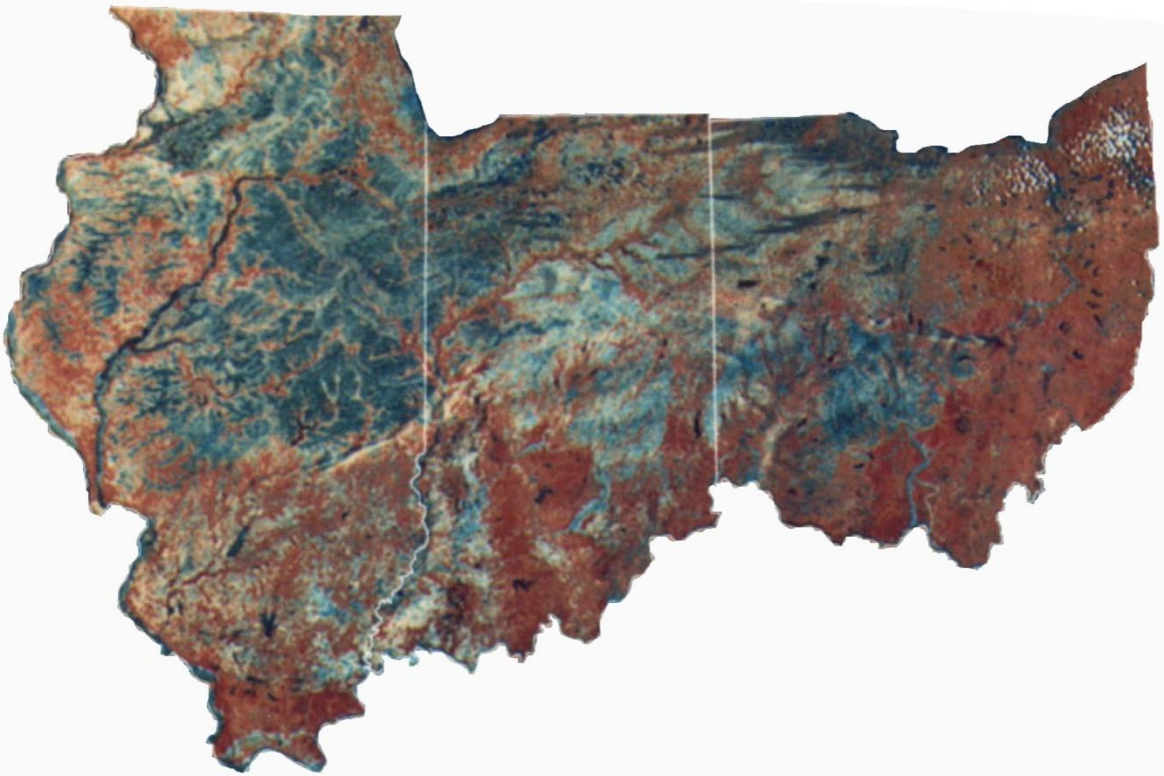


PERFORMANCE OBJECTIVES

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



2015

Tri-State Certified Crop Adviser Performance Objectives
(Revised & Effective December 1, 2015)

CONTENTS

INTRODUCTION.....	1
<u>NUTRIENT MANAGEMENT COMPETENCY AREAS</u>	2
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
<u>SOIL AND WATER MANAGEMENT COMPETENCY AREAS</u>	7
1 - Natural Resource Conservation Issues	8
2 - Soil Productivity and Environmental Management.....	8
3 - Water Quality	9
4 - Soil Erosion.....	10
<u>INTEGRATED PEST MANAGEMENT (IPM) COMPETENCY AREAS</u>	12
1 - IPM Principles and Concepts.....	13
2 - Insect Management	13
3 - Crop Disease and Nematode Management.....	14
4 - Weed Management	15
5 - Health, Safety, and Environmental Stewardship of Pesticides	17
6 - Pesticide Performance and Application	17
7 - Pest Resistance Management	19
<u>CROP MANAGEMENT COMPETENCY AREAS</u>	20
1 - Cropping Decisions.....	21
2 - Hybrid and Variety Selection.....	22
3 - Crop Growth, Development, and Diagnostics	22
4 - Crop Harvesting, Handling, and Storage	23
5 - Managing Agronomic Information	24
RESOURCE MATERIAL INFORMATION	25

