

NORTH CAROLINA CERTIFIED CROP ADVISOR

Performance Objectives

Prepared for
The American Society of Agronomy
And
The North Carolina Certified Crop Adviser Board

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North Carolina Certified Crop Adviser

PERFORMANCE OBJECTIVES

CONTENTS

INTRODUCTION	2
NUTRIENT MANAGEMENT COMPETENCY AREAS	3
Competency Area 1. Basic concepts of plant nutrition.....	4
Competency Area 2. Basic concepts of soil fertility.....	4
Competency Area 3. Soil testing and plant analysis	5
Competency Area 4. Nutrient sources and applications	7
Competency Area 5. Soil pH and soil amendments.....	8
Competency Area 6. Nutrient management planning	9
SOIL AND WATER MANAGEMENT COMPETENCY AREAS	11
Competency Area 1. Basic soil properties.....	12
Competency Area 2. Erosion processes.....	13
Competency Area 3. Tillage and Residue Management	14
Competency Area 4. Restrictive soil layers	14
Competency Area 5. Federal regulations and policy	14
Competency Area 6. Site characterization.....	14
Competency Area 7. Water and solute movement.....	15
Competency Area 8. Plant-water relations	15
Competency Area 9. Water quality.....	16
INTEGRATED PEST MANAGEMENT (IPM) COMPETENCY AREAS	17
Competency Area 1. Basic concepts of pest management.....	18
Competency Area 2. Pest identification, biology, and ecology	18
Competency Area 3. Sampling and monitoring.....	21
Competency Area 4. Decision-making guidelines	21
Competency Area 5. Non-pesticide pest management.....	22
Competency Area 6. Pesticide pest management	23
Competency Area 7. Environmental stewardship	27
Competency Area 8. Health, safety, and regulatory aspects	27
CROP MANAGEMENT COMPETENCY AREAS.....	29
Competency Area 1. Crop establishment.....	30
Competency Area 2. Crop growth and development	31
Competency Area 3. Hybrid and variety selection	33
Competency Area 4. Cropping systems.....	33
Competency Area 5. Crop damage and diagnostics	34
Competency Area 6. Tillage	34
Competency Area 7. Crop harvest, storage, and quality.....	34
Competency Area 8. Economic aspects.....	35

INTRODUCTION

NORTH CAROLINA PERFORMANCE OBJECTIVES

The Certified Crop Adviser Performance (CCA) Performance Objectives outline the knowledge and skill areas that are needed for an adviser to effectively carry out their duties. Performance objectives are the heart of the Certified Crop Adviser Program, used as the framework for test construction and the basis of CCA continuing education programs.

To help you organize your learning, the Performance Objectives are divided into four (4) sections: Nutrient Management, Soil and Water Management, Integrated Pest Management, and Crop Management. Each section is broken down into Competency Areas. Within each Competency Area is one or more specific Performance Objectives that describes the knowledge needed to demonstrate competency.

The foundation for the North Carolina Performance Objectives is International Performance Objectives developed by Dr. Jim Vorst of Purdue University and reviewed by 300 persons involved in crop advising. To obtain the North Carolina Performance Objectives, the International Objectives were enhanced by faculty of North Carolina State University and others to include additional knowledge and skills important to crop advisers in our state.

Since the Performance Objectives have been developed over the material that Certified Crop Advisers need to know, they are the base on which the entire CCA program is built. The first step is mastering the material covered in the Performance Objectives so you can demonstrate minimum competency by passing the CCA examination. All the questions on the State exam are based directly on these Performance Objectives.

The Performance Objectives serve as the guide for CCA continuing education, an equally important part of the CCA program. Once certified, crop advisers will be required to participate in continuing education programs. This ensures that a CCA will maintain or increase in proficiency to protect the credibility and success of all those who have earned the CCA designation. Continuing education units are accumulated for each Competency Area and specific Performance Objectives.

Certified Crop Advisers should use the Performance Objectives to identify areas where they need to strengthen their proficiency. Education tied to specific Performance Objectives helps also to better describe continuing education credits so they can be demonstrated to the North Carolina CCA Board for meeting re-certification requirements.

NORTH CAROLINA CERTIFIED CROP ADVISER

NUTRIENT MANAGEMENT COMPETENCY AREAS

COMPETENCY AREA 1. BASIC CONCEPTS OF PLANT NUTRITION

COMPETENCY AREA 2. BASIC CONCEPTS OF SOIL FERTILITY

COMPETENCY AREA 3. SOIL TESTING AND PLANT ANALYSIS

COMPETENCY AREA 4. NUTRIENT SOURCES AND APPLICATIONS

COMPETENCY AREA 5. SOIL PH AND SOIL AMENDMENTS

COMPETENCY AREA 6. NUTRIENT MANAGEMENT PLANNING

NUTRIENT MANAGEMENT

COMPETENCY AREA 1. BASIC CONCEPTS OF PLANT NUTRITION

1. List the 16 elements essential for plant nutrition
2. Classify the essential elements as primary nutrients, secondary nutrients, or micronutrients
3. Recognize the primary functions of the essential nutrients in plants
4. Distinguish each primary nutrient, secondary nutrient, and micronutrient as mobile or immobile in the plant
5. List chemical uptake forms of each essential nutrient
6. Specify how nutrient needs change according to plant growth stages

