# CERTIFIED CROP ADVISER

## Performance Objectives

## for Kentucky

**(SW Revised 2006)**

# INTRODUCTION

The International Certified Crop Adviser (ICCA) program is coordinated by the American Society of Agronomy. State or regional boards administer the CCA program in each state, province, or region, respectively. The Kentucky CCA Board is responsible for developing state-specific performance objectives and the Kentucky CCA exam. This performance objectives booklet outlines the knowledge and skills that the Kentucky CCA Board believes all Certified Crop Advisers practicing in Kentucky should possess. The booklet, thus, is useful in determining areas of expertise that may be covered in the Kentucky CCA exam.

The booklet is divided into four sections: (1) Nutrient Management; (2) Soil and Water Management; (3) Integrated Pest Management; and (4) Cropping Systems Management. Each section is further divided into competency areas and specific performance objectives within each competency area. Sections are updated periodically to keep the Kentucky CCA program in step with changing trends and technology. The latest revisions were: Nutrient Management—2005; Soil and Water Management—2006; Integrated Pest Management—2004; Cropping Systems Management—2004. Integrated Pest Management is scheduled to be revised in 2007.

The main rationale for having a state-specific CCA program and performance objectives is to address practices and situations that are not covered by the ICCA exam and performance objectives. The booklet covers the most important non-horticultural crops grown in Kentucky. These include:

**Corn for grain and silage**
**Forage grasses and legumes**
**Soybean**
**Tobacco**
**Small Grains**

**To the user of this booklet:**

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## TABLE OF CONTENTS

# NUTRIENT MANAGEMENT COMPETENCY AREAS:

# Revised 2005

1. Basics of soil fertility
2. Soil pH and liming
3. Nitrogen
4. Phosphorus
5. Potassium
6. Secondary and micronutrients
7. Soil and plant sampling and analyses

## COMPETENCY AREA 1. Basics of soil fertility

1. Recognize and name the ion forms in which each of these essential elements is taken up by plants from the soil.

| | | | |
|---|---|---|---|
| Nitrogen | Calcium | Iron | Boron |
| Phosphorus | Magnesium | Manganese | Chlorine |
| Potassium | Sulfur | Molybdenum | Copper |
| | | | Zinc |

2. State the general range, including the units, of cation exchange capacity (CEC) into which most Kentucky soils fall.

3. Identify the soil properties that affect CEC.

4. Explain how CEC affects the movement of cationic vs. anionic forms of the plant nutrient elements.

5. Define mineralization and briefly explain the effects of these soil conditions on the mineralization process.
    a. Temperature
    b. Water relationships
    c. $O_2$ level
    d. pH
    e. Tillage system

6. In plant nutrition, mineralization is most important for three nutrient elements. Name them.

7. Describe the effects of the following on nutrient movement in soil and water.
    a. Soil texture
    b. Soil structure
    c. Drainage -- surface and internal
    d. Nutrient form – cations or anions
    e. Rate of nutrient application
    f. Time of year of nutrient application
    g. Rainfall--amount and distribution throughout the year
    h. Soil slope and crop residue cover

8. Identify the agronomic and economic advantages and disadvantages of broadcast and banded fertilizer applications.

9. Describe the management of poultry, swine, and dairy cattle manures with regard to how to store (if applicable), how to apply, when to apply, and what rate to apply.

10. List the approximate amounts of total and available nitrogen, phosphorus, potassium, sulfur, and copper from each poultry, swine, and dairy cattle manures.

11. Be able to calculate the amount of N, P, and K removed in harvested crops, based on yields and average concentration.

12. Calculate the amounts of fertilizer materials needed to supply the recommended amounts of nutrients, given the guaranteed analyses of the fertilizer materials commonly used in Kentucky.

