KANSAS CERTIFIED CROP ADVISER

PERFORMANCE OBJECTIVES

Prepared by: Kansas CCA Board Exam Committee

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INTRODUCTION

Questions for the Kansas Certified Crop Adviser state examination will be developed within the scope of the state performance objectives provided in this document. The Kansas state examination questions will be drawn from the four competency areas in proportion to the percentages shown below and will include the major Kansas crops.

Major Kansas Crops

The questions on the Kansas examination will be limited to the following major crop species:

- Alfalfa
- Corn
- Soybeans
- Sorghum
- Sunflowers
- Wheat
- Forages (e.g., summer annuals, bromegrass, bermudagrass, tall fescue)

NUTRIENT MANAGEMENT COMPETENCIES:

1. Soil and nutrient interaction
2. Soil pH
3. Major nutrients (N, P and K) and application
4. Macronutrients and micronutrients
5. Nutrient management planning
6. Nutrient sources
7. Lime and soil amendments

SOIL AND WATER MANAGEMENT COMPETENCIES:

1. Basic physical properties of soil
2. Soil water management
3. Soil management and conservation
4. Irrigation water management
5. Environmental impacts of soil and water management
6. Saline and sodic soils and waters

PEST MANAGEMENT COMPETENCIES:

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

CROP MANAGEMENT COMPETENCIES:

1. Crop growth and adaptation
2. Basic principles of forage production
3. Planting and seed management
4. Cropping systems
5. Site specific management
6. Harvest and storage management
7. Basic concepts of crop production economics
8. Biotechnology-related issues

NUTRIENT MANAGEMENT COMPETENCY AREAS:

1. Soil and nutrient interaction
2. Soil pH
3. Major nutrients (N, P and K) and application
4. Macronutrients and micronutrients
5. Nutrient management planning
6. Nutrient sources
7. Lime and soil amendments

NUTRIENT MANAGEMENT COMPETENCIES

Competency Area 1: Soil and Nutrient Interaction

1. Recognize how basic soil properties affect movement and retention of nutrients in soil or water, including:
   1) soil pH
   2) soil texture
   3) soil organic matter
   4) cation exchange capacity
2. Describe how soil characteristics and weather conditions can affect different processes within the soil nitrogen cycle, including:
   1) mineralization
   2) nitrification
   3) ammonia volatilization
   4) denitrification
   5) immobilization
   6) leaching
3. Outline the steps for troubleshooting or diagnosing crop growth problems to determine if cause is due to nutrients.
4. Differentiate between nutrient deficiency/toxicity symptoms and the symptoms or injury resulting from:
   1) plant pathogens (e.g., diseases, nematodes)
   2) weather damage
   3) environmental stress
   4) herbicide toxicity
   5) insect feeding
   6) mechanical damage

Competency Area 2: Soil pH

1. Have understanding of the following soil conditions:
   a. acidic
   b. alkaline or basic
   c. calcareous
   d. sodic
2. Explain the difference between the “soil pH” and the “buffer pH” values on a soil test report.
3. Identify the general soil pH ranges which are likely to affect growth of common Kansas crops.
4. Understand how soil pH influences:
   a. aluminum or manganese toxicity

b. iron deficiency chlorosis
c. phosphorus and zinc fertilizer management
d. soil persistence of certain pesticides
e. legume nodulation and nitrogen fixation

5. Explain how soil pH might be affected by long-term use of:
   a. ammonia-nitrogen or ammonium-nitrogen fertilizers
   b. nitrate-nitrogen fertilizers
   c. sulfate-sulfur fertilizers
   d. sulfur fertilizers (i.e., "elemental" sulfur products)
   e. high bicarbonate irrigation water

Competency Area 3: Major Nutrients (N, P, K) and Application

1. Describe how the soil properties of pH, texture, and organic matter might affect nutrient applications, including:
   a. timing
   b. product or source
   c. placement method
   d. recommended application rate
2. Explain how cropping and tillage system affect nutrient applications.
3. Nitrogen
   a. Identify the soil and weather conditions where the following nitrogen fertilizer enhancement products are most beneficial:
      1) urease inhibitors
      2) polymer coatings
      3) nitrification inhibitors
      4) slow release materials
4. Phosphorus
   a. Explain the difference between plant availability and plant uptake.
5. Potassium
   a. Describe how clay mineralogy and weather can affect soil potassium availability.
6. Describe the effects of nutrient deficiency on crop development, crop yield, and crop quality.

