Northeast Region Certified Crop Adviser (NRCCA)

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

August 28, 2007

Performance Objectives

CERTIFIED
CROP ADVISER

(SW revised 12-2005; CP revised 08-2006; PM revised 11-2006, NM revised 08-2007)

Cornell University

Table of Content

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. List the 18 elements essential for plant nutrition.

2. Classify the essential elements as macronutrient or micronutrients.

3. Recognize the functions of N, P, and K in the plants.

4. Distinguish each macronutrient as mobile or immobile in the plant.

5. List chemical uptake forms for each macronutrient.

6. Describe how nutrient demands change at different plant growth stages.

Competency Area 2: Basic Concepts of Soil Fertility

7. 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

8. Describe the following nutrient transformations and interactions:
   A. Mineralization
   B. Immobilization
   C. Nutrient uptake antagonism

9. Describe how the processes of mass flow, diffusion, and root interception affect nutrient uptake.

10. Describe how cation exchange capacity (CEC) influences nutrient mobility and uptake.

11. Distinguish each macronutrient as mobile or immobile in the soil.

12. Describe how the following soil characteristics affect nutrient uptake:
   A. Texture
   B. Structure
   C. Drainage/aeration
   D. Moisture
   E. pH
   F. Temperature

13. Describe how the following affect the fate of N in soil:
   A. Fixation by clay
   B. Ammonification/mineralization
   C. Nitrification
   D. Volatilization
   E. Denitrification
   F. Immobilization
   G. Leaching
   H. Symbiotic fixation
   I. Plant uptake

14. Describe how the following soil factors affect symbiotic nitrogen fixation:
    A. pH
    B. Moisture
    C. Population of correct *Rhizobia* species
    D. Nitrogen level
    E. Aeration
    F. Organic matter

Competency Area 3: Soil Testing and Plant Tissue Analysis

15. Convert fertilizer analysis from elemental to oxide form and from lbs/acre to ppm and vice versa.

16. 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

17. 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, Mehlich-3, Bray, Olson)

18. Compare and contrast the following approaches for making fertilizer recommendations:
    A. Sufficiency level
    B. Soil buildup and maintenance
    C. Cation saturation ratios

19. 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 lbs/acre
    D. Within-field variability
    E. Laboratory choice
    F. Environmental risk
    G. Extraction method

20. Describe soil sampling strategies:
    A. Random sampling
    B. Grid-based
    C. Soil type based sampling

21. Recognize factors that influence the results of the pre-sidedress nitrogen test:
    A. Rotation
    B. Manure type and history
    C. Timing of sampling relative to weather patterns
    D. Depth of sampling
    E. Field variability
    F. Sample processing

22. Describe how to use plant tissue analysis for:
    A. Problem solving/diagnosis
    B. Nutrient program monitoring
    C. In-season nutrient management

23. 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

24. 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

Competency Area 4: Nutrient Sources, Analyses, Application Methods

25. Describe the role of the following in providing plant nutrients:
    A. Soil organic matter
    B. Commercial fertilizer
    C. Soil minerals
    D. Animal manures
    E. Composts
    F. Sludges
    G. Plant residue

26. Describe 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

27. 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

28. 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

29. 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

30. Define the following commercial fertilizer terms:
    A. Nutrient use efficiency
    B. Total availability
    C. Water solubility
    D. Guaranteed analysis
    E. Salt effect

31. 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

32. Calculate fertilizer application rates from fertilizer analysis information.

33. Calculate manure application rates from manure analysis information.

34. Describe advantages and limitations of the following fertilizer placement methods:
    A. Injection
    B. Surface broadcast
    C. Broadcast incorporated
    D. Band application
    E. Fertigation
    F. Foliar application
    G. Sidedress
    H. Topdress
    I. Seed placement

35. Recognize certifiable organic nutrient sources.

Competency Area 5: Soil pH and Liming

36. Define:
    A. Soil pH
    B. Buffer pH
    C. Exchangeable acidity
    D. Alkalinity

37. Describe the long-term change in soil pH from applying N.

38. Describe how CEC, soil texture, exchangeable acidity and soil organic matter affect lime requirements.

39. Describe how soil pH affects the availability of each nutrient.

40. Describe how liming materials increase soil pH.

41. Describe how purity, fineness, and Calcium Carbonate Equivalent (CCE) affect the neutralizing ability of liming materials.

42. Calculate lime application rates to meet lime requirements.

43. Identify how biosolid application and soil pH affect heavy metal availability to plants.

Competency Area 6: Nutrient Management Planning

44. Describe how to set a realistic yield goal by using the combination of:
    A. Production history
    B. Soil productivity
    C. Management level
    D. Soil type
    E. Artificial drainage

45. 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. Pre-sidedress N test

46. Describe environmental effects from nutrient loss by:
    A. Erosion
    B. Runoff
    C. Volatilization
    D. Denitrification
    E. Leaching

47. Understand the role of the NRCS 590 Nutrient Management Standard in national nutrient management planning policy.

48. Define Mass Nutrient Balance and describe why there is a net excess Mass Nutrient Balance on many dairy and livestock farms.

49. Distinguish P-based from N-based manure application and describe implications.

50. Compare surface application of manure and immediate incorporation of manure in terms of potential nutrient loss pathways, applications rates to meet crop N guidelines, land base requirements, impact on soil test P, etc.

51. Understand the importance of precision feeding for whole farm nutrient management.

52. Define environmentally sensitive area.

53. Describe the importance of the following steps of an economically and environmentally sound nutrient management plan:
    A. Locate facilities and fields on maps
    B. Identify environmentally sensitive areas, including wells
    C. Specify crop rotation
    D. Determine expected yields
    E. Obtain results of soil, plant, and water analyses
    F. Quantify nutrient from all sources available to the farm
    G. Develop a nutrient budget for each field
    H. Make recommendations of nutrient rate, timing, form, and method of application
    I. Review and modify plan as needed

54. Know how to calculate total animal manure production on a livestock farm:
    A. Animal excretion plus other additions to process wastewater
    B. Load records and manure spreader calibration

55. Recognize production, environmental and management factors that determine the capacity of manure storage needed on a livestock farm.

56. List the 3 options for P based management as defined by USDA-NRCS (national level):
    A. Agronomic soil test
    B. Environmental P thresh-hold soil test level
    C. P index

57. Explain the concept and purpose of the P index and list the four score management categories of the P index.
    A. Identification of risk areas by overlapping P source and P transport potentials.

58. Describe the impacts of the following practices on the P index score of a field:
    A. Manure application rate
    B. Manure application method
    C. Manure application timing
    D. Manure application relative to streams
    E. Soil conservation

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

60. Understand the nitrate leaching index principles and interpretations.

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

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

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

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

SOIL AND WATER MANAGEMENT

Competency Area

1) Basic Soil Properties

2) Soil Hydrology

3) Drainage and Irrigation

4) Soil Health and Compaction

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. Processes associated with glaciation
   B. Glacial till, glacial outwash, lake and marine sediments, organic deposits
   C. Vegetation influence on soil formation

3. Know the particle size fractions and size ranges
   A. Sand, silt, and clay; coarse fragments
   B. Understand and use the textural triangle

4. Understand soil consistency states and the consistency limits
   A. Liquid, plastic, friable, loose, hard, frozen
   B. Liquid limit and plastic limit
   C. "Ball test" to assess conditions for tillage and traffic

5. Understand and be able to use a soil survey publication to
   A. Determine soil type at any location
   B. Interpret soil properties and suitability for agricultural and other purposes

6. Understand soil structure and its importance to crop production and environmental protection

7. Understand different types of soil organic matter, their dynamics, and roles with respect to soil functioning

Competency Area 2: Soil Hydrology AEM

8. Know the components of the hydrologic cycle.

9. Describe the water budget for a soil profile.

10. Understand characteristics of rainfall and the concept of return periods.

11. Understand factors that affect:
    A. Soil infiltration
    B. Evaporation and transpiration
    C. Leaching
    D. Runoff
    E. Soil Water Storage

12. Know the relationship between soil water content, soil water tension and soil pore size and the following soil parameters (and qualitatively understand how these parameters vary for different soil types) and their relationships to plant growth and the fate and transport of nutrients and pesticides:
    A. Field capacity
    B. Permanent wilting point
    C. Available water capacity
    D. Total soil water storage capacity
    E. Drainable porosity
    F. Soil texture, structure
    G. Macroporosity/Preferential flow

13. Understand permeability and infiltrability, and how they are affected by soil type, weather, and management practices.

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

15. Know simple field methods to assess soil water conditions.

Competency Area 3: Drainage and Irrigation AEM

16. Understand the relationship between drainage class and productivity.

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

18. Know the advantages and disadvantages of:
    A. Surface drainage
    B. Subsurface drainage
    C. Random layout
    D. Pattern layout

19. Understand the potential impacts of the following factors affecting soil drainability and the installation of drainage systems:
    A. Location of bedrock
    B. Soil gradation and porosity
    C. Topography
    D. Organic soils
    E. Type of crop
    F. Outlet

20. Understand the benefits and risks to the environment that are potentially inherent from a drainage system.

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

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

23. 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.

24. Know the four methods of irrigation and the advantages and disadvantages of each with respect to different soil conditions and crop types.

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

26. Describe the components of irrigation scheduling.

Competency Area 4: Soil Health and Compaction

27. Understand the concept of soil health, and know some indicators.
    A. Chemical
    B. Physical
    C. Biological

28. Describe different types of soil compaction, and understand their agronomic and environmental implications
    A. Plow layer
    B. Subsoil
    C. Crusts

29. 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 of tillage and traffic as it relates to soil water conditions
    C. Tillage methods

30. Understand how long-term intensive crop production may cause soil compaction in the plow layer and subsoil.

31. Understand the relation between soil compaction and the following factors. Understand each factors relation to plant growth and important soil chemical and biological processes.
    A. Aeration
    B. Aggregation/structure
    C. Soil strength
    D. Runoff and erosion
    E. Drainage

32. Understand variable susceptibility to compaction among soil types due to
    A. Drainage
    B. Texture

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

34. Understand the relation between soil strength and soil water content and its implication for root growth.

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

36. Understand how compaction leads 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

37. Know how to prevent or minimize soil compaction.

38. Describe approaches for remediation of soil compaction, and understand when they are appropriate.
    A. Deep tillage (subsoil compaction)
    B. Organic matter additions and cover crops (plow layer compaction; subsoil compaction when using deep-rooted cover crops)
    C. Reduced tillage (plow layer compaction)

Competency Area 5: Soil Conservation AEM

Erosion

39. Understand the four stages of soil erosion and their relation to soil properties.

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

41. Understand the different types of soil erosion.

42. Understand how soil types differ in soil erodibility.

43. Understand how climatic factors affect soil erosion.

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

45. Explain the Revised Universal Soil Loss Equation (RUSLE).

46. Understand how agronomic management practices can reduce erosion.
    A. Tillage and crop residue management
    B. Rotations
    C. Cover cropping

47. Understand the basic approaches to structural soil conservation practices.
    A. Filter strips
    B. Grass waterways
    C. Diversions
    D. Ponds and WASCOB's
    E. Terraces
    F. Drop structures

Tillage

48. Understand the purposes of tillage.

49. Describe the basic components and workings of tillage systems, and understand their agronomic and environmental benefits.
    A. Plow-till
    B. No-till
    C. Mulch-till (chisel, disc, etc.)
    D. Ridge-till
    E. Zone tillage

50. Understand the adaptability of tillage systems to common soil types in the Northeast based on
    A. Texture
    B. Drainage class
    C. Climate

51. 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

52. Understand the relation between tillage practices and
    A. Residue cover
    B. Soil roughness
    C. Soil quality
    D. Residue fragility and persistence

53. Understand the relation between tillage systems and
    A. Soil structure and compaction
    B. Runoff and erosion
    C. Use of fertilizer and pesticides
    D. Infiltration and percolation

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

55. Understand the relationship between soil consistency and tillage conditions; the “ball test”, and the effects of soil freezing.

Competency Area 6: Watershed Hydrology AEM

56. Describe a watershed and its main functions.

57. Understand the major inputs and outputs of water in a watershed.
    A. Precipitation
    B. Storms
    C. Infiltration and percolation
    D. Storage (Depression, Channel, Detention, Ground water, Retention)
    E. Vegetation
    F. Base Flow
    G. Storm Flow
    H. Runoff (Surface, Channel and Subsurface)
    I. Evaporation
    J. Transpiration

58. Understand a stream hydrograph and its relation to pollution. Understand the relation between a pollutograph and a hydrograph.

59. Explain the pollutant delivery process, and describe the relationship of nutrient budgets and total maximum daily loads (TMDL) to Non Point Source pollutant loading.

60. Understand precipitation return periods and define a 25-year, 24-hour precipitation event and list sources for identifying this event in various parts of the Northeast.

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

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

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

64. Understand the relation between geologic conditions and the potential for groundwater and surface water contamination.

65. Understand recharge areas for groundwater and surface water

66. 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.

67. Understand key processes that occur in wetlands and riparian buffer zones and their role in a watershed.

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

69. Be able to identify impaired water bodies and the causes listed for the impairment, and understand the implications for agriculture.

Competency Area 7: Non-point source pollution AEM

70. Describe the main sources of agricultural Non-point source (NPS) pollution and their origins.
    A. Nitrogen
    B. Phosphorus
    C. BOD
    D. Sediment
    E. Pesticides
    F. Pathogens
    G. Silage leachate
    H. Chemicals and toxins
    I. Processing waste water

71. Distinguish between agricultural and non-agricultural NPS pollution and Point Source pollution and the extent and importance of each.

72. Understand the environmental impacts of various agricultural contaminants on the quality of surface water and groundwater as it relates to their various uses.

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

74. Understand the concept of Best Management Practices for NPS pollution control.

75. Know some appropriate Best Management Practices for agricultural NPS and Point Source pollution control in a given farming system.

76. Understand 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. FIFRA
    E. Local regulations

Competency Area 8: Concentrated Source Pollution AEM

77. 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. Organic filter bed
    E. Constructed wetlands
    F. Stone filled trench
    G. Lime flocculation
    H. Spray irrigation
    I. Aerobic septic system
    J. Inclusion in liquid manure handling system

78. Describe the potential pollution impacts of silage leachate.

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

80. Understand the various methods to manage and treat silage leachate.

81. List management and environmental objectives for improving a barnyard.

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

83. Discuss advantages and disadvantages of various barnyard surfaces.

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

Competency Area 9: Conservation Planning AEM

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

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

87. Understand the NRCS 9-Step Planning Process and other state planning tools.

88. Explain 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. Revised Guide to Agricultural Environmental Management (AEM) or other state planning Guidance

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

90. Understand the roles and responsibilities of the local, state, and federal conservation agencies (i.e. CES, SWCD, FSA, NRCS, DEC, RD, EPA, DOH, and RC&D).

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) Management of Pesticide Resistance
7) Using Pesticides in an Environmentally Sound Manner
8) Protecting Humans Against Pesticide Exposure

Competency Area 1: Integrated Pest Management (IPM)

1. Know the definition of IPM and the major IPM strategies.

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

3. Know the typical steps in the integrated pest management 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

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

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

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

7. 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

8. Outline methods for sampling plant and pest material.

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

Competency Area 2: Weed Management

Weed Biology

10. Demonstrate familiarity with life cycles and growth habits (dicotyledons and monocotyledons) of weeds and how these characteristics affect weed management.

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

12. Demonstrate the ability to identify the following weeds by common name in seedling and mature stages, and be able to classify each by life cycle and growth habit.
    A. Velvetleaf
    B. Barnyardgrass
    C. Pigweed, redroot/smooth
    D. Large crabgrass
    E. Common ragweed
    F. Giant foxtail
    G. Wild mustard
    H. Green foxtail
    I. Common lambsquarters
    J. Yellow foxtail
    K. Hairy galinsoga
    L. Fall panicum
    M. Eastern black nightshade
    N. Quackgrass
    O. Corn chamomile
    P. Wirestem muhly
    Q. Common burdock
    R. Johnsongrass
    S. Bull thistle
    T. Yellow nutsedge
    U. Horsenettle
    V. Hedge bindweed
    W. Canada thistle

13. Be familiar with use of a dichotomous key to identify weeds.

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

<u>Weed Control Methods</u>

15. Mechanical – Understand the advantages and limitations of mechanical control measures, especially those associated with tillage and cultivation.

16. Cultural or managerial – 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

17. Biological – Understand why biological control measures do not work as well with intensively managed crops as in extensively managed production systems/natural areas.

18. Chemical – Familiarity with the ways herbicides are classified, i.e. how they are used and by herbicide family/site of action classification.

19. Chemical – Know example herbicides (product names), types of weeds they control, and weed/crop injury symptoms caused by each of the following herbicide site of action groups:
    A. Growth regulators (synthetic auxins)
    B. Amino acid synthesis inhibitors

C. Lipid synthesis inhibitors
D. Seedling root and shoot inhibitors
E. Photosynthesis inhibitors
F. Cell membrane disrupters
G. Pigment inhibitors

20. Chemical – Know time(s) of application for different types of herbicides and how soil (texture, organic matter, pH) and weather (rainfall/soil moisture, temperature, etc.) affect herbicide performance.

21. 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.
    B. Be familiar with problems of off-site movement of herbicides.
    C. Causes of herbicide crop injury
    D. Understand the advantages and disadvantages of herbicide persistence as it relates to weed control, crop rotation, and water quality.

Competency Area 3: Management of Infectious Plant Diseases

Biology of infectious plant diseases

22. For each of the following field 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 species attacked by the pathogen
    F. Know how the pathogen is spread

Alfalfa	*Wheat*
Anthracnose	Fusarium head blight (scab)
Brown root rot	Leaf rust
Leaf and stem blight complex including spring black stem and leaf spot, lepto leaf spot, and common leaf spot	Leaf and glume blotch complex including Septoria tritici blotch, Stagonospora nodorum blotch, and Tan spot
Fusarium crown and root rot	Loose smut
Phytophthora root rot	Powdery mildew
Pythium damping-off	Soilborne wheat mosaic
Verticillium wilt	Wheat spindle streak mosaic
	Yellow dwarf
Corn	*Oat*
Anthracnose leaf blight and stalk rot	Crown rust

Common rust	Yellow dwarf (red leaf)
Common smut	
Eyespot	Soybean
Gibberella stalk and (red) ear rot	Asian soybean rust
Gray leaf spot	Bacterial blight
Northern leaf blight	Bacterial pustule
Northern (carbonum) leaf spot	Downy mildew
Seed decay/seedling blights	Pod and stem blight
Stewart's leaf blight	Sclerotinia stem rot
	Septoria brown spot
	Soybean cyst nematode
	Soybean mosaic

Control of infectious plant diseases

23. For the field crop diseases listed under (22) 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. Other cultural practices such as rotation, tillage, site selection, soil drainage, planting time, harvest time, fertility, weed and insect control

Biology, detection, and prevention of mycotoxins

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

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

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

Competency Area 4: Management of Arthropods

Biology of Arthropods

27. 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	*Small Grains*
Western/Northern corn rootworm	Cereal leafbeetle
European Corn Borer	Wireworm
True armyworm	
Fall armyworm	*Soybeans*
Black cutworm	Soybean aphid
White grub	Spider mites
Wireworm	
Corn leaf aphid	*Alfalfa*
Grasshopper	Alfalfa snout beetle
Seedcorn maggot	Alfalfa weevil
	Alfalfa blotch leafminer
	Clover root curculio
	Pea aphid
	Potato leafhopper

28. Be able to discuss how ecological factors such as temperature, photoperiod, competition and moisture influences insect population growth and decline.

Control – Chemical

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

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

31. Understand the concepts of resistance management as it pertains to pesticides and genetically modified crops.

Control – Cultural

32. Know examples of and understand the advantages and limitations of cultural controls for arthropod crop pests.
    A. Resistant varieties
    B. Sanitation
    C. Planting date
    D. Rotation
    E. Tillage
    F. Harvest date

Control – Biological

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

34. 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. Damsel bug
    F. Minute pirate bug
    G. Lacewings
    H. Big-eyed bug
    I. Lady-bird beetle
    J. Ground beetles
    K. Predaceous mites
    L. Entomopathogenic nematodes
    M. Entomopathogenic fungi

Competency Area 5: Pesticide Formulations and Labels

35. 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.

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

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

38. Know the four times when you should read the pertinent parts of a label

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

Competency Area 6: Management of Pesticide Resistance

40. Define pesticide resistance, and be able to describe how it develops in a pest population. Know examples of resistant field crop pests in the Northeast.

Competency Area 7: Using Pesticides in an Environmentally Sound Manner - AEM

<u>Pesticide Movement in Soil and Water</u>

41. Recognize how movement of a pesticide in soil or into water may be affected by:
    A. Soil texture
    B. Erosion
    C. Pesticide degradation
    D. Pesticide persistance
    E. Degradation processes
    F. Leaching
    G. Precipitation runoff
    H. Pesticide solubility
    I. Pesticide adsorption
    J. Source of entry into the environment

42. Understand soil/pesticide interactions and their influence on pesticide selection, pesticide use, and water quality protection. Be aware of pesticide runoff/leaching potential predicting tools such as Win-PST 3 and be able to recommend mitigation to improve or minimize the negative effects on the environment.

43. Recognize how the following impact proper pesticide use in regard to water quality protection: soil characteristics, ground cover, proximity to water sources (surface water, groundwater, wells, etc.).

Government Regulations

44. Recognize the general provisions of state pesticide regulation laws.

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

Competency Area 8: Protecting Humans from Pesticide Exposure

Keeping Pesticides on Target

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

47. Know the factors that affect particle drift and why they affect drift:
    A. Droplet size
    B. Wind speed
    C. Nozzle distance from target
    D. Temperature and humidity

48. Know factors that affect spray droplet size:
    A. Spray pressure
    B. Nozzle size
    C. Spray rate (gallons per acre)
    D. Drift control agents (foams, invert emulsions, spray additive stabilizers, etc.)

Human Toxicity

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

50. Distinguish between chronic and acute poisoning effects.

51. Recognize general symptoms of acute pesticide poisoning.

52. List possible chronic effects of pesticide poisoning.

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

54. Recognize that Material 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

55. Describe protective gear used during mixing and application of pesticides.

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

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

58. Describe safe storage of pesticides.

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

CROP MANAGEMENT

Competency Areas

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

Competency Area 1: Crop Adaptation

Soil Adaptation of Crops

1. Know the response of corn, alfalfa, perennial grasses, wheat, oats, and soybeans to:
   A. Soil pH range
   B. Soil drainage classification range

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

Climatic Adaptation of Crops

3. Understand the adaptation of major Northeast crops to extremes in precipitation on well-drained, poorly drained, and moderately well drained soils.

4. Understand the adaptation of major Northeast crops to extremes in temperature.
   A. Understand the response of corn to a late-spring or early-fall frost.
   B. What factors are responsible for successful over-wintering of alfalfa, perennial grasses and winter wheat.

Competency Area 2: Crop Staging, Growth and Development

Crop Staging - Grain Crops and Soybeans

5. Know the different systems used to stage corn, small grain and soybean.

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

Crop Staging - Forage Legumes and Grasses

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

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

Growth and Development

9. Know how to calculate Growing Degree Days (GDD) according to the 86 - 50 system. Know how environmental effects such as water stress or photoperiod affect the accuracy of GDD in predicting growth and development of corn.

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

Competency Area 3: Tillage Systems

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

12. Know advantages and limitations of spring tillage.

13. Describe the advantages and limitations of plow, chisel, reduced and no-tillage systems for corn and alfalfa production in the Northeast.

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

15. Describe the ideal seedbed conditions for corn, alfalfa, perennial grasses, small grains, and soybeans.

Competency Area 4: Seeding Factors

16. Understand the importance of certified seed in small grain production.

17. Know the factors that influence corn hybrid selection in the Northeast.

18. Know the factors that influence alfalfa variety selection in the Northeast.

19. Know the factors used to determine optimum planting date of major Northeast crops.

20. Recognize the consequences of seeding major Northeast crops too early or too late.

Competency Area 5: Seeding Rates and Row Spacing

21. Know factors that influence the seeding rate of major Northeast crops.
    A. Compare seeding rates for corn silage and corn grain.
    B. Know how soil type, planting date, and tillage systems influence corn seeding rates.

22. Know the factors that influence the planting pattern of major Northeast crops. Know the advantages of broadcast versus drilled small grains.

23. Know recommended seeding rates for major Northeast crops.

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

25. Know the recommended seeding depths for major Northeast crops.

Competency Area 6: Considerations in Replanting Decisions

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

27. Describe the type of damage that hail, frost, drought and wind can cause corn, small grains, soybeans and forage crops.

28. Recognize when major Northeast crops are most susceptible to specific environmental stresses such as frost, defoliation, drought, etc.

Competency Area 7: Forage Harvesting Factors

Perennial Crops

29. Know the optimum development stage for first cutting of alfalfa or perennial grasses.
    A. Know the basic procedures for evaluating forage quality of grasses and legumes.
    B. Know the ideal forage quality (NDF, ADF, CP, etc.) for alfalfa and perennial grasses.

30. Understand how frequency of harvest is related to forage yield, quality, food reserves, and stand longevity.

Annual Crops

31. 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 (NDFD, ADF, NDF, NEL, TDN, etc.).

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

Competency Area 8: Cropping Systems

33. Know advantages and limitations of growing cover crops and companion crops in a cropping system.

34. Compare and contrast single crop systems and crop rotations such as corn-alfalfa, corn-soybean, wheat/clover, etc. for:
    A. Yield
    B. Soil structure
    C. Soil nutrient status
    D. Insect pests
    E. Pathogens
    F. Weeds
    G. Economic

35. Compare and contrast different residue management systems for corn on:
    A. Yield
    B. Structure
    C. Soil water and nutrient status
    D. Insect pests
    E. Pathogens
    F. Weeds
    G. Economics

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

37. Know the basic criteria for organically grown crops, and the primary advantages and disadvantages of organic farming.
