

Iowa Certified Crop Adviser
Performance Objectives

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INTRODUCTION

The Certified Crop Advisor (CCA) program is coordinated at the national level by the American Society of Agronomy. A state/regional board administers the CCA program in each respective state or region, including the state of Iowa. The Board is responsible for developing the Performance Objectives and state exam. The Performance Objectives provide applicants with specific information on knowledge and skill areas covered in the state exam.

The Performance Objectives are divided into four sections: 1) Soil Fertility; 2) Soil and Water Management; 3) Pest Management; and 4) Crop Production. Each section is further divided into several categories. The Performance Objectives will be evaluated and upgraded by the Iowa Board as necessary.

NOTE: The Crop Management and Pest Management Objectives were reviewed by a select committee of CCAs in October, 2007 through February of 2008. The Soil and Water and Nutrient Management Objectives were reviewed in 2005—2006.

SOIL FERTILITY

Basics of Soil Fertility

1. Know the elements essential for plant growth (listed below). Understand which nutrients are mobile in the plant.

Carbon	Sulfur	Phosphorous	Iron
Hydrogen	Boron	Potassium	Manganese
Oxygen	Chlorine	Calcium	Molybdenum
Nitrogen	Copper	Magnesium	Zinc

2. Understand the ionic form in which essential elements are taken up by plants from the soil.

3. Define cation exchange capacity (CEC) and understand its relationship with base saturation and crop nutrient use.

4. Recognize the soil properties that affect CEC and the relationship of CEC to the following:

- Mobility of nutrients in the soil
- Plant availability of nutrients

5. Understand nutrient movement in soil and water. Understand how the factors listed below influence nutrient movement.

- Cation exchange capacity
- Soil texture, structure, and bulk density
- Soil pH
- Drainage – surface and subsurface
- Nutrient form – cations and anions
- Rate of nutrient application
- Time of nutrient application
- Precipitation – amount and distribution
- Irrigation
- Soil slope and crop residue cover
- Temperature

6. Identify advantages and disadvantages of broadcast and banded fertilizer applications and determine the effect of the following on each method of application.

- Tillage system, including nutrient stratification
- Cropping system
- Soil sampling method; grid, soil type, management zone, whole field
- Application timing

7. Understand the nutrients available from materials other than commercial fertilizers, including the following:

- Manures
- Legumes
- Sludges
- By-products

soil pH on plant toxicity of elements in the soil
Effect of soil pH on soil microorganisms
Effect of fertilizer materials on soil pH
Suggested soil pH ranges for crop production

8. Understand the difference between soil pH and buffer pH and what each measures.
9. Distinguish between liming practices and determine the effect of each of the following factors on lime application rates.
 - Soil organic matter, clay content, texture, and cation exchange capacity
 - Liming material and quality
 - Calculating lime requirements from ECCEs
 - Depth of incorporation
 - Cropping system
 - Cost of liming materials
10. The role of gypsum; dolomitic limestone, calcitic limestone, etc in soil management.

Nitrogen

1. Understand how nitrogen affects plant growth.
2. Recognize and interpret nitrogen deficiency symptoms in the following crops.
 - Corn
 - Small grains
 - Forage grasses
3. Understand the nitrogen cycle in soils and know the mechanisms and the nitrogen forms involved in each of the following processes.
 - Mineralization
 - Nitrification
 - Immobilization
 - Nitrogen loss pathways
 - Leaching
 - Denitrification
 - Volatilization from soils and plants
 - Crop removal
 - Soil erosion/ overland flow
 - Use of nitrification inhibitors
4. Understand the proper time and method to sample soil for the late-spring soil nitrate test for corn and interpretation of soil test values.
5. Determine the availability of nitrogen from the following organic sources and interpret the effect of the C/N ratio on nitrogen availability.
 - Legume crops
 - Non-legume crops
 - Manures
 - Sludges

By-products

6. Recognize the effects of soil properties, rate of nitrogen fertilization, availability of other nutrients, and environmental conditions on nitrogen uptake and nitrogen use efficiency by crops.
7. Recognize how cropping systems affect nitrogen requirements.
8. Recognize the analysis, physical form, and handling precautions of each of the following nitrogen fertilizer materials and understand their effect on soil pH and nitrogen availability.
 - Anhydrous ammonia
 - Urea
 - Ammonium nitrate
 - MAP and DAP
 - UAN solutions
 - Ammonium sulfate
9. Distinguish between the advantages and disadvantages of each of the following nitrogen fertilizer materials in different soils, cropping systems, and tillage systems.
 - Anhydrous ammonia
 - Urea
 - Ammonium nitrate
 - MAP and DAP
 - UAN solutions
 - Ammonium sulfate
10. Understand how and when to sample for and use the cornstalk nitrate test, (taken after corn grain maturity) including interpretation of nitrate test values.

