

Nebraska *Certified Crop Adviser Program*



Performance Objectives

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The Nebraska Certified Crop Adviser Board
Committee for Exams and Continuing Education
8700 Executive Woods Dr, Ste 400
Lincoln, NE 68512-9612
Phone: (402) 476-1528 | E-Mail: info@necca.org

Introduction

Just as the International Certified Crop Adviser (CCA) Performance Objectives outline the knowledge and skill areas that advisers need in order to effectively meet their duties and responsibilities on the general scheme, the Nebraska CCA Performance Objectives have been developed to indicate the knowledge and skills needed to perform well in Nebraska's climate and cropping systems. These performance objectives are the heart of the CCA Program. They are used as the framework for test construction and the basis for continuing education programs. The Nebraska Certified Crop Advisers Board provides oversight and direction to the Committee for Exam and Continuing Education. The Board ensures that the Nebraska CCA Performance Objectives are reviewed and revised in a timely manner.

These performance objectives are dynamic. They are upgraded as needed, particularly as the technology of the crop production industry evolves. The upgrading is done by the Exam and Continuing Education Committee, which is a standing committee for the Nebraska Certified Crop Adviser Board. The upgrading process ensures that the CCA Program will remain viable and useful, and that the program recognizes the high level of competency needed by individuals, who will advise producers now and in the future.

The Nebraska CCA Performance Objectives, as outlined in this document, delineate the knowledge and skills that are considered important for certified crop advisers working in Nebraska. Expertise in these areas is expected. All questions on the Nebraska CCA Exam are based on the Nebraska CCA Performance Objectives. Certified crop advisers must also demonstrate their expertise in International CCA Performance Objectives. The International CCA Exam questions are based on the International CCA Performance Objectives.

Since the International and Nebraska Performance Objectives are developed over the materials that Certified Crop Advisers need to know, it is apparent that they are the basis for the entire CCA Program. The first step for persons interested in becoming a certified crop adviser is adequately mastering the material covered in the Performance Objectives, so one can pass the CCA exams (i.e., International and Nebraska). All the questions on both exams are based directly on these Performance Objectives.

The Performance Objectives serve as the guide for CCA continuing education, which is the backbone of the CCA Program. Once certified, the CCA must participate in continuing education programs. These programs ensure that the CCA maintains or increases their proficiency and maintains the integrity of the CCA Program. Certified Crop Advisers should use these Performance Objectives to identify areas where they need to strengthen their proficiency.

Major Crops in Nebraska

Alfalfa	Corn	Pulse Crops (Dry Edible Beans, Field Peas, Chickpeas)	Grain Sorghum
Forages (Small Grains, Corn Silage, Summer Annuals)	Soybean	Sugar Beets	Wheat

Nutrient Management

Competency Area 1: Basic Concepts in Plant Nutrition

1. Understand the 4R concept and the four components (rate, time, source, place) that make up the 4Rs and how they relate to plant nutrition.
2. Identify plant species that fix atmospheric nitrogen, describe the process involved in nitrogen fixation and identify limiting factors.
3. Describe how nutrient cycles and plant nutrient availability are impacted by management (tillage, cropping system, 4Rs etc.).
4. Understand how plants absorb nutrients and the functions of various nutrients in the plant.

Competency Area 2: Basic Concepts in Soil Fertility

1. Describe transformations of soil and fertilizer nutrients, including N, P, and K, which could include immobilization, mineralization, and fixation.
2. Understand soil macro-nutrients and micro-nutrients and their importance in soil fertility.
3. Identify soil conditions/quality factors that restrict or enhance nutrient availability to plants and propose ways to maintain or increase it.
4. Describe means by which nitrogen can be lost from the soil and propose methods to reduce the loss (nitrification, denitrification, volatilization, and dissolution).
5. Describe the importance of soil organic matter; and soil physical, chemical and biological properties that are important to soil fertility.

Competency Area 3: Soil Testing for Nutrients and Plant Analysis

1. Describe the objectives and processes of soil testing.
2. Understand soil test reports and how they are used for site specific and management zone nutrient recommendations.
3. Provide instructions for collecting and submitting proper soil samples for nutrient analysis and fertilizer recommendations.
4. Understand the uses of plant tissue analysis and some of its limitations.
5. Provide instructions for collecting and submitting proper plant tissue for nutrient analysis and fertilizer recommendations.
6. Understand the plant tissue test report and how it is used for nutrient recommendations.

