MINNESOTA

PERFORMANCE OBJECTIVES

2007

Adapted from the National Certified Crop Adviser Performance Objectives

Modified by
The Minnesota Certified Crop Adviser Board

Website: www.mcpr-cca.org

I. NUTRIENT MANAGEMENT

EXPERTISE WITHIN EACH COMPETENCY AREA:

A. Basic Concepts in Soil Fertility

The learner shall be able to:

1. Identify the 16 elements essential for plant growth.
2. Characterize the essential nutrients (elements) as either mobile or immobile in soils.
3. Understand the effect of basic soil properties such as texture, pH, and soil drainage on the availability of nutrients to plants.
4. Describe, in general terms, the concept of cation exchange capacity.

B. Basic Concepts of Plant Nutrition

The learner shall be able to:

1. Understand the concepts of mass flow, diffusion, and root interception as the mechanisms for movement of plant nutrients to the surface of roots and root hairs.
2. Understand the importance of root hairs in nutrient uptake.
3. Describe how root structure has a major effect on nutrient uptake.
4. Relate nutrient uptake patterns of major crops of Minnesota in relation to stage of growth.

C. Soil pH and Soil Amendments

The learner shall be able to:

1. Give a brief description of the concepts of soil pH, buffer pH, acid and calcareous soils.
2. Recognize how the following affect the lime recommendations:
    a. crop grown
    b. soil texture
    c. soil organic matter content
    d. location in state
    e. depth of sampling
    f. tillage system
3. Describe how liming acid soil increases the soil pH.
4. Describe, in general, how soil pH affects nutrient availability.
5. Describe **E**ffective **N**eutralizing **P**ower (**ENP**).
6. Describe how characteristics of a liming material influence the rate of liming material recommended.

C. Soil pH and Soil Amendments (con't)

7. Describe the neutralizing value, physical properties and handling precautions of the following liming materials:

    a. calcitic limestone
    b. dolomitic limestone
    c. quicklime (calcium hydroxide)
    d. slaked lime
    e. fluid lime
    f. marl
    g. water treatment lime
    h. wood ashes

8. List the benefits of liming for crop production.

9. Understand the concept of and soil test information required for variable rate lime application.

10. Identify materials that may be used to lower soil pH of calcareous and saline soils.

11. Distinguish between calcareous and saline soils.

D. Primary Plant Nutrients (N, P, K)

D1. Nitrogen

The learner shall be able to:

1. Understand the function(s) of nitrogen in plants.

2. Identify the forms of nitrogen taken up by growing plants.

3. Describe how the following processes of nitrogen in soils are different from each other:

    a. fixation
    b. ammonification
    c. nitrification
    d. volatilization
    e. denitrification
    f. immobilization
    g. leaching

4. Describe symbiotic nitrogen fixation and how the process is affected by:

    a. soil pH
    b. soil moisture
    c. level of nitrogen in the soil
    d. population of Rhizobia and other soil bacteria

5. Recognize how soil physical properties affect nitrogen fertilization.

6. Recognize how crops grown in rotation affect nitrogen fertilization.

7. Recognize how soil drainage, irrigation, rainfall, and potential for water contamination affect nitrogen fertilization practices.

D1. Nitrogen (con't)

8. Understand the analysis, physical form, and handling precautions for each of the following nitrogen fertilizer sources:

    a. Anhydrous ammonia (82-0-0)
    b. Urea (46-0-0)
    c. Urea-ammonium nitrate (28-0-0)
    d. Ammonium nitrate (34-0-0)
    e. Ammonium sulfate (21-0-0-24)

9. Describe the relationship of soil texture to movement of ammonium and nitrate-nitrogen through soils.

D2. Phosphorus

The learner shall be able to:

1. Recognize how the soil affects the management of phosphate fertilizers.

2. Understand how the intended crop affects the placement of phosphate fertilizers.

3. Identify the appropriate soil properties that affect the choice for use of the Bray, Olsen, or Mehlich III extraction procedures.