Phosphorus

1. Understand the functions of phosphorus in plant growth.
2. Recognize and interpret phosphorus deficiency symptoms in the following crops.
 - Corn
 - Soybean
 - Small grains
 - Alfalfa
3. Recognize how each of the following factors affect phosphorus fertilization.
 - Soil properties
 - Cropping system
 - Availability of soil phosphorus
 - Soil test level
 - Crop grown
 - Environmental concerns, particularly the Iowa P Index
 - Availability of capital

4. Recognize how each of the following factors affect soil retention and fixation of phosphorus and related losses through erosion.

- Soil clay
- Soil pH
- Soil texture
- Crop residue
- Tillage system

5. Recognize the analysis, physical form, handling precautions, and phosphorus availability of each of the following fertilizer phosphorus materials.

- Diammonium phosphate
- Monoammonium phosphate
- Triple superphosphate
- Ordinary superphosphate
- Ammonium polyphosphate
- Manure (by species and how it is handled)

6. Distinguish between the advantages and disadvantages of each of the following phosphorus fertilizer materials in different soil, cropping systems, and placement in different tillage systems.

- Diammonium phosphate
- Monoammonium phosphate
- Triple superphosphate
- Ordinary superphosphate
- Ammonium polyphosphate
- Manure (by species and how it is handled)

7. Understand the use of soil tests for phosphorus and interpretation of soil test values.

Potassium

1. Understand the function of potassium in plant growth.

2. Recognize and interpret potassium deficiency symptoms in the following crops.

- Corn
- Soybean
- Small grains
- Alfalfa

3. Recognize how each of the following factors affect soil retention of potassium.

- CEC
- Soil texture
- Cropping system

4. Recognize how each of the following factors affect potassium fertilization.

- Soil properties
- Availability of soil potassium
- Soil test level

Cropping system
Tillage system
Crop grown
Availability of capital

5. Recognize the analysis, physical form, handling precautions, potassium availability, and relationship to chloride in soils of each of the following potassium fertilizer materials.

Potassium chloride
Potassium sulfate
Potassium nitrate
Manure (by species)

6. Understand the use of soil tests for potassium and interpretation of soil test values.

Secondary and Micronutrients

1. Identify plant deficiency symptoms of each of the following secondary and micronutrients in corn, soybean, alfalfa, and small grains. Recognize soil properties and nutrient interactions affecting their availability to plants.

Magnesium
Sulfur
Zinc
Iron
Boron

2. Identify plant toxicity symptoms of each of the following elements in corn, soybean, alfalfa, and small grains and recognize soil properties and nutrient interactions affecting their availability to plants.

Aluminum
Manganese
Boron

3. Understand the advantages and disadvantages of each of the following practices for correcting and micronutrient deficiencies and toxicities.

Foliar application
Soil application
Adjusting soil pH

Soil and Plant Sampling Analysis

1. Understand Iowa industry-standard (ISU), recommended soil sampling and handling procedures and the effect of the following factors on soil test results and interpretations.

- Taking consistent, representative samples
- Time of sampling
- Depth of sampling
- Sample location (within the fields)
- Frequency of sampling
- Sampling density (number per acres)

2. Interpret laboratory soil and plant test reports for the following:
 - Degree of nutrient deficiency or adequacy
 - Expected crop response to applied nutrients
 - Units of measure and conversion between different units
 - The effect of extractant on soil test P results
 - (Bray P-1, Mehlich-3 P, Mehlich-3 ICP, Olsen P)

3. Identify the plant parts to sample and the time to sample (calibrated plant growth stage) when determining the nutrient status of the following crops by analysis.
 - Corn
 - Soybean
 - Alfalfa
 - Small grains

SOIL AND WATER MANAGEMENT

Soils and Landscapes

1. Recognize that Soil Surveys provide a soil resource inventory for each county.

Understand:

- Natural drainage classes
- Soil depth
- Soil slope
- Parent materials
- Influence of natural vegetation

2. Understand the relationships among the following:

- Soil series
- Soil type
- Soil map unit

3. Recognize general management considerations associated with different soil parent materials (loess, till, alluvium, etc.)