**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.

Tri-State PO Committee
November 2015

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
 - h. tile drainage

COMPETENCY AREA 2. NUTRIENT APPLICATION, AVAILABILITY, AND UPTAKE

1. Recognize how the following affect nitrogen fertilization practices
 - a. soil texture
 - b. soil organic matter
 - c. crop and cropping system
 - d. soil moisture
 - e. soil temperature
 - f. time and method of application
2. Describe how soil pH and soil nitrogen levels affect nitrogen fixation
3. Describe how to use the following nitrogen fertilizers
 - a. anhydrous ammonia
 - b. urea
 - c. Urea/Ammonium-Nitrate (UAN) solutions
 - d. ammonium sulfate
 - e. manure/biosolids
4. Explain factors affecting when to apply the fertilizers listed in #3
5. Describe characteristics of slow and controlled release fertilizers
6. Explain when to use urease and nitrification inhibitors in a nitrogen fertilization program

7. 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 and cropping system
 - h. source of P
 - i. band vs. broadcast application

8. 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 and cropping system
 - f. cation exchange capacity (CEC)
 - g. fall, winter, or spring application

9. List advantages and limitations of banded and seed placed methods of applying N, P, and K fertilizers

10. Describe environmental and economic impacts of the following on applying N, P, and K
 - a. time
 - b. method
 - c. form

COMPETENCY AREA 3. CROP NUTRIENT DEFICIENCIES

1. Recognize nitrogen deficiency symptoms in corn, soybeans, wheat, and alfalfa
2. Recognize phosphorus deficiency symptoms in corn, soybeans, wheat, and alfalfa
3. Recognize potassium deficiency symptoms in corn, soybeans, wheat, and alfalfa
4. Identify plant deficiency symptoms for the following
 - a. magnesium in corn
 - b. sulfur in corn and alfalfa
 - c. zinc in corn
 - d. boron in alfalfa
 - e. iron or manganese in soybeans
5. Describe how to apply nutrients for correcting deficiencies listed in #1-4
6. List soil characteristics and cropping systems that contribute to causing nutrient deficiencies listed #1-4

7. Describe environmental conditions that cause deficiencies in #1-4

COMPETENCY AREA 4. SOIL TEST INTERPRETATION

1. 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
2. Explain why phosphorus recommendations differ between Bray P1 and Mehlich-3 soil test procedures
3. Explain how to interpret soil nitrate and incubation tests for nitrogen availability

COMPETENCY AREA 5. LIME APPLICATION AND SOIL PH

1. Recognize how the following factors affect lime application
 - a. tillage system
 - b. crop and cropping system
 - c. soil type
 - d. soil pH and buffer pH
 - e. timing of surface urea application
2. Describe how dolomitic differs from calcitic limestone
3. Describe how fineness and purity influence lime quality
4. Recognize how soil pH affects nutrient availability
5. Describe appropriate uses of liquid or pelletized lime
6. Explain how soil pH affects herbicide activity

COMPETENCY AREA 6. MANURES AND BIOSOLIDS

1. List nutrient availability rates from manure/biosolids
2. Describe advantages and limitations of using manure/biosolids as nutrient sources
3. Describe timing, methods, and rates of applying manures and biosolids

COMPETENCY AREA 7. NUTRIENT MANAGEMENT PLANNING

1. Name the agency responsible for overseeing Nutrient Management Plans
2. Use soil test reports to make economically and environmentally sound fertilizer recommendations
3. List the purposes of a nutrient management plan
4. 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/biosolids management
2. Describe how the following practices affect soil and water conservation
 - a. tillage/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

1. Explain how the following affect soil and crop productivity potential
 - a. soil nutrient level
 - b. tillage/residue management
 - c. crop rotation
 - d. soil organisms
 - e. drainage
 - f. cover crops
 - g. soil texture
 - h. soil organic matter

2. Describe how the following factors influence soil temperature and moisture
 - a. plant cover
 - b. surface residue
 - c. tillage system
 - d. soil organic matter
 - e. soil texture
 - f. drainage

3. Describe how the following influence soil compaction
 - a. soil moisture
 - b. soil texture
 - c. organic matter
 - d. tillage practices
 - e. traffic patterns
 - f. livestock
 - g. machinery

