Information: [www.cdms.net/manuf/manuf.asp](http://www.cdms.net/manuf/manuf.asp)
5. Herbicide Safety Information: [www.greenbook.net](http://www.greenbook.net)
6. Field Crops Entomology IPM: <http://www.entm.purdue.edu/fieldcropsipm>
7. Weed Science: [www.weedscience.com](http://www.weedscience.com)
8. Extensive Corn related Information: [www.kingcorn.org](http://www.kingcorn.org)
9. Hybrid & Variety Performance: [vt.cropsci.uiuc.edu/](http://vt.cropsci.uiuc.edu/)
10. Purdue Agricultural Extension Publications:  
[www.agcom.purdue.edu/AgCom/Pubs/menu.htm](http://www.agcom.purdue.edu/AgCom/Pubs/menu.htm)
11. Purdue Agronomy OnLine: [www.agry.purdue.edu](http://www.agry.purdue.edu)
12. Various Soybean Information: [www.stratsoy.uiuc.edu](http://www.stratsoy.uiuc.edu)
13. Integrated Pest Management: [www.gemplers.com/pages/techserv.aspx](http://www.gemplers.com/pages/techserv.aspx)
14. Midwest Corn Insect Diagnostic guide:  
<http://muextension.missouri.edu/xplor/manuals/m00166.htm>
15. Purdue Entomology Extension Publications:  
<http://www.entm.purdue.edu/Entomology/ext/targets/e-series/e-list.htm>
16. Purdue Entomology Image Links:  
<http://www.entm.purdue.edu/entomology/courses/307b/images.html>
17. Purdue Botany Extension Publications: <http://www.btny.purdue.edu/Pubs/>
18. Purdue Botany Extension Links: <http://www.btny.purdue.edu/Extension/>
19. NRCS-Natural Resources Conservation Service: [www.nrcs.usda.gov](http://www.nrcs.usda.gov)
20. Ohio State University-Ohionline links: <http://ohionline.osu.edu/index.html>
21. National Sustainable Agriculture Information Service: <http://www.attra.org>
22. Corn information: <http://corn.osu.edu>
23. Tillage, Manure Management, and Water Quality:  
<http://www.extension.iastate.edu/Publications/PM1901H.pdf>
24. Iowa Manure Management Action Group:  
<http://www.agronext.iastate.edu/immag/sp.html>
25. ARS Manure and Byproduct Utilization National Program (206):  
[http://www.ars.usda.gov/research/programs/programs.htm?np\\_code=206&docid=246](http://www.ars.usda.gov/research/programs/programs.htm?np_code=206&docid=246)