4. List the analysis, physical form, and handling precautions, if any, for each of the following phosphate fertilizers.

    a. rock phosphate
    b. superphospheric acid
    c. triple superphosphate
    d. monoammonium phosphate
    e. diammonium phosphate
    f. ammonium polyphosphate

5. Describe the differences in orthophosphate and polyphosphate and relate them to the effect on crop production.

D3. Potassium

The learner shall be able to:

1. Understand the effect of soil physical and chemical properties on the availability of potassium and associated management of potash fertilizers.

2. Recognize how intended crop and choice of tillage system affect the management of potash fertilizers.

3. Describe the physical form and analyses of each of the following fertilizers that supply potassium:

    a. potassium chloride
    b. potassium sulfate
    c. potassium nitrate
    d. potassium / magnesium sulfate

D4. Calcium and Magnesium

The learner shall be able to:

1. Recognize how intended crop affects the management of soil amendments and / or fertilizers used to supply calcium and magnesium.

2. Understand how calcium and magnesium may interact with potassium in plants.

3 Describe the physical form and analysis of each of the following calcium and / or magnesium sources:

    a. calcitic lime
    b. dolomitic lime
    c. gypsum
    d. potassium / magnesium sulfate
    e. Epsom salts

D5. Sulfur

The learner shall be able to:

1. Understand the effect of soil physical and chemical properties on availability of sulfur in soils and management of sulfur fertilizers.

2. Recognize how the intended crop affects the management of sulfur fertilizers.

3. Understand the role of soil microorganisms on the availability of soil and fertilizer sulfur.

4. Describe the physical form, analysis and handling precautions, if any, for each of the following sources of sulfur:

    a. elemental sulfur
    b. gypsum
    c. ammonium sulfate
    d. ammonium thiosulfate
    e. potassium / magnesium sulfate

D6. The Micronutrients

The learner shall be able to:

1. Understand the effect of soil physical and chemical properties and the availability of micronutrient fertilizers.

2. List the essential micronutrients.

3. For Minnesota, identify the soil and cropping conditions where a specific micronutrient deficiency might be expected.

4. Describe the physical form, water solubility and handling precautions, if any, for the following two broad categories of micronutrient sources:

    a. inorganic salts
    b. organic chelated products.

E. Soil Sampling

The learner shall be able to:

1. Recognize the management practice of soil sampling as used for the following purposes:

    a. a basis for fertilizer recommendations
    b. monitoring changes in soil test values as affected by crop production practices
    c. an aid in diagnosing nutrient deficiencies

2. Describe the sampling procedure used for the Soil Nitrate Test used in either fall or spring.

3. Describe the advantages and disadvantages of grid sampling and zone sampling as a basis for understanding nutrient variability and fertilizer applications.

4. Recognize the effect of depth of sample collection on soil test values.

5. Describe changes in soil test values for various nutrients over time as affected by cropping system, soil properties, and nutrient mobility.

6. Understand that the pattern used in sample collection is affected by tillage system and placement of the immobile nutrients.

7. Understand the correct procedure for handling soil samples after they have been collected.

8. Understand the sampling techniques that are recommended for grid sampling and their potential impact on analytical results and subsequent fertilizer recommendation.

9. Understand the procedures for sampling an entire field including the number of cores needed and locations to avoid in the collection of the sample.

10. Understand how frequently fields should be sampled for measurement of the various nutrients.

F. Fertilizer Recommendations

The learner shall be able to:

1. Recognize the importance of realistic yield goal in accurate fertilizer recommendations.

2. Understand each of the following concepts of fertilizer recommendations:

    a. crop sufficiency
    b. soil building and maintenance
    c. crop removal

3. Recognize the economic and environmental implications involved in making fertilizer recommendations.

4. Understand the concept of relative soil test level as it relates to nutrient sufficiency and probability of response to applied immobile nutrients.

5. Given soil test information, realistic yield goal, and an understanding of the grower's goals and objectives, make economically and environmentally sound fertilizer recommendations.