Competency Area 4: Macronutrients and Micronutrients

1. Explain the difference between a macronutrient and a micronutrient.
2. Provide the proper chemical or elemental name for each ion or molecule in the following list:
   a. Al^{3+}
   b. Ca^{2+}
   c. Cl^{-}
   d. Cu^{2+}
   e. Fe^{2+}
   f. Fe^{3+}
   g. H_3BO_3
   h. Mg^{2+}
   i. Mn^{2+}
   j. MoO_4^{2-}
   k. S_2

l. SO_4^{2-}
m. Zn^{2+}

3. List the following information for each ion or molecule in the previous objective:
   a. whether it is considered a macronutrient or a micronutrient
   b. whether it is considered mobile or immobile in the soil
   c. whether it presents a concern for deficiency or toxicity to common Kansas crops

4. Describe the difference in the typical visual plant symptoms between:
   a. nitrogen deficiency and sulfur deficiency
   b. nitrogen deficiency and potassium deficiency
   c. iron deficiency chlorosis and zinc deficiency
   d. iron deficiency chlorosis and potassium deficiency
   e. phosphorus deficiency and aluminum toxicity

5. Compare methods of correcting minor nutrient and micronutrient deficiencies.

6. Explain the difference between foliar application and sprinkler irrigation application.

Competency Area 5: Nutrient Management Planning

1. Interpret a laboratory soil test report for the following:
   a. potential for nutrient deficiency or adequacy (as described by categories of “low”, “medium”, “high”)
   b. expected response to added fertilizer nutrients by different crops
   c. conversion between different units of measure, including:
      1) part per million (ppm)
      2) pounds per acre (lb/ac or “parts per two million”)
      3) percent (%)
      4) milligrams per kilogram (mg/kg)
   d. effect of different soil analysis extraction methods on soil test interpretation, including the Bray, Olsen sodium bicarbonate, Mehlich, and DTPA methods.

2. Use information from a soil test report, crop rotation, soil characteristics, field history, fertilizer analysis, and fertilizer price to calculate a fertilizer application rate and cost per acre.
   a. Adjust a fertilizer application rate based on previous crop (i.e., legume).
   b. Use the product density to calculate fertilizer application rates in gallons per acre (gal/ac), quarts per acre (qt/ac), or pounds per acre (lb/ac).
   c. Use information from a laboratory analysis report for irrigation water, manure, biosolids or wastewater to adjust the fertilizer recommendation.
      1) Explain the concept of “first year availability” for nitrogen.

3. Explain why a nutrient recommendation might require adjustment for:
   a. soil properties (soil pH, soil organic matter, or soil texture)
   b. cropping system
   c. crop to be grown
   d. availability of capital
   e. land ownership/land tenure
   f. environmental concerns

4. Explain why a nutrient recommendation might be affected by:
   a. number of cores (subsamples) used to composite a soil sample
   b. non-standard soil sampling depth

c. sample location within a field or land management unit
d. sample density (number of samples within a field)
e. time of year sample was collected

5. Explain why subsoil samples may improve fertilizer recommendations for certain nutrients.
6. Explain why diagnostic soil sample depths may need to be different than routine soil sampling depths.
7. Describe proper methods to collect and handle plant tissue samples to determine nutrient levels.
8. Explain why growth stage and plant parts would affect interpretation of plant analysis results.
9. Describe how plant tissue analysis results can be used for:
   a. diagnosing field problems
   b. monitoring crop nutrient status
   c. in-season nutrient management

Competency Area 6: Nutrient Sources

1. Identify basic characteristics of the following common fertilizer materials, to include physical form, fertilizer grade (analysis), and possible differences in method of application.
   a. anhydrous ammonia (NH3)
   b. urea-ammonium nitrate solution
   c. urea
   d. ammonium sulfate (AMS)
   e. diammonium phosphate (DAP)
   f. monoammonium phosphate (MAP)
   g. ammonium polyphosphate solution (APP)
   h. ammonium thiosulfate (ATS)
   i. potassium chloride (muriate of potash)
   j. potassium-magnesium sulfate
   k. potassium thiosulfate (KTS)
   l. “elemental” sulfur
   m. 10% ammoniated zinc
   n. chelated micronutrients
   o. zinc sulfate
   p. zinc oxide
2. Explain the difference between the following fertilizer terms:
   a. elemental and oxide
   b. phosphorus (P) and phosphate (P2O5)
   c. potassium (K) and potash (K2O)
   d. orthophosphate
   e. polyphosphate
   f. water soluble phosphate
   g. citrate soluble phosphate
   h. plant available phosphate
3. Explain how planting time management may affect fertilizer placement decisions.
   a. Calculate a fertilizer salt index given a fertilizer analysis, application rate, and product density.
   b. Explain how the salt index value of a seed-placed fertilizer may affect germination and emergence.
   c. Identify fertilizer materials that may present a hazard to germination when placed in proximity to the seed.

