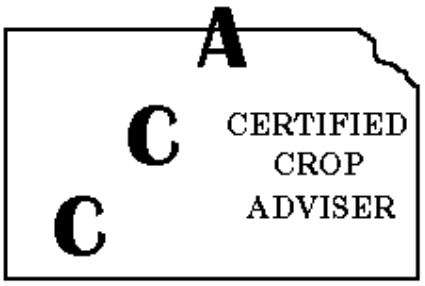
Kansas Certified Crop Adviser Program

Performance Objectives



Prepared by:
Kansas CCA Board
Subcommittee on Exam Preparation

The Kansas State Performance Objectives are in addition of the International Performance Objectives. These objectives and the expertise within the competency areas are also guidelines for the continuing education requirement for those who qualify as a Kansas CCA.

Questions for the Kansas CCA State examination will be developed within the scope of the national and state performance objectives. The exam questions will be drawn from the four main competency areas (NOT INCLUDING WQP TOPICS which are noted in *italics*) in proportion to the percentages shown below.

Major Kansas Crops:

Alfalfa
Corn
Soybeans
Sorghum
Sunflowers
Wheat
Forages.

COMPETENCY AREAS:

NUTRIENT MANAGEMENT (25%)

1. Soil and nutrient interaction
2. Soil pH and liming
3. Major nutrients (N, P and K)
4. Secondary nutrients and micronutrients
5. Soil test reports and fertilizer recommendations
6. Nutrient sources
7. Soil amendments

SOIL AND WATER MANAGEMENT (15%)

1 Basic physical properties of soil
2 Soil water management
3 Soil conservation
4 Irrigation management
5 Managing for water quality

PEST MANAGEMENT (40%)

1. Weed management
2. Plant disease management
3. Insect management
4. Integrated pest management
5. Pesticide use and safety

CROP PRODUCTION (20%)

1. Crop growth and adaptation
2. Basic principles of forage production
3. Planting and seeding management
4. Crop damage, mortality and factors influencing replanting decisions
5. Cropping systems
6. Site specific management

NUTRIENT MANAGEMENT COMPETENCY AREAS:

1. Soil and nutrient interaction
2. Soil pH and liming
3. Major nutrients (N, P and K)
4. Secondary nutrients and micronutrients
5. Soil test reports and fertilizer recommendations
6. Nutrient sources
7. Soil amendments
8. *Equipment Calibration*
9. *Waste Management*
10. *Elements of Nutrient Management Planning*

EXPERTISE WITHIN EACH COMPETENCY AREA:

1) Soil and nutrient interaction

a) Recognize how soil, climatic and nutrient properties affect movement and retention of nutrients in soil or water.

2) Soil pH and liming

a) Understand the effect of soil pH on plant growth

b) Determine how each of the following factors affect lime rate:

1) type of cropping and tillage systems used
2) soil characteristics and variability
3) soil pH

c) Describe how lime quality (Effective Calcium Carbonate) influences lime rate.

d) Compare the neutralizing value, physical properties and handling precautions of the following liming materials:

1) calcitic limestone
2) dolomitic limestone
3) fluid lime
4) pelletized lime
5) ag-lime

e) Be able to calculate the amount of liming material that should be applied to meet a soil test report recommended rate of lime.

3) Major Nutrients

a) Nitrogen

1) Describe the soil nitrogen cycle.
2) Explain how to select nitrogen fertilizer sources for agronomic efficiency and environmental quality.
3) Describe how soil physical properties affect nitrogen fertilization.
4) Explain how cropping and tillage systems affect nitrogen fertilization.

b) Phosphorus

1) List the advantages and disadvantages of different phosphorus application methods and sources.
2) Recognize how cropping and tillage systems affect phosphorus fertilization.
3) Utilize best management practices (BMPs) to maximize agronomic efficiency and to minimize environmental impact.

c) Potassium

1) List the advantages and disadvantages of different potassium application methods and sources
2) Explain how cropping and tillage systems affect potassium fertilization

4) Secondary nutrient and micronutrients (with emphasis on sulfur, zinc, iron, boron & chloride

a) Describe the general deficiency and potential toxicity symptoms of the secondary nutrients and the micronutrients.

b) Compare the methods of correcting secondary and micronutrient deficiencies.