Competency Area 4: Nutrient Sources and Applications

1. Give the desired source of starter fertilizers and identify situations where they should be used.
2. Perform computations using rate of nutrient required to calculate rate of fertilizer recommended and vice versa.

3. Select suitable placement methods for fertilizers considering soil and cropping conditions, and fertilizer characteristics.
4. Select common fertilizer sources to provide appropriate plant nutrients in selected soils and management systems.
5. Understand how application timing, source and rate of fertilizer can limit the losses of mobile nutrients while ensuring nutrients are available when the crop needs them.
6. Determine suitable rates and methods for application of manure/compost products.
7. Understand the use and availability/mineralization of nutrients from manure, irrigation water, legumes/cover crops and other nutrient sources and factors that impact nutrient recommendations.

Competency Area 5: Soil pH, Amendments & Salinity

1. Describe the concept of soil pH and identify ways to maintain, raise or lower it.
2. Describe saline and sodic soils, identify their cropping problems, and propose means for managing or adjusting their levels in soils.
3. Explain the relationship between pH and macro and micro nutrient availability.

Competency Area 6: Nutrient Management Planning

1. Relate ease of movement of nutrients through the soil profile keeping in mind soil characteristics and nutrient form, management practices (tillage, use of cover crops) and soil nutrient holding capacity.
2. Understand the use of organic materials as nutrient sources for plants considering their:
 - a. Composition
 - b. Carbon/nitrogen ratios
 - c. Method and uniformity of application
 - d. Mineralization rates
 - e. Advantages and disadvantages of use
3. Define soil and plant conditions where sulfur, zinc, and iron deficiency for plants may be a problem.
4. Describe the process and the products in the conversion of organic materials into plant available nutrient forms.

SOIL AND WATER MANAGEMENT

SOIL MANAGEMENT

Competency Area 1: Basic Concepts in Biological Soil Properties

1. Define the soil food web.
2. Describe the importance of soil biological diversity.
3. Describe major functions of soil organisms.
4. Describe how tillage and crop rotations impact the soil food web.

Competency Area 2: Basic Concepts in Physical and Chemical Soil Properties

1. List approximate available water holding capacity for common soil textural classes.
2. Describe the concepts of permanent wilting point, field capacity, and plant available water of soils.
3. Describe how tillage affects soil structure.
4. Describe how wetting/drying and freezing/thawing affects soil structure.
5. List key soil physical properties and how they impact plant water availability, plant growth, infiltration, runoff, bulk density, and nutrient cycling.
6. Define CEC and its relationship to nutrient availability and soil production potential.

Competency Area 3: Soil Health Principles

1. Describe the benefits and risks of livestock manure application.
2. Describe these soil health planning principles:
 - a. Keeping the soil covered
 - b. Maximizing living plant roots
 - c. Limiting disturbance
 - d. Increasing crop diversity
 - e. Integrating livestock
3. Understand the principles of carbon sequestration.
4. Distinguish between organic matter (OM) and organic carbon (OC).

Competency Area 4: Basic Concepts in Erosion Processes

1. Relate how the following conditions can affect the severity of erosion by water and wind:
 - a. Soil moisture content
 - b. Surface crusting
 - c. Tillage (surface condition)
 - d. Standing crop residue
 - e. Flattened crop residue
 - f. Importance of aggregate stability

2. Explain how the following conservation practices affect sheet, rill, gully, and wind erosion:
 - a. Field windbreaks
 - b. Stripcropping
 - c. Vegetative barriers
 - d. Contour farming
 - e. Terraces
 - f. Cover cropping

Competency Area 5: Basic Concepts of Soil Tillage and Crop Residue Management

1. Describe how the following impact the amount of soil surface residue cover:
 - a. Crop rotation
 - b. Crop yield
 - c. Harvesting method
 - d. Tillage system
 - e. Fertilizer and manure application
 - f. Weather and climate
 - g. Carbon to Nitrogen Ratio (C:N)
 - h. Livestock grazing
2. Recognize the approximate residue reduction caused by common tillage practices.
3. Recognize the impact of various tillage practices and systems on:
 - a. Nutrient availability and fertilizer application
 - b. Pest management and herbicide applications
 - c. Soil moisture content and soil temperature
 - d. Crop development and weed control
 - e. Soil structure
 - f. Compaction
 - g. Aggregate Stability
4. Distinguish between clean till and high surface residue management systems regarding surface crusting, soil structure, and aggregate stability.
5. Describe how tillage and soil surface residue cover affect soil moisture losses due to evaporation.