4. Explain how the following factors influence water infiltration into soil
 - a. plant cover
 - b. surface residue
 - c. tillage system
 - d. soil slope
 - e. soil compaction
 - f. soil properties

COMPETENCY AREA 3. WATER QUALITY

1. Define hypoxia

2. Define eutrophication

3. Describe how the following influence movement of pollutants in surface water quality
 - a. soil permeability
 - b. topography
 - c. cropping practices
 - d. surface and subsurface drainage
 - e. controlled drainage
 - f. pollutant characteristics
 - g. conservation buffer strips and setbacks
 - h. soil test nutrient levels
 - i. tillage practices
 - j. livestock operations
 - k. nutrient application methods

4. Explain how the following influence movement of pollutants in groundwater
 - a. pollutant characteristics
 - b. slope
 - c. nutrient type, form and time of application
 - d. water table depth
 - e. soil permeability
 - f. restrictive layers
 - g. soil nutrient levels
 - h. Karst topography
 - i. exposed sand and gravel
 - j. abandoned wells
 - k. livestock lots
5. Describe nutrient application practices that minimize nutrient loss from a field
6. Define total maximum daily load (TMDL)
7. Define water quality impairment
8. Describe how the following affect water quality
 - a. sediments
 - b. nutrients
 - c. pathogens
 - d. pesticides
9. Describe soil characteristics that affect rate of liquid manure/waste application

COMPETENCY AREA 4. SOIL EROSION

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

4. Describe how the following management practices affect erosion by wind
 - a. tillage/residue management
 - b. surface roughness
 - c. row direction
 - d. crop strip width
 - e. windbreak
 - f. cover crops
5. Describe how water and sediment control basins, grassed waterways, and grade stabilization structures affect erosion
6. Describe how wind erosion damages growing crops
7. 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 and Nematode Management
4. Weed Management
5. Health, Safety, and Environmental Stewardship of Pesticides
6. Pesticide Performance and Application
7. Pest Resistance Management

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
 - f. weather conditions
3. Describe how to use a weed identification or dichotomous key
4. Describe how the following environmental factors affect pest management recommendations
 - a. low temperature stress
 - b. drought
 - c. heat stress
 - d. excessive moisture
 - e. crop competition or density
 - f. humidity extremes
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 management methods

COMPETENCY AREA 2. INSECT MANAGEMENT

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

Adult

bean leaf beetle
corn flea beetle

Adult and Larval or Nymph

aphids
stink bugs
corn rootworms
European corn borer
Hessian fly
Japanese beetle
potato leafhopper
spider mites

Larval

alfalfa weevil
armyworm
cutworms
corn earworm
seedcorn maggot
slugs
stalk borer
western bean cutworm
white grubs
wireworms

2. Identify crop injury symptoms caused by each pest in objective #1
3. Describe management strategies for each pest in objective #1
4. 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
 - e. sucking or chewing mouthparts
5. Explain how an insect's overwintering and oversummering strategies affect pest management decisions
6. Describe how the following cropping practices affect management and potential crop damage from insects
 - a. planting date
 - b. harvest date
 - c. tillage method
 - d. presence of weeds
 - e. pesticide interactions
 - f. insecticide selection and application method
 - g. hybrid, variety and trait selection
 - h. crop rotation

COMPETENCY AREA 3. CROP DISEASE AND NEMATODE MANAGEMENT

1. Identify the symptoms of the following crop diseases

Corn

anthracnose stalk rot
 Aspergillus ear rot
 diplodia stalk and ear rot
 fusarium stalk and ear rot
 gibberella stalk and ear rot
 Goss's leaf blight
 gray leaf spot
 nematodes
 northern corn leaf blight
 rusts
 seedling blights

Soybeans

Asian rust
 bean pod mottle virus
 brown stem rot
 brown spot
 frog-eye leaf spot
 phytophthora stem and root rot
 sclerotinia stem rot
 seedling blights
 soybean cyst nematode
 soybean vein necrosis virus
 sudden death syndrome

Wheat

barley yellow dwarf virus
 head scab
 powdery mildews
 rusts
 Septoria leaf blotch
 Stagonospora glume blotch
 Stagonospora leaf blotch