Competency Area 7: Lime and Soil Amendments

1. Understand the basic concepts of lime quality
   a. Describe how lime quality is affected by chemical purity and by fineness.
   b. Define the term “Effective Calcium Carbonate” or ECC
   c. Calculate a lime application rate from the lime requirement provided on a soil test report and the quality of the liming material.
2. Determine how each of the following factors could affect lime application rate and timing:
   a. soil pH
   b. buffer pH
   c. current crop
   d. crop rotation
   e. tillage system
   f. soil texture
3. Compare the effective neutralizing value, physical properties and handling of the following materials:
   a. ag-lime (agricultural limestone)
      1) calcitic limestone
      2) dolomitic limestone
   b. fluid lime
   c. pelletized lime
   d. water treatment residual (alum sludge, hydrosolids)
   e. gypsum (calcium sulfate)

SOIL AND WATER MANAGEMENT COMPETENCY AREAS:

1. Basic physical properties of soil
2. Soil water management
3. Soil management and conservation
4. Irrigation water management
5. Environmental impacts of soil and water management
6. Saline and sodic soils and waters

SOIL AND WATER COMPETENCIES

Competency Area 1: Basic physical properties of soil

1. Understand the basic concepts of the land survey system used in Kansas.
    a. Be able to identify a tract of land using township, range, section number, and subsection description.
    b. Use a written soil survey report or an on-line web soil survey to identify soils in a field and describe basic characteristics and properties of each soil profile.
2. Define these basic physical soil properties:
    a. texture
    b. structure
    c. organic matter
    d. clay mineralogy
    e. bulk density
    f. porosity
3. Explain how the soil physical properties in the previous objective can affect:
    a. water holding capacity
    b. water intake and infiltration
    c. internal soil drainage
    d. soil tilth
    e. compaction
    f. root growth

Competency Area 2: Soil water management

1. Describe how soil moisture storage may be affected by:
    a. evaporation and transpiration
    b. crop rotation and cropping system
    c. cover crop use
    d. tillage methods and timing
    e. soil physical properties, both surface and subsoil
    f. type and amount of crop residue
2. Understand the advantages and disadvantages of using surface and subsurface drainage to manage excess water.

Competency Area 3: Soil conservation and management

1. Describe how the following factors affect potential for wind and water erosion:
    a. residue cover and management
    b. conservation systems
    c. length and grade of slope

d. soil characteristics
e. rainfall characteristics
f. crop characteristics
g. tillage
h. unsheltered distance
i. shelter belts
j. critical wind erosion period

2. Explain how natural or tillage-induced restrictive soil layers may affect:
   a. root development and plant growth
   b. surface and profile water movement
   c. aeration
   d. nutrient movement

3. Identify situations where soil compaction may develop:
   a. before and during planting
   b. during the growing season
   c. at harvest
   d. after harvest

4. Describe methods that help manage problems resulting from soil compaction or naturally-restrictive soil conditions, such as:
   a. subsurface tillage
   b. freeze-thaw
   c. plant roots

Competency Area 4: Irrigation management

1. Define the following terms:
   a. saturation
   b. field capacity
   c. wilting point
   d. available water holding capacity
   e. evapotranspiration
   f. potential evapotranspiration (PET)
   g. consumptive use
   h. crop water use
   i. effective root zone depth
   j. water use efficiency

2. Explain how the following factors affect water use and efficiency:

   a. weather
      1) precipitation (amount, duration, and intensity)
      2) temperature
      3) wind
      4) solar radiation
      5) relative humidity

b. soil factors
    1) slope
    2) surface texture
    3) subsoil properties
    4) compaction
    5) drainage

c. crop factors
    1) crop growth stage
    2) plant canopy
    3) rooting depth
    4) tillage system
    5) residue cover
    6) crop rotation

3. Compare the water use, application patterns and irrigation efficiency of the following irrigation system types:

    a. gravity/furrow/flood
        1) conventional
        2) surge flow

    b. sprinkler center pivot systems
        1) conventional (medium-pressure to high-pressure systems)
        2) low pressure, in-canopy application
            (1) LEPA (low energy precision application)
            (2) MESA (medium elevation spray application)
            (3) LESA (low elevation spray application)

    c. other sprinkler types
        1) fixed
        2) towable
        3) lateral-move

    d. drip systems
        1) buried (subsurface)
        2) stationary surface
        3) mobile surface

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

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

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

7. Be able to calculate crop water use and irrigation output when provided with crop requirements, growth stage, and irrigation system specifications (e.g., gallons per minute, area irrigated, etc.).

8. Describe how the following methods and technologies are used to schedule and to manage irrigation:
    a. "feel" method for soil moisture
    b. soil moisture sensors (e.g., granular sensors, gypsum blocks, tensiometers, capacitance probes)
    c. high-resolution weather data
    d. ET networks (e.g., Mesonet, High Plains Regional Climate Center)
    e. “checkbook” method
    f. software programs (e.g., KanSched2, Crop Water Allocator, Water Optimizer)

Competency Area 5: Environmental impacts of soil and water management

1. Explain how the following factors affect movement of sediment, nutrients, or pesticides by runoff and leaching:
   a. residue cover and management
   b. tillage systems
   c. length and grade of slope
   d. soil physical characteristics (texture, organic matter, etc.)
   e. rainfall characteristics precipitation intensity and duration
   f. crop characteristics (growth habit, residue type and quantity, etc.)
2. Describe the purpose of a risk assessment tool, like the Phosphorus Index or the Nitrogen Index.
3. Have a general understanding of how state rules and regulations could affect soil or water management, including:
   a. application of nutrients, waste and pesticides
   b. system calibration for nutrient, waste and pesticide application
   c. water use limitations and restrictions
   d. the regulatory authority, including Kansas Department of Agriculture, Kansas Department of Health and Environment, and Kansas Corporation Commission.

Competency Area 6: Saline and sodic soils and waters

1. Define the term “salt” as it relates to soil.
2. Explain in general how salinity and/or sodium may accumulate in soils due to natural causes or due to human activities.
3. Summarize the differences between saline, sodic, and saline-sodic soil conditions, including:
   a. the effect of total salinity concentration on crop growth and yield.
   b. the effect of excess sodium on soil characteristics
   c. the effect of dissolved ions on potential plant toxicity, especially chloride (Cl) and boron (B).
4. Explain how the following soil analysis results are used to identify salt or sodium affected soils:
   a. electrical conductivity of the saturated paste soil extract (ECe)
   b. exchangeable sodium percentage (% Na)
   c. sodium adsorption ratio (SAR).
5. List the chemical constituents that are commonly measured when evaluating irrigation water quality.
6. Describe the important irrigation water quality constituents and calculations which identify the potential for:
   a. accumulating excess soil salinity that can affect crop and soil management.
   b. soil degradation due to aggregate dispersion, soil crusting, and reduced infiltration rates.
   c. causing specific ion toxicities through foliar and/or root absorption.
7. Describe how various amendments, cropping practices, and soil management methods help to improve saline, saline-sodic, and sodic soil conditions.

PEST MANAGEMENT COMPETENCY AREAS:

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

PEST MANAGEMENT COMPETENCIES

Weed Management Competencies:

Competency Area 1: Weed Management

1. Weed biology *(refer to Table PM-1)*:
   a. Identify the basic growth habit of common Kansas weeds.
   b. Distinguish between grasses, sedges, and broadleaves.
   c. Identify the basic life cycle of common Kansas weeds (annual, biennial, perennial).
   d. Identify the most common reproductive method of Kansas weeds, whether by seed, vegetative, or both.
2. Weed management strategy
   a. Explain how the differences in the weed life cycle of the common weeds can affect weed management strategy.
   b. Describe how the critical weed-free period affects weed management in the common Kansas crops.
   c. Be familiar with year-round weed control strategies.
   d. Understand how the common weeds listed in Table PM-1 can interact and compete with the common Kansas crops.
   e. Describe how the following strategies are used to manage weeds and why they may or may not work:
      1) crop rotation
      2) plant population and row spacing
      3) tillage and cultivation
      4) planting date of crop
      5) proper soil fertility and pH
      6) herbicide tolerant crops
      7) herbicides
      8) environmental conditions
      9) biological controls
   f. Explain why the efficacy of a herbicide applied at the following times can be affected by the weed life cycle and by the critical weed-free period:
      1) early preplant
      2) preplant incorporated
      3) preemergence
      4) postemergence
      5) non-crop season