- Texture
- Bulk density
- Water relationships
- Landscape shape
- Erosion potential – water and wind

Soil Properties

1. Define soil structure and determine its relationship to each of the following:

- Crop growth and production
- Tillage and cropping system
- Soil organisms
- Soil drainage

2. Understand the relationship of soil organic matter to each of the following:

- Soil color
- Soil structure
- Nutrient retention and availability
- Herbicide retention
- Soil erosion

3. Recognize the effects of plant cover, plant residue, soil fertility level, and tillage system on water infiltration, soil erosion, soil temperature, and soil moisture.

4. Relate properties such as soil texture and soil moisture to potential development of soil compaction.

Soil Erosion

1. Relate erosion control practices to air and water quality.
2. Recognize the effect of tillage practices common in Iowa on erosion, soil structure, soil organic matter, compaction, and crop productivity.
3. Recognize the components of an approved conservation plan and its relationship to crop management decisions.
 - RUSLE2
 - P-Index
 - Recordkeeping requirements
4. Identify and understand the following erosion control practices recommended for use in Iowa.
 - Residue management
 - Contouring
 - Terracing
 - Grass waterways
 - Crop rotation
 - Vegetative filter strips
 - Windbreaks
 - Reduced tillage
5. Recognize practices used to control excess soil water.
 - Surface drainage
 - Subsurface drainage

Tillage

1. Recognize how each of the following factors influence the selection and use of tillage systems.
 - Crop rotation/field history
 - Field design (terrace and waterway spacings, point rows, etc.)
 - Soil properties
 - Land shape (HEL, nonHEL)
 - Governmental program requirements
 - Availability of capital
2. Identify tillage implements used for each of the following systems.
 - Full-width (conventional) tillage
 - Strip till
 - No-till
 - Ridge-till

3. Identify advantages, disadvantages, and limitations of each of the following tillage systems.

- Full-width tillage
- Strip till
- No-till
- Ridge-till

4. Describe the influence of tillage systems and tillage implements on each of the following:

- Soil disturbance/compaction
- Crop residue remaining on the soil surface
- Incorporation of fertilizers, lime, and pesticides
- Weed control

Residue Cover

1. Recognize how each of the following factors affect soil residue cover.
 - Crop rotation
 - Crop yield
 - Harvesting methods
 - Weather
 - Tillage system
 - Fertilizer and manure application methods
2. Know how to measure soil residue cover and how to apply the results in a management system.

PEST MANAGEMENT

General use of pesticides

1. Understanding label information:
 - a. Section 3 (standard label), Section 18 (emergency exemption), Section 24C (special local need)
 - b. Restricted-entry intervals (R.E.I.s)
 - c. Pre-harvest intervals (P.H.I.s)
 - d. Worker protection provisions (WPS)
 - e. Recordkeeping
 - f. Required application techniques (ground and aerial)
 - gallonage
 - nozzle selection
 - adjuvants
 - mix partners (multiple products for multiple pests)

Pesticide Application

1. Use information found on pesticide labels to determine proper pesticide dosage.
 - a. Relate pesticide reentry times and harvest restrictions to human exposure.
 - b. Identify the rules regarding pesticide use, storage and distribution contained in the Iowa Pesticide Act.
 - c. Recognize reporting and cleanup procedures when pesticide spills occur.
 - d. Requirements for recordkeeping, including spray logs, environment, etc.
 - e. Identify potential pest problems with different tillage systems and pest changes that may result when changing systems.
 - f. Identify benefits and concerns with insecticide and fungicide seed treatments.