Alfalfa

anthracnose
 bacterial wilt
 leaf spots
 phytophthora

2. Describe how the diseases in objective #1 affect crop growth, quality, and productivity
3. Describe management strategies for each disease in objective #1
4. Explain how the following factors affect crop disease damage and management
 - a. cultivar or hybrid selection
 - b. fertility practices
 - c. insect vectors
 - d. date of planting
 - e. time of infection/crop stage
 - f. environmental stresses
 - g. tillage system
 - h. crop rotation
 - i. soil compaction
 - j. alternate host
5. Describe how disease race affects hybrid and variety selection

COMPETENCY AREA 4. WEED MANAGEMENT

Weed Identification and Biology

1. Identify the following vegetative structures of grass weeds
 - a. ligule
 - b. auricle
 - c. blade
 - d. sheath
 - e. leaf and stem pubescence
2. Identify broadleaf weeds using the following characteristics
 - a. cotyledon shape
 - b. true leaf shape
 - c. leaf arrangement
 - d. leaf and stem pubescence
 - e. seed
3. Identify the following grass and broadleaf reproductive structures
 - a. seed heads
 - b. seeds
 - c. stolons
 - d. rhizomes
 - e. tubers and bulbs

4. Identify the following weeds at seedling, vegetative and reproductive growth stages

Sedges and Grasses

barnyardgrass
crabgrasses
fall panicum
giant foxtail
green foxtail
yellow foxtail
Johnsongrass
quackgrass
shattercane
woolly cupgrass
yellow nutsedge

Broadleaves

bindweeds
burcucumber
Canada thistle
common chickweed
common cocklebur
common milkweed
common ragweed
giant ragweed
dandelion
eastern black nightshade
hemp dogbane
henbit
horseweed (marestail)
jimsonweed

Broadleaves

kochia
lambsquarters
morningglories
Palmer amaranth
pigweed species
poison hemlock
pokeweed
purple deadnettle
smartweeds
velvetleaf
waterhemp
wild carrot
wild garlic
wild mustard
wild onion

5. Classify each weed in #4 as winter annual, summer annual, biennial, or perennial
6. Explain how tillage systems affect weed infestations, seed bank dynamics, and species composition

Weed Control

7. Describe plant damage symptoms for corn and soybeans caused by the following WSSA-Weed Science Society of America herbicide MOA-mode of action groups
- Group 1: ACCase inhibitors
 - Group 2: ALS inhibitors
 - Group 3: seedling root inhibitors
 - Group 4: synthetic auxins
 - Groups 5, 6, 7: photosystem II inhibitors
 - Group 9: EPSP inhibitors
 - Group 10: nitrogen metabolism inhibitors
 - Group 14: cell membrane disrupters
 - Group 15: seedling shoot inhibitors
 - Group 22: photosystem I inhibitors
 - Groups 27, 28: pigment inhibitors
8. Describe how to use the following to manage weeds
- crop rotation
 - plant population and row spacing
 - tillage and cultivation
 - planting date of crop
 - proper soil fertility and pH
 - herbicide tolerant crops
 - herbicides

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

1. Explain how the following soil physical and 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
 - f. soil pH
 - g. organic matter
 - h. soil texture
2. Explain how the following cultural and environmental factors influence the persistence and carryover of pesticides within a field environment
 - a. moisture
 - b. temperature
 - c. leaching
 - d. soil erosion
 - e. crop residue
 - f. timing of application
3. Explain how the pesticide signal words Caution, Warning, and Danger relate to toxicity
4. List sources of information about your state's pesticide laws
5. List record keeping requirements related to pesticides
6. Using information on a label or Material Safety Data Sheet (MSDS), determine the following
 - a. toxicity
 - b. handling precautions
 - c. first aid procedures
 - d. environmental hazards
 - e. dosage or use rate
 - f. application restrictions
 - g. Re-Entry Interval (REI)
 - h. WSSA-MOA group number

COMPETENCY AREA 6. PESTICIDE PERFORMANCE AND APPLICATION

Pesticide Performance

1. Recognize how soil and environmental factors affect pesticide performance
2. Explain how timing of application affects pesticide performance
3. Understand the pesticides that may control, or only partially suppress, pests.