## COMPETENCY AREA 2. Soil pH and Liming

13. Explain the effects of soil pH on plant availability of the following plant nutrients:
    a. Nitrogen
    b. Phosphorus
    c. Calcium
    d. Magnesium
    e. Micronutrients—Zn, Fe, Mn, Mo, B, Cu

14. Explain the effects (if any) on soil pH of these fertilizer materials commonly used in Kentucky:
    a. Ammonium nitrate
    b. Ammonium sulfate
    c. Anhydrous ammonia
    d. Diammonium phosphate
    e. Muriate of potash
    f. Sulfate of potash
    g. Urea
    h. UAN solution

15. Name the three most common liming materials used in Kentucky and identify the material most commonly used.

16. Differentiate between calcitic and dolomitic lime and state the relative advantages of each.

17. Explain how composition and fineness determine the quality and effectiveness of ground limestone as a liming material.

18. Given composition and fineness values for ground limestone, calculate its Relative Neutralizing Value (RNV) and compare this method of calculating quality of the lime to the minimum requirements of the Kentucky lime law.

19. Given that the buffering capacity of a soil greatly affects the amount of lime required to cause a desired change in pH, explain generally how each of the following factors affect the buffering capacity of a soil.
    a. Soil organic matter content
    b. Soil texture
    c. Cation exchange capacity

20. Know the soil depth that pH is most affected by:
    a. no-till
    b. chisel plowing
    c. conventional plowing
    d. injection of anhydrous ammonia

21. List the most suitable soil pH ranges for the production of these crops:
    a. Corn
    b. Soybeans
    c. Wheat
    d. Tobacco
    e. Alfalfa
    f. Grass-legume mixtures

22. Determination of a soils lime needs in the laboratory usually involves measuring soil pH both in water and in a buffer solution. State the purpose of each of the measurements.

23. Identify optimum timing of lime application with regard to:
    a. Crop rotations
    b. Time of year
    c. Tillage operations

## COMPETENCY AREA 3. Nitrogen

24. Recognize nitrogen deficiency symptoms in the following crops:
    a. Tobacco
    b. Corn
    c. Small grains
    d. Forage grasses

25. Rank plant availability of nitrogen from the following organic sources (especially with regard to time to release) and relate to their C:N ratios.
    a. Legume crops
    b. Non-legume crop residues
    c. Manures

26. Explain how each of the following factors affects nitrogen uptake and efficiency of nitrogen use by crops:
    a. Soil properties—texture, structure, internal drainage, slope
    b. Rate of nitrogen fertilization
    c. Environmental conditions
    d. Availability of other nutrients
    e. Tillage system

27. Recognize how cropping systems and farmers' objectives affect the need for nitrogen supplementation with fertilizers.

28. Understand the factors that cause variability in nitrogen content of animal manures.

29. Identify the advantages and disadvantages of each of the following nitrogen fertilizer materials in relation to kinds of soils, cropping systems, and tillage systems.
    a. Anhydrous ammonia
    b. Urea
    c. Ammonium nitrate
    d. UAN solutions
    e. Ammonium sulfate
    g. Nitrate of soda, calcium nitrate, and potassium nitrate

30. Describe how nitrification inhibitors, polymer coatings and urease inhibitors each may increase nitrogen fertilizer efficiency.

## COMPETENCY AREA 4. Phosphorus

31. Recognize phosphorus deficiency symptoms in the following crops:
    a. Tobacco
    b. Corn
    c. Soybean
    d. Small grains
    e. Alfalfa
    f. Red clover
    h. Forage grasses

32. Explain how each of these factors affect soil retention and fixation of phosphorus.
    a. Kind of clay
    b. Amount of clay
    c. Iron oxides content
    d. Soil pH

33. Recognize how each of the following factors affects phosphorus fertilizer applications.
    a. Crops and cropping systems
    b. Soil residue cover
    c. Environmental concerns
    d. Distance from a source of water

34. Assess the relative advantages and disadvantages of each of the following phosphorus fertilizer materials.
    a. Diammonium phosphate
    b. Monoammonium phosphate
    c. Triple superphosphate
    d. Ammonium polyphosphate
    e. Animal manures

35. Use phosphorus soil tests results to make phosphorus fertilizer recommendations.

36. Assess the effects of phosphorus additions, crop removal and crop residues on:
    a. Soil-test phosphorus changes
    b. Movement of phosphorus by erosion, runoff, or leaching

## COMPETENCY AREA 5. Potassium

37. Identify potassium deficiency symptoms in the following crops:
    a. Tobacco
    b. Corn
    c. Soybean
    d. Small grains
    e. Alfalfa
    f. Red clover
    g. Forage grasses