Sprayer Calibration

1. Describe the pattern, relative droplet size, pattern overlap, and primary uses of the following nozzle types.
 - a. Standard flat fan
 - b. Even flat fan
 - c. Hollow cone
 - d. Flood tip
 - e. Air induction nozzle
2. Recognize the information required to select a nozzle that will achieve a given application rate.
3. Recognize how the following factors affect spray delivery and spray coverage.
 - a. Spray pressure
 - b. Application speed
 - c. Nozzle type
 - d. Nozzle spacing
 - e. Off-target movement and use of drift retardants

4. Recognize the responsibilities of and the assistance available through the following State and Federal Agricultural agencies.
 - a. Iowa State University Extension Service
 - b. Iowa Department of Agriculture and Land Stewardship
 - c. Iowa Department of Natural Resources
 - d. Farm Service Agency
 - e. Natural Resources Conservation Service

Weed Management

1. Identify the following weeds by common name at all growth stages and classify each by life cycle.

grass family: quackgrass downy brome sandbur crabgrasses barnyardgrass woolly cupgrass foxtail barley wirestem muhly <i>- panicums:</i> witchgrass wild proso millet fall panicum <i>- foxtails:</i> giant foxtail green foxtail yellow foxtail <i>- sorghums:</i> shattercane johnsongrass	lambsquarter family: lambsquarters kochia russian thistle pigweed family: redroot pigweed -water hemp complex -smooth pigweed -Palmer pigweed mustard family: yellow rocket wild mustard field pennycress mallow family: velvetleaf venice mallow carrot family: wild carrot wild parsnip poison hemlock milkweed family: common milkweed hemp dogbane bindweed and morningglory families: field bindweed hedge bindweed tall morningglory	nightshade family: jimsonweed smooth groundcherry horsenettle black nightshade sunflower family: giant ragweed common ragweed cocklebur wild sunflower musk thistle bull thistle Canada thistle marestail prickly lettuce sowthistle dandelion other weeds: volunteer corn volunteer soybean equisetum (snakegrass, horsetails) common mullein, yellow nutsedge wild hemp asiatic dayflower henbit purple deadnettle
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2. Recognize the importance of each of the following factors affecting weed—crop competition in corn, soybeans, small grains and forages.

- Growth rate (crop and weed) and life cycle
- Germination and emergence
- Seed dormancy
- Vegetative reproduction
- Allelopathy
- Weed density and height and competition

3. Recognize the factors that affect the use of mechanical weed control and soil conditioning including rotary hoeing and row-crop cultivation.

Herbicides and Herbicide Management

1. Describe the advantages and disadvantages of preplant incorporated, preemergence, and postemergence herbicide applications and their uses in different tillage systems.

2. Recognize the soil, climatic, and environmental factors that affect the performance of preplant incorporated, preemergence, and postemergence applied herbicides.

3. Define herbicide persistence and describe the effect of the following factors and herbicide families on herbicide persistence.

- | <u>environmental factors</u> | | <u>herbicide families</u> |
|------------------------------|---|--|
| • soil moisture | 2 | triazines |
| • soil temperature | 2 | sulfonylureas |
| • soil pH | 2 | imidazolinones |
| • application rates | 2 | acetanilides |
| | | • dinitroanilines (microtubule inhibitors) |
| | | • diphenylethers |
| | | • pigment inhibitors including Callisto and Impact |
| | | • Amino Acid derivatives |
| | | • Benzoic acids |
| | | • Growth regulators (including phenoxy herbicides) |

4. Determine the classification of herbicides by mode of action.

5. Identify general plant symptoms (including weed and crop damage) caused by the following herbicide mode of action groups and identify the herbicides in each group.

Acetolactate synthase inhibitors (ALS)

Root and shoot inhibitors

- Microtubule inhibitors (Dinitroanilides)
- Seedling growth inhibitors (amides)

Cell-membrane disruptors

Growth regulators

Photosynthetic inhibitors

Amino acid synthesis inhibitors

Pigment inhibitors

6. Describe the relationship of plant (crop and weed) vigor and plant growth stage to herbicide effectiveness and plant susceptibility to post-emergence herbicides.

7. Describe how spray additives affect herbicide performance.

8. List factors influencing the development of herbicide resistance and ways to prevent the occurrence of herbicide resistant weeds.