Competency Area 6: Basic Concepts of Restrictive Soil Layers

1. Explain how tillage can both create and reduce soil compaction.
2. Explain the use of cover crops and crop rotation to reduce compaction.
3. Describe the difference between a restrictive layer and a compacted layer.
4. Understand management options for hardpan areas.

Competency Area 7: Basic Concepts of State and Federal Regulations and Policy

1. Recognize the intended environmental benefits federal, state, and local conservation programs such as the Environmental Quality Incentives Program (EQIP).
2. Identify the general provisions of the Nebraska Erosion and Sediment Control Act.
3. Recognize the basic regulations dealing with groundwater and surface water use in Nebraska.

4. List the basic Natural Resources District responsibilities for water quantity and quality.

Competency Area 8: Basic Concepts in Landscape Characterization

1. Recognize how landscape characteristics can affect potential groundwater and surface water contamination.
2. Recognize how soil properties can affect potential groundwater and surface water contamination.
3. Understand the basic concepts and use of a soil survey.

WATER MANAGEMENT

Competency Area 1: Basic Concepts of Water and Contaminant Movement

1. Describe how the following factors affect infiltration and runoff:
 - a. Soil texture
 - b. Soil structure
 - c. Soil organic matter
 - d. Soil surface roughness
 - e. Soil surface residue
 - f. Bulk Density
 - g. Aggregate Stability
2. Describe the relationships among tillage, residue, surface crusting, soil structure, infiltration, runoff, aggregate stability, and compaction.
3. Describe how the following may impact contaminant movement:
 - a. Precipitation and runoff characteristics
 - b. Contaminant degradation characteristics
 - c. Contaminant adsorption characteristics
 - d. Soil and site conditions
4. Describe how the vadose zone characteristics and depth to ground water may impact contaminant accumulation and movement in ground water.

Competency Area 2: Basic Concepts in Soil, Plant & Water Relationships

1. List typical daily water use and total seasonal water requirements for major Nebraska crops.
2. Describe critical stages of crop growth for major Nebraska crops when adequate moisture is required.
3. List the minimum allowable soil water balance (or maximum allowable soil water depletion) to prevent crop water stress in Nebraska irrigated crops.
4. Describe factors that determine the amount of rainfall that will be available for crop use (effective rainfall).
5. Describe practices to conserve soil moisture available for crop use in dryland/rainfed production settings.

Competency Area 3: Basic Concepts in Water Quality

1. Differentiate between and describe point and non-point sources of pollution.

2. Describe the significance of the following:
 - a. Maximum contaminant level
 - b. Maximum contaminant level goal
 - c. Secondary maximum contaminant level
 - d. Health advisory level
 - e. Total maximum daily load
3. Differentiate between chemical concentration and loading in surface water.
4. Select best management practices to reduce phosphorus in surface water.
5. Select best management practices to reduce the potential for fertilizer and pesticide contamination of groundwater.
6. Explain the relationship between:
 - a. Parts per million
 - b. Parts per billion
 - c. Milligrams per liter
 - d. Micrograms per liter

Competency Area 4: Basic Concepts of Irrigation Water Management

1. Calculate crop root zone soil water balance.
2. Describe common methods to measure/monitor soil moisture status and tools used.
3. Describe impact of weeds on soil moisture depletion.
4. Explain impact of crop residue retention on soil moisture management.
5. Define ET and describe its use in irrigation scheduling.
6. Calculate the amount of irrigation water applied with an irrigation event.
7. Describe the common procedures for scheduling irrigation.
8. Describe the basic procedures for scheduling the last irrigation of the season for the Major Crops in Nebraska.
9. Calculate the number of days before the next irrigation is needed and the necessary irrigation amount.
10. List the factors that influence irrigation system application efficiency.
11. Describe the factors to consider when selecting and designing an irrigation system.
12. List the factors that impact the selection of sprinkler devices for center pivot systems.
13. Describe the principles of surge irrigation application.
14. Explain how to adjust irrigation schedules for electrical load management, system flow rates, soil moisture at rooting depth, and soil texture.

