

PERFORMANCE OBJECTIVES

FOR THE

TRI-STATE CERTIFIED CROP ADVISER PROGRAM



Photo By Dennis Bowman

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Tri-State Certified Crop Adviser Performance Objectives

(Revised & Effective August 15, 2021)

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

INTRODUCTION

The Certified Crop Adviser (CCA) Program is a 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 (POs). These describe the knowledge and skills that crop advisers consider important in order to carry out their duties.

The Competency Areas and POs outlined in this publication are the result of a cooperative effort by the Illinois, Indiana, and Ohio 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 PO documents. The Tri-State POs are intended to complement and build upon the International POs. The Tri-State POs address areas of crop advising that are specific to the Tri-State Region.

The POs are dynamic and continuously updated, 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.

The following are considered Important Crops in the Tri State Region and will be the crops on which the exam will focus.

- Corn
- Soybeans
- Wheat
- Alfalfa

Tri-State PO Committee
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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. Know the following elements essential for plant growth (listed below) and understand their ionic forms, and mobility in soil and plants:
 - a. Macronutrients: C, H, O, N, P, K
 - b. Secondary Nutrients: Ca, Mg, S
 - c. Micronutrients: B, Cl, Cu, Fe, Mn, Mo, Zn

2. 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 characteristics of the following nitrogen fertilizers and how to appropriately manage their timing and placement:
 - a. anhydrous ammonia
 - b. urea
 - c. Urea/Ammonium-Nitrate (UAN) solutions
 - d. ammonium sulfate
 - e. manure/biosolids

4. Describe characteristics of slow and controlled release fertilizers.

5. Explain when to use urease and nitrification inhibitors in a nitrogen fertilization program.

6. 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

7. 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

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

9. 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 important crops in the Tri State Region.
2. Recognize phosphorus deficiency symptoms in important crops in the Tri State Region.
3. Recognize potassium deficiency symptoms in important crops in the Tri State Region.
4. Identify plant deficiency symptoms for the following:
 - a. magnesium in corn and soybeans
 - 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. Understand the mechanics of soil sampling.
 - a. Know the reasons behind grid sampling, zone sampling, and whole field sampling.
 - b. Know the importance of depth, timing, and number of samples for soil sampling.
 - c. Know the difference between predictive and diagnostic sampling.
2. 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
3. Explain why phosphorus recommendations differ between Bray P1 and Mehlich-3 soil test procedures.
4. 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. soil pH and buffer pH
 - b. crop and cropping system
 - c. soil type
 - d. tillage system
 - e. timing of surface urea application
2. Describe how dolomitic differs from calcitic limestone.
3. Describe how fineness and purity influence lime quality.
 - a. Be able to calculate lime recommendations based upon the source.
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. Know methods of determining nutrient content in manures and biosolids.
 - a. List nutrient availability rates from manure/biosolids.
 - b. Be able to calculate application rates based upon nutrient availability of dry and liquid materials.
2. Describe advantages and limitations of using manure/biosolids as nutrient sources.

3. Describe timing, methods, and rates of applying manures and biosolids.
4. Understand how to manage manures and biosolids in conjunction with commercial fertilizers.

COMPETENCY AREA 7. NUTRIENT MANAGEMENT PLANNING

1. Name the agencies responsible for overseeing Nutrient Management Plans.
2. Understand the purposes and differences between Comprehensive Nutrient Management Plans (CNMP) and a nutrient management plans.
3. Identify sources of information and processes for obtaining a nutrient management plan in your state including use of:
 - a. soil test reports to make economically and environmentally sound fertilizer recommendations
 - b. yield history
 - c. environmental assessment
 - d. record keeping
 - e. a method to update and review the plan (adaptive management)

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SOIL AND WATER MANAGEMENT COMPETENCY AREAS

1. Soil Health and Productivity
2. Drainage Management
3. Resource Concerns and Management Tools
 - Water Quality and Quantity
 - Soil Erosion
4. Natural Resource Conservation and Best Management Practices

SOIL AND WATER MANAGEMENT

COMPETENCY AREA 1. SOIL HEALTH AND PRODUCTIVITY

1. Understand the use of, and information contained in, a soil survey.
2. Be able to understand the information available for a soil series (soil type).
 - a. slope
 - b. productivity
 - c. drainage
3. 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
4. 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
5. 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
6. 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 2. DRAINAGE MANAGEMENT

1. Understand how soil texture and the soil profile affect placement and depth of tile drainage.
2. Explain how to manage edge of field practices and their downstream impact.
 - a. buffer

- b. riparian
 - c. control structures
3. Understand the value of surface drainage.
 4. Describe how planned drainage and cropping systems affect the management of wetlands.

COMPETENCY AREA 3. RESOURCE CONCERNS AND MANAGEMENT TOOLS

Water Quality and Quantity

1. Understand how nutrient loss can impact hypoxia and eutrophication.
2. 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
3. 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
4. Describe nutrient application practices that minimize nutrient loss from a field.
5. Define total maximum daily load (TMDL).
6. Define water quality impairment.
7. Describe how the following affect water quality:
 - a. sediments
 - b. nutrients
 - c. pathogens
 - d. pesticides
8. Describe soil characteristics that affect rate of liquid manure/waste application.