9. Recognize how herbicide performance is affected by the environment.

10. Recognize the effects that herbicides may have on the environment.

Plant Diseases Management.

1. Identify each of the following diseases and nematodes and how and when it infects crop plants. Recognize host-plant symptoms and classify each by type of causal organism and importance in corn, soybean and alfalfa crops.

<u>Corn</u>	<u>Soybean</u>	<u>Forage</u>	<u>General</u>
Stalk rots	Brown stem rot	Black stem	Pythium
Common rust	Phytophthora		Rhizoctonia
Southern rust	Brown spot (Septoria)		
Eyespot	Soybean mosaic		
Crazy top	Soybean cyst nematode		
Anthraxnose	Soybean rust		
Northern leaf blight	Sudden Death Syndrome		
Stewart's wilt	White mold		
Gray leaf spot	Charcoal rot		
Anthracnose:	Bean pod mottle virus		
-Top dieback	Frogeye leaf spot		
- leaf spot	Bacterial blight		
- stalk rot	Bacterial pustule		
- root rot	Cercospora leaf spot		
Corn nematodes	Downy mildew		

1. Recognize cultural techniques for management of plant diseases.
2. Recognize genetic techniques for management of plant diseases.
 - General resistance
 - Race-specific resistance
 - Tolerance
3. Explain nematode management through cultural or chemical means.
4. Understand the process of reporting soybean rust and other critical crop diseases (the "Fast-Track System.")

Fungicides and Fungicide Management

1. Identify fungicides used for management of crop diseases in Iowa.
2. Understand the appropriateness and timing of applications; preventative, curative, etc.
3. Understand families of fungicides used on Iowa crops (Strobilurins, triazoles, etc.)
4. Understand crop tolerance concerns with different fungicide classes and related off-target concerns.

Insect and Mite Management

1. Identify each of the following insects and mites, recognize each of their associated crop injury symptoms, and understand each of their life cycles. (see specific issues in #6)

<u>Corn</u>	<u>Soybean</u>	<u>Alfalfa</u>
Armyworm	Bean leaf beetle	Alfalfa weevil
Corn earworm	soybean aphids	Cloverleaf weevil
Corn leaf aphid	Green cloverworm	Aphids (pea and cowpea)
Corn rootworms	Potato leafhopper	Blister beetles
Cutworms (black & dingy)	Seedcorn maggot	Plant bugs
European corn borer	Spider mites	Potato leafhopper
Fall armyworm	Thistle caterpillar	Spittlebugs
Grasshoppers	Grasshoppers	Grasshoppers
Colaspis beetles	Whitefly	
Seedcorn beetles		
Seedcorn maggot		
Stalk borer		
Spider mites		
Western bean cutworm		
White grubs		
Wireworms		

2. Identify common predators and parasitoids and their potential impact on pest insects.

- Lady beetles
- Ground beetles
- Lacewings
- Damsel bugs
- Minute pirate bugs
- Predatory wasps

3. Know the concepts of economic threshold and economic injury level and how they are used in decision-making for insect control.

4. Recognize how cropping sequence or crop rotation influences the potential for the occurrence of insect pests in crops.

5. Recognize the influence of the following cropping practices on insects.

- Early or late planting
- Early or late harvest
- Tillage and Weed control
- Crop residue effects

6. Identify the primary management strategy for the following key insect problems.
 - Corn rootworm on corn, including extended diapause and variant-western CRW management
 - Black cutworm in corn
 - European corn borer on corn
 - Western bean cutworm on corn
 - Soybean aphid on soybean, including traditional and “speed” scouting
 - Bean leaf beetle on soybean
 - Grasshoppers on soybean
 - Spider mites on soybean
 - Alfalfa weevil on alfalfa
 - Potato leafhopper on alfalfa

General Insecticide Use

1. Recognize the effects that insecticides have on the environment.
2. Relate the timing of insecticide applications to the pest stage of development.