15. For furrow irrigation describe how the following can affect the uniform application of irrigation water and leaching potential along the length of the furrow:
 - a. Slope
 - b. Set size
 - c. Furrow flow rate
 - d. Set time
 - e. Soil texture
16. Describe how furrow irrigation management changes depending on the runoff control measures used:
 - a. No runoff control in place
 - b. Tailwater recovery system
 - c. Blocked field ends
17. For a center pivot irrigation system, describe how the following impact the uniform application of irrigation water:
 - a. Sprinkler package
 - b. Soil texture
 - c. Slope
 - d. Surface storage
 - e. Runoff
 - f. Topography
 - g. Wind
18. Describe the factors that impact the scheduling of the first irrigation when using a center pivot.
19. Describe sub-surface drip systems.
20. Understand benefits and challenges for use with drip/sub-surface irrigation systems.

Competency Area 5: Basic Concepts in Application of Fertilizers and Pesticides by Chemigation

1. List factors to consider when selecting materials to be applied by chemigation.
2. Recognize the requirements of the Nebraska Chemigation Act including the requirements for installed safety devices.
3. Describe how to evaluate a field site for environmental impacts of using chemigation as a means of chemical application.
4. Given a set of circumstances, select the equipment best suited for chemigation application of fertilizers and pesticides.
5. Identify the proper procedures for calibrating a chemigation and irrigation system for chemigation purposes.
6. Describe the appropriate mixing and cleanup procedures for fertilizers and pesticides applied via chemigation.

7. List the specific requirements for backflow safety when fertilizers and pesticides are mixed with irrigation water.

Competency Area 6: Basic Concepts in Livestock Environmental Issues

1. Recognize potential soil and water contaminants in manure (nitrogen, phosphorus, pathogens, salts, and organic matter) and identify:
 - a. Environmental impact of contaminants
 - b. Pathways for movement to surface and ground water
 - c. Management principles for minimizing risk to the environment
2. Describe the concept of whole farm nutrient management as it applies to integrated livestock/crop operation and:
 - a. Distinguish fields with significant imbalance (accumulation) of nutrients
 - b. Distinguish primary sources of excess nutrients
 - c. Choose strategies that improve the soil nutrient balance
 - d. Select management practices that properly utilize nutrients in manure
3. Prepare nutrient management plans for manure and other organic nutrient sources that:
 - a. Identify land requirements (acreage) based upon livestock capacity and feeding program choices
 - b. Determine the quantity of manure in an overall crop nutrient program
 - c. Accurately credit these nutrients in an overall crop nutrient program including credits for second and third year organic nitrogen
 - d. Minimize the accumulation of phosphorous in the soil
 - e. Provide tools for in-season monitoring of crop nitrogen status
 - f. Provide appropriate record keeping tools
4. Formulate a process for prioritizing fields to receive manure and timing of applications that consider:
 - a. Runoff and erosion potential
 - b. Proximity to surface water
 - c. Crop production and cultural practices
5. Identify risks associated with contaminant movement from stored and stacked manure.
6. Recognize odor and nuisance risk associated with land application of manure and appropriate practices for limiting those risks.

Pest Management

Competency Area 1: Basic Concepts in Weed Biology

1. List the life cycle of the weeds listed and the method(s) of reproduction (seed or vegetative) for the weeds in the table below:

Barnyardgrass	Giant ragweed	Palmer Amaranth
Canada thistle	Green foxtail	Plumeless thistle
Common lambsquarter	Henbit	Redroot pigweed
Common mullein	Johnsongrass	Sandbur
Common ragweed	Jointed goatgrass	Shattercane
Common sunflower	Kochia	Tansy mustard
Common waterhemp	Large crabgrass	Toothed leaf spurge
Downy brome/Cheat	Marestail/Horseweed	Velvetleaf
Field bindweed	Musk thistle	Volunteer corn
Field pennycress	Nightshades (Black and Hairy)	

2. List the relative weed competitiveness of corn (field and popcorn), grain sorghum, soybean, wheat, dry edible beans, and sugarbeet.
3. List the relative competitiveness of green foxtail, velvetleaf, common sunflower, Palmer amaranth, common lambsquarter, and sandbur.
4. Describe the critical weed free period as it relates to weed management.
5. Be able to identify the following noxious weeds:

Bohemian knotweed	Phragmites
Canada thistle	plumeless thistle
giant knotweed	purple loosestrife
Japanese knotweed	saltcedar
leafy spurge	Sericea lespedeza
musk thistle	spotted and diffuse knapweeds

Competency Area 2: Basic Concepts of Herbicides

1. Classify the following herbicides as preemergent and/or post emergent and identify their site of action and mode of action:

2,4-D e.g., 2,4-D amine nicosulfuron e.g., Accent carfentrazone-ethyl e.g., Aim metsulfuron e.g., Ally atrazine e.g., Atrazine sulfentrazone e.g., Authority/Spartan isoxaflutole e.g., Balance dicamba e.g., Banvel bentazon e.g., Basagran primisulfuron e.g., Beacon imazamox e.g., Beyond bromoxynil e.g., Buctril fluthiacet-methl e.g., Cadet mesotrione e.g., Callisto chlorimuron e.g., Classic EPTC e.g., Eptam fomesafen e.g., Flexstar	paraquat dichloride e.g., Gramoxone glufosinate e.g., Liberty metalachlor e.g., Dual dimethenamid-p e.g., Outlook sethoxydim e.g., Poast Pendimethalin e.g., Prowl imazethapyr e.g., Pursuit imazamox e.g., Raptor flumiclorac e.g., Resource glyphosate e.g., Roundup clethodim e.g., Select metribuzin e.g., Sencor fluroxypyr e.g., Starane trifluralin e.g., Treflan flumioxazin e.g., Valor fluroxypyr + clopyralid e.g., Widematch
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2. Describe the impact of soil texture and organic matter on efficacy of soil applied herbicides.
3. Describe the impact of soil texture and organic matter on herbicide leaching.

Competency Area 3: Herbicide Resistance

1. Understand the weed management implications of Roundup Ready, Clearfield, Liberty Link, RR2 Xtend, Enlist and STS crop hybrids/varieties.
2. Understand resistance, the primary causes of development and management strategies of resistance for the following plants:
 - a. Palmer Amaranth in row crops
 - b. Waterhemp in row crops
 - c. Marestail in row crops
 - d. Ragweed in row crops
 - e. Kochia in row crops and fallow
 - f. Shattercane in corn or milo
 - g. Sunflowers in sunflower rotations (ALS Traits)
3. For the list of known herbicide resistant weeds in Nebraska above, explain management strategies to reduce the risk of resistance development, cross resistance, or reduce further development of those weeds.
4. Define Mode of Action, Site of Action and understand multiplicity of resistance to multiple Sites of Action. Explain Effective Modes of Action when selecting herbicide combinations.
5. Define Target Site Resistance and Metabolic Resistance in a weed population. Know an example of each.
6. Understand how to identify factors that help in diagnosing potential resistant species within a given field environment. Know the signs of resistance development.

Competency Area 4: Basic Concepts of Integrated Management of Insects and Mites

1. Diagnose for each of the following insects and mites each of their associated crop injury symptoms and understand each of their life cycles:

Corn	Soybean	Alfalfa
Armyworm	Gall midge	Alfalfa weevil
Corn leaf aphid	Grasshoppers	Aphids
Corn rootworms	Green cloverworm	Blister beetles
Cutworms	Japanese Beetles	Cloverleaf weevil
European corn borer	Potato leafhopper	Grasshoppers
Fall armyworm	Seed corn maggot	Plant bugs
Flea beetles	Spider mites	Potato leafhopper
Grasshoppers	Thistle caterpillar	
Seed corn beetles	Thrips	Grain Sorghum
Seed corn maggot	Woolly bears	Chinch bug
Spider mites	Wheat	Corn leaf aphid
Stalk borer	Army cutworm	Greenbug
White grubs	Armyworm	
Wireworms	Chinch bug	Dry Bean
Western Bean Cutworms	Greenbug	Mexican bean beetle
	Hessian fly	Western bean cutworm
Sugar Beet	Russian wheat aphid	
Sugarbeet root aphid	Wheat curl mite	
Sugarbeet root maggot	Wheat stem sawfly	

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

Damsel bug	Lady beetles	Predatory mites
Ground beetles	Minute pirate bug	
Lacewing	Parasitic wasps	

3. Recognize the fundamental definitions 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 occurrence of insect pests in crops.
5. Recognize the influence of the following cropping practices on insects:
 - a. Early or late planting
 - b. Early or late harvest
 - c. Tillage
 - d. Weed control
 - e. Crop rotation