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. Define soil erosion tolerance level (T).
5. Define highly erodible land (HEL).
6. Describe land management practices recommended for HEL.
7. 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
8. Describe how water and sediment control basins, grassed waterways, and grade stabilization structures affect erosion.
9. Describe how wind erosion damages growing crops.
10. Describe how to use the line transect method to measure crop residue.

COMPETENCY AREA 4. NATURAL RESOURCE CONSERVATION AND BEST MANAGEMENT PRACTICES

1. Describe how the following affect conservation of natural resources:
 - a. sedimentation
 - b. soil erosion
 - c. nutrient transport (including leaching, runoff, off-target movement)
 - d. pesticide transport (including leaching, runoff, off-target movement)
 - e. fertilizer/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, and field borders
 - e. cropping systems
3. Describe how the following conservation practices impact wildlife habitat and pollinators:
 - a. crop rotation
 - b. tillage/residue management
 - c. buffer strips, riparian areas, and field borders
 4. Identify costs/benefits associated with implementing conservation measures.
 5. Identify state and federal agencies involved with soil and water management.
 6. List factors used by USDA to define a wetland (WL).

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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 and local area reports
 - 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.
7. Describe how beneficial insects are important to an IPM program.

COMPETENCY AREA 2. INSECT MANAGEMENT

1. Identify the following pests and their life stages (A=Adult, L=Larval, N=Nymph):

Corn	Soybean
Aphids – A, L, N	Asian soy aphid – A, L, N
bird cherry oat aphid	bean leaf beetle - A
corn leaf aphid	Japanese beetle – A, L, N
armyworm - L	seedcorn maggot - L
corn earworm - L	slugs - L
corn flea beetle - A	spider mites – A, L, N
corn rootworms – A, L, N	stink bugs – A, L, N
northern	wireworms - L
southern	
western	
cutworms – L	Alfalfa
European corn borer – A, L, N	alfalfa weevil - L
Japanese beetle – A, L, N	potato leafhopper – A, L, N
seedcorn maggot - L	
slugs - L	
spider mites – A, L, N	Wheat
stalk borer - L	armyworm - L
stink bugs – A, L, N	Hessian fly – A, L, N
western bean cutworm - L	Aphids – A, L, N
white grubs - L	bird cherry oat aphid
wireworms - L	corn leaf aphid

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 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	Soybeans
Anthracnose stalk rot	Asian soybean rust
Aspergillus ear rot	bean pod mottle virus
common rust	brown stem rot
corn nematodes	frogeye leaf spot
Diplodia stalk and ear rot	Phytophthora stem and root rot
Fusarium stalk and ear rot	Sclerotinia stem rot (white mold)
Gibberella stalk and ear rot	seedling blights
Goss's wilt	Septoria brown spot
gray leaf spot	soybean cyst nematode
northern corn leaf blight	soybean vein necrosis virus
seedling blights	Stagonospora glume blotch
southern rust	Stagonospora leaf blotch
tar spot	sudden death syndrome
	Alfalfa
Wheat	Anthracnose
	bacterial wilt
barley yellow dwarf virus	leaf spots
Fusarium head scab	Lepto leaf spot
powdery mildews	Phytophthora
rusts	Sclerotinia crown and stem rot
Septoria leaf blotch	Verticillium wilt

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 the disease triangle.
5. 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

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, and classification (WA=winter annual, SA=summer annual, B=biennial, P=perennial):

Sedges and Grasses	Broadleaves	Broadleaves con't
annual bluegrass WA	bindweeds P	kochia SA
barnyardgrass SA	burcucumber SA	lambsquarters SA
crabgrasses SA	Canada thistle P	morningglories SA
fall panicum SA	common chickweed WA	Palmer amaranth SA
giant foxtail SA	common cocklebur SA	redroot pigweed SA
green foxtail SA	common milkweed P	smooth pigweed SA
Johnsongrass P	common ragweed SA	poison hemlock B
quackgrass P	giant ragweed SA	pokeweed P
shattercane SA	dandelion P	purple deadnettle WA
woolly cupgrass SA	eastern black nightshade SA	smartweeds SA
yellow foxtail SA	hemp dogbane P	velvetleaf SA
yellow nutsedge P	henbit WA	waterhemp SA
	horseweed (marestail) WA/SA	wild carrot B
	jimsonweed SA	wild garlic P
		wild mustard WA

5. Explain how tillage systems affect weed infestations, seed bank dynamics, and species composition.

6. Describe how to use the following to manage 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

- f. herbicide tolerant crops
 - g. herbicides
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:
- a. Group 1: ACCase inhibitors
 - b. Group 2: ALS inhibitors
 - c. Group 3: seedling root inhibitors
 - d. Group 4: synthetic auxins
 - e. Groups 5, 6, 7: photosystem II inhibitors
 - f. Group 9: EPSP inhibitors
 - g. Group 10: nitrogen metabolism inhibitors
 - h. Group 14: cell membrane disrupters
 - i. Group 15: seedling shoot inhibitors
 - j. Group 22: photosystem I inhibitors
 - k. Groups 27, 28: pigment inhibitors