Pest Management and Integrated Pest Management

1. Describe standard scouting procedures for major pests in different crops.
2. Define pesticide resistance and pesticide tolerance.
3. Describe the methods to prevent and manage the development of pesticide-resistant weeds and insects and diseases.
4. Recognize the effect of soil moisture, temperature and microbes (bacteria and fungus) on pesticide degradation.
5. Differentiate between the following factors affecting spray drift and spray volatilization.
 - Climatic conditions
 - Pesticide formulation and property
 - Additives
6. Relate the degree-day concept to insect development and be able to calculate degree-days for insect development.
7. Given a situation, provide economically and environmentally sound pest management information.

Pesticide Movement in Soil and Water

1. Recognize how movement of pesticides in soil or into surface or groundwater may be affected by the following pesticide and soil properties.

- Soil texture
- Soil pH
- CEC
- Leaching
- Erosion and erosion control practices
- Depth of water table
- Precipitation and runoff
- Source of entry into the environment
- Pesticide adsorption
- Pesticide degradation and persistence
- Pesticide application rate and timing

2. Differentiate between and recognize point and non-point sources of pollution and describe practices that reduce point and non-point source contamination.

Rules and Regulations

2. Explain Iowa and Federal pesticide recordkeeping requirements.
3. Identify the rules regarding pesticide use, storage and distribution contained in the Iowa Pesticide Act.
4. Recognize the responsibilities of and the assistance available through the following State and Federal agricultural agencies:
 - Iowa State University Extension Service
 - Iowa Department of Agriculture and Land Stewardship
 - Iowa Department of Natural Resources
 - USDA Farm Service Agency
 - USDA Natural Resources Conservation Service

CROP PRODUCTION

Seeding issues

1. Interpret the consequences early and late planting date.
2. List factors that influence the planting of agronomically important crops.
3. Know the recommended seeding depths of agronomically important crops and interpret the following factors that affect seedling depth.

Soil Conditions

Calendar date

Weather outlook

4. Describe crop responses to planting patterns and plant population (seeding rates).
5. Explain the effect of seed quality on crop growth and development.
6. Understand terminology and principles used in varietal selection
7. Determine pure live seed (PLS) from seed sample analyses.
8. Understand the practices in measuring and calculating seeding rates and plant populations.

Crop Growth and Development

1. Describe the effect of temperature extremes on growth and development of crops.
2. Describe how the water and nutrient needs of crops change during growth and development and how soil type and climate influence water availability during the growing season.
3. Relate the growing degree day concept (GDD) to corn development, and recognize its function in production systems, and be able to calculate growing degree days for corn development and general crop pest development.
4. Distinguish the growth stages during which crops are most susceptible to environmental and pesticide stress.
5. Identify damage to agronomic crops from hail, frost, flooding, drought, and wind.
6. Recognize climatic and plant factors that influence plant mortality or plant's abilities to resume growth after an injury.

7. Determine crop damage levels that justify replanting and interpret the following factors that affect replant decisions:
 - Calendar date
 - Environmental conditions
 - Emergence, population, and plant distribution
8. Compare or contrast advantages and limitations of monoculture versus crop rotations.
9. Identify the stages of crop development for the following crops:
 - Small grains
 - Field corn
 - Soybean
 - Grass forage crops
 - Legume forage crops
10. Compare crop growth responses in different tillage systems.

Harvest

1. Outline harvest timing or scheduling for silage and forage crops, small grains, corn and soybean for best grain or forage quality.
2. Understand the relationship of late season crop stages with harvest issues, including yield, grain moisture at harvest, lodging, and post crop tillage and nutrient situations.

Biotechnology-related issues

1. Understand the current issues in crop and varietal selection for use of biotechnologically generated varieties
2. Understand the concept pest-resistance management including rotation of modes of actions and appropriate use of refuges to defer pest resistance to new technologies.
3. Understand what a biotechnological “event” is and how it is applied to crop varieties used in Iowa agriculture.

Biofuels issues

1. Understand the value of nutrients contained in biosolids removed from production fields.

General: suggested references

- Various pesticide label resources
- Soil survey manual – especially understand determining acreages and topographical relationships between mapped soils
- Crop-related publications available at the Iowa State University Extension store: www.extension.iastate.edu/store (click on “crops” in the upper lefthand panel)
- Herbicide modes of action publication, Texas A and M University at <http://www-aes.tamu.edu/mary/Moaonly.pdf>
- Iowa State University Extension ICM News (website) at www.extension.iastate.edu/CropNews (free site)