6. Identify the primary management strategies for the following key insect problems:
 - a. Corn rootworms in corn
 - b. Cutworms in corn
 - c. European corn borer in corn
 - d. Bean leaf beetles in soybean
 - e. Grasshoppers in corn and soybeans
 - f. Spider mites in corn and soybean
 - g. Alfalfa weevils in alfalfa
 - h. Potato leafhoppers in alfalfa
 - i. Chinch bugs in sorghum and wheat
 - j. Greenbugs in sorghum and wheat
 - k. Russian wheat aphid in wheat
 - l. Wheat stem sawfly in wheat
 - m. Hessian fly in wheat
 - n. Army cutworms in wheat
 - o. Western bean cutworm in dry bean
 - p. Sugarbeet root maggot in sugar beet
7. Understand resistance, the primary causes of development and management strategies of resistance for the following insects:
 - a. Corn rootworm all stages
8. For the list of known insecticide resistant insects in Nebraska above, explain management strategies to reduce the risk of resistance development, cross resistance, or reduce further development of those insects.
9. Define Mode of Action, Site of Action and understand multiplicity of resistance to multiple Sites of Action. Explain Effective Modes of Action when selecting pesticide combinations.
10. Define Target Site Resistance and Metabolic Resistance in a disease population. Know an example of each.
11. Understand how to identify factors that help in diagnosing potential resistant species within a given field environment. Know the signs of resistance development.

Competency Area 5: Basic Concepts in Plant Disease Biology

1. Define the concept of disease in plants.
2. Recognize the types of plant diseases and the factors related to disease development.
3. Relate disease development with environmental and cultural factors.
4. Recognize the concept of host range of plant pathogens.

Competency Area 6: Basic Concepts Involving Signs and Symptoms of Plant Disease

1. Identify key symptoms of commonly occurring diseases of field crops:

<u>Corn</u>	<u>Soybean</u>	<u>Alfalfa</u>
Anthracnose	Bean pod mottle	Anthracnose
Common rust	Brown spot	Common leaf spot
Eye spot	Brown stem rot	Downy mildew
Goss's wilt	Charcoal rot	Phytophthora root rot
Gray leaf spot	Cyst nematode	Spring black stem
Maize chlorotic mottle	Downy mildew	Summer black stem
Maize dwarf mottle	Pythium damping off	
Nematode injury	Phytophthora root rot	<u>Grain Sorghum</u>
Southern rust	Pod and stem blight	Bacterial leaf stripe
Stalk rots	Sclerotinia stem rot	Downy mildew
Stewart's wilt	Seedling blight	Ergot
Tar spot	Soybean rust	Sooty stripe
	SDS (Sudden Death Syndrome)	Zonate leaf stripe
<u>Wheat</u>	White mold	
Crown and root rot		<u>Dry Edible Beans</u>
Ergot	<u>Sugar Beet</u>	Bacterial brown spot
Leaf rust	Aphanomyces root rot	Bacterial wilt
Powdery mildew	Cercospora leaf spot	Common blight
Soil-borne wheat mosaic	Cyst nematode	Fusarium root rot
Stripe rust	Rhizoctonia crown rot	Halo blight
Tan spot	Rhizomania	Rust
Wheat streak mosaic		White mold

Competency Area 7: Basic Concepts in Control and Management of Plant Diseases

1. Describe the primary management strategy for the following key field crop diseases:

- a. Anthracnose of alfalfa
- b. Corn grain molds
- c. Corn virus diseases such as maize chlorotic mottle
- d. Crown and root rots of wheat
- e. Goss's Wilt management in corn
- f. Gray leaf spot of corn
- g. Phytophthora root rot of alfalfa
- h. Rhizomania disease of sugarbeet
- i. Rust of dry edible beans
- j. Sclerotinia stem rot/ White Mold in soybeans
- k. Spring black stem of alfalfa
- l. Soybean cyst nematode
- m. Soybean rust
- n. Soybean seedling blight diseases
- o. Stalk rot diseases of corn
- p. Sudden Death Syndrome (SDS) in soybean
- q. Wheat leaf rust
- r. Wheat stripe rust
- s. Bacterial blight in dry edible beans
- t. Leaf spot in soybean

2. Understand resistance, the primary causes of development and management strategies of resistance for the following diseases:
 - a. Frogeye in soybeans
 - b. Early blight in potatoes
 - c. Cyst nematode traits
 - d. Soil-borne pathogens
 - e. Foliar pathogens
3. For the list of known pesticide resistant diseases in Nebraska above, explain management strategies to reduce the risk of resistance development, cross resistance, or reduce further development of those diseases.
4. Define Mode of Action, Site of Action and understand multiplicity of resistance to multiple Sites of Action. Explain Effective Modes of Action when selecting pesticide combinations.
5. Define Target Site Resistance and Metabolic Resistance in a disease population. Know an example of each.
6. Understand how to identify factors that help in diagnosing potential resistant species within a given field environment. Know the signs of resistance development.