5) Fertilizer recommendations

a) Use of soil test reports and calibration data to make economically and environmentally sound fertilizer recommendations.

b) Understand use of alternative nutrient sources such as animal waste, sludge or biosolids, legume crops and soil organic matter.

c) Utilize precision agricultural techniques: ie chlorophyll meters, variable rate technology, and other emerging technologies.

6) **Nutrient sources**

a) Identify the basic characteristics of common major nutrient materials such as:

1) anhydrous ammonia (NH_3)
2) urea-ammonium nitrate solution
3) urea
4) diammonium phosphate (DAP)
5) monoammonium phosphate (MAP)
6) ammonium polyphosphate solution (APP)
7) potassium chloride (KCl)
8) ammonium thiosulfate (ATS)

b) Know the basic characteristics of common secondary and micronutrient materials

7) Soil amendments

a) Know characteristics of material used as amendments for saline and sodic soils

b) Evaluate non-traditional products for use in Kansas

8) Equipment Calibration

a) Explain the importance of and procedures to calibrate nutrient application equipment, including fertilizer applicators, manure/sludge applicators and others.

9) Livestock Waste Management

a) Calculate total annual waste produced by an animal feeding operation.

b) Assess the effect on plant nutrient availability and on the potential environmental impact from various aspects of waste management, including:

1) *animal species*
2) *laboratory analysis vs. average nutrient values*
3) *rate of waste application*
4) *timing of waste application*
5) *method of waste application, including:*
   (a) incorporation
   (b) surface broadcast,
   (c) injection
   (d) irrigation

c) Distinguish between total nutrient content, and plant nutrient availability for:

1) *Nitrogen*
2) *Phosphorus*
3) *Potassium*
4) *Micronutrients*

d) Understand factors affecting the application and potential loss of livestock waste

1) *slope*
2) *plant species and growth habit*
3) *volatilization*
4) *leaching*
5) *plant rooting depth*
6) *ground and surface water*
7) *surface run-off*
8) *residue cover*
9) *flooding*
10) *soil texture*
11) *frozen soil and snow cover*
12) *salinity*
13) *pH*

e) Know how to take an accurate and representative sample for each of the major waste handling methods.

f) Compare the economic value of waste nutrients to other nutrient sources.

10) Nutrient Import and Export

a) Describe the source of nutrients and pollutants that enter and leave farms and livestock operations.

b) Identify management options to reduce nutrient surplus on farms and livestock operations.

c) Name management strategies that can reduce imported nutrients, reduce exported nutrients, and improve the efficiency of nutrient cycling on livestock farms and animal feeding operations.

SOIL AND WATER MANAGEMENT COMPETENCY AREAS:

1. Basic physical properties of soil
2. Soil water management
3. Soil conservation
4. Irrigation management
5. Managing for water quality
6. *Soil Hydrology*
7. *Drainage*
8. *Watershed Hydrology*
9. *Ground Water Hydrology*
10. *Critical Management Zones*
11. *Agricultural Non-Point Source (NPS) Pollution Control*

EXPERTISE WITHIN EACH COMPETENCY AREA:

1) Basic physical properties of soil

a) Recognize effects of soil physical properties on:

1) water holding capacity
2) water intake, and infiltration
3) internal soil drainage
4) soil tilth
5) compaction
6) root growth

2) Soil water management

a) Understand how cropping systems and tillage practices affect water storage availability for plant use.

3) Soil conservation

a) Describe factors important in controlling wind and water erosion, such as:

1) residue cover and management
2) conservation systems
3) length and grade of slope
4) soil characteristics
5) rainfall characteristics
6) crop characteristics
7) tillage
8) unsheltered distance
9) critical wind erosion period

b) Explain how these factors affect runoff and leaching:

1) residue cover and management
2) conservation systems
3) length and grade of slope
4) soil characteristics
5) rainfall characteristics
6) crop characteristics
7) tillage

c) Be able to estimate residue cover.