38. Recognize how each of these factors affects soil retention of potassium.
    a. CEC
    c. Soil texture

39. Explain how each of these factors affects the need for potassium supplementation by fertilizer applications.
    a. Soil test level
    b. Cropping system
    c. Crop to be grown
    d. Residue management

40. Recognize the analysis, chemical composition, physical form, and relative cost of each of these potassium fertilizer materials.
    a. Potassium chloride
    b. Potassium sulfate
    d. Potassium nitrate
    e. Animal manures

41. Use potassium soil test results to make potassium fertilizer recommendations.

## COMPETENCY AREA 6. Secondary and micronutrients

42. Identify plant deficiency symptoms of each of the following secondary and micronutrients in the crops indicated.
    a. Magnesium—corn, tobacco
    b. Sulfur—corn
    c. Zinc—corn
    d. Boron—alfalfa, red clover
    e. Manganese—soybean
    f. Molybdenum—soybean, tobacco, alfalfa

43. Identify toxicity symptoms of each of the following elements in the crops indicated:
    a. Aluminum—small grains, soybean, tobacco
    b. Manganese—tobacco, soybean

44. Describe advantages and disadvantages of each of the following methods for correcting secondary and micronutrient deficiencies or toxicities:
    a. Foliar application of the nutrients
    b. Soil application of the nutrients
    c. Adjusting soil pH

## COMPETENCY AREA 7. Soil and plant sampling analysis

45. Summarize the University of Kentucky recommended soil sampling procedures with regard to:
    a. Number of sub-samples to make a composite sample
    b. Number of composite samples to represent a field
    c. Depth of sampling
    d. Time of year to sample
    e. How often to sample
    f. Sampling for precision agriculture

46. Describe the recommended procedures for handling soil and plant samples to protect their integrity for accurate analysis.

47. Explain each of these philosophies of soil test interpretation and fertilizer recommendations.
    a. Sufficiency
    b. Buildup and maintenance
    c. Basic cation saturation ratio
    d. Crop removal

48. Interpret soil and plant tissue test reports **for:**
    a. Degree of nutrient deficiency and adequacy
    b. Expected crop response to applied nutrients
    c. Units of measure and conversion between different units
    d. Reliability

49. List the calibrated plant growth stage for each crop and the part of the plant that may be sampled for plant tissue analysis of the following crops:
    a. Tobacco
    b. Corn
    c. Soybean
    d. Alfalfa
    e. Red clover
    f. Small grains
    g. Forage grasses

# SOIL AND WATER MANAGEMENT COMPETENCY AREAS:

## Revised 2006

1. Soils and landscapes

2. Soil properties

3. Soil erosion

4. Tillage

5. Crop residue cover

## COMPETENCY AREA 1. Soils and landscapes

1. Using information in a soil survey, determine the following characteristics for a given soil.

    a. Natural drainage classes
    b. Soil depth
    c. Soil slope
    d. Parent materials

2. Distinguish among the following:

    a. Soil series
    b. Soil type (consociation)
    c. Soil map unit

3. Describe the general location of each of the following positions on the landscape.

    a. Upland
    b. Footslope
    c. Depression
    d. Terrace
    e. Bottom (floodplain)

4. Name the landscape position or positions where each of the common soil parent materials are usually found.

    a. Alluvium
    b. Loess
    c. Residuum
    d. Colluvium

5. State the general relationship between soil parent materials (loess, alluvium, colluvium, limestone residuum, shale residuum, and sandstone residuum) and the following soil properties:

    a. Texture
    b. Available water holding capacity

## COMPETENCY AREA 2. Soils properties

6. Distinguish among sand, silt, and clay with regard to particle size, and describe the feel that each size group imparts to a moist soil.

7. Describe granular, blocky, and platy types of soil structure, and state where in a soil profile each type is most likely to be found.

8. Explain the relationships between types of soil structure and

    a. Crop growth and production
    b. Tillage and cropping system
    c. Soil microorganisms and earthworms
    d. Soil compaction

9. Define soil organic matter and distinguish between plant residue and soil humus.

10. Describe how soil organic matter affects

    a. Soil color
    b. Soil structure
    c. Nutrient supply
    d. Water holding capacity

11. List the major soil and management factors that affect water infiltration, soil temperature, and soil water-supplying capacity.