Competency Area 8: Concepts in Calibration of Pesticide Application Equipment

1. Identify the relative qualities of the following nozzle tip materials:
 - a. Plastic
 - b. Stainless steel
 - c. Ceramic
 - d. Brass
 - e. Hardened stainless steel
2. Describe the pattern, relative droplet size, pattern overlap, and primary uses of the following nozzle types:
 - a. Flat fan
 - b. Even flat fan
 - c. Hollow cone
 - d. Flooding tip
 - e. Venturi tip
 - f. Turbo T-Jet
 - g. Turbo Drop
 - h. TTI Low Drift
3. Know the information required to select the size and type of nozzle that will achieve a given application rate.
4. Calculate nozzle flow rate and size for a given target carrier amount, nozzle type, and target application speed.

5. Identify and describe characteristics of the following pumps:
 - a. Diaphragm
 - b. Roller
 - c. Centrifugal
 - d. Piston
6. Know how the following factors affect spray delivery, coverage, and potential drift:
 - a. Nozzle pressure
 - b. Sprayer speed
 - c. Nozzle type
 - d. Nozzle spacing
 - e. Nozzle height
 - f. Weather condition
 - g. Wind speed
 - h. Nozzle configuration
7. Identify the function of the following sprayer plumbing components:
 - a. Throttling valve
 - b. Tank shut-off
 - c. By-pass line
 - d. Pressure relief valve
 - e. Agitator
 - f. Regulating valve
 - g. Line strainer
 - h. Anti-drip bodies
8. Calculate the amount of product required to create a specific tank solution.
9. Understand the factors of calibration and the "ounce calibration" method:
 - a. Spray width
 - b. Travel speed
 - c. Nozzle discharge (gpm)
10. Identify the maximum acceptable variance among nozzles on a spray boom.
11. Know chemigation calibration principles.
12. Identify the chemigation equipment needed to prevent groundwater contamination.
13. Know the effect of climatic conditions, pesticide formulation, and properties and additives on spray drift and volatilization.
14. Know the Nebraska Department of Agriculture and Nebraska Department of Environment and Energy rules and regulations concerning pesticide and fertilizer storage.
15. Describe preferred nozzle type, spray droplet size, and carrier volumes for application to the following:
 - a. Pre-Herbicide
 - b. Burndown Herbicide Application with Liquid Fertilizer
 - c. Post Herbicide Application
 - d. Foliar Fungicide/Insecticide Application

16. Describe preferred adjuvant for the following applications:

- a. Pre-Herbicide
- b. Burndown Herbicide Application with Liquid Fertilizer
- c. Post Herbicide Application
- d. Foliar Fungicide/Insecticide Application

Crop Management

Competency Area 1: Basic Concepts in Crop Adaptation

1. Describe the influence of temperature and precipitation on cropping systems options.
2. Describe the influence of day length and climate on hybrid and cultivar selection, and crop adaptation.
3. List the minimum, optimum, and maximum temperatures for seed germination and growth for the Major Crops in Nebraska.
4. Describe the consequences of temperature and precipitation timing and extremes on crop growth/development and harvest quality.

Competency Area 2: Basic Concepts of Crop Growth and Development

1. Describe the important growth stages for the Major Crops in Nebraska.
 - a. Emergence
 - b. Vegetative stages
 - c. Floral initiation
 - d. Flowering
 - e. Grain or seed development
 - f. Maturity
2. Describe changes in water requirements during growth and development and which stages are most sensitive to stress.
3. Relate crop growth stage to appropriate crop management practices for the Major Crops in Nebraska.
4. 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.
5. Define physiological maturity and harvest maturity in grain and seed crops.
6. Compare and contrast rooting patterns of the Major Crops in Nebraska.
7. Discuss water use requirement differences for the Major Crops in Nebraska.
8. List the yield components for the Major Crops in Nebraska.