4) Irrigation management

a) Explain how the following factors affect water efficiency, infiltration and runoff:

1) weather
   (a) precipitation
   (b) temperature
   (c) season
   (d) crop residue

2) soil factors
   (a) texture
   (b) slope
   (c) compaction
   (d) soil amendments

3) irrigation system type
   (a) sprinkler
   (b) gravity/furrow
   (c) drip
   (d) sub-surface drip irrigation

4) crop management
   (a) tillage
   (b) residue
   (c) cropping system

b) Describe how the following factors affect crop water use:

1) temperature
2) wind
3) solar radiation
4) relative humidity
5) crop growth state (plant canopy, rooting depth, etc.)
6) soil factors (texture, compaction, etc.)

c) Differentiate between irrigation system types:

1) gravity/furrow
   (a) conventional
   (b) surge flow

2) sprinkler
   (a) center pivot (conventional, low pressure, LEPA (Low energy precision application), etc.)
   (b) lateral-move

3) drip (buried or surface)

d) Identify critical water use periods for different crops and the effect of water stress on growth and yield.

e) Explain the relationship between available water holding capacity and soil texture.

f) Understand how irrigation water supply and irrigation well output affects crop selection and crop management.

g) Be able to calculate crop water use and irrigation output.

h) Describe how to use management techniques and weather information to schedule and manage irrigation. Examples include:

1) "feel" method
2) gypsum blocks
3) tensiometer
4) checkbook method
5) computer models
6) water sensors

i) Define the following terms:

1) evapotranspiration
2) available water holding capacity
3) field capacity
4) wilting point
5) consumptive use or crop water use
6) potential evapotranspiration (PET)
7) chemigation (including application of pesticides and fertilizers)
8) water use efficiency
9) leaching
10) effective root zone

j) Identify and understand how irrigation water quality affects crop and soil management.

1) effect of total salinity concentration on crop growth and yield
2) effect of excess sodium on soil characteristics
3) effect of dissolved ions on potential plant toxicity, such as chloride (CI), nitrate (NO_3), sulfate (SO_4), boron (B), etc.
4) understand reclamation methods and methods for managing saline and sodic soils

k) Have an awareness of both state and national rules and regulations for irrigation water quality and use including:

1) application of nutrients, waste and pesticides through irrigation systems
2) system calibration for nutrient, waste and pesticide application
3) water use limitations and restrictions
4) the Kansas Department of Agriculture's regulatory authority

5) Managing for water quality

a) Have an awareness of state and national rules and regulations concerning:
1) Pesticide Management Areas
2) wildlife management areas
3) Wellhead Protection Areas
4) Ground Water Management Districts
5) nutrient management plans
6) best management practices (BMPs)
7) Total Maximum Daily Loads (TMDLs)
8) buffer zones
9) stream set-backs
10) Clean Water Act (CWA)

6) Soil Hydrology

a) Identify the basic components of the hydrologic cycle.

b) Describe the water budget for a soil profile and understand factors that affect:

1) *soil infiltration*
2) *evaporation and transpiration*
3) *runoff*
4) *storage*
5) *drainage*

c) Explain how soil water content, soil water tension and soil pore size vary for different soil types and their relation to plant growth

1) *field capacity*
2) *permanent wilting point*
3) *available water capacity*
4) *total soil water storage capacity*
5) *drainable porosity*
6) *soil texture, structure*
7) *macroporosity/preferential flow*

d) Understand the relationship between soil type and hydraulic conductivity. Explain how this relationship affects water movement through the soil profile.

e) Describe how seasonal soil conditions, weather, crop management, and landscape position affect runoff and drainage.

7) Drainage

a) Identify the NRCS hydrologic class for a given soil type and explain the significance to productivity, nutrient availability, and nutrient loss.

b) Know the advantages and disadvantages of surface and subsurface drainage systems.

c) Understand the potential impacts of the following factors affecting drainage systems:

1) *location and depth of bedrock*
2) *soil gradation and porosity*
3) *topography*
4) *organic soils*
5) *type of crop*
6) *outlet*

d) List potential benefits and risks to the environment from a drainage system.