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

1. Explain how the following physical and chemical characteristics of soil and pesticides influence the persistence and carryover of pesticides within a field environment:
 - a. microbial degradation
 - b. photodegradation
 - c. chemical breakdown
 - d. volatility (it is a characteristic of the pesticide)
 - e. adsorption
 - 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. cover crop
 - g. timing of application
 - h. rate of application
 - i. tillage
3. Explain how the pesticide signal words Caution, Warning, and Danger/Poison relate to acute toxicity.
4. Know where to find sources of information about your state's pesticide laws.
5. Understand general record keeping requirements for pesticide application.
6. Understand the components of a pesticide label and be able to locate the following information:
 - a. signal word

- b. handling precautions
 - c. first aid procedures
 - d. hazards to humans and domestic animals
 - e. environmental hazards
 - f. dosage or use rate
 - g. application restrictions
 - h. Re-Entry Interval (REI)
 - i. Post Harvest Interval (PHI)
 - j. Plant back interval
 - k. WSSA-MOA group number
 - l. PPE requirements
 - m. Storage and disposal
6. Understand issues related to dicamba and other active ingredients regarding:
- a. stewardship for pollinators/endangered species and proper use
 - b. setbacks
 - c. appropriate sources of information

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. non-pesticide alternatives
 - b. field pest history
 - c. severity of infestation
 - d. crop growth stage
 - e. application method
 - f. economic threshold
 - g. previous pesticide applications
 - h. previous/current tillage system
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 quality 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
- f. time of day
- g. inversions
- h. cloud cover

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 pesticide application:
 - a. wind speed
 - b. wind direction
 - c. humidity and temperature
 - d. inversion
 - e. nozzle type
 - f. ground speed
 - g. spray volume
 - h. spray pressure
 - i. sprayer boom height
 - j. delivery mechanism
 - i) foam injection
 - ii) pivot
 - iii) aerial
 - iv) ground rig

4. List consequences of inadequate spray application.

5. Explain why frequency of cleaning spray equipment is important.

6. Distinguish spray particle drift from volatilization.

7. State the purpose of a sprayer calibration and describe the basic steps involved.

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:
 - a. insecticides
 - b. herbicides
 - c. fungicides
3. Explain how the following methods can help prevent weeds from developing herbicide resistance:
 - a. alternate modes of action
 - b. tank mix multiple modes of action
 - c. use full labeled rates
 - d. treat weeds when small
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
 - h. cover crop
2. Understand environmental and economic factors which influence selection of a tillage system.
3. Compare and contrast agronomic advantages and limitations of intensive, reduced, strip-till, and no-till systems.
4. Understand consequences of planting corn, soybeans, wheat, or forage crops earlier or later than optimum.
5. Explain 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 and water management
 - f. soil productivity index or rating
 - g. economics
 - h. drainage
7. Understand 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
 - g. water quality
 - h. species selection

- i. planting method
- j. grazing considerations

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 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. Explain how planting date affects hybrid and variety selection.
4. Explain 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
 - f. identity preserved crops
 - g. organic crops
6. Understand the agronomic and economic advantages and limitations of growing value-added crops.

COMPETENCY AREA 3. CROP GROWTH AND DEVELOPMENT

1. Be able to use the following systems to identify corn and soybean growth stages:
 - a. Nodal (corn and soybean)
 - b. Horizontal leaf method (corn)
2. Identify the location of growing points through vegetative stages of corn and soybeans.
3. Differentiate soybean Rhizobium 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 variation in row spacing, population, and in-row plant spacing.
 6. Use the following to quantify corn root injury:
 - a. Iowa 1-6 scale (6 point scale)
 - b. node-injury scale (0-3 point scale)
 7. Identify 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 (such as GDD)
 - f. nutrient placement
 - g. residue management
 - h. seed quality
 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
 - g. economics
 11. Describe how crop and pest growth stages affect the following management decisions:
 - a. pest management
 - b. nutrient management
 - c. water management
 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.
14. Be able to calculate GDD.
 - a. Know base temperatures for corn, soybean, wheat and alfalfa.

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
 - f. weather
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. Outline harvest, handling, and storage practices for identity-preserved (IP) crops.
5. Explain 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. cooperator reliability
 - d. equipment capability
2. Relate site specific information to yield map variability:
 - a. soil characteristics (texture, drainage, fertility, etc)
 - b. topography (slope position)
 - c. historical management (different cropping, land use)
 - d. yield goals
3. Describe how to use crop management data to make crop management decisions:
 - a. number of treatments
 - b. number of replications

- c. number of locations
 - d. trial and sample size
 - e. statistical analysis including interpretation of mean separation (LSD, Duncan, Tukey)
4. Describe how to use the following to determine crop variability:
- a. yield monitor
 - b. soil sampling
 - c. tissue sampling
 - d. as-applied maps
 - e. remote sensing (use of drones, aerial photography, satellite imagery)
 - f. field scouting
5. Understand the importance of yield monitor and application equipment calibration and the information needed to perform the calibration.