g. Explain how the following tillage systems could affect weed infestations, weed seed dynamics, and species composition:
    1) clean tillage
    2) reduced tillage or conservation-tillage
    3) strip tillage or ridge-tillage
    4) no-till

h. Explain how herbicide activity, crop injury, or residual activity can be affected by:
    1) herbicide properties (e.g., chemical structure, solubility, adsorption, and degradation)
    2) soil characteristics (e.g., texture, organic matter content, and pH)
    3) application rate or method
    4) environmental conditions (e.g., soil moisture and temperature)
    5) weed and crop species

i. Explain how the effectiveness of pesticide applications can be influenced by:
    1) spray additives
    2) weather conditions
    3) weed growth stage
    4) crop growth stage and canopy
    5) spray volume
    6) nozzle type
    7) pressure

3. Herbicide resistance

    a. Know the factors that influence the development of herbicide resistance and ways to reduce the risk of selecting herbicide resistant weed biotypes.

    b. Define the concept of "herbicide mode of action classes" and how to use them in resistance management.

    c. Briefly explain the terms used in Table PM-2:
        1) "WSSA classification number"
        2) "typical herbicide family"
        3) "mode or site of action"

4. Weed identification

    a. Describe how to use plant characteristics to identify a weed and differentiate weeds.

    b. Describe how to properly collect, package, and ship a weed specimen for identification.

Table PM-1. Common Kansas weeds		
Life cycle	**Grasses and sedges**	**Broadleaves**
Summer annual	barnyardgrass fall panicum foxtails large crabgrass shattercane	common cocklebur giant ragweed ivyleaf morninglory kochia Pennsylvania smartweed pigweed species waterhemp species Russian thistle velvetleaf wild buckwheat
Winter annual	cheat grasses jointed goatgrass	field pennycress henbit mustards marestail horseweed
Biennial		musk thistle
Perennial	johnsongrass yellow nutsedge	Canada thistle field bindweed hemp dogbane sericea lespedeza

Table PM-2. Herbicide mode-of-action classes *(per Weed Science Society of America)*		
WSSA* group no.	**Typical herbicide family**	**Mode or site of action**
1	aryloxyphenoxypropionate, cyclohexanedione, phenylpyrazoline	grass growing point disintegrators, lipid synthesis inhibitors
2	imidazolinone, sulfonylurea, triazolopyramidine	amino acid synthesis inhibitors; ALS, AHAS inhibitors
3	dinitroaniline	seedling root inhibitors
4	benzoic, phnoxy, carboxylic acid, quinolone carboxylic acid	synthetic auxins; growth regulators
5	triazines, uracils	photosynthetic inhibitors
6	nitriles, benzothiadiazole	photosystem II inhibitors
7	phenylurea	photosystem II inhibitors
8	thiocarbamate	seedling growth inhibitors
9	glyphosate	EPSP aromatic amino acid inhibitors
10	organophosphate	nitrogen metabolism inhibitors
13	isoxazolidinone	pigment inhibitor
14	diphenylether, N-phenylphthalimide, aryl-triazinone, pyrimidinedione	cell membrane disrupters
15	amide, acetamide, pyrazole	seedling growth inhibitor
17	organic arsenical	unknown
19	semicarbazone	auxin transport inhibitor
22	bypyridilium	cell membrane disrupters
27	isoxazole, triketone	pigment inhibitors
N/C	sodium chlorate	unknown

Plant Pathogen Management Competencies:

Competency Area 2: Plant pathogen management

1. Biology of plant pathogens
    a. Name diseases or pathogens of common Kansas crops. (*refer to Table PM-3*).
    b. Identify whether a disease is caused by bacterial, fungal, or viral plant pathogens.
    c. Describe the general pathways or conditions by which crops become infected with a pathogen.
    d. Identify which pathogens attack at the seedling, vegetative, maturity, or storage stages.
    e. Explain how the following factors might affect the impact of diseases or pathogens:
        1) crop rotation
        2) alternate host
        3) tillage system
        4) cultivar or hybrid selection
        5) planting date
        6) crop stage at time of infection
        7) environmental stresses
        8) soil compaction, soil texture
        9) insect vectors
        10) fertility practices
2. Plant pathogen management
    a. List cultural techniques that may be used to manage pathogens.
    b. If cultural treatments are not effective, describe proper use of fungicide treatment.
    c. Identify growth stage (stages) where control of a disease or pathogen is most critical.
    d. Identify the field conditions that are more favorable for effectiveness of seed treatments.
    e. Explain the general relationship between molds and mycotoxins in stored grain and forages.
3. Fungicide use
    a. Explain at what growth stage (or stages) a fungicide treatment may be most cost effective.
    b. Know the fungicide families and primary fungicides used to manage crop diseases in Kansas.
    c. Know the differences between preventative and curative applications.
    d. Understand how weather conditions and spray application technology can influence the effectiveness of fungicide applications.

Table PM-3. Frequent pathogens of common Kansas crops						
Type	**Corn**	**Soybeans**	**Wheat**	**Sorghum**	**Sunflowers**	**Alfalfa**
Bacterial	Goss's wilt	bacteria blight		bacterial streak bacterial stripe		
Fungal: soil-borne	charcoal rot *Pythium* seedling rot *Fusarium* stalk rot Diplodia stalk rot Anthracnose stalk rot	charcoal rot sudden death syndrome *Pythium* seedling rot *Phytophthora* root rot *Rhizoctonia* root rot *Rhizoctonia* crown rot	charcoal rot *Pythium* seedling rot take-all	charcoal rot *Pythium* seedling rot *Fusarium* seedling blight *Fusarium* stalk rot	charcoal rot *Pythium* seedling rot	*Phytophthora* root rot *Fusarium* crown rot
Fungal: stem/leaf	gray leaf spot common rust southern rust northern corn leaf blight anthracnose	*Septoria* brown spot frogeye leaf spot *Phomopsis* pod blight *Phomopsis* leaf blight stem canker	stripe rust leaf rust speckled leaf blotch powdery mildew	sooty stripe	rust *Rhizopus* head rot *Alternaria* leaf blight *Phoma* black stem	rust spring black stem summer black stem
Fungal: grain	*Aspergillus* ear rot *Diploidia* ear rot *Gibberella* ear rot *Fusarium* ear rot	purple seed stain Phomopsis blight	scab black point			
Viral		bean pod mottle virus bud blight soybean vein necrosis virus	wheat streak mosaic barley yellow dwarf High Plains disease			alfalfa mosaic virus
Nematodes	sting nematode root lesion nematode stubby-root nematode	soybean cyst nematode	root lesion nematode			

Insect and Mite Management Competencies:

Competency Area 3: Insect and mite management

1. Biology
    a. Identify the dispersing (movement) and damaging stages of common Kansas insects and mites. (*refer to Table PM-4*).
    b. Know the type of metamorphosis for each type of pest.
    c. Identify the life cycle stage (or stages) of the pest when crops are damaged.
    d. Identify the growth stage (or stages) when a crop is affected and treatment is warranted.
2. Insect pest management
    a. Explain how the following characteristics influence pest management decisions:
        1) developmental time and period of activity
        2) host plants for egg, larval, pupal, adult or nymph life stages
        3) site of feeding on plant
        4) insect or mite mobility
    b. 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
    c. Recognize how cultural practices can influence the potential for the occurrence of insects in crops. including
        1) crop rotation
        2) date of planting
        3) tillage
        4) weed infestations
        5) refuges
        6) transgenic traits
    d. Describe how the following cropping practices affect insect/mite pest management decisions
        1) planting date
        2) harvest date
        3) tillage method
        4) presence of weeds
        5) pesticide interactions
        6) pesticide product selection
        7) application method
        8) hybrid, variety and trait selection
        9) crop rotation
3. Insecticide and miticide application
    a. Understand how weather conditions, spray application technology, and spray additive can influence the effectiveness of insecticide and miticide applications.

4. Identification

    a. Identify the general crop injury symptoms caused by each type of pest.

    b. Differentiate between economic and non-economic damage.

Table PM-4. Frequent insect and mite pest of common Kansas crops						
Type	**Corn**	**Soybeans**	**Wheat**	**Sorghum**	**Sunflowers**	**Alfalfa**
Aphids		soybean aphid	Russian wheat aphid bird cherry-oat aphid English grain aphids greenbugs	greenbugs sugarcane aphid corn leaf aphid		pea aphid spotted alfalfa aphid cowpea aphid
Insects, above-ground	black cutworm earworm flea beetle corn rootworm ● Western ● Northern ● Southern European corn borer grasshopper southwestern corn borer Western bean cutworm	grasshopper Dectes stem borer bean leaf beetle green cloverworm stink bug soybean podworm	fall armyworm grasshopper Hessian fly armyworm army cutworm	chinch bug grasshopper sorghum headworm sorthum webworm sorghum midge	grasshopper head clipper weevil head moth seed weevil stem weevil Dectes stem borer	alfalfa weevil blister beetle grasshopper potato leafhopper army cutworm
Insects, below ground	white grubs wireworm	bean leaf beetle	false wireworm	wireworm white grub		
Insects, stored grain	Indian meal moth lesser grain borer		Indian meal moth grain beetles	Indian meal moth grain beetles		
Mites	Banks grass mite two-spotted spider mite	Banks grass mite two-spotted spider mite	winter grain mite wheat curl mite	Banks grass mite two-spotted spider mite		

Integrated Pest Management Competencies:

Competency Area 4: Integrated pest management

1. Understand the requirements for making economically and environmentally sound pest management recommendations for a specific site or situation.
2. Explain the relationship between pest management practices and development of pest resistance.
3. Verifying that pest management intervention strategies had the desired effect.
4. Describe diagnostic steps to differentiate between symptoms and injury resulting from plant diseases from
   a. weather damage
   b. environmental stress
   c. herbicide toxicity
   d. insect feeding
   e. mechanical damage
   f. nutrient deficiencies/toxicities
   g. other causes
5. Explain the term "refugia".
6. Compare the methods of establishing refugia to prevent insects from developing resistance to plant-incorporated protectants (e.g. *Bt* or other insecticidal toxins).

Pesticide Use and Safety

Competency Area 5: Pesticide use and safety

1. Interpret pesticide labels and labeling terms, including:
   a. mode of action class
   b. pre-harvest intervals
   c. plant-back or recropping restrictions
   d. endangered species bulletins
2. Describe the requirements for proper pesticide application and use documentation.
3. Explain how the following items impact proper pesticide use in regard to environmental and 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.)
   d. government regulations
   e. pesticide characteristics
4. Be familiar with the general provisions of state pesticide regulation laws.
5. Describe the general provision of EPA regulations and how they might affect you:
   a. Clean Water Act (CWA)
   b. Worker Protection Standard (WPS)
   c. Safe Drinking Water Act (SWDA)
   d. FIFRA (Federal Fungicide, Insecticide, and Rodenticide Act)

6. Locate and apply the following information on the pesticide label:
    a. dosage or use rate
    b. application restrictions
    c. toxicity
    d. re-entry interval (REI)
    e. limitations, if any, on cropping sequence
    f. herbicide residual toxicity (carryover potential)
    g. resistance management information
    h. WSSA-MOA group number
    i. pesticide container disposal and pesticide spill cleanup
    j. environmental hazards
    k. handling precautions
    l. first aid procedures
7. Locate and apply the following information in a Safety Data Sheet, SDS (formerly known as "Material Safety Data Sheet, MSDS"):
    a. emergency phone numbers
    b. potential health effects
    c. active ingredient
    d. first aid measures
    e. fire-fighting measures
    f. accidental release measures.
    g. exposure controls/personal protection
    h. physical and chemical properties.
    i. stability and reactivity
    j. disposal, transport, and regulatory information
8. Distinguish between spray droplet drift and volatilization.
    a. Identify conditions most conducive to drift or volatilization.
9. Describe the pattern form, relative droplet size, proper pattern overlap, operating pressure, and primary uses of the following nozzle types (in accordance with pesticide label requirements).
    a. standard flat fan
    b. even flat fan
    c. flood tip
    d. hollow-cone
    e. air induction
    f. others

CROP MANAGEMENT COMPETENCY AREAS:

1. Crop growth and adaptation
2. Basic principles of forage production
3. Planting and seed management
4. Cropping systems
5. Site specific management
6. Harvest and storage management
7. Basic concepts of crop production economics
8. Biotechnology-related issues

CROP MANAGEMENT COMPETENCIES

Competency Area 1: Crop growth and adaptation

1. Identify the life cycle and adaptation of crops commonly grown in Kansas.
2. Relate the growing degree day (GDD) concept to crop development, recognize its function in production systems, and calculate GDD for corn, grain sorghum, or sunflowers.
3. Describe and use the staging systems to identify growth stages between emergence and physiological maturity for crops commonly grown in Kansas.
4. Identify the location and development of the growing point during the early growth stages of the major crops.
5. Recognize relationships between the growth and development of major Kansas crops and making crop management decisions.
6. Compare and contrast rooting patterns of the major crops.