4. 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. previous/current tillage system
 - h. non-pesticide alternatives

5. Describe how the following spray application 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. water characteristics
 - j. micronutrients

6. Describe how the following environmental factors can affect liquid pesticide performance
 - a. wind speed
 - b. wind direction
 - c. rainfall
 - d. temperature
 - e. humidity

Pesticide Application

1. Describe how the following pesticide formulations differ
 - a. water soluble liquids
 - b. water soluble powders
 - c. water soluble concentrates
 - d. wettable powders
 - e. emulsifiable concentrates
 - f. water dispersible granules
 - g. pellets
 - h. granules

2. 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 induction
 - e. twin jet

3. Describe the sprayer and environmental factors to consider to minimize off-target movement from a herbicide application
 - a. wind speed
 - b. wind direction
 - c. humidity

- d. temperature inversion
 - e. nozzle type
 - f. spray volume
 - g. spray pressure
 - h. sprayer boom height
4. List consequences of inadequate spray equipment
 5. Explain why frequency of cleaning spray equipment is important
 6. Distinguish spray particle drift from volatilization

COMPETENCY AREA 7. PEST RESISTANCE MANAGEMENT

1. Explain why refuge design in insect resistant crops varies with insect species and traits
2. List factors that cause pests to develop resistance to pesticides
3. List methods that can help prevent weeds from developing herbicide resistance
4. Describe how to identify and manage herbicide resistant weed populations
5. Describe how the following influence the evolution of resistance
 - a. number and type of traits
 - b. pest life cycle
 - c. pest's genetics
 - d. refuge requirements
 - e. crop rotation
 - f. diversity of pest control methods
 - g. layering of products

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. Describe how the following affect management decisions within continuous and rotational systems
 - a. pest resistance
 - b. pest persistence
 - c. crop traits
 - d. residue management
 - e. tillage
 - f. nutrient management
 - g. soil physical properties
2. Describe environmental and economic factors which influence selection of a tillage system
3. List agronomic advantages and limitations of intensive, reduced, strip-till, and no-till systems
4. Describe consequences of planting corn, soybeans, wheat, or forage crops earlier or later than optimum
5. Describe how row spacing affects the following
 - a. weed control
 - b. disease control
 - c. insect control
 - d. crop yield
 - e. interplant competition
 - f. lodging
6. Describe how the following factors influence selection of optimum population
 - a. soil type
 - b. planting date
 - c. hybrid and variety
 - d. row spacing
 - e. irrigation
 - f. soil productivity index or rating
 - g. economics
7. Describe the role of cover crops in the following
 - a. nutrient management
 - b. soil conservation
 - c. soil physical properties
 - d. herbicide selection
 - e. pest cycles
 - f. beneficial organisms

COMPETENCY AREA 2. HYBRID AND VARIETY SELECTION

1. Describe how the following influence hybrid and variety selection:
 - a. yield potential for corn, soybeans, and wheat
 - b. maturity rating for corn, soybeans, and wheat
 - c. lodging resistance in corn, soybeans, and wheat
 - d. pest resistance in corn, soybeans, wheat, and alfalfa
 - e. winter hardiness of wheat and alfalfa
 - f. intended end use of corn, soybeans, wheat, and alfalfa
2. Describe how the following affect transgenic crop selection
 - a. refuge requirements
 - b. weed management programs
 - c. insect management programs
 - d. trait characteristics
 - e. presence of weed resistance
 - f. presence of insect resistance
3. Describe how planting date affects hybrid and variety selection
4. Describe how tillage systems affect hybrid and variety selection
5. Describe the advantages and limitations of growing the following:
 - a. herbicide tolerant crops
 - b. insect tolerant crops
 - c. disease tolerant crops
 - d. non-transgenic crops
 - e. drought tolerance crops
6. Describe the agronomic and economic advantages and limitations of growing value-added crops

COMPETENCY AREA 3. CROP GROWTH, DEVELOPMENT, AND DIAGNOSTICS

1. Use the Iowa State system to identify corn and soybean growth stages
2. Identify the location of growing points through vegetative stages of corn and soybeans
3. Differentiate soybean fixation nodules and soybean cysts
4. Use the Feeke's scale to identify each of the following growth stages in cereal grains
 - a. emergence
 - b. tillering
 - c. jointing
 - d. boot
 - e. flag leaf emergence
 - f. flowering
 - g. physiological maturity
5. Describe how corn, soybeans, and wheat respond to row spacing, population, and in-row plant spacing variation