Competency Area 3: Basic Concepts in Crop Damage, Mortality, and Replant Decisions

1. Identify damage to agronomic crops from hail, frost, drought, wind, flooding, herbicide injury, disease, and insect defoliation.
2. Understand the consequences of damage to plant growth and crop yield and the relationship between amount of crop damage and stage of development.

3. Recognize weather and plant factors that influence the plant's ability to resume growth after injury has occurred.
4. Assess crop damage and determine if replanting is warranted and evaluate field management history for potential replant issues.

Competency Area 4: Basic Concepts of Cultivar and Hybrid Selection

1. Describe the differences between hybrids and cultivars and how these differences influence management decisions.
2. List the characteristics important for selecting hybrids and cultivars including:
 - a. Yield
 - b. Maturity
 - c. Harvest quality (grain, legume, and/or plant)
 - d. Disease and pest resistance
 - e. Standability/lodging resistance
3. Understand and interpret significance in yield test reports such as least significant difference (LSD) and T-square.

Competency Area 5: Basic Concepts of Seeds and Seeding

1. List those traits used to determine seed quality.
2. Calculate the data from a seed analysis when given:
 - a. Purity
 - b. Percent germination
 - c. Percent weed seeds
 - d. Percent inert matter
 - e. Percent other crop seeds
 - f. Pure-live seed percentage
3. 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.
4. Describe how the seeding rate and row spacing optimizes the impacts of crop canopy, residue cover, and tillage system on weed pressure and pest control strategies.
5. Discuss the effects of seed size and shape on planting, germination, and emergence and stand establishment.
6. List the three steps in the seed germination process and the environmental conditions necessary for each step.
7. Define seed dormancy, list the causes and the crops in which it most commonly occurs, and the techniques used to correct seed dormancy.
8. Explain how dormancy affects weeds differently than crops.

9. Describe types of seed treatments, indicate the crops on which they are most commonly used and why, and discuss the cost/benefits.
10. List and describe the germination tests used to estimate field emergence and the relative value of each test.
11. List and explain the factors that determine planting date, planting depth, planting method, and planting rate of the Major Crops in Nebraska.
12. List the advantages and disadvantages of early and late planting of the Major Crops in Nebraska.
13. Describe the difference between seeding rate and plant population at emergence and list the factors that affect seedling survival.

Competency Area 6: Basic Concepts in Cropping Systems

1. List the advantages and disadvantages of crop rotations versus a single crop system.
2. Understand Vegetative Functional Groups
 - a. Warm season grasses
 - b. Warm season broadleaves
 - c. Cool season broadleaves
 - d. Cool season grasses
3. 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:
 - a. East of Highway 81-rainfed and irrigated
 - b. Highway 81 to Panhandle-rainfed and irrigated
 - c. Panhandle-rainfed and irrigated
 - d. Sandhills-irrigated
4. Describe the following cropping systems and indicate where in Nebraska each system is most likely to be used:
 - a. Continuous cropping: Corn and soybean
 - b. Double cropping
 - c. Strip cropping
 - d. Ecofallow
 - e. Wheat fallow
 - f. Pulse crops
 - g. Specialty cropping
 - h. Continuous cropping in traditional fallow areas
 - i. Rotational cropping
 - j. Cover crops

5. Describe the following tillage systems and indicate the advantages and disadvantages of each system for row, close seeded, or drilled crops:
 - a. Clean tillage
 - b. Ridge till
 - c. Conventional tillage
 - d. No till
 - e. Strip Till
 - f. Continuous No Till
6. Describe the characteristics among sustainable, resource intensive, and organic cropping systems.
7. Characterize the following precision agriculture terms:
 - a. Geographic Information Systems (GIS)
 - b. Global Positioning Systems (GPS)
 - c. Site-Specific Management
 - d. Grid Soil Sampling
 - e. Zone Soil Sampling
 - f. Variable Rate Technology (VRT)
 - g. Yield Mapping
 - h. Imagery using Satellite or Drone Technologies
8. List the advantages and/or disadvantages of GIS/GPS in a cropping system.
9. List the opportunities and limitations of VRT in a cropping system.

Competency Area 7: Basic Concepts Crop Production Economics

1. Calculate profit/acre given yields, prices, and input costs.
2. Describe the concepts of profit maximization and optimum input.
3. Describe and understand return on investment (ROI).
4. Given information, analyze a crop budget and how it might affect the financial health of an operation. Be familiar with tools such as cropwatch.unl.edu/budgets.