F. Fertilizer Recommendation (con't.)

6. Understand the possible relationships of cation exchange capacity to nutrient availability.

7. Interpret the results of laboratory analysis of soil samples.

8. Distinguish a soil test value for P and / or K as being low, medium, or high.

9. Understand the factors that should be considered in arriving at a realistic yield goal.

G. Plant Analysis

The learner shall be able to:

1. Understand the predictive and diagnostic purposes when using plant analysis.

2. Recognize how the following affect the results of analysis of tissue samples:

    a. crop
    b. plant maturity
    c. plant part
    d. time of sample collection
    e. sample handling

3. Recognize how the following describe the level of plant nutrition:

    a. critical value
    b. sufficiency range
    c. luxury consumption
    d. toxic level

H. Fertilizer Materials and Application

The learner shall be able to:

1. Calculate rates of various fertilizer grades needed for optimum yield based on the analysis of the fertilizer, realistic yield goal, and the results of a soil test.

2. Understand how fertilizer placement is affected by:

    a. soil test information
    b. tillage systems
    c. intended crop
    d. nutrient mobility
    e. fertilizer material used

3. Understand how fertilizer timing is affected by:

    a. soil test information
    b. tillage systems
    c. intended crop
    d. nutrient mobility
    e. fertilizer material used

4. Define fertigation.

H. Fertilizer Materials and Application (con't)

5. Understand the importance of equipment calibration.

6. Describe the following fertilizer placement methods.

    a. deep banding
    b. broadcast
    c. surface band
    d. fertigation
    e. foliar application
    f. sidedress
    g. topdress
    h. pop-up or seed placed
    i. starter band

I. Manure Management

The learner shall be able to:

1. Calculate the value of nutrients in manure.

2. Recognize the factors that affect the nutrient content of manure.

3. Understand how method and time of application affect the nutrient value of manure.

4. Describe manure sampling and handling procedures.

5. Understand the procedure to be followed in the calibration of a manure spreader.

6. Understand the importance and magnitude of nutrient losses associated with the different methods of manure storage and application.

7. Describe the effect of manure on:

    a. soil tilth
    b. nutrient supply to crops
    c. microbial activity

8. Understand how variability in applications can be affected by:

    a. storage
    b. handling
    c. agitation
    d. patterns of application in the field

J. Diagnosis of Nutrient Deficiencies in Crops

The learner shall be able to:

1. Understand the advantages and disadvantages of using a soil analysis and / or plant samples u for the purpose of determining nutrient deficiencies.

2. Recognize the deficiency symptoms in major Minnesota crops for:

    a. nitrogen
    b. phosphorus
    c. potassium
    d. calcium
    e. magnesium
    f. sulfur
    g. micronutrients

K. Nutrient Management Planning

The learner shall be able to:

1. Construct a realistic yield goal on either a field or whole farm basis based on:

    a. production history
    b. soil survey information
    c. level of management of the grower

2. Use the results of a soil-testing program, realistic yield goal, sources of nutrients and an appropriate analysis of each, design a nutrient management plan that is both economically and environmentally sound.

3. Understand the Best Management Practices (BMP's) for nitrogen and how they are used as guidelines for the application of nitrogen.

4. Understand the guidelines for effective use of phosphorus fertilizers.

5. Familiar with the following components of a NRCS Nutrient Management Plan:

    a. soil survey map
    b. field map
    c. sensitive features of the landscape
    d. practices to be used for sensitive features
    e. practices to be used to address **S**oil **T**est**P**hosphorus (**STP**) levels at or greater than 21ppm (Bray) or 16ppm (Olsen)
    f. crop rotation and planned crop
    g. schedule of nutrient applications
    h. calculations and data used to develop the schedule of nutrient applications including nutrient budgets
    i. operation, maintenance, and record keeping
    j. use of manure as a nutrient source

II. SOIL AND WATER MANAGEMENT

EXPERTISE WITHIN EACH COMPETENCY AREA:

A. Basic Soil Properties

The learner shall be able to:

1. Recognize the following basic soil chemical properties listed:

    a. cation exchange capacity
    b. soil pH

2. Understand the differences among saline, sodic, calcareous, and acid soils.

3. Recognize the following basic soil physical properties:

    a. soil texture
    b. soil structure
    c. water holding capacity
    d. infiltration rate
    e. pore space (porosity)
    f. organic matter content
    g. bulk density

B. Soil Erosion

The learner shall be able to:

1. Understand the role of the following conservation practices in reducing soil erosion:

    a. conservation crop rotations
    b. residue management
    c. contour practices
    d. grass waterways
    e. field windbreaks
    f. terraces, diversions and water and sediment control basins
    g. plant wind barriers
    h. cross wind strip cropping
    i. grass filter strips
    j. riparian buffer forested strips

2. Identify which of the conservation practices listed in B1 can be used to reduce sheet and rill water erosion and which practices can be used to reduce wind erosion.

3. Understand how each of the following factors affect the rate of erosion by water:

    a. duration and intensity of rainfall
    b. soil texture
    c. slope length
    d. percent slope
    e. vegetative and / or residue cover

4. Understand the term “tolerable soil loss” and the relationship to maintenance of the soil resource base.

B. Soil Erosion (con't.)

5. Identify the tillage systems that can be used to reduce soil erosion and explain how the reduction takes place.

6. Identify practices that will reduce sheet and rill erosion.

7. Identify practices that will reduce wind erosion.

C. Tillage and Residue Management

The learner shall be able to:

1. Relate the selection of tillage practices to:

    a. crop selection and rotation
    b. soil physical properties
    c. climate
    d. economics
    e. anticipated reduction in soil erosion
    f. pest management

2. Identify tillage equipment used in row and drilled crop production for the following conservation tillage systems:

    a. mulch tillage
    b. strip tillage
    c. ridge tillage
    d. no-till

3. List the advantages, disadvantages, and limitation of the following conservation tillage systems:

    a. mulch tillage
    b. strip tillage
    c. ridge tillage
    d. no-till

4. Understand the method of measuring and calculating the percent of the soil surface covered by residue.

D. Water Quality

The learner shall be able to:

1. Understand the factors affecting the transport of pesticides to surface and ground waters:

    a. pesticide solubility
    b. half-life
    c. absorption capacity
    d. soil texture
    e. soil permeability
    f. soil organic matter content
    g. depth to water table
    h. soil and water conservation practices
    i. climate

D. Water Quality (con't.)

2. Understand the principles and consequences involved in the loss of nitrogen to surface or ground water and management practices that are appropriate for minimizing this loss.

3. Understand the principles and consequences involved in the loss of phosphorus to surface waters and management practices that are appropriate for minimizing this loss.

4. Understand the meaning of the term "bioavailable" phosphorus.

5. Describe how placement of fertilizer and manure phosphorus influences the amount available for transport to lakes and streams.

6. Distinguish "soluble P" from "sediment P".

7. Identify and describe methods that are used to prevent back siphoning when filling a fertilizer or pesticide tank.

8. Understand how erosion and sediment loss affect the quality of surface waters and the loss of organic matter.

9. Understand how the application of manure can affect pathogens and dissolved oxygen in surface waters.

10. Understand how the following practices can affect sediment load and transport:

    a. control of soil erosion
    b. filter strips
    c. wetlands

11. Understand the meaning of the term, **T**otal **M**aximum **D**aily **L**oad (**TMDL**).

E. Drainage Systems

The learner shall be able to:

1. Recognize soil properties that affect the movement of water through soils.

2. Understand how excessive soil moisture (poor drainage) affects:

    a. root growth and development
    b. nutrient availability
    c. nutrient absorption by plants
    d. loss of nitrogen from the root zone
    e. crop yield

3. Understand the general nature of tile drainage systems.

4. Identify the various materials that are used for tile drainage systems.

5. Understand that all crops are not affected equally by poor drainage.

6. Understand how tile depth and spacing, (random, pattern) affect tile arrangement drainage.

7. Recognize that open tile inlets can have a serious impact on water quality.

8. Have a general understanding of the regulatory process associated with tile drainage.

F. Soil Compaction and Restrictive Layers

The learner shall be able to:

1. Identify causes of and characteristics of the following restrictive layers:

    a. subsurface compaction
    b. surface compaction
    c. crusting

2. Explain how restrictive soil layers hinder plant growth.

3. Describe methods for preventing and alleviating restrictive soil layers.

4. Understand the concept of “controlled traffic”.

III. PEST MANAGEMENT

EXPERTISE WITHIN EACH COMPETENCY AREA:

A. Weed Management and Herbicides

A1. Weed Identification and Biology

The learner shall be able to:

1. Identify the weeds listed below by common name at any stage of growth:

2. Classify each weed listed below by its life cycle:

    a. giant foxtail
    b. green foxtail
    c. yellow foxtail
    d. wild proso millet
    e. wild oat
    f. barnyardgrass
    g. yellow nutsedge
    h. velvetleaf
    i. common lanbsquarters
    j. common ragweed
    k. Canada thistle
    l. cocklebur
    m. giant ragweed
    n. redroot pigweed
    o. Pennsylvania smartweed
    p. wild mustard
    q. eastern black nightshade
    r. quackgrass
    s. wild buckwheat
    t. tall waterhemp
    u. large crabgrass
    v. woolly cupgrass
    w. horseweed
    x. common dandeloin

3. Define weed competition and factors that influence competition.

4. Describe how weeds reproduce and spread.

A2. Weed Control

The learner shall be able to:

1. Define cultural weed control.

2. Define chemical weed control.

3. Define mechanical weed control.

A3. Herbicide Persistence

The learner shall be able to:

1. Recognize what factors affect herbicide carryover and why.

A4. Herbicide Resistance

The learner shall be able to:

1. Recognize how herbicide resistance develops and how to prevent resistance.

2. Differentiate herbicide resistance from other factors that affect herbicide performance.

A5. Herbicide Mode of Action

The learner shall be able to:

1. Define Herbicide Mode of Action.

2. Identify the four key steps in the herbicide mode of action process.

3. Define what it means for a herbicide to be systemic or nonsystemic (contact) and how it relates to herbicide injury and potential for recovery from herbicide-induced injury.

A6. Herbicide Injury

The learner shall be able to:

1. Describe how the following factors can influence he likelihood and severity of herbicide injury:

    a. time and method of application
    b. environmental factors
    c. stage of plant development
    d. genetic make-up of plant

A7. Herbicide Application

The learner shall be able to:

1. List factors influencing soil applied herbicides.

2. List factors influencing postemergence herbicides.

3. Recognize physical characteristics of various herbicide formulations and how those characteristics affect application methods, timing, and efficacy of control.

B. Plant Disease Management and Fungicides

Bl. Disease Diagnosis and Causal Organisms

The learner should be able to:

1. Describe the basic steps in diagnosis of plant diseases.

2. Describe the differences between symptoms and signs of plant disease.

3. Identify each of the crop diseases listed below by host plant symptoms and signs:

4. List the crops affected by each of the diseases listed below:

5. Classify each disease listed below by the type of causal organism (bacteria, virus, fungus, nematode, other):

    a. Corn stalk rots
    b. northern corn leaf blight
    c. sudden death syndrome
    d. Phytophora root rot
    e. brown stem rot
    f. bean pod mottle virus
    g. stem rust
    h. loose smut
    i. ergot
    j. potato early blight
    k. grey leaf spot of corn
    l. leaf rust
    m. cyst nematode
    n. bacterial blight (leaf)
    o. barley yellow dwarf
    p. red leaf oat
    q. white mold
    r. Fusarium head blight
    s. tanspot
    t. rhizoctonia crown rot
    u. rhizoctonia root rot
    v. common smut
    w. cercospora leaf spot
    x. common leaf spot of alfalfa

B2. Biology of Plant Pathogens and Plant Diseases

The learner should be able to:

1. Give examples of simple disease cycles and how they relate to disease management.

2. Describe differences between fungi, bacteria, viruses, and nematodes relative to disease management.

3. Draw the disease triangle and describe the basics of how plant pathogens infect plants and cause disease.

4. Provide basics of factors affecting survival and spread of plant pathogens.

B3. Disease Management for Common Diseases

The learner should be able to:

1. Describe how avoidance, resistance, exclusion, and chemicals are used for disease management.

2. Describe the most important fundamentals of disease management for common diseases of common crops.

3. List some pros and cons of using resistance and chemicals to manage disease.

B4. Disease Resistance

The learner should be able to:

1. Define the differences between disease resistance and tolerance.

2. Explain possible reasons why a crop variety labeled as resistant to a disease becomes affected by that disease.

3. Describe how different races of a pathogen such as the soybean cyst nematode or Phytophthora can affect how well resistance functions.

B5. Fungicide Characteristics and Application

The learner should be able to:

1. Define Fungicide Mode of Action.

2. Describe the differences between contact and systemic fungicides and provide examples of each.

3. Describe how time and method of application, environmental factors, and stage of plant and disease development can influence the efficacy of a fungicide application.

B6. Relationships Between Agronomic Practices and Plant Diseases

The learner should be able to:

1. Describe how tillage and crop rotation can influence plant diseases.

2. List several agronomic practices that affect plant disease development, and provide examples of specific agronomic practices that affect some specific diseases (for example, decreased planting density or increased row width may reduce white mold in soybeans).

C. Insect Management and Insecticides

C1. Insect Identification and Biology

The learner shall be able to:

1. Identify the crop-damaging insects and mites listed below:

    a. grasshoppers
    b bean leaf beetle larva and adult
    c. alfalfa weevil larva and adult
    d. pea aphid
    e. potato leafhopper nymph and adult
    f. European corn borer larva
    g. corn earworm larva
    h. corn leaf aphid
    i. northern corn rootworm adult and larva
    j. western corn root worm adult and larva
    k. dingy cutworm larva
    l. black cutworm larva
    m. armyworm larva
    n. seed corn maggot
    o. greenbug
    p. wheat sawfly larva
    q. soybean aphid
    r. two-spotted spidermites
    s. white grubs
    t. stem maggot
    u. English grain aphid
    v. Colorado potato beetle adult and larva
    w. green peach aphid
    x. wireworm larva

2. Describe the life cycle of each of these insects and mites in Minnesota:

    a. Specify the type of metamorphosis (gradual, complete), number of generations per year, and how they reproduce (sexual, asexual).
    b. List the over-wintering stage (if any) in Minnesota and how that relates to seasonal appearance of these insects in crops.
    c. Identify how they colonize and infest fields.

3. Characterize the feeding injury of each insect and damage to crops:

    a. Describe the host range of each insect and list the crop(s) that it attacks.
    b. Classify each insect by how they feed.
    c. Recognize and diagnose the feeding injury of each pest, and associated crop symptoms.

C2. Insect Control

The learner shall be able to:

1. Define the following key concepts in insect management:

    a. Economic damage
    b. Economic injury level
    c. Economic threshold
    d. Action level

2. Describe the following control options:

    a. Natural control
    b. Biological control
    c. Cultural control
    d. Host plant resistance
    e. Transgenic crops
    f. Insecticides

3. Compare and contrast control options for each insect or mite pest listed above based on their availability, effectiveness, cost, health and environmental concerns.

4. Describe scouting and decision procedures for each insect or mite pest listed above:

    a. List the scouted stage of each pest and method of sampling
    b. Define the seasonal scouting window for each pest
    c. Specify current action levels or economic thresholds for each pest

C3. Insecticide Resistance

The learner shall be able to:

1. Recognize why / how insect resistance develops and explain the role of selection pressure.

2. Provide Minnesota examples of resistance developing against:

    a. Cultural control (crop rotation)
    b. Host plant resistance
    c. Insecticides

3. Describe how to prevent resistance.

4. Explain current insect resistance management plans for transgenic crops.

C4. Insecticide Mode of Action

The learner shall be able to:

1. Describe how insecticides kill insects.

C5. Insecticide Application

The learner shall be able to:

1. List factors influencing soil and foliar-applied insecticide performance.

2. Recognize physical characteristics of various insecticide formulations and how those characteristics affect application methods, timing, and efficacy of control.

3. Select appropriate insecticide(s) for each insect or mite pest listed above based on a consideration of effectiveness, cost, safety and environmental risks:

4. Identify human and landscape features of fields that applicators should consider during insecticide application.

D. Integrated pest management

D1. Principles of Integrated Pest Management

The learner shall be able to:

1. Define Integrated Pest Management **(IPM**).

D2. Pest Management Recommendations

The learner shall be able to:

1. Use given information to make economically and environmentally sound pesticide recommendations.

E. Pesticide Use

E1. Laws and Regulations

The learner shall be able to:

1. Describe federal and local regulations regarding pesticide use outlined in the Federal Insecticide, Fungicide and Rodenticide Act along with its 40 CFR regulations and the Minnesota Pesticide Control Law (Minn. Stat. 18B):

    a. Pesticide distribution, use, storage & handling
    b. Disposal of pesticides, rinsates, and containers
    c. Applicator licensing requirements
    d. Applicator recordkeeping requirements
    e. Restricted-Use pesticide requirements
    f. Posting and field re-entry restrictions for treated areas

E2. Pesticide Labels and Labeling Comprehension

The learner shall be able to:

1. Recognize the types of information on the label:

    a. Safety information including Child Hazard Warning, Signal Word, Hazards to Human & Domestic Animals, Protective Clothing & Equipment, Statement of Practical Treatment
    b. Environmental Hazard Information
    c. Product information including Restricted-Use Classification, Brand Name Formulation, Ingredient Statement, Product Registration Number, EPA Establishment Number, Weight, Physical & Chemical Hazard
    d. Use information including Misuse Statement, Storage & Transportation, Container Rinsing & Disposal, Restricted Entry Statements, Directions for Use

2. Read and follow all product label directions and precautions.

E3. Pesticide Safety

The learner shall be able to:

1. Select the proper pesticide for a given situation.

2. Describe the procedures for handling a pesticide spill.

3. Describe disposal procedures for waste pesticides and empty containers.

4. List setback requirements when mixing and loading.

5. Describe how to prevent backsiphoning.

6. Describe proper storage and security of pesticides.

7. Recognize Worker Protection Standards – worker and handler requirements:

    a. Handling, mixing, and loading
    b. Re-entry precautions, posting, and decontamination
    c. Protective clothing, equipment and maintenance procedures
    d. Pesticide poisoning effects, symptoms, and first aid procedures
    e. Pesticide toxicity knowledge
    f. Minimizing exposure—risk assessment
    g. Personal safety and hygiene

E4. Environmental Considerations

The learner shall be able to:

1. Describe the environmental fate of pesticides as it relates to:

    a. Drift to non-target sites
    b. Pesticide accumulation
    c. Pesticide persistence

2. Recognize pesticides that are a concern for ground and surface water.

3. List pesticide and site characteristics affecting off-site movement.

4. Describe state-established pesticide voluntary Best Management Practices (BMP's).

5. Describe state-established chemical-specific voluntary Best Management Practices (BMP's).

E5. Pesticide Application Equipment and Calibration

The learner shall be able to:

1. List types of application equipment.

2. Recognize equipment parts and select appropriate nozzles.

3. Describe sprayer maintenance and cleaning procedures.

4. Define pesticide transfer.

5. Understand calibration factors and methods.

6. Calculate rates and volumes for mixing.

IV. CROP PRODUCTION

EXPERTISE WITHIN EACH COMPETENCY AREA:

A. Identification of Crops

The learner shall be able to:

1. Identify the plant of each of the crops listed below:

    a. alfalfa
    b. barley
    c. canola
    d. corn
    e. dry edible beans
    f. flax
    g. oats
    h. orchard grass
    i. red clover
    j. reed canary grass
    k. rye
    l. smooth brome grass
    m. potatoes
    n. soybean
    o. sugar beet
    p. wheat
    q. peas
    r. sunflowers
    s. timothy

B. General Crop Adaptation

B1. Soil Adaptations

The learner shall be able to:

1. Describe how crops respond to the following factors:

    a. soil fertility levels
    b. soil pH
    c. soil drainage and texture
    d. soil temperature

2. List the recommended soil pH ranges for agronomically important crops.

B2. Climatic Adaptations

The learner shall be able to:

1. Describe the adaptation of agronomically important crops to extremes of precipitation.

2. Describe the adaptation of agronomically important crops to ambient temperature.

3. Describe the adaptation of agronomically important crops to day length.

4. Be able to describe the components of **G**rowing **D**egree **U**nits (**GDU**).

C. Anatomy, Growth, and Developmental Stages of Major Agronomic Crops

C1. Plant Staging – Grain Crops and Soybeans

The learner shall be able to:

1. Describe the systems used to stage corn, soybeans and small grains.

2. Use the staging systems to identify the stage of growth at any time between emergence and physiological maturity.

C2. Plant Staging – Forage Legumes and Grasses

The learner shall be able to:

1. Describe the systems used to stage forage legumes and grasses.

2. Use the systems to identify growth stages of forage legumes and grasses.

C3. Harvesting Forages and Ensiles

The learner shall be able to:

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. Describe how crop maturity at harvest affects feed quality (**T**otal **D**igestible **N**utrients and Relative Feed Value).

C4. Regrowth of Forage Crops after Harvesting

The learner shall be able to:

1. Describe the locations and functions of meristems used for regrowth in forage legumes and forage grasses.

C5. Management Factors Related to Anatomy, Growth, & Development of Major Crops

The learner shall be able to:

1. Relate anatomical features of major crops to developmental stages.

2. Recognize relationships between the growth and development of major crops and management factors.

D. Seeding Date Factors

The learner shall be able to:

1. Describe factors that determine when to seed corn, soybeans, small grains and forages.

2. Recognize consequences of seeding too early or too late.

E. Seeding Rates and Pattern Factors of Major Crops

The learner shall be able to:

1. List factors that influence the seeding rate of major crops.
2. List factors that determine the seed placement at planting and its ramifications.
3. Recognize characteristics of major crops that make them adapted to high or low seeding rates.
4. List methods used to seed small grains and forage crops.
5. Explain why forage crop establishment is more difficult than the establishment of grain crops.
6. List recommended seeding rates for major crops.
7. List advantages and disadvantages of seeding pure grass or legume stands vs. mixed stands.
8. Recognize the advantages and disadvantages of various row spacing on various crops.

F. Seeding Depth Factors

The learner shall be able to:

1. List the recommended seeding depths for major crops.
2. Recognize how crops respond to depth of planting.
3. Recognize conditions that would cause recommended seeding depth to be altered.

G. Crop Damage, Mortality, and Factors Influencing Replanting Decisions

The learner shall be able to:

1. Describe the type of damage that insects, disease, pesticides, seed quality, and acts of nature can cause to corn, soybean, and small grain and forage crops.
2. Describe the effect of pesticide use and crop rotation on replanting decisions.
3. Describe climatic and plant factors, which influence a plant's ability to resume growth after being damaged
4. Determination when crop damage would economically justify replanting.

H. Cropping Systems

The learner shall be able to:

1. List advantages and limitations of growing cover crops and companion crops in a cropping system.

2. Compare and contrast single crop systems and crop rotations.

3. Define the objective of using transgenic crops in a particular cropping system.

I. Site Specific Technology

The learner shall be able to:

1. List the advantages and limitations of soil sampling:

    a. grid
    b. soil type
    c. other

2. List the advantages and limitations of the following application systems:

    a. fertilizer and manure
    b. pesticides
    c. seed

3. List the advantages and limitation of scouting.

4. List the advantages and limitation of harvest monitors.

5. List the advantage and limitations of remote sensing.

6. List the advantages and limitations of GPS / GIS.