8) Watershed Hydrology

a) Describe a watershed and its main functions.

b) Understand the major inputs and outputs of water in a watershed, including:

1) *precipitation*
2) *storms*
3) *infiltration and percolation*
4) *storage (depression, channel, detention, ground water, retention, vegetation)*
5) *base flow*
6) *storm flow*
7) *runoff (surface, channel, subsurface)*
8) *evaporation*
9) *transpiration*
10) *recharge*

c) Explain the pollutant delivery process to surface water, and describe the relationship of nutrient budgets and total maximum daily loads (TMDL) to non-point source pollutant loading.

d) Identify the main agricultural point and non-point sources of contaminants in a typical rural watershed

9) Ground Water Hydrology

a) Recognize some major concepts of ground water, including:

1) *aquifer*
2) *aquitard*
3) *vadose zone*
4) *saturated and unsaturated zones*
5) *recharge area*
6) *ground water gradient*
7) *effect of aquifer characteristics on ground water flow*

b) Name state and local contacts for well decommissioning

10) ***Critical Management Zones***

a) Apply the concepts of hydrologically sensitive areas and critical management zones at the field, farm and watershed levels. Be able to give examples

b) Use available tools (online, soil survey, etc.)to locate a tract of land and identify the soil type(s) and basic soil properties.

c) Understand how to access and use sources of information for characterizing land application areas, including:

1) *soil survey*
2) *Sensitive Ground Water Area delineation*
3) *wetlands*
4) *Wellhead Protection Areas*
5) *setback distances from surface water and ground water supplies*
6) *environmentally sensitive areas*
7) *Critical Water Quality Management Area*

d) Identify some Best Management Practices (BMPs) that address water quality concern(s) in critical management zones on a field, farm, or watershed basis.

e) Name agencies, organizations, and references that will provide information on local, state and national watershed and ground water concerns.

11) Agricultural Non-Point Source (NPS) Pollution Control

a) Describe the main sources of agricultural NPS pollution and their origins.

1) *nutrients (especially nitrogen and phosphorus)*
2) *chemical (especially pesticides)*
3) *biological (especially pathogens and biochemical oxygen demand)*
4) *physical (especially sediment)*

b) Distinguish the difference between point source and non-point source pollution. Identify both agricultural and non-agricultural pollution sources. Understand the extent and importance of various sources in managing surface water and ground water quqlity.

c) Understand the environmental impacts of various agricultural contaminants on the quality of surface and ground water as they relate to various uses, including:

1) *domestic and potable water*
2) *recreational use*
3) *irrigation*
4) *industrial*

d) Describe the concept of Best Management Practices for NPS pollution control.

e) Know some appropriate Best Management Practices for agricultural NPS pollution control in given production system.

f) List federal, state and local laws and regulations related to non-point source pollution control.

g) Identify federal, state and local sources of technical and financial assistance to address agricultural NPS pollution.

PEST MANAGEMENT COMPETENCY AREAS:

1. Weed management
2. Plant disease management
3. Insect management
4. Integrated pest management
5. Pesticide use and safety
6. *Using Best Management Practices for water quality protection (WQP)*

EXPERTISE WITHIN EACH COMPETENCY AREA:

1) Weed Management

a) Weed biology: Describe reproductive method (seed or vegetative), life cycle, and principles of managing the following weeds in major Kansas crops within different cropping strategies:

Summer annuals

1) barnyardgrass
2) common cocklebur
3) fall panicum
4) foxtails
5) giant ragweed
6) ivyleaf morningglory
7) kochia
8) large crabgrass
9) Pennsylvania smartweed
10) pigweed and waterhemp species
11) Russian thistle
12) shattercane
13) velvetleaf
14) wild buckwheat

Winter annuals

15) cheat grasses
16) field pennycress
17) henbit
18) jointed goatgrass
19) mustards

Biennials

20) musk thistle

Perennials

21) Canada thistle
22) field bindweed
23) hemp dogbane
24) johnsongrass
25) sericea lespedeza
26) yellow nutsedge

2) Plant disease management

a) Biology of plant diseases: Identify each of the following diseases by host plant systems, and classify each by crops infected and type of casual organism:

Wheat	Soybeans	Corn	Sorghum	Sunflowers
charcoal rot *Pythium* seeding rot rust take-all wheat streak mosaic barley yellow dwarf tan spot	charcoal rot *Pythium* seeding rot *Phytophthora* root rot *(Also in Alfalfa)* rust soybean cyst nematode sudden death syndrome	*Anthracnose* charcoal rot *Fisarium* stalk rots gray leaf spot *Pythium* seeding rot rust	charcoal rot *Fisarium* stalk rots *Pythium* seeding rot rust sooty stripe	charcoal rot *Pythium* seeding rot *Rhizopus* head rot rust

b) Identify whether diseases are caused by bacterial, fungal, or viral plant pathogens.