12. Relate the potential for compaction to soil texture and soil water content.

13. Recognize the general features of well-drained, moderately well drained, and somewhat poorly drained soils.
14. Recognize the general features of a fragipan and its affect on drainage and rooting depth.

## COMPETENCY AREA 3. Soil erosion

15. Explain how soil erosion affects air and water quality.

16. Recognize the components of an effective conservation plan.

17. Explain how the following soil properties affect potential erosion.

    a. Texture
    b. Organic matter
    c. Surface cover (rock and plant)
    d. Slope—percent and length
    e. Permeability
    f. Structure

18. Describe the following practices, and recognize how each controls soil erosion.

    a. Conservation tillage
    b. Vegetative cover—dead or live
    c. Strip-cropping
    d. Terracing

e. Vegetative filter strips
f. Grass waterways

**COMPETENCY AREA 4. Tillage**

19. Define plow-tillage, reduced tillage, and no-tillage.

20. Distinguish between primary and secondary tillage.

21. Recognize implements commonly used for each of the following tillage systems.

    a. Plow-tillage
    b. Disk tillage
    c. No-tillage
    d. Chisel-plow tillage

22. Compare plow-tillage, disk tillage, chisel-plow tillage, and no-tillage with regard to:

    a. Soil disturbance
    b. Crop residue remaining on the soil surface
    c. Incorporation of fertilizers, lime, and pesticides
    d. Soil compaction
    e. Ground water and surface water quality

## COMPETENCY AREA 5. Crop residue cover

23. Explain how each of the following factors affects crop residue cover.

    a. Crop rotation
    b. Crop yield
    c. Harvesting method
    d. Weather
    e. Fertilization

24. Explain how to measure crop residue cover.

# INTEGRATED PEST MANAGEMENT (IPM) COMPETENCY AREAS:

## Revised 2004

1. IPM concepts (strategies to address pest problems)
2. Pest characteristics
3. Pest management tactics
4. Safety/regulatory aspects
5. Pesticide stewardship

## COMPETENCY AREA 1. IPM concepts (strategies to address pest problems)

1. State the premise on which IPM is based, including its relationship to economically and environmentally sound pest management.

2. Distinguish among economic injury level, economic threshold, and treatment guidelines.

3. Recognize how economic injury level, economic threshold, and treatment guidelines are used in making pest control decisions.

4. Explain how environmental and cultural factors influence pest populations.

5. State why it is important to use correct pest monitoring procedures based on pest behavior or biology or both.

6. Describe the general methods for sampling and submitting plant, soil, and pest materials for analysis and diagnosis.

7. Discuss the necessity for correct pest identification in making pest management decisions.

8. Describe the consequences of making pest management decisions based on incorrect pest identification.

9. Describe the importance of the following components of an IPM program:

    a. Records of past, present, and potential pest problems
    b. Development of a management plan
    c. Selection of a scouting process
    d. Implementation of a plan
    e. Evaluation and record-keeping

10. Briefly describe management tactics for the following difficult-to-control pests as applicable to corn, soybeans, wheat, tobacco, and alfalfa:

    a. Johnsongrass
    b. Triazine resistant pigweed
    c. Musk thistle
    d. Marestail
    e. European corn borer
    f. Soybean cyst nematode
    g. Corn stalk and ear rots
    h. Black shank of tobacco
    i. Barley yellow dwarf
    j. Alfalfa weevil

11. State the benefits of listing and mapping weed species in each field.

12. Describe how to monitor European corn borer and black cutworm using pheromone traps and degree-days.

## COMPETENCY AREA 2. Pest characteristics

### I. Weed pests

13. The following weeds are grouped according to life cycle. Define the life cycles and identify the weeds at the seedling and reproductive stages.

ANNUALS:

**Warm season:**

Grasses: Giant foxtail, large crabgrass, fall panicum, shattercane, and broadleaf signalgrass

Broadleaf: Cocklebur, morning glory, giