Northeast Region Certified Crop Adviser (NRCCA)

(CT/MA/ME/NH/NY/RI/VT)

Performance Objectives

CERTIFIED
CROP ADVISER

Revised 2022

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FOREWORD

These Performance Objectives provide guidance to individuals preparing for the Northeast Region Certified Crop Adviser Exam. They supplement the International Performance Objectives and emphasize nutrient, soil, water, pest, and crop management principles that are of particular importance in the Northeast Region. For reference, a listing of key crops in the Northeast Region are presented in the table below. Exam questions are based on Northeast and International Performance Objectives as they apply to providing advice to crop producers in Northeast Region.

As is true of the International Performance Objectives, the Northeast Performance Objectives outline the knowledge and skill areas that Certified Crop Advisers in the region have indicated they need to carry out their duties. Performance Objectives cover the minimum level of fundamental principles considered essential for effective crop advising. Once an individual achieves certification, continuing education programs will help individuals expand upon these principles, cover with greater rigor the four technical areas, respond to changes in science and technology, and learn topics important to development as a professional. Thus, reviewing and understanding the Performance Objectives is a first step in meeting the criteria for certification and continuing the process of professional development.

KEY NORTHEAST REGION CROPS				
Corn	Cover Crops	Forages	Nursery Crops	Orchard Crops
Potatoes	Small Fruits	Small Grains	Soybeans	Turfgrass
Vegetable (Specialty) Crops	Grapes	Cannabis		

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SOIL FERTILITY AND NUTRIENT MANAGEMENT

Competency Areas

1) Basic Concepts of Plant Nutrition
2) Basic Concepts of Soil Fertility
3) Soil Testing and Plant Tissue Analysis
4) Nutrient Sources, Analyses, and Application Methods
5) Soil pH and Liming
6) Nutrient Management Planning

Competency Area 1: Basic Concepts of Plant Nutrition

1. Classify the plant essential elements as macronutrient, secondary, or micronutrient.
2. Recognize the functions of N, P, and K in plants.
3. Distinguish each macronutrient as mobile or immobile in the plant.
4. List chemical uptake forms for each macronutrient.
5. Describe how nutrient demands change at different plant growth stages.
6. List the regional concerns with nutrient deficiencies such as Se, B, Zn, and S.
7. List the regional concerns with nutrient excesses such as Cu and B.

Competency Area 2: Basic Concepts of Soil Fertility

1. Recognize the role of the following in supplying nutrients from the soil:
    a. Soil solution
    b. Cation exchange sites
    c. Organic matter
    d. Soil minerals
    e. Plant residue
2. Describe the following nutrient transformations and interactions:
    a. Mineralization
    b. Immobilization
    c. Nutrient uptake antagonism
3. Describe how the processes of mass flow, diffusion, and root interception affect nutrient uptake.
4. Describe how cation exchange capacity (CEC) influences nutrient mobility and uptake.
5. Distinguish each macronutrient as mobile or immobile in the soil and recognize difference in mobility depending on form.
6. Describe how the following soil characteristics affect nutrient uptake:
    a. Texture
    b. Structure
    c. Drainage/aeration
    d. Moisture
    e. pH
    f. Temperature
7. Describe how the following affect the fate of N in soil:
    a. Fixation by clay
    b. Ammonification/mineralization
    c. Nitrification
    d. Volatilization
    e. Immobilization
    f. Denitrification
    g. Leaching
    h. Plant uptake
    i. Symbiotic N fixation

8. Describe how the following soil factors affect symbiotic nitrogen fixation.
    a. pH
    b. Moisture
    c. Aeration
    d. Nitrogen level
    e. Organic matter
    f. Population of correct *Rhizobia* species
9. Recognize how different crops and cropping systems affect soil fertility and fertilization strategies.

Competency Area 3: Soil Testing, and Plant Tissue Analysis

1. Recognize how the following affect soil sampling methods:
    a. Method of previous fertilizer application
    b. Tillage system
    c. Nutrient stratification
    d. Within-field soil and crop variability
    e. Measuring soil health parameters (nutrient analyses vs soil health panel)
2. Indicate how the following may cause variability in soil test results:
    a. Time of sampling
    b. Depth of sampling
    c. Number of samples taken
    d. Sample handling
    e. Type of extraction method used (Morgan, Modified Morgan, Mehlich-3, Bray, Olson)
3. Compare and contrast the following approaches for making fertilizer recommendations:
    a. Sufficiency level
    b. Soil buildup and maintenance
    c. Cation saturation ratios
4. Recognize how the following affect soil test interpretation:
    a. Probability of crop response to added nutrients
    b. Estimate of nutrient sufficiency level
    c. Results reported as ppm or lb/acre
    d. Within-field variability
    e. Results reported as elemental versus oxide forms (conversion factors)
    f. Environmental risk
    g. Extraction method
5. Describe soil sampling strategies and know their application:
    a. Random sampling
    b. Grid-based

c. Soil type based sampling
d. Electrical Conductivity (EC)
e. Yield map based

6. Recognize factors that influence the results of the pre-sidedress nitrogen test:
    a. Timing of sampling relative to weather patterns
    b. Depth of sampling
    c. Field variability
    d. Sample processing
    e. Manure history
    f. Pre-plant fertilizer
    g. Recent nutrient application
7. Describe how to properly take a plant tissue sample.
    a. Type of crop
    b. Part of plant to be sampled
    c. Growth stage
    d. Timing
8. Describe how to use plant tissue analysis for:
    a. Problem solving/diagnosis
    b. Nutrient program monitoring
    c. In-season nutrient management
9. Recognize how the following terms relate to plant nutrient level:
    a. Critical value
    b. Sufficiency range
    c. Optimum, below optimum, and above optimum soil nutrient levels
    d. Luxury consumption
    e. Toxicity level
10. Recognize how the following affect plant tissue analysis results:
    a. Crop species
    b. Growth stage
    c. Plant part sampled
    d. Crop stress level
    e. Time of day sampled
    f. Sample handling
11. Recognize factors that influence the results of the end of season corn stalk nitrate test:
    a. Sampling protocol
    b. Manure history

c. Crop rotation
d. Fertilizer rate, method of application and timing

Competency Area 4: Nutrient Sources, Analyses, and Application Methods

1. Describe the following crop response relationships:
    a. Diminishing returns response curve
    b. Plateau yield
    c. Critical response level
    d. Optimum economic nutrient rate
2. Describe the differences in rates of release of nutrients from the following sources:
    a. Soil organic matter
    b. Commercial fertilizer
    c. Soil minerals
    d. Animal manure
    e. Compost
    f. Biosolids
    g. Plant residue
3. Identify the physical form and analysis of each of the following nitrogen sources:
    a. Anhydrous ammonia
    b. Urea
    c. Ammonium nitrate
    d. Urea/ammonium nitrate solution (UAN)
    e. Ammonium sulfate
    f. Coated urea products (polymer or sulfur coated)
4. Describe the physical form and analysis of each of the following phosphorus sources:
    a. Rock phosphate
    b. Triple superphosphate
    c. Monoammonium phosphate
    d. Diammonium phosphate
    e. Ammonium polyphosphate
5. Describe the physical form and analysis of each of the following potassium sources:
    a. Potassium chloride
    b. Potassium sulfate
    c. Potassium nitrate
    d. Potassium-magnesium sulfate

6. Describe the physical form and analysis of the following calcium and/or magnesium sources:
    a. Calcitic lime
    b. Dolomitic lime
    c. Gypsum
    d. Potassium-magnesium sulfate
7. Define the following terms associated with commercial fertilizer:
    a. Nutrient use efficiency
    b. Total availability
    c. Water solubility
    d. Equivalent acidity
    e. Prill vs granulated
    f. Guaranteed analysis
    g. Sale effect
    h. Density
    i. Ammoniated vs Blend fertilizer
8. Define the following nutrient terms:
    a. Total Kjeldahl nitrogen (TKN)
    b. Organic N
    c. Inorganic N
    d. Organic P\
    e. Inorganic P
    f. Dissolved P
    g. Particulate P
9. Calculate fertilizer application rates from fertilizer analysis information.
10. Understand how to calculate manure application rates from manure analysis information.
11. Describe advantages and limitations of the following fertilizer placement methods.
    a. Injection
    b. Surface broadcast
    c. Broadcast incorporated
    d. Banding (different depths)
    e. Fertigation
    f. Foliar application
    g. Sidedress
    h. Topdress
    i. Seed placement (pop-up)

j. Starter band

12. Describe how the following nitrogen additives impact N behavior and management:
    a. Urease inhibitors
    b. Nitrification inhibitors
    c. Controlled release products
13. Recognize nutrient sources that can be used as an approved product in an organic system and where to locate or find references for this information.
14. Understand how variable rate fertilizer application is achieved with mapping guidance.

Competency Area 5: Soil pH and Liming

1. Define:
    a. Soil pH
    b. Buffer pH
    c. Exchangeable acidity
    d. Alkalinity
2. Describe the long-term change in soil pH from applying N.
3. Describe how applying N in a no-till or long-term perennial forage crop results in pH stratification (acid roof) and how this impacts, root growth, herbicide activity, soil sampling, and liming management.
4. Describe how cation exchange capacity (CEC), soil texture, exchangeable acidity and soil organic matter affect lime requirements.
5. Describe how soil pH affects the availability of each nutrient.
6. Describe how liming materials increase soil pH.
7. Describe how purity, fineness, and calcium carbonate equivalent (CCE) affect the neutralizing ability of liming materials.
8. Calculate lime application rates to meet pH requirements.
9. Explain how bio-solid application and soil pH affect availability of heavy metals and other contaminants to plants.
10. Describe the need for appropriate incorporation of wood ash, short fiber paper waste and other liming agents to avoid problems with nutrient tie-up, herbicide effectiveness, and crop response.
11. Describe the need for testing for contaminants that are associated with liming materials.

Competency Area 6: Nutrient Management Planning

1. Describe how to set a realistic yield goal by using:
    a. Production history
    b. Soil productivity
    c. Management level
    d. Soil type/characteristics
    e. Artificial drainage
    f. Soil drainage class
2. Determine crop nutrient needs by using:
    a. Yield potential
    b. Crop rotation/sequence
    c. Soil nutrient supply
    d. Soil test information
    e. Field history
    f. Field-specific N testing (e.g., pre sidedress nitrate test, corn stalk nitrate test, Illinois soil nitrogen test)
    g. Adapt-N
    h. Crop population
3. Know how to calculate an N or P based manure application rate based on:
    a. Crop requirement
    b. Manure analysis
    c. Planned application method and timing
    d. Linkage with supplemental fertilizer application (e.g., starter)
    e. Manure history
    f. Soil analysis
4. Describe environmental effects and nutrient loss due to:
    a. Erosion
    b. Runoff
    c. Volatilization
    d. Denitrification
    e. Leaching
5. Describe how to apply the basic concepts of the 4Rs (right source, right rate, right timing, and right placement).
6. Understand the role of the NRCS 590 Nutrient Management Standard in national nutrient management planning policy.
7. Define nutrient mass balance and describe why there can be a net excess nutrient mass balance on farms.

8. Distinguish P-based from N-based manure application recommendations and describe implications.
9. Understand the importance of precision livestock feeding for whole farm nutrient management.
10. Describe various conditions and environmentally sensitive areas associated with an elevated risk for nutrient loss from agricultural fields.
11. Know the importance of the following components used to develop a nutrient management plan that is economically and environmentally sound:
    a. Location of facilities and fields on maps
    b. Identify environmentally sensitive areas, including wells, and perform field risk assessments
    c. Specify crop rotation
    d. Determine expected yields
    e. Interpret results of soil, plant, and water analyses
    f. Quantification of nutrients from all sources available to the farm
    g. Develop a nutrient budget for each field
    h. Make recommendations of nutrient rate, timing, form, and application method (4Rs) based on both agronomic guidelines and environmental risk assessments (NRCS 590).
    i. Review and modify plan as needed
    j. Explain the importance of recordkeeping of nutrient applications and yields by field
    k. Describe the difference between routine livestock mortalities and catastrophic livestock mortalities and describe disposal options for both
12. Understand the factors that are required to estimate manure and waste production volumes on a livestock farm.
    a. Animal units
    b. Species and age
    c. Milk production rolling herd average
    d. Bedding type and amount
    e. Rainfall
    f. Impervious area
    g. Type of storage
13. Recognize production, environmental and management factors that determine the capacity/duration of manure storage needed on a livestock farm.
14. Explain the purpose of the P runoff index and list the four management categories of the P index.

15. Describe the impacts of the following manure application practices on the P runoff index score of a field:
    a. Application rate
    b. Application method
    c. Application timing
    d. Location relative to surface water and groundwater

16. Calculate crop P removal given yield and P concentration.

17. Understand the nitrate leaching index principles and interpretations.

18. Describe and understand practices that reduce the risk of nitrate leaching.

19. Describe and understand practices that reduce manure odor issues.

20. Describe and understand practices that reduce agricultural impacts on air quality.

21. Describe and understand practices that reduce pathogen concerns from manure.

22. Understand the concepts of adaptive nutrient management and associated tools:
    a. Corn stalk nitrate test, Illinois soil nitrogen test, standard soil fertility testing
    b. Nutrient mass balance
    c. Record keeping
    d. Analysis and adaptation over multiple seasons based on field-specific observations
    e. Precision agricultural equipment (crop sensors/soil sensors and models)

SOIL AND WATER MANAGEMENT

Competency Areas

1) Basic Soil Properties
2) Soil Hydrology
3) Drainage and Irrigation
4) Soil Health
5) Soil Conservation
6) Watershed Hydrology
7) Non-Point Source Pollution
8) Concentrated Source Pollution
9) Conservation Planning

Competency Area 1: Basic Soil Properties

1. Know the five soil functions.

2. Understand the processes of soil formation in the Northeast.
    a. Know the five soil forming processes.
    b. Describe glacial till, glacial outwash, lake and marine sediments, organic, and alluvial deposits.

3. Understand soil moisture conditions and the “Ball test” to assess conditions for tillage, traffic, and irrigation.

4. Understand and be able to use soil survey information to:
    a. Determine soil series at any location.
    b. Interpret soil properties and suitability for agricultural
    c. land use and environmental implications.

5. Understand soil structure and its relationship to crop production and environmental protection.

6. Understand different types of soil organic matter, their dynamics, and roles with respect to soil chemical, biological and physical properties.

7. Understand soil carbon dynamics and how organic carbon differs from organic matter.

Competency Area 2: Soil Hydrology

1. Understand the water budget for soil profiles characteristic to the Northeast region.
    a. Soil infiltration
    b. Evaporation and transpiration
    c. Leaching
    d. Runoff
    e. Soil water storage

2. Know the relationship between the listed soil parameters and soil water content, soil water tension, soil pore size, plant growth and the fate and transport of nutrients and pesticides. Qualitatively understand how these parameters vary for different soil types.
    a. Field capacity
    b. Permanent wilting point
    c. Available water capacity
    d. Total soil water storage capacity
    e. Porosity

f. Soil texture, structure
g. Macroporosity/preferential flow
h. Saturated and unsaturated flow

3. Understand how permeability and infiltration are affected by crusting and compaction, and how they are affected by soil type, precipitation, and management practices.

4. Understand how seasonal soil conditions and landscape position affect runoff and leaching.

5. Know simple field methods to assess soil water conditions.
    a. Observation/visual assessment
        - redoxymorphic features
        - vegetation
        - soil moisture – Ball test
    b. Soil probe
    c. Tensiometer

Competency Area 3: Drainage and Irrigation

1. Understand the relationship between soil drainage class and crop productivity and know where to find this information.

2. Qualitatively understand how hydrology and soil and landscape properties influence drainage class and drainage criteria.

3. Know the advantages and disadvantages of:
    a. Surface drainage
    b. Subsurface drainage
    c. Topographically driven (random) layout of drainage systems
    d. Pattern layout of drainage systems

4. Understand the potential impacts of the following factors affecting soil drainage and the installation of drainage systems:
    a. Location of bedrock
    b. Soil type and texture
    c. Soil porosity
    d. Topography
    e. Organic soils
    f. Type of crop
    g. Outlet

5. Understand the benefits and risks to the environment that are potentially inherent from a drainage system and potential for management of outlet/water control structures.

6. Understand the concept of hydric soils, hydric soil indicators, and the regulatory aspects associated with wetlands and the installation of drainage systems.

7. Explain the factors that influence the potential and actual evapotranspiration of crops.

8. Understand the relationships of hydrology, the soil water budget, and crop water requirements as these pertain to irrigation system water requirements and the potential benefits of irrigation.

9. Know the various methods of irrigation and the advantages and disadvantages of each with respect to different soil conditions and crop types.
    a. drip irrigation
    b. surface riser sprinkler irrigation
    c. center pivot
    d. lateral irrigation
    e. traveler gun irrigation

10. Understand the sources of water for irrigation and how the quantity and quality affects irrigation methods.

11. Describe the components of irrigation scheduling and understanding decision models with regard to irrigation.

12. Understand the need for pathogen testing of irrigation water for food safety/quality.

13. Explain the use of overhead irrigation for frost protection in specialty crops.

Competency Area 4: Soil Health

1. Understand the concept of soil health and know and identify some indicators.
    a. Chemical indicators, for example soil OM, soil OC, pH, CEC, cation balance
    b. Physical indicators, for example compaction, soil structure
    c. Biological indicators, for example microbial activity and invertebrates

2. Describe different types of soil compaction and understand their agronomic and environmental implications.
    a. Plow layer
    b. Subsoil
    c. Crusts
    d. Surface

3. Understand the processes and management practices that cause soil compaction and their relative significance under Northeast conditions.
    a. Equipment traffic and load distribution
    b. Timing/frequency/intensity of tillage and traffic as it relates to soil water conditions, i.e., time of year and soil saturation
    c. Tillage methods
    d. Livestock

4. Understand the relation between soil compaction and the following factors. Understand each factor's relation to plant growth and important soil chemical and biological processes.
    a. Aeration
    b. Aggregation/structure
    c. Runoff and erosion
    d. Drainage

5. Understand variation in susceptibility to compaction among soil types due to:
    a. Drainage
    b. Texture

6. Understand the effect of soil compaction on root and shoot growth, and crop yield.

7. Understand the appropriate use of a soil penetrometer and how to detect compaction layers.

8. Understand how compaction can lead to soil and water degradation. Understand the broader environmental consequences of soil degradation from compaction affecting:
    a. Energy requirements
    b. Pesticide use
    c. Runoff and water quality

9. Describe approaches for remediation of soil compaction and understand when they are appropriate.
    a. Crop rotation
    b. Deep tillage (subsoil compaction)
    c. Organic matter additions and cover crops (plow layer compaction; subsoil compaction when using deep-rooted cover crops)
    d. Reduced tillage (plow layer compaction)

10. Understand how various practices influence soil organic matter/organic carbon
    a. crop residue management
    b. tillage system
    c. cover crops
    d. crop rotation
    e. organic matter amendments

Competency Area 5: Soil Conservation

Erosion/Sedimentation Aspects

1. Explain the three stages of soil erosion by water and their relation to soil properties.

2. Understand the main agronomic and environmental consequences of soil erosion and sedimentation.

3. Understand the different types of soil erosion by water and wind.

4. Understand how soil types differ in soil erodibility (the soil K factor).

5. Understand how climatic factors affect soil erosion.

6. Know how the topographic factors of slope and slope length affect water soil erosion.

7. Explain the factors used in the Revised Universal Soil Loss Equation (RUSLE) and/or Water Erosion Prediction Project (WEPP).

8. Understand how agronomic management practices can reduce erosion.
    a. Vegetation type and growth stage
    b. Filter strip, buffer strip, riparian areas
    c. Tillage and crop residue management
    d. Crop rotations
    e. Cover cropping

9. Understand the basic approaches to structural soil conservation practices.
    a. Grass/rock-lined waterways
    b. Diversions
    c. Ponds, surface inlets, and Water and Sediment Control Basins
    d. Terraces
    e. Drop structures

Tillage Aspects

1. Understand the purposes of tillage.

2. Describe the basic components and role of tillage systems and understand their agronomic and environmental benefits.
    a. Plow-till
    b. No-till
    c. Mulch-till
    d. Ridge-till
    e. Zone/Strip tillage

f. Vertical tillage

3. Understand the adaptability of tillage systems to common soil types in the Northeast based on:
   a. Texture
   b. Drainage class
   c. Climate

4. Understand the adaptability of tillage systems to various cropping systems.
   a. Livestock-based
   b. Conventional cash grain
   c. Low-input and organic cash grain
   d. Horticultural and vegetable production

5. Understand the relation between tillage practices and:
   a. Residue cover
   b. Surface roughness
   c. Soil health
   d. Residue fragility and persistence

6. Understand the relation between tillage systems and:
   a. Soil structure and compaction
   b. Runoff and erosion
   c. Nutrient cycling and pest management
   d. Infiltration and percolation

7. Understand the concept of soil tilth and the roles of soil texture, organic matter, structure/aggregation, and bulk density as they affect tilth.

8. Understand the relationship between soil consistency and tillage conditions; the "Ball Test", and the effects of soil freezing.

Competency Area 6: Watershed Hydrology

1. Define a watershed and describe its main functions.

2. Understand the major inputs and outputs of water in a watershed.
   a. Precipitation
   b. Storms
   c. Infiltration and percolation
   d. Storage
   e. Vegetation
   f. Base flow
   g. Storm flow
   h. Runoff
   i. Evaporation and transpiration

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

4. Describe the main agricultural point and non-point sources of contaminants in a typical rural watershed in the Northeast.

5. Understand and describe aquifers (confined, unconfined) and the geologic conditions that affect water yield from wells.

6. Understand the concepts of pumping and drawdown in wells, the cone of depression, and well capture zones.

7. Understand the relationship between geologic conditions and the potential for groundwater and surface water contamination.

8. Understand recharge areas for groundwater and surface water.

9. Understand and apply the concepts of hydrologically sensitive areas and critical management zones at the field, farm, and watershed levels. Be able to give examples.

10. Understand key processes that occur in wetlands and riparian buffer zones and their role in a watershed with respect to downstream water quality.

11. Understand the multiple-barrier concept in watershed protection.

12. Be able to identify impaired water bodies and the causes listed for the impairment and understand the implications for agriculture.
    a. Clean Water Act: Total Maximum Daily Loads (TMDLs)
    b. 303(d) listing of impaired waters
    c. Implications in the Clean Water Act for addressing items in a TMDL report that may involve agriculture.

Competency Area 7: Non-Point Source Pollution

1. Distinguish between agricultural and non-agricultural non-point source (NPS) pollution and point source pollution and the extent and importance of each.

2. Describe the main sources of agricultural (NPS) pollution and their origins.
    a. Nitrogen
    b. Phosphorus
    c. Biological oxygen demand (BOD)
    d. Sediment
    e. Pesticides
    f. Pathogens

g. Silage leachate
h. Chemicals
i. Processing wastewater
j. antibiotics

3. Understand the environmental impacts of the various agricultural contaminants listed above (in #2) on the quality of surface water and groundwater as it relates to their various uses.

4. Identify basic water quality indicators and explain their significance.

5. Understand the concept of best management practices for NPS pollution control.

6. Know some appropriate best management practices for agricultural NPS and point source pollution control in a given farming system.

7. Understand the importance of federal, state, and local laws and regulations related to NPS and point source pollution control.
   a. Clean Water Act
   b. Safe Drinking Water Act
   c. Coastal Zone Management Act
   d. Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)
   e. Local regulations

Competency Area 8: Concentrated Source Pollution

1. Understand the advantages, disadvantages, and situational appropriateness of various options for handling milking center waste and/or other process waste waters.
   a. Septic systems/leach fields
   b. Vegetative filter areas
   c. Aerobic lagoon
   d. Bark Mound/bark beds
   e. Constructed wetlands
   f. Stone filled trench
   g. Spray irrigation
   h. Aerobic septic system
   i. Inclusion in liquid manure handling system

2. Describe the potential pollution impacts of silage leachate.

3. Explain management factors that reduce or prevent the potential of stored silage to leach.

4. Understand the various methods to manage and treat high and low flow silage leachate.

5. List management and environmental objectives for improving a farmstead with respect to surface drainage in animal operations.

6. Understand why excluding clean water is important and describe methods of excluding outside (clean) water from barnyards and other livestock areas.

7. Understand advantages and disadvantages of various barnyard surfaces.

8. Explain establishment and/or maintenance requirements of barnyards and barnyard runoff treatment options.

9. Compare and contrast AFO and CAFO requirements and regulations.

Competency Area 9: Conservation Planning

1. Understand how policies, procedures, technical guidance, and programs at the federal, state and local level fit together in the conservation planning process. Understand the key elements of the planning process.

2. Explain how federal, state, and local programs support implementation of conservation plans.

3. Understand the NRCS 9-Step Planning Process, including identifying resource concerns, planning criteria, and client objectives, and other state planning tools.

4. Be aware of the uses of the following USDA NRCS references:
    a. Field Office Technical Guide (FOTG)
    b. National Handbook of Conservation Practices (NHCP)
    c. National Planning Procedures Handbook (NPPH)
    d. Agricultural Waste Management Field Handbook (National Engineering Handbook Part 651)

5. Define “Concentrated Animal Feeding Operation” (CAFO) and “Animal Feeding Operations” (AFO) and explain how these relate to local regulations and national Clean Water Act strategies.

6. Understand the roles and responsibilities of the local, state, and federal conservation agencies.
    a. USDA Farm Service Agency (FSA)
    b. USDA Natural Resource Conservation Service (NRCS)
    c. USDA Rural Development (RD)
    d. Environmental Protection Agency (EPA)
    e. Cooperative Extension Service (CES)
    f. Soil and Water Conservation District (SWCD)
    g. State Environmental Regulation Agencies
    h. State Departments of Agriculture

PEST MANAGEMENT

Competency Areas

1) Integrated Pest Management (IPM)
2) Weed Management
3) Management of Infectious Plant Diseases
4) Management of Arthropods
5) Pesticide Formulations and Labels
6) Using Pesticides in an Environmentally Sound Manner
7) Protecting Humans Against Pesticide Exposure

Competency Area 1: Integrated Pest Management (IPM)

1. Define pesticide resistance.

2. Describe how pesticide resistance develops in a pest population.
    a. Overuse of a single active ingredient
    b. Inappropriate timing for life stage of the target
    c. Use of reduced rates
    d. Use of pesticides with the same mode/mechanism of action

3. Know examples of resistant field crop pests in the Northeast.
    a. Herbicide resistant weeds
    b. Potato leafhopper
    c. Colorado potato beetle
    d. Powdery mildew
4. Know the definition of integrated pest management (IPM) and the major IPM strategies.

5. Know the relationship between the economic injury level, economic threshold, action threshold and general equilibrium position of a pest population.

6. Know the typical steps in the IPM process. These include:
    a. Proper identification of problems
    b. Sampling to determine the extent of the problem
    c. Analysis to assess problem importance
    d. Selection of appropriate management alternative
    e. Proper implementation of management action
    f. Evaluation of effectiveness of management action

7. Recognize the importance of using appropriate sampling methods to determine presence or absence, and to estimate population density of a pest species. Know the components of proper sampling including method, location, timing, and sample size.

8. Outline methods for sampling plant and pest material.

9. Outline basic methods for submitting plant and pest material for diagnosis and laboratory analysis.

10. List types of pest monitoring methods and the advantages and disadvantages of each.

11. Define and distinguish between the following classes of plant response to injury: resistance, tolerance, and susceptibility.

12. Recognize how variables including the following are used to calculate the economic injury level (EIL), and how the EIL changes with a change in any of the variables:
    a. Pest density/crop damage relationship
    b. Crop value
    c. Cost of control
    d. Effectiveness of control action
    e. End-use or market requirements

13. Understand how weather-based computer models can be utilized to predict pest arrivals and outbreaks, and how they can be useful in management decisions. Also understand the limitations of computer-based pest models.

Competency Area 2: Weed Management

Weed Biology

1. Demonstrate familiarity with life cycles (annual, biennial, perennial) and growth habits (dicotyledons and monocotyledons) of weeds and how these characteristics affect weed management.

2. Understand the survival mechanisms of weeds, i.e., how they reproduce, spread, and the role seed dormancy plays in survival.

3. Demonstrate the ability to classify each of the following weeds by life cycle and growth habit, i.e., recognize whether they are broadleaf weeds, grasses, or sedges.

Summer Annuals	**Summer/Winter Annual**	**Perennials**
Velvetleaf	Horseweed	Common Milkweed
Redroot/smooth pigweed*	Chickweed	Hedge bindweed
Common ragweed	Shepherd's purse	Canada thistle
Common lambsquarters*		Field bindweed
Hairy galinsoga	**Biennials**	Smooth bedstraw
Wild mustard	Common burdock	Horsenettle
Eastern black nightshade	Bull thistle	Dandelion
Large crabgrass	Cow parsnip/wild parsnip	Quackgrass
Barnyardgrass		Wirestem muhly
Fall panicum		Johnsongrass
Giant foxtail		Yellow nutsedge
Yellow foxtail		Poison Ivy/poison oak
Green foxtail		
Palmer amaranth*		
Waterhemp*		
Powell Amaranth*		
Sowthistle		
Prickly lettuce		

*some of the species exhibit herbicide resistance

4. Recognize how weed life cycle and growth habit impact choice and timing of control measures.

Weed Control Methods

1. Mechanical – Understand the advantages and limitations of mechanical control measures, especially those associated with tillage, cultivation, mowing, and the impacts on soil health and pest populations.

2. Cultural – Understand the advantages and limitations of cultural practices that influence the competitive relationship between crops and weeds including the role of the following in weed management:
    a. Choice of crop and variety/hybrid selection including the advantages and disadvantages of herbicide-resistant crops.
    b. Crop rotation
    c. Soil management – pH, fertility, soil water
    d. Planting date
    e. Seeding rate/plant populations/row spacing
    f. Nurse crops/cover crops
    g. Minimize introduction of weed seeds via use or incorporation of feed, bedding, cover crop mixes, or buying equipment from other regions
    h. Sanitation

3. Biological – Understand how biological control measures can play a role with intensively or extensively managed production systems.

4. Chemical – Be familiar with the ways herbicides are classified, i.e., how they are used and by herbicide mode/site of action classification by HRAC/WSSA.

5. Chemical – Know time(s) of application (pre-plant incorporated, pre-emergence, or post emergence) for different types of herbicides and how soil (texture, organic matter, pH) and weather (rainfall/soil moisture, temperature, etc.) affect herbicide performance.

6. Chemical – Be familiar with problems associated with herbicide use.
    a. Herbicide resistant weeds – Know weeds that have developed herbicide resistant populations in the northeast and the practices involved in herbicide resistance management (see species in weed table above).
    b. Problems of off-site movement of herbicides and be able to recognize symptoms of common types of off target herbicide injury.
    c. Causes of crop injury by herbicides.
    d. Advantages and disadvantages of herbicide persistence as it relates to weed control, crop rotation, and water quality.
    e. Herbicides as potential sources of non-point pollution of surface- and groundwater.

Competency Area 3: Management of Infectious Plant Diseases

Biology of Infectious Plant Diseases

1. For each of the following crop diseases:
    a. Classify by type of pathogen
    b. Know the type of symptoms produced and plant parts affected
    c. Know what conditions favor disease development
    d. Know how the pathogen survives between crop seasons
    e. Know other crop/weed species attacked by the pathogen
    f. Know how the pathogen is spread

Alfalfa	**Corn**
Anthracnose	Anthracnose leaf blight and stalk rot
Brown root rot	Common rust
Pythium damping-off	Common smut
Leaf and stem blight complex including:	Eyespot
spring black stem and leaf spot	Gibberella stalk and (red) ear rot
lepto leaf spot	Goss's wilt
common leaf spot	Gray leaf spot
Fusarium crown and root rot	Northern corn leaf blight
Phytophthora root rot	Northern corn leaf spot
Verticillium wilt	Seed decay/seedling blights
	Stewart's bacterial leaf blight and wilt
	Tar spot
Small Grains (wheat, barley, oats, rye)	
Crown rust	**Soybean**
Fusarium head blight (scab)	Bacterial blight
Leaf rust	Bacterial pustule
Loose smut	Brown stem rot
Powdery mildew	Downy mildew
Stripe rust	Pod and stem blight
Leaf and glume blotch complex including:	Sclerotinia stem rot (white mold)
Septoria	Septoria brown spot
Stagonospora	Soybean cyst nematode
tan spot	Soybean mosaic
Soil-borne wheat mosaic virus	Stem canker
Wheat spindle streak mosaic virus	Sudden death syndrome
Yellow dwarf virus	Frogeye leaf spot
	Anthracnose
Perennial Grasses and Clover	**Grapes**
Leaf rust	Bitter rot
Leaf spot	Black rot
Powdery mildew	Botrytis
	Downy mildew
	Powdery mildew
	Sour rot

Potatoes	**Brassicas** (Cabbage and Broccoli)
Brown spot	Alternaria leaf blight
Early blight	Anthracnose
Grey mold/Botrytis	Bacterial leaf spot
Late blight	Black rot/Xanthomonas
Pink rot	Clubroot
Pythium leak	Downy mildew
Rhizoctonia stolon canker/black scurf	Powdery mildew
Silver scurf	Sclerotinia white mold
White mold/Sclerotinia	
	Tomatoes
Cucurbits (Pumpkin, Squash, Cucumbers)	Bacterial canker
Alternaria leaf blight	Bacterial leaf spot
Angular leaf spot	Early blight
Anthracnose	Gray leaf spot (Stemphylium)
Bacterial wilt	Gray mold/Botrytis
Downy mildew	Late blight
Gummy stem blight	Phytophthora capsici
Phytophthora crown and root rot	Septoria leaf spot
Plectosporium/Michrodochium blight	
Powdery mildew	**Apples**
	Bitter rot
Cannabis	Fire blight
Anthracnose	Fly speck and sooty blotch
Brown blight (Alternaria)	Powdery mildew
Brown spot and stem canker (Phoma)	Scab
Downy mildew	White rot
Fusarium root rot/wilt	
Gray mold/Botrytis	**Raspberry and Blackberry**
Olive leaf spot (Cercospora)	Anthracnose
Rust	Botrytis
Seedling damping-off	Downy mildew
Stemphylium leaf and stem spot	Fire blight
Yellow leaf spot (Septoria)	Phytophthora root rot
	Powdery mildew
	Rusts

Control of Infectious Plant Diseases

1. For the crop diseases listed under (1) above, know the availability and relative usefulness in disease management under Northeast conditions of:
    a. Seed-, foliar-, and soil-applied fungicides
    b. Resistant or tolerant crop varieties
    c. Use of certified seed
    d. Biological control; biopesticides
    e. Other cultural practices such as rotation, tillage, site selection, soil drainage, planting time, harvest time, fertility, weed and insect control

2. Understand role of biodiversity in healthy soils in managing diseases

Biology, Detection, and Prevention of Mycotoxins

1. Define 'mycotoxin' and be acquainted with specific mycotoxins: aflatoxins, deoxynivalenol, zearalenone, fumonisins, and ochratoxin.

2. Know the mycotoxins found in Northeast grain and silage, the fungus genera they are produced by, why they are important, and how they are detected.

3. Know strategies for minimizing contamination of commodities by mycotoxins.

4. Know types of environmental conditions that are conducive to development of mycotoxins in the field and in stored grain.

Competency Area 4: Management of Arthropods

Biology of Arthropods

1. For each of the following:
   a. Be able to sight identify.
   b. Classify as an important economic pest or a sub-economic/occasional pest.
   c. Classify by feeding habit, host range, injury mechanism, symptoms and damaging stage(s).
   d. Understand how biology influences management.
   e. Know how environmental conditions influence population dynamics.
   f. Know how the environment influences potential for crop damage.

Corn	**Soybeans**
Western/Northern corn rootworm	Soybean aphid
European Corn Borer	Spider mites
Armyworm	slugs/snails
Seedcorn maggot	
Fall armyworm	**Alfalfa**
Western Bean cutworm	Alfalfa snout beetle
Black cutworm	Alfalfa weevil
White grub	Clover root curculio
Wireworm	Pea aphid
Corn leaf aphid	Potato leafhopper
Slugs/snails	
Corn earworm	**Small Grains** (wheat, barley, oats, rye)
	Cereal leaf beetle
Perennial Grasses and Clover	Wireworm
Armyworm	Thrips
Slugs/snails	Armyworm
White grubs	

Potatoes	**Cucurbits** (Pumpkin, Squash, Cucumbers)
Aphids	Aphids
Colorado potato beetle	Cucumber beetle
European corn borer	Squash bug
Flea beetles	Squash vine borer
Potato leafhopper	
Spider mites	**Tomatoes**
Tarnished plant bugs	Aphids
Wireworms	Hornworms
	Spider mites
Brassicas (Cabbage and Broccoli)	
Aphids	**Apples**
Cabbage looper	Apple maggot
Cabbage maggot	Borers
Diamondback moth	Codling moth
Flea beetle	Leafhoppers
Imported cabbageworm	Leafminers
	Mites
Grapes	Obliquebanded leafroller
Brown marmorated stink bug	Oriental fruit moth
Leafhoppers and treehoppers	Plant bugs
Mites	Plum curculio
Phylloxera	Rosy apple aphid
Spotted lantern fly	San Jose scale
Thrips	Stink bugs
	Wooly apple aphid
Cannabis	
Aphids	**Raspberry and Blackberry**
Flea beetles	Aphids
Japanese beetles	Japanese beetle
Potato leafhopper	Lygus bugs
Slugs and snails	Mites
Tarnished plant bugs	Rose chafer
	Spotted wing Drosophila

2. Be able to discuss how ecological factors such as temperature and moisture influence insect population growth and decline.
3. Understand monitoring movement of emerging invasive pests (Spotted Wing Drosophila, Swede Midge, Spotted Lanternfly, Brown Marmorated Stinkbug)

Control – Chemical

1. Know the advantages and disadvantages of using pesticides to control arthropod crop pests.

2. Recognize the advantages and disadvantages of target specificity of pesticides used to control arthropod crop pests.

3. Understand the concepts of resistance management as it pertains to pesticides and genetically modified crops with plant incorporated protectants (PIPs) incorporated into their genome.

Control – Cultural

1. Know examples of and understand the advantages and limitations of cultural controls for arthropod crop pests.
    a. Resistant varieties
    b. Planting date adjustment
    c. Crop rotation
    d. Tillage
    e. Harvest date adjustment
    f. Sanitation
2. Understand refuge requirements for insect-traited corn.
    a. Size
    b. Distance
    c. Refuge in a bag

Control – Biological

1. Recognize the three major classes of beneficial organisms and know at least two examples of each (parasites, predators and pathogens).

2. For each example, be able to discuss its importance in pest population regulation. Examples include:
    a. Spiders
    b. Parasitic wasps
    c. Parasitic flies
    d. Predaceous insects
    e. Predaceous mites
    f. Entomopathogenic nematodes
    g. Entomopathogenic fungi

Competency Area 5: Pesticide Formulations and Labels

1. Recognize the distinction between the federal and state pesticide regulations, and that state regulations can be more restrictive than federal regulations. Be able to explain what to do if state laws are stricter than label directions.

2. Be able to explain the difference between a pesticide label and labeling.

3. Identify and locate the kinds of information found on a pesticide label.

4. Know what FIFRA is and how it applies to a CCA's work.

5. Be able to explain the meaning of the phrase “Use Inconsistent with Labeling”.

6. Recognize the general provisions of EPA regulations such as the Clean Water Act and Worker Protection Standards.

Competency Area 6: Using Pesticides in an Environmentally Sound Manner

Pesticide Movement in Soil and Water

1. Recognize how movement of a pesticide in soil or into water may be affected by:
    a. Soil texture
    b. Erosion
    c. Topography/proximity to surface water
    d. Pesticide degradation
    e. Pesticide persistence
    f. Pesticide solubility
    g. Pesticide adsorption
    h. Degradation processes
    i. Precipitation and runoff
    j. Leaching
    k. Source of entry into the environment
    l. Organic matter
    m. Alkaline hydrolysis

2. Explain pesticide:
    a. Degradation
    b. Half life
    c. Washing off of foliage via rainfall
    d. Excessive incorporation
        i. physical
        ii. rainfall
    e. Photodegradation

3. Explain various spray adjuvants and how they impact product efficacy, crop health and environment.

4. Understand soil/pesticide interactions and their influence on pesticide selection, pesticide use, and water quality protection.

5. Be aware of pesticide runoff/leaching potential prediction tools such as Win-PST 3 and be able to recommend mitigation to improve or minimize the negative effects on the environment.

6. Recognize how the following impact proper pesticide use in regard to water quality protection:
    a. Soil characteristics,
    b. Ground cover,
    c. Proximity to water sources (surface water, groundwater, wells, etc.).

Competency Area 7: Protecting Humans from Pesticide Exposure

Keeping Pesticides on Target

1. Be familiar with spray drift and problems drift can cause for applicators and others.

2. Know the factors that affect particle drift and how they affect drift:
    a. Droplet size
    b. Wind speed
    c. Application speed
    d. Type of spray equipment
    e. Nozzle distance from target
    f. Temperature, humidity, and temperature inversions
    g. Type of chemical being sprayed
3. Know factors that affect spray droplet size and minimize spray drift:
    a. Spray pressure
    b. Nozzle size and type
    c. Spray rate (gallons per acre)
    d. Drift control agents (foams, invert emulsions, spray additive stabilizers, etc.)
    e. Choice of pesticide
    f. Shielded spray applications
4. Understand how precision targeted pesticide applications may be utilized.

Human Toxicity

1. List pesticide modes of entry into the human system.

2. Distinguish between chronic and acute poisoning effects.

3. Recognize general symptoms of acute pesticide poisoning.

4. List possible chronic effects of pesticide poisoning.

5. Recognize general procedures to follow if pesticide gets on skin, in eyes, in mouth or stomach, or if inhaled.

6. Recognize that Safety Data Sheets are the best source of information concerning level of toxicity, handling precautions, first aid procedures, and other safety information.

Handling Pesticides Safely

1. Know personal protective equipment (PPE) to be used during mixing and application of pesticides and where to find that information on a pesticide label.

2. Describe proper cleanup procedures for application equipment and protective gear.

3. Recognize proper ways to dispose of pesticides and containers.

4. Describe safe storage of pesticides.

5. Recognize procedures to follow when a pesticide spill occurs.

CROP MANAGEMENT

Competency Areas

1) Crop Adaptation
2) Tillage Systems
3) Seeding Factors
4) Seeding Rates and Row Spacing
5) Considerations in Replanting Decisions
6) Crop Staging, Growth and Development
7) Forage Harvesting Factors
8) Cropping Systems

Competency Area 1: Crop Adaptation

Crops and Soils

1. Know the response of the Key Northeast Region crops to:
    a. Soil pH range
    b. Soil drainage classification range

2. Know the recommended soil pH ranges for major specialty crops.

Grower Adaptations to Climatic Limitations of Crops

1. Understand grower considerations and the impact/limitations of major Northeast crops to extremes in precipitation on well drained, moderately well drained, and poorly drained soils.

2. Understand grower considerations and the impact/limitations of major Northeast crops to extremes in temperature.

Competency Area 2: Tillage Systems

1. Know the Northeast soil types best adapted to fall tillage. Know the advantages and disadvantages of fall tillage.

2. Know advantages and limitations of spring tillage.

3. Describe the advantages and limitations various tillage methods such as moldboard plow, chisel plow, strip tillage, zone tillage, and no-till systems for crop production in the Northeast.

4. Know how to make economically and environmentally sound tillage recommendations in a given situation.

5. Describe the ideal seedbed conditions for the Key Northeast Region crops.

Competency Area 3: Planting Factors

1. Understand the importance of certified seed.

2. Know the factors that influence cultivar selection in the Key Northeast Region crops.

3. Know the factors used to determine optimum planting time of Key Northeast Region crops.

4. Recognize the consequences of planting or seeding Key Northeast Region crops too early or too late.

5. Understand considerations for transplants with respect to temperature, timing, depth, bed preparation, and row covers.

Competency Area 4: Seeding Rates and Row Spacing

1. Know factors that influence the seeding rate of Key Northeast Region crops.

2. Know the factors that influence the planting pattern of Key Northeast Region crops and understand the advantages and disadvantages of broadcast versus drilled seeding.

3. Know recommended seeding rates for Key Northeast Region crops.

4. Know how to measure plant populations in the field for various crops.

5. Know the advantages and disadvantages of seeding pure grass or legume stands versus mixed stands.

6. Know the recommended seeding depths for Key Northeast Region crops and recognize the effects of improper depth or spacing.

7. Know how precision planting can be used to manage populations based on precision guidance related to yield maps, soil type, drainage tile.

Competency Area 5: Considerations in Replanting Decisions

1. Know the minimum stand for major Northeast crops before considering replanting. Recognize factors that result in thin stands of Key Northeast Region crops.

2. Describe the types of damage that hail, frost, drought, and wind can cause crops.

3. Recognize when Key Northeast Region crops are most susceptible to specific environmental stresses such as frost, drought, ozone, etc.

4. Understand the impact of prior herbicide usage on replant decisions.

Competency Area 6: Crop Staging, Growth and Development

Crop Staging - Grain Crops and Soybeans

1. Know the different systems used to stage corn, small grains, and soybean.

2. Know how to identify growth stages between emergence and physiological maturity of corn, small grain, and soybean.

Crop Staging - Forage Legumes and Grasses

1. Describe the systems used to stage harvest of alfalfa and grasses.

2. Know how stage of growth and timing of cutting affects quality of forages.

Growth and Development

1. Understand how Growing Degree Days (GDD) are calculated using the 86 - 50 system for corn, or the Base 41 system for forages. Know how environmental effects such as water stress or photoperiod affect the accuracy of GDD in predicting growth and development of corn.

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

Crop Staging – Specialty Crops

1. Know how to identify growth stages with respect major management practices for specialty crops.

2. Understand how growth stages and maturity relate to harvest quality.

Competency Area 7: Forage Harvesting Factors

Perennial Crops

1. Know the critical factors influencing first cutting of alfalfa or perennial grasses or mixed species forages.
    a. Know the basic procedures for evaluating forage quality of grasses and legumes.

b. Know the optimum forage quality (neutral detergent fiber (NDF), acid detergent fiber (ADF), crude protein (CP), etc.) for alfalfa and perennial grasses and their importance in animal nutrition for various livestock and life stages.

2. Understand how frequency of harvest and cutting height is related to forage yield, quality, root reserves, and stand longevity.

Annual Crops

1. Describe the stage of development when corn is ready to harvest as silage.
   a. Know the basic procedures for evaluating forage quality, including fiber digestibility.
   b. Know the ideal forage quality at harvest (neutral detergent fiber digestibility (NDFD), ADF, NDF, net energy lactation (NEL), total digestible nutrients (TDN), etc.).

2. Describe the stage of development when small grains are ready to harvest as silage.

Competency Area 8: Cropping Systems

1. Know advantages and limitations of integrating cover crops and/or companion crops into a cropping system.

2. Compare and contrast single crop systems (monocultures) with and crop rotations such as corn-alfalfa, corn-soybean, wheat-clover, etc. for:
   a. Yield
   b. Soil structure
   c. Soil water and nutrient status
   d. Insect pests
   e. Pathogens
   f. Weeds
   g. Economics

3. Compare and contrast different residue management systems for crops on:
   a. Yield
   b. Soil structure
   c. Soil nutrient status
   d. Insect pests
   e. Pathogens
   f. Weeds
   g. Economics
   h. organic matter

4. Understand the aspects of crop management that can affect long term sustainability of different cropping systems.

5. Know the basic criteria for organically grown crops, and the primary advantages and disadvantages of organic crop production.

6. Understand the potential advantages of yield mapping.