6. Use the node injury scale to quantify corn root injury
7. Describe physical damage to corn, soybeans, wheat, and alfalfa from
 - a. hail
 - b. frost
 - c. flooding
 - d. drought
 - e. wind
8. Identify the most susceptible growth stage of corn, soybeans, wheat, and alfalfa for each type of damage in #7
9. Describe how the following inhibit stand development and plant growth
 - a. planter operation
 - b. pesticide application
 - c. pests
 - d. soil factors
 - e. climatic factors
 - f. nutrient placement
 - g. residue management
10. Use the following factors to make a replant decision
 - a. type and level of crop damage
 - b. crop growth stage
 - c. calendar date
 - d. existing population and stand uniformity
 - e. potential yield
 - f. environmental factors
11. Describe how crop and pest growth stages affect the following management decisions
 - a. pest management
 - b. nutrient management
 - c. water management
 - d. tillage
12. Identify the following growth stages of alfalfa
 - a. vegetative
 - b. flowering
 - c. one-tenth bloom
 - d. full bloom
13. Identify wheat and alfalfa frost heaving damage

COMPETENCY AREA 4. CROP HARVESTING, HANDLING, AND STORAGE

1. Describe how the following factors affect harvest practices and timing
 - a. crop moisture
 - b. drying cost
 - c. forage growth stage
 - d. pest population and activity
 - e. susceptibility to lodging

2. Identify causes of harvest loss in corn, soybeans, wheat, and forages due to the following
 - a. machine operation
 - b. environmental conditions
 - c. nutrient deficiencies
 - d. pest infestations
 - e. crop moisture
3. Describe how storage moisture, temperature, and pests affect grain quality and marketability
4. Describe harvest, handling, and storage practices for identity-preserved (IP) crops
5. 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

1. 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
 - f. trial and sample size
2. Relate site specific information to yield map variability
3. Describe how to use crop management data to make crop management decisions
4. Describe how to use the following to determine crop variability
 - a. yield monitor
 - b. soil sampling
 - c. tissue sampling
 - d. remote sensing rating
 - e. as-applied maps
5. Describe how to calibrate a yield monitor and equipment

**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.certifiedcropadviser.org

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. Weed Science Society of America: www.wssa.net
2. National Corn Growers Association: www.ncga.com
3. Herbicide Safety Information: www.cdms.net/manuf/manuf.asp
4. Herbicide Safety Information: www.greenbook.net
5. Field Crops Entomology IPM: <http://www.entm.purdue.edu/fieldcropsipm>
6. Weed Science: www.weedscience.com
7. Extensive Corn related Information: www.kingcorn.org
8. Hybrid & Variety Performance: <http://vt.cropsci.illinois.edu/>
9. Purdue Agricultural Extension Publications:
<https://mdc.itap.purdue.edu/dept.asp>
10. Purdue Agronomy OnLine: www.ag.purdue.edu/agry
11. Various Soybean Information: www.vipsoybeans.org
12. Integrated Pest Management: www.gemplers.com/tech
13. Midwest Corn Insect Diagnostic guide: <http://extension.missouri.edu/p/M166>
14. Purdue Entomology Extension Publications:
<http://www.extension.entm.purdue.edu>
15. Purdue Botany Extension Publications:
<https://ag.purdue.edu/btny/Extension/Pages/ExtPubs.aspx>
16. Purdue Botany Extension Links:
https://ppdl.purdue.edu/PPDL/reference_links.html
17. NRCS-Natural Resources Conservation Service: www.nrcs.usda.gov
18. Ohio State University-Ohionline links: <http://ohionline.osu.edu/index.html>
19. National Sustainable Agriculture Information Service:
<http://www.attra.ncat.org>
20. Corn information: <http://corn.osu.edu>
21. Tillage, Manure Management, and Water Quality:
<http://www.extension.iastate.edu/Publications/PM1901H.pdf>
22. Iowa Manure Management Action Group:
<http://www.agronext.iastate.edu/immag/sp.html>
23. ARS Manure and Byproduct Utilization National Program (206):
http://www.ars.usda.gov/research/programs/programs.htm?np_code=206