COMPETENCY AREA 2. BASIC CONCEPTS OF SOIL FERTILITY

7. Recognize the following as nutrient sources in the soil
 - a) soil solution
 - b) cation exchange site
 - c) organic matter
 - d) soil minerals
 - e) plant residues
8. Describe the processes of nutrient mineralization and immobilization in soil.
9. Describe how the processes of mass flow, diffusion, and root interception affect nutrient uptake.
10. Describe cation exchange capacity (CEC) and its influence on plant nutrient availability.
11. Describe how the following soil characteristics affect availability of soil-applied nutrients.
 - a) texture
 - b) type of clay
 - c) pH
 - d) organic matter content
 - e) structure
 - f) drainage/aeration
 - g) soil moisture

12. Recognize that nutrients may be lost from the soil through
 - a) leaching of soluble nutrients
 - b) runoff of soluble nutrients
 - c) volatilization of gaseous nutrients
 - d) erosion of soil-bound nutrients

13. Identify the most likely ways each essential nutrient may be transported off the field.

14. Describe how soil pH and clay content affect phosphorus retention capacity.

15. Describe the potential role of subsoil depth in supply of S and K.

16. Describe the following nitrogen transformations
 - a) ammonification
 - b) nitrification
 - c) volatilization
 - d) denitrification
 - e) immobilization
 - f) leaching
 - g) symbiotic fixation

17. Describe how the following affect symbiotic nitrogen fixation
 - a) soil pH
 - b) soil moisture
 - c) soil nitrogen level
 - d) soil microbe population

18. Recognize how different crops and cropping systems affect soil fertility and fertilization strategies.

COMPETENCY AREA 3. SOIL TESTING AND PLANT ANALYSIS

19. Describe soil sampling and handling procedures and how these may vary for different soil types and tillage systems.

20. Recognize how the following affect soil sampling methods
 - a) pattern of fertilizer application
 - b) nutrient stratification
 - c) soil type

21. Describe zone soil sampling and traditional soil sampling and the benefits of each.

22. Compare and contrast each of the following concepts of fertilizer recommendations and identify which concept is used by the soil test lab(s) you use
 - a) crop sufficiency
 - b) soil building and maintenance
 - c) cation saturation
23. Interpret soil test results from the NC Department of Agriculture and Consumer Services (NCDACS) and other labs. Relate results to expected crop response and nutrient management.
24. Describe how NCDACS soil "CLASS" affects recommendations for P, K, Zn, Cu, and lime.
25. Recognizing that soil test results do not include nitrogen, explain how N recommendations for NC crops are derived.
26. Describe corn stalk nitrate test and presidedress nitrate test and discuss whether either are applicable NC.
27. Describe and recognize the general deficiency symptoms for N, P, and K
28. Describe the following general deficiency symptoms
 - a) magnesium deficiency in corn, cotton, small grains, soybeans, and tobacco
 - b) sulfur deficiency in corn, small grains, soybeans, and cotton
 - c) boron deficiency in cotton, peanuts, and tobacco
 - d) manganese deficiency in corn, cotton, small grains, soybean, and tobacco
 - e) zinc deficiency in corn
29. Recognize how the following terms describe plant nutrition level
 - a) critical value
 - b) sufficiency range
 - c) luxury consumption
 - d) toxic level
30. Describe correct plant sampling methods and uses of tissue analysis in a plant nutrition program.
31. Interpret the information on a plant analysis report and identify treatments to correct deficiencies where appropriate.
32. Recognize how the following affect plant analysis results
 - a) crop
 - b) plant maturity (stage of growth)
 - c) plant part

- d) sample handling

COMPETENCY AREA 4. NUTRIENT SOURCES AND APPLICATIONS

33. Describe how the following serve as plant nutrient sources
- a) organic matter
 - b) irrigation water
 - c) fertilizer application
 - d) soil minerals
 - e) animal waste
 - f) urban/industrial waste
 - g) plant residue
34. 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
35. Describe the physical form and analysis of each of the following phosphorus sources
- a) normal superphosphate
 - b) triple superphosphate
 - c) monoammonium phosphate
 - d) diammonium phosphate
36. Describe the physical form and analysis of the following potassium sources
- a) potassium chloride
 - b) potassium sulfate
 - c) potassium nitrate
 - d) potassium magnesium sulfate
37. Describe the physical form and analysis of the following calcium and/or magnesium sources
- a) calcitic lime
 - b) dolomitic lime
 - c) gypsum
 - d) magnesium sulfate
 - e) potassium magnesium sulfate
38. Identify conditions where gypsum should be recommended as a soil amendment or fertilizer.
39. Recognize conditions and crops where boron, manganese, zinc, and copper deficiencies are most likely to occur.

40. Describe methods and materials for correcting deficiencies of magnesium, sulfur, and micronutrients through soil and foliar applications.
41. Convert fertilizer analysis from elemental to oxide form, and vice versa.
42. Calculate fertilizer application rates from fertilizer analysis information.
43. Describe advantages, limitations and safety considerations when using the following fertilizer placement methods
 - a) injection
 - b) broadcast
 - c) band
 - d) fertigation
 - e) foliar
 - f) sidedress
 - g) topdress
44. Describe the calibration process for different types of fertilizer applicators.

COMPETENCY AREA 5. SOIL PH AND SOIL AMENDMENTS

45. Define soil pH, acidity, and alkalinity.
46. Distinguish between soil pH and soil acidity.
47. Describe how soil texture and soil organic matter affect soil buffering.
48. List natural processes or agricultural practices which cause changes in soil pH.
49. Describe how soil pH affects the availability of each nutrient and state the normal pH range for most crops produced in NC soils.
50. List the major benefits of liming an acid soil.
51. Describe how liming materials increase soil pH and reduce soil acidity.
52. Define *Effective Calcium Carbonate Equivalent (ECCE)*.
53. Identify the ECCE and particle size standards for “Standard Ag-lime” materials in North Carolina.
54. Identify differences between calcitic, dolomitic, quicklime (calcium hydroxide), and burnt

- lime (calcium oxide) liming materials.
55. Define target pH and identify the target pH for corn in mineral, mineral organic, and organic soil groups as defined by NCDACS.
 56. For the mineral soil group, identify the target pH of corn, cotton, hay crops, soybean, and tobacco.
 57. Given the crop, soil pH and Ac values on an NCDACS soil test report, calculate the lime requirement and amounts of “Standard Ag-lime” to recommend for various target pH values.
 58. List the advantages and limitations of lime incorporation.
 59. List soil amendments that can lower soil pH.

COMPETENCY AREA 6. NUTRIENT MANAGEMENT PLANNING

60. Identify general differences and similarities in the following soil properties for soils of the Coastal Plain, Blacklands, Sandhills, Piedmont, and Mountain regions of North Carolina
 - a) acidity
 - b) soil texture
 - c) organic matter content
 - d) parent material
61. Define agronomic rate (of a nutrient).
62. Define the concept of realistic yield expectations (R.Y.E.).
63. Describe the effects of previous or current weather on crop N use and soil N availability.
64. Determine N rate adjustments following leguminous crops, such as peanuts, soybeans, alfalfa, and clover.
65. Determine the agronomic rate of crop nutrients other than N, based on crop
 - a) crop nutrient demand
 - b) soil test information
 - c) crop rotation/sequence
 - d) soil productivity
66. Describe how to correctly sample and submit a waste material for waste analysis.
67. Interpret a waste analysis report.
68. Recognize how the method of application affects plant available nutrient content of manure

| and biosolids.

| 69. Describe the “priority” or rate-limiting nutrient concept for manures and waste products.

70. Recognize the needed information for an organic based nutrient management plan:

- a) RYE of the crop
- b) waste analysis
- c) method of application

| 71. List the environmental implications and applicable restrictions to spreading manure on saturated soils, sloping land, or land adjacent to surface water.

| 72. Discuss economic, agronomic, and environmental considerations involved in comparing manure and/or biosolid management with commercial fertilization.

| 73. Describe the calibration process for a manure spreader.

| 74. Describe the pros and cons of precision agriculture.

NORTH CAROLINA CERTIFIED CROP ADVISER

SOIL AND WATER MANAGEMENT COMPETENCY AREAS

SOIL MANAGEMENT

COMPETENCY AREA 1. BASIC SOIL PROPERTIES

COMPETENCY AREA 2. EROSION PROCESSES

COMPETENCY AREA 3. TILLAGE AND RESIDUE MANAGEMENT

COMPETENCY AREA 4. RESTRICTIVE SOIL LAYERS

COMPETENCY AREA 5. FEDERAL REGULATIONS AND POLICY

COMPETENCY AREA 6. SITE CHARACTERIZATION

WATER MANAGEMENT

COMPETENCY AREA 7. WATER AND SOLUTE MOVEMENT

COMPETENCY AREA 8. PLANT-WATER RELATIONS

COMPETENCY AREA 9. WATER QUALITY

SOIL AND WATER MANAGEMENT

SOIL MANAGEMENT

COMPETENCY AREA 1. BASIC SOIL PROPERTIES

CHEMICAL

1. Define anion and cation.
2. Define cation exchange capacity (CEC).
3. Describe factors causing CEC to vary among soils.
4. Differentiate between saline-sodic, calcareous, and acid soils.

BIOLOGICAL

5. List sources and beneficial effects of organic matter.
6. List physical and chemical properties of organic matter.
7. Describe methods of maintaining a favorable organic matter level.
8. Explain how the following factors influence soil microbial activity
 - a) temperature
 - b) moisture
 - c) soil pH
 - d) organic matter
 - e) tillage
9. Describe how soil organisms affect soil structure.

PHYSICAL

10. Use the textural triangle to identify soil textural class.
11. Describe how particle size affects surface area and reactivity of soils.
12. Define soil texture and soil structure.

13. Describe how soil texture affects water holding capacity, available water, and wilting point of soils.

COMPETENCY AREA 2. EROSION PROCESSES

14. Define soil erosion.

15. Differentiate the following types of soil erosion

- a) sheet and rill
- b) gully
- c) saltation
- d) suspension
- e) surface creep

16. Recognize how the following conditions may change the rate of erosion

- a) rainfall duration and intensity
- b) slope percentage
- c) slope length
- d) soil texture and structure
- e) soil surface roughness
- f) vegetative and residue cover
- g) wind velocity
- h) unsheltered distance

17. Describe how erosion may influence

- a) crop yield potential
- b) nutrient and organic matter content
- c) infiltration
- d) water quality
- e) air quality

18. Describe the relationship between soil test P, erosion, and total P loss.

19. Explain how the following conservation practices affect sheet, rill, gully, and wind erosion

- a) strip cropping
- b) terraces
- c) grassed waterways
- d) surface residue
- e) cover crops
- f) wind breaks
- g) row arrangement

COMPETENCY AREA 3. TILLAGE AND RESIDUE MANAGEMENT

20. Distinguish between conventional tillage, 30% surface residue conservation tillage, and long term, high (70%) surface residue conservation tillage systems regarding

- a) soil temperature
- b) soil erosion potential
- c) soil moisture
- d) compaction
- e) organic matter

21. Describe how to measure surface residue percent cover.

COMPETENCY AREA 4. RESTRICTIVE SOIL LAYERS

22. Recognize causes of subsurface compaction, surface compaction, and crusting.

23. Describe visual and physical symptoms of subsurface compaction, surface compaction, and crusting and methods of alleviation and prevention.

24. Describe how subsoiling may affect crop rooting, nutrient uptake, and water use.

25. Identify soil and cropping systems in North Carolina where subsoiling may be beneficial.

COMPETENCY AREA 5. FEDERAL REGULATIONS AND POLICY

26. Recognize the intended environmental benefits of

- a) Highly Erodible Land Conservation Provisions
- b) Wetland Conservation Provisions
- c) Conservation Reserve Program
- d) Wetlands Reserve Program

COMPETENCY AREA 6. SITE CHARACTERIZATION

27. Use a soil survey to locate a tract of land.

28. Use a soil survey to determine characteristics of soil map units.

29. Identify sources of information used to determine the following field limitations

- a) leaching potential
- b) surface water proximity
- c) erosion potential
- d) wetlands classification
- e) endangered and threatened species habitat

WATER MANAGEMENT

COMPETENCY AREA 7. WATER AND SOLUTE MOVEMENT

30. Describe the effects of the following characteristics on solute movement
- charge of the solute
 - solubility and retention
 - persistence of organic compounds
31. Describe how soil structure affects infiltration and permeability.
32. Describe how the following factors influence surface runoff, leaching potential, and lateral flow
- infiltration rate
 - drainage
 - permeability of various horizons in the soil profile
 - soil depth
33. Describe how pH, organic matter, CEC, soil texture, and soil structure affect solute movement.
34. Describe how the following management practices affect potential for solute movement
- timing and rate of application
 - type of tillage operation
 - conservation practices
 - irrigation

COMPETENCY AREA 8. PLANT-WATER RELATIONS

35. Define evapotranspiration (ET).
36. Describe how crop growth stage, water status, and soil water potential influence evapotranspiration.
37. Describe how the following factors influence evapotranspiration
- wind
 - temperature
 - solar radiation
 - relative humidity
 - amount of plant canopy
38. Describe how plants lose water.

39. Describe effects of excessive soil moisture on plant nutrient availability and uptake.

40. Describe effects of soil moisture deficiency on plant nutrient availability and uptake.

COMPETENCY AREA 9. WATER QUALITY

41. Identify sources of information that provide drinking water standards.

42. Distinguish between nitrate analysis expressed as nitrate or nitrate-nitrogen.

43. Identify the nitrate-nitrogen drinking water standard.

44. Identify the health effects of drinking water containing nitrate-nitrogen above the drinking water standard.

45. Describe how contamination occurs at the wellhead.

46. Explain the purpose of anti-backsiphoning devices.

47. Identify how high sediment levels affect surface water quality.

48. Recognize indicators of surface water eutrophication.

49. Identify how nitrogen and phosphorus affect surface water quality.

50. Describe the predominant loss pathways into water resources for nitrogen and phosphorus.

51. Discuss how soil test phosphorus has been increased in NC, how soil test phosphorus levels can affect water quality, and the relationship between soluble or sediment-attached phosphorus can pose a problem to water quality.

52. Describe how nutrient loss by erosion, runoff, volatilization, or leaching affects agronomic performance, farm profitability and the environment.

53. Explain the water quality benefits of filter/buffer strips, riparian zones/tree plantings, and wetlands.

54. List the NC river basins or watersheds which are regulated to reduce or not increase phosphorus?

NORTH CAROLINA CERTIFIED CROP ADVISOR

INTEGRATED PEST MANAGEMENT (IPM) COMPETENCY AREAS

COMPETENCY AREA 1. BASIC CONCEPTS OF PEST MANAGEMENT

COMPETENCY AREA 2. PEST IDENTIFICATION, BIOLOGY, AND ECOLOGY

COMPETENCY AREA 3. SAMPLING AND MONITORING

COMPETENCY AREA 4. DECISION-MAKING GUIDELINES

COMPETENCY AREA 5. NON-PESTICIDE PEST MANAGEMENT

COMPETENCY AREA 6. PESTICIDE PEST MANAGEMENT

COMPETENCY AREA 7. ENVIRONMENTAL STEWARDSHIP

COMPETENCY AREA 8. HEALTH, SAFETY, AND REGULATORY ASPECTS

INTEGRATED PEST MANAGEMENT

COMPETENCY AREA 1. BASIC CONCEPTS OF PEST MANAGEMENT

1. Explain the role of the following components of IPM
 - a) prevention
 - b) sampling and monitoring
 - c) identification
 - d) biological control
 - e) record-keeping
 - f) pesticide selection and use
 - g) evaluation
2. Define economic threshold and economic injury level
3. Explain the information needed to set economic thresholds and economic injury levels for insects and weeds

COMPETENCY AREA 2. PEST IDENTIFICATION, BIOLOGY, AND ECOLOGY

4. Explain how to use the following information to identify pests
 - a) host crop
 - b) time of year
 - c) symptom appearance and patterns
 - d) physical characteristics of pest
 - e) distribution of pest in the field
5. List non-pest causes of plant damage.
6. Describe how the following plant pathogens survive and disperse
 - a) Fungi
 - b) Bacteria
 - c) Nematodes
 - d) Viruses
7. Explain how the following factors affect insect, disease, or weed population development
 - a) natural enemies
 - b) host plants
 - c) initial pest levels
 - d) temperature
 - e) moisture and humidity
 - f) wind
 - g) soil characteristics

8. Use the following plant characteristics to differentiate weeds
 - a) cotyledons
 - b) arrangement, shape, and vein pattern of leaves
 - c) ligules
 - d) auricles
 - e) hairiness
 - f) shape, color, and size of seed
 - g) stem shape
 - h) life cycle
 - i) root system
 - j) leaf sheath

9. Classify the following weeds by life cycle:
 - a) Palmer amaranth
 - b) Horseweed (Marestail)
 - c) Morningglory
 - d) Texas panicum
 - e) Italian Ryegrass
 - f) Sicklepod

10. Describe how the following weed factors affect the ability of weeds to survive and be competitive
 - a) growth rate
 - b) seed production
 - c) seed dormancy
 - d) reproduction method
 - e) herbicide resistance

11. Know the effect of the following factors on weed/crop competition
 - a) growth rate (crop and weed)
 - b) germination and emergence
 - c) seed dormancy
 - d) vegetative reproduction
 - e) shade tolerance
 - f) life cycle
 - g) seed size

12. Describe tactics to minimize development of pesticide resistance by diseases, insects, or weeds.

13. Differentiate between insect and mite pests by appearance.

14. Describe the life cycle, damage caused, host plants, and type of metamorphosis of the following insects
- brown stink bug (*Euschistus servus*)
 - Corn earworm (*Helicoverpa zea*)
 - Kudzu bug (*Megacoptera criberia*)
 - Tobacco thrips (*Frankliniella occidentalis*)
 - Hessian fly (*Mayetiola destructor*)
15. Name common invasive pests in NC crops and the crops they attack.
16. Describe the life cycle and identify common prey of the following natural enemies:
- big-eyed bug
 - minute pirate bug
 - predatory mites
 - red-tailed wasp (*Cariochiles nigriceps*)
 - Cotesia congregata*
17. Describe how production practices can impact natural enemies.
18. Explain how the following characteristics of insects influence their ability to survive and cause damage
- phenology
 - reproduction rate
 - number of generations per season
 - feeding behavior
 - metamorphosis type
 - dispersal strategies
19. List characteristics that distinguish diseases caused by fungi, bacteria, viruses, and nematodes.
20. Identify plant-pathogenic fungi, bacteria, viruses, and nematodes, according to
- identifiable characteristics
 - means of survival
 - production and dispersal of inoculum
 - degree of host specificity
 - mode of host infection
 - symptoms induced

21. Describe the generalized life cycle of pathogens that cause the following diseases and explain how they impact plant productivity
- rust fungus
 - root-knot nematode
 - fungal leaf spot
 - Southern stem blight
 - tobacco mosaic virus

COMPETENCY AREA 3. SAMPLING AND MONITORING

22. Recommend a sampling program for the following pest distribution patterns
- clumped
 - uniform
 - edge effect
23. Describe how to collect and prepare for shipping a sample for identification for the following. Also describe the information which should be included in with the sample to aid in diagnosis.
- weeds
 - insects
 - diseased plants
 - soil for nematode analysis
24. List advantages and limitations of the following insect sampling methods
- direct observation
 - presence/absence sampling
 - sweep net
 - pheromone traps
 - light traps
25. Determine when to begin and end insect monitoring by using information about the following
- degree days
 - catch in a trap
 - time of the year
 - crop stage
26. Describe the advantages and disadvantages of disease forecasting systems.

COMPETENCY AREA 4. DECISION-MAKING GUIDELINES

27. Use degree day information to estimate pest development when provided with pest development threshold and biofix.

28. Use information about the following to assess a pest situation
 - a) current crop pest data from monitoring
 - b) pest history
 - c) pesticide history
 - d) cropping history
 - e) fertility program
 - f) pest distribution
29. Describe the benefits and risks of using weed economic thresholds to time herbicide applications.
30. Know the factors influencing weed management decisions in reduced tillage systems versus conventional tillage systems.
31. List the factors which determine the timing of insecticide applications.
32. Describe how natural enemies impact insect pest population economic thresholds.
33. Describe how the following factors influence fungicide use
 - a) field disease history
 - b) disease severity
 - c) crop growth stage
 - d) weather
 - e) fungicide selection and application method
 - f) potential for economic return
 - g) fungicide resistance

COMPETENCY AREA 5. NON-PESTICIDE PEST MANAGEMENT

34. Distinguish among genetic resistance, genetic tolerance, and transgenic resistance.
35. Explain how genetically altered crops are used in pest management.
36. Explain the role of susceptible pest populations in managing genetic resistance.
37. List the advantages and limitations of controlling pests by incorporating multiple traits into crops through transgenic techniques.
38. Describe biological control approaches for weeds, insects, plant pathogens, and nematodes.
39. Describe the role of biological, cultural, and mechanical methods of weed control.

40. Recognize the importance of the following factors in pest management programs
- a) field history
 - b) variety selection
 - c) seed/plant source
 - d) planting date and method
 - e) plant density
 - f) Sanitation
 - g) Harvest date and method
 - h) Tillage
 - i) Nutrient management
41. Describe how the following management techniques affect insect populations
- a) biological control
 - b) cultural control
 - c) mechanical control
 - d) host plant resistance
 - e) attractants and repellents
 - f) exclusion and quarantine
42. Describe the following insect biological control methods
- a) mass release
 - b) conservation
 - c) classical biological control
43. Describe the role of the following in the management of plant diseases and nematodes
- a) general resistance
 - b) race specific resistance
 - c) tolerance
 - d) plant diversity

COMPETENCY AREA 6. PESTICIDE PEST MANAGEMENT

44. Describe the factors influencing the selection of rate, timing, and method of pesticide application.
45. Identify the types, purposes, and advantages of using adjuvants with pesticides.
46. Given a specific situation, recommend whether or not to use an adjuvant in a pesticide application.
47. Explain the order of adding different pesticide formulations and additives to spray tank mixes.

48. Explain the following physical characteristics of pesticide formulations
- water soluble liquids and powders
 - emulsifiable concentrates
 - water dispersible granules
 - dusts
 - pellets
 - granules
 - wettable powders
 - fumigants
49. Describe the pattern form, relative droplet size, pattern overlap, and primary uses of the following nozzle types
- standard fan fan
 - even flat fan
 - hollow cone
 - flood tip
 - solid cone
50. Recognize the factors affecting the selection of nozzles, pressure, and speed to achieve desired application rates.
51. Explain how the following pesticide characteristics affect pesticide selection
- mode of action
 - chemical and physical properties
 - toxicity to target and non-target organisms
 - environmental hazard
 - persistence
 - label restrictions
 - selectivity
52. Explain how the following factors affect pesticide selection
- pest resistance
 - economics
 - application method
 - field history
 - pest identity, stage, and level
 - environmental conditions
 - crop growth stage
53. Distinguish between contact and systemic pesticides.

54. List factors that increase the risk of crop injury from pesticides.
55. Know how the following factors influence crop injury caused by pesticides and fertilizers
- crop sensitivity
 - weather
 - persistence
 - rate and formulation
 - type of application
 - pesticides capability
56. Explain how the following factors affect spray drift
- wind speed
 - nozzle
 - boom height
 - evaporation rate
 - spray viscosity
 - spray pressure
57. Describe environmental, application technology, cultural practices, and crop factors involved in making herbicide recommendations.
58. Describe how the following herbicide characteristics affect use
- systemic vs. contact activity
 - soil incorporated
 - broad spectrum vs. narrow spectrum
59. Explain the advantages and disadvantages of preplant incorporated, preemergence, and postemergence herbicide applications.
60. Identify the soil, climatic, and antagonistic factors which affect the performance of preplant incorporated, preemergence, and postemergence applied herbicides.
61. Explain the relationship among the following factors influencing postemergence herbicides efficacy
- plant growth stage
 - plant vigor
 - soil moisture
 - plant size
 - plant morphology
 - plant stress
62. Explain how the environment, type of crop, and crop growth stage affects the uptake, movement, selectivity, and carryover of herbicides.

63. List the effect of the following factors and herbicide families on herbicide persistence
- a) soil moisture
 - b) soil type
 - c) soil temperature
 - d) soil pH
 - e) herbicide rate
 - f) herbicide families
 - i) Triazines
 - ii) Sulfonyl ureas
 - iii) Phenoxy
 - iv) Dinitroanilines
 - v) Imidazolinones
 - vi) Substituted ureas
64. List the major modes of action of herbicides and explain the relationship between herbicide mode of action and weed control.
65. Identify plant injury symptoms for the following herbicide modes of action
- a) photosynthesis inhibitors
 - b) cell membrane disruptors
 - c) growth regulators
 - d) pigment inhibitors
 - e) cell growth inhibitors
 - f) growing point disintegrators
 - g) amino acid synthesis inhibitors
66. Explain the importance of the following when applying herbicides to herbicide-resistant crops
- a) marking or signing the field
 - b) correct herbicide - hybrid/variety match
67. Use information about the following to recommend timing and placement of insecticides
- a) contact activity
 - b) stomach poison activity
 - c) systemic activity
 - d) ovicidal activity
 - e) juvenile hormone activity
68. Describe the toxicity and persistence of the organophosphate, carbamate, synthetic pyrethroid, and neonicotinoid insecticide families.

69. Explain the advantages and disadvantages of microbial insecticides.

70. Describe how the following fungicide characteristics affect use

- a) contact vs. locally systemic vs. systemic
- b) protective vs. curative
- c) seed vs. soil vs. foliar applied
- d) broad spectrum vs. narrow spectrum
- e) mode of action

71. Recognize how the following factors affect soil fumigant activity

- a) temperature
- b) soil moisture
- c) soil type

COMPETENCY AREA 7. ENVIRONMENTAL STEWARDSHIP

72. Read and follow a pesticide label correctly.

73. Define the following terms associated with pesticide use

- a) point source pollution
- b) non-point source pollution
- c) maximum contaminant level
- d) parts per million and parts per billion
- e) pesticide tolerance in the crop
- f) best management practices

74. Explain how the following pesticide and site characteristics affect vulnerability of soil and water to pesticide contamination

- a) soil texture
- b) temperature
- c) soil organic matter
- d) soil pH
- e) water table depth
- f) erosion and erosion control practices
- g) source of entry into the environment
- h) precipitation and runoff
- i) pesticide application rate and timing
- j) history of pesticide application
- k) well construction
- l) pesticide persistence

COMPETENCY AREA 8. HEALTH, SAFETY, AND REGULATORY ASPECTS

75. Describe federal and state pesticide record keeping requirements.
76. Describe the following Worker Protection Standards for handling pesticides
- re-entry interval (REI)
 - information exchange requirements
 - personal protective equipment (PPE) required by law
 - emergency assistance requirements
 - oral and posted warning requirements
 - site decontamination procedures
77. Distinguish among the pesticide regulatory agencies (EPA, FDA, NCDA) and describe their duties with respect to availability, sale, distribution, and use of restricted use pesticides.
78. Explain the basic changes made by the Food Quality Protection Act to the Federal Food, Drug, and Cosmetic Act (FFDCA) and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).
79. List the state requirements to become a pest control consultant.
80. Describe pesticide modes of entry into the human system.
81. Distinguish between chronic and acute pesticide poisoning and describe symptoms of both.
82. List possible chronic effects of pesticide poisoning.
83. Describe procedures to follow if a pesticide gets on skin, in eyes, mouth, or stomach, or is inhaled.
84. Describe protective gear to use while mixing and applying pesticides.
85. Describe proper cleanup procedures for application equipment and protective gear.
86. Describe proper ways to dispose of pesticides and containers.
87. Describe how to store pesticides safely.
88. List procedures to follow when a pesticide spill occurs.

NORTH CAROLINA CERTIFIED CROP ADVISER

CROP MANAGEMENT COMPETENCY AREAS

COMPETENCY AREA 1. CROP ESTABLISHMENT

COMPETENCY AREA 2. CROP GROWTH AND DEVELOPMENT

COMPETENCY AREA 3. HYBRID AND VARIETY SELECTION

COMPETENCY AREA 4. CROPPING SYSTEMS

COMPETENCY AREA 5. CROP DAMAGE AND DIAGNOSTICS

COMPETENCY AREA 6. TILLAGE

COMPETENCY AREA 7. CROP HARVEST, STORAGE, AND QUALITY

COMPETENCY AREA 8. ECONOMIC ASPECTS

CROP MANAGEMENT

COMPETENCY AREA 1. CROP ESTABLISHMENT

PLANTING PRACTICES

1. Describe how soil temperature, soil water, soil tilth, and seed-soil contact affect seed germination.
2. Recognize how crops respond to depth of planting.
3. Recognize conditions that alter recommended depth of planting or transplanting.
4. Describe factors that determine planting or transplanting date.
5. Recognize consequences of seeding or transplanting too early or too late.
6. Identify climatic factors that affect seeding rates.
7. Recognize characteristics of crops that influence their optimal seeding rate.
8. Calculate a plant population in a field.
9. Distinguish between seeding rate and plant population.
10. Identify the recommended planting depths, dates, and rates of North Carolina's major agronomic crops
 - a) Bermudagrass
 - b) Corn
 - c) Cotton
 - d) Ladino clover
 - e) Peanuts
 - f) Soybeans
 - g) tall fescue
 - h) tobacco
 - i) wheat

SEED QUALITY

11. Use seed tag information to determine seed quality.
12. Recognize how pre-harvest and harvest conditions influence seed quality.

- 13. Recognize how storage time, handling, and storage conditions affect seed quality.
- 14. Describe the benefits and limitations of seed treatments.
- 15. Define seed dormancy and hard seed.
- 16. Describe characteristics of high-quality seed.
- 17. Describe the uses and limitations of the standard germ test and vigor tests.
- 18. Define pure live seed (PLS).
- 19. Use PLS to adjust seeding rate.
- 20. Identify the role of the following state agencies involved in the seed supply industry
 - a) North Carolina Foundation Seed Producers
 - b) North Carolina Crop Improvement Association
 - c) North Carolina Department of Agriculture
- 21. Recognize differences among and performance expectations of the following classes of seed
 - a) Foundation
 - b) Registered
 - c) Certified
- 22. Describe how the following laws apply to crop producers and to North Carolina's major crops
 - a) Plant Variety Protection (PVP) Act
 - (1) 1970
 - (2) 1994
 - b) Utility Patent Law
 - c) Federal Seed Law
 - d) North Carolina Seed Law

COMPETENCY AREA 2. CROP GROWTH AND DEVELOPMENT

- 23. Define the following growth stages
 - a) germination and emergence
 - b) vegetative
 - c) flowering
 - d) seed development
 - e) maturation

24. Define growing degree day.
25. Describe how growing degree days are used in cropping systems.
26. Distinguish between determinate and indeterminate plants.
27. Recognize how day length and temperature affect flowering.
28. Locate the growing points in grass and broadleaf plants.
29. Describe how extremes in the moisture, temperature, and aeration of the soil affect seed germination.
30. Describe how temperature and moisture extremes affect crop growth and development at different growing stages.
31. Describe how the following factors relate to crop growth and development
 - a) leaf area index
 - b) air temperature
 - c) plant water status
 - d) light intensity and duration
 - e) transpiration
32. Describe how the following factors affect light distribution in the leaf canopy
 - a) row spacing
 - b) plant population
 - c) leaf angle
 - d) leaf width
33. Identify the plant parts of North Carolina's major agronomic crops.
34. Describe the process of legume nodulation and the importance of symbiotic nitrogen fixation.
35. Describe how the following factors are involved in photosynthesis
 - a) CO₂
 - b) H₂O
 - c) light
 - d) O₂
 - e) Sugar
36. Describe how crop growth regulators are used in the production of cotton and tobacco.

37. Describe the function of the plant vascular system (xylem and phloem).

COMPETENCY AREA 3. HYBRID AND VARIETY SELECTION

38. Distinguish between a hybrid and a variety.

39. Describe how the following characteristics influence hybrid or variety selection

- a) maturity
- b) adaptation to soil and climatic conditions
- c) pest resistance and tolerance
- d) herbicide resistance
- e) yield potential and stability
- f) harvestability
- g) quality
- h) end use

40. Define transgenic plants.

41. Distinguish between well-designed and poorly designed field trials.

42. Use precalculated least significant difference (LSD) and multiple range test (MRT) values to determine meaningful differences among hybrids and varieties.

COMPETENCY AREA 4. CROPPING SYSTEMS

43. List advantages and limitations of crop rotations.

44. Compare and contrast single crop and crop rotation systems.

45. Describe the following systems

- a) double cropping
- b) strip cropping

46. List the advantages and limitations of growing green manure crops, cover crops, and companion crops in a cropping system.

47. Describe how cropping sequence influences the following

- a) tillage options
- b) pest management
- c) moisture availability
- d) available resources
- e) risk management
- f) residue management

48. Define allelopathy and autotoxicity.

49. Define the following precision agriculture terms

- a) site-specific management
- b) geographic information system (GIS)
- c) global positioning system (GPS)
- d) grid soil sampling
- e) yield mapping
- f) variable rate technology (VRT)

COMPETENCY AREA 5. CROP DAMAGE AND DIAGNOSTICS

50. Describe climatic and plant factors that influence a plant's ability to resume normal growth and development after damage.

51. Recognize factors that affect replanting decisions.

52. List the general steps involved in diagnosing a crop production problem in the field.

COMPETENCY AREA 6. TILLAGE

53. Describe how clean-till and high surface residue management systems affect the following

- a) crop residue
- b) crop rooting patterns
- c) seed placement
- d) pest management
- e) stand establishment
- f) soil fertility
- g) fertilizer placement

COMPETENCY AREA 7. CROP HARVEST, STORAGE, AND QUALITY

54. Describe how the following conditions influence crop quality in storage

- a) temperature
- b) moisture
- c) aeration
- d) pests
- e) crop condition at harvest
- f) length of storage
- g) additives

55. Describe how the quality of North Carolina's major crops is influenced by
- a) crop characteristics and intended use
 - b) growth conditions prior to harvest
 - c) harvest timing
 - d) harvest methods and handling
 - e) storage conditions

COMPETENCY AREA 8. ECONOMIC ASPECTS

| 56. Use the elements of a crop budget to determine resource allocation.

| 57. Describe how current crop prices and input costs affect cropping decisions.

| 58. Identify how current market trends affect management decisions.

| 59. Identify the standard number of pounds per market unit (bushel, bale, etc.) of North Carolina's major crops.