Competency Area 2: Basic principles of forage production

1. Describe how frequency of harvest is related to forage yield and quality.
2. Describe how frequency and timing of harvest affects stand longevity, food reserves and stand persistence.
3. Be able to distinguish between warm and cool season forages.
4. Be able to distinguish between perennial and annual forages.
5. Identify appropriate stages of development for harvesting legumes, grasses, and grain crops as silage or hay.
6. Know the major toxicities that may be found in forages, including nitrates, prussic acid, fescue toxicosis, and mineral deficiencies (e.g., grass tetany).

Competency Area 3: Planting and seeding management

1. Calculate the percentage of pure live seed (% PLS) from a seed sample analyses or seed tag information.
2. List the minimum and optimum temperatures for seed germination of the major Kansas crops.
3. Interpret results from yield comparisons or variety trials using appropriate statistical data, such as least significant difference (LSD) and other calculations.
4. Identify environmental and crop management factors that influence:
   1) seeding or planting dates

2) seeding rates or plant populations
3) seeding or planting depths

5. Calculate the final seeding rate in seeds per acre or seeds per foot of row, when given:
   1) pure live seed percentage
   2) seeds per pound
   3) row spacing
   4) desired population
   5) expected field emergence

6. Describe how crops may respond to:
   1) plant populations or seeding rates
   2) planting or seeding dates
   3) planting patterns

7. Explain the value of inoculation of legume seed and the situations when it should be recommended.
   1) Know proper methods for successful seed inoculation.
   2) Identify the characteristics and appearance of effective vs. ineffective nodules.

Competency Area 4: Cropping systems

1. Compare the advantages and disadvantages of crop rotations to single-crop, monoculture systems.

2. Describe the influence of the following factors on cropping system options and production strategies.
   a. crop characteristics
   b. temperature, precipitation, climate, growing season
   c. day length
   d. water use efficiencies
   e. irrigated or dryland conditions
   f. tillage system
   g. soil conditions

3. Define the difference between a cover crop and a companion crop.

4. Describe the advantages and limitations of growing cover and companion crops, including:
   a. effect on soil moisture and moisture storage
   b. weed competition
   c. erosion control
   d. nutrient management
   e. cost and return
   f. effect on primary crop
   g. pest management
   h. grazing or forage management

Competency Area 5: Site specific management

1. Relate the concepts of "site specific" management (“precision farming"), including, but not limited to:
   a. global positioning systems (GPS)
   b. geographic information systems (GIS)
   c. grid soil sampling
   d. variable rate application (nutrient, pesticide)
   e. monitoring technologies (yield, planting)

f. development of field maps
g. soil mapping technologies

2. Describe how the following techniques are used to identify variability in soils and crops:
   a. yield monitoring
   b. soil sampling
   c. in-field sensing (e.g., NDVI, chlorophyll meter)
   d. plant tissue sampling
   e. remote sensing (e.g., aerial or satellite imaging)
   f. interpretation and use of field maps
3. Explain how site specific management techniques can help maximize or optimize crop production and soil management.

Competency Area 6: Harvest and storage management

1. Describe the optimum stage at which to harvest forage crops for pasture, hay, or silage.
2. Explain how to determine physiological maturity of the major grain crops.
3. Explain the advantages and disadvantages of grain storage when using:
   a. aeration (natural air)
   b. artificial (heated) drying
   c. high moisture grain storage
4. Describe how harvest and storage conditions affect development of:
   a. molds
   b. mycotoxins (aflatoxin, etc.)
   c. stored grain insects
5. Explain how molds, mycotoxins, or insects can potentially affect quality of grain, hay, or silage.
6. Identify resources for managing grains or forages that have been affected by molds, mycotoxins, or insects.

Competency Area 7: Basic concepts of crop production economics

1. When given yields, market prices, and input costs:
   a. Calculate gross profit per acre.
   b. Calculate break-even costs per yield unit.
   c. Compare profitability of alternative crop production systems or crop rotations.

Competency Area 8: Biotechnology-related issues

1. Compare the differences and similarities of traits developed by conventional genetic techniques and those developed by genetic modification.
2. Explain the adaptation and important uses of biotechnology in cropping systems.
3. Define a biotechnological “event” and how it is applied to crops.
4. Describe the current issues in use of biotechnologically generated crops.
5. 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.