3) Insect management

a) Insect biology: Identify the dispersing and damaging stages of the following pests:

1) alfalfa weevil
2) aphids
   (a) pea aphid
   (b) blue alfalfa aphid
   (c) spotted alfalfa aphid
3) armyworm
4) black cutworm
5) blister beetle
6) cereal leaf beetle
7) chinch bugs
8) corn earworm
9) corn flea beetle
10) corn rootworm
   (a) Western corn rootworm
   (b) Northern corn rootworm
   (c) Southern rootworm
11) *Dectes* stem borer
12) European corn borer

13) fall armyworm
14) grasshopper
15) greenbug
16) Hessian fly
17) potato leafhopper
18) Russian wheat aphid
19) spider mites
    (a) Banks grass mite
    (b) two-spotted spider mite
20) southwestern corn borer
21) stored grain insect complex
22) sunflower head clipper weevil
23) sunflower head moth
24) sunflower seed weevil
25) sunflower stem weevil
26) Western bean cutworm
27) white grubs
28) wireworm

b) Classify these insects and mites by feed habits, crops they attack, type of metamorphosis and predominant management strategies.

c) Identify common beneficial insects and their potential impact on crop pests.
1) lady beetles
2) parasitic wasps
3) ground beetles
4) lacewing
5) damsel bug
6) predatory mites

4) Integrated pest management

a) Make economically and environmentally sound pest management recommendations for a specific site or situation.

b) Explain the relationship between pest management practices and development of pest resistance.

c) Recognize the need for following up to verify that pest management intervention strategies have had the desired effect.

d) Describe diagnostic steps to differentiate between symptoms and injury resulting from plant diseases from weather damage, environmental stress, air pollution injury, herbicide toxicity, insect feeding, mechanical damage, nutrient deficiencies/toxicities, and other causes.

e) Describe how to establish refugia to prevent insects from developing resistance to plant incorporated protectants (eg. Bt or other insecticidal toxins).

5) Pesticide use and safety

a) Interpret pesticide labels and labeling terms, including endangered species bulletins, pre-harvest intervals, plant-back or recropping restrictions, and others.

b) Exhibit competency in pesticide record keeping

c) Demonstrate an awareness of Worker Protection Standard requirements (notification, protective gear, and re-entry)

6) Using Best Management Practices for water quality protection (WQP)

a) Pesticide Movement in soil and water.

1) *Describe how movement of a pesticide in soil or into water may be affected by:*
   (a) soil texture
   (b) erosion
   (c) pesticide persistence and degradation processes
   (d) leaching
   (e) precipitation and irrigation runoff
   (f) pesticide solubility
   (g) pesticide absorption
   (h) source of entry into the environment

2) *Assess soil/pesticide interactions and their influence on pesticide selection, pesticide use, BMPs, and water quality protection.*

3) *Explain how the following items impact proper pesticide use in regard to water quality protection:*
   (a) soil characteristics (chemical and physical)
   (b) residue cover and organic matter
   (c) proximity to water sources (surface water, ground water aquifers, water supply wells, etc.)

b) Government regulations

1) *List the general provisions of state pesticide regulation laws.*

2) *Describe the general provision of recent EPA regulations such as the Clean Water Act and Worker Protection Standards.*

CROP PRODUCTION COMPETENCY AREAS:

1. Crop growth and adaptation
2. Basic principles of forage production
3. Planting and seed management
4. Crop damage, mortality and factors influencing replanting decisions
5. Cropping systems
6. Site specific management

EXPERTISE WITHIN EACH COMPETENCY AREA:

1) Crop growth and adaptation

a) Identify the life cycle and adaptation of crops commonly grown in Kansas.

b) Describe and use the staging systems to identify growth stages between emergence and physiological maturity for crops commonly grown in Kansas.

c) Recognize relationships between the growth and development of major Kansas crops and management factors.

d) Relate the growing degree day (GDD) concept to crop development, recognize its function in production systems, and calculate GDD for corn, grain sorghum and wheat.

e) Compare and contrast rooting patterns of the major crops.

f) Identify the location of the growing point during the early growth stages of the major crops.

2) Basic principles of forage production

a) Describe how frequency of harvest is related to forage yield and quality.

b) Describe how frequency and timing of harvest affects stand longevity, food reserves and stand persistence.

c) Be able to distinguish between warm and cool season forages.

d) Be able to distinguish between perennial and annual forages.

e) Identify appropriate stages of development for harvesting legumes, grasses, and grain crops as silage or hay.

f) Know the major toxicities that may be found in forages, including nitrates, prussic acid, fescue toxicosis, and mineral deficiencies (e.g., grass tetany).

3) Planting and seeding management

a) Describe factors affecting seeding date of above crops.

b) Describe environmental and cultural factors that influence the seeding rate.

c) Describe factors influencing seeding depths.

d) List the minimum and optimum temperatures for seed germination of the major Kansas crops.

e) Interpret results from yield comparisons or variety trials using least significant differences and other calculations.

f) Calculate the seeding rate in seeds per acre, or seeds per foot of row, adjusted for pure live seed percentage, when given the seeds per pound, row spacing, desired seeding rate, and expected field emergence.

g) Interpret a seed analysis report from an accredited laboratory and define traits used to determine seed quality, including:

1) purity
2) percent germination
3) percent weed seeds
4) percent inert matter
5) percent other crop seeds
6) pure-live seed percentage

4) Explain the value of inoculation of legume seed and the situations when it should be recommended.

5) Crop damage, mortality and factors influencing replant decisions

a) Understand the effect of hail, frost, flooding, drought, insect, disease, and wind damage on crops listed above.

b) Recognize when major Kansas crops are most susceptible to specific environmental stresses.

c) Describe climatic and plant factors which influence a plant's ability to resume growth after being damaged.

6) Cropping systems

a) Understand the advantages and limitations of growing cover and companion crops.

b) Compare and contrast single crop systems and crop rotations.

c) Explain adaptation and use of biotechnology in cropping systems.

d) Assess the economic impact of crop management decisions.

e) List the advantages and limitations of organic farming.

f) Describe the influence of the following on cropping systems options and production strategies.
1) temperature and precipitation
2) day length and climate
3) water use efficiencies
4) irrigated or dryland conditions
5) tillage system
6) soil conditions

g) Describe how the following affect reliability of agronomic trials:
1) weather variability
2) field variability
3) number of locations
4) number of treatments
5) number of replications

h) Describe possible and most likely crop rotations or single crop systems for the following areas, and indicate the economic and environmental factors which impact crop rotations in each area:
1) East of Highway 81
2) Highway 81 to Panhandle
3) Panhandle
4) Eastern Nebraska - rainfed and irrigated
5) Central Nebraska - rainfed and irrigated
6) Western Nebraska - rainfed and irrigated
7) Sandhills – irrigated

i) Differentiate the characteristics of general cropping areas (see attached map):
1) Northeast Kansas (east of Flint Hills)
2) Southeast and East Central Kansas (east of Flint Hills)
3) Flint Hills
4) South Central Kansas (Red Hills)
5) Smoky Hills
6) Sand Hills (Arkansas River Valley) - rainfed and irrigated
7) High Plains, Southwest Kansas - rainfed and irrigated
8) High Plains. Northwest Kansas - rainfed and irrigated

7) Site specific management

a) Distinguish concepts of "site specific" management (“precision farming"), including, but not limited to:

1) Global positioning systems (GPS)
2) Geographic information systems (GIS)
3) Grid sampling
4) Variable rate technology
5) Monitoring technology
6) Field mapping

b) Use legal description or geographic coordinates to locate a tract of land or a point in a field.

8) Harvest & Storage

a) Describe the optimum stage at which to harvest the major crops, and understand consequences of harvesting too early or too late.

b) Explain how to determine physiological maturity of the major crops.

c) Recognize how harvesting equipment operation, harvest moisture, drying temperature, handling, storage time and storage conditions affect grain quality or forage quality.

d) Explain the advantages and disadvantages of aeration, artificial (heated) drying, and high moisture grain storage.

9) Basic concepts of crop production economics

a) Calculate profit/acre when given yields, market prices, and input costs.

b) Compare the concepts of profit maximization and optimum inputs.

10) Biotechnology-related issues

a) Describe the current issues in crop and varietal selection for use of biotechnologically generated varieties

b) Understand the concepts of pest-resistance management including rotation of modes-of-action and appropriate use of refuge to defer pest resistance to new technologies.

c) Define a biotechnological “event” and how it is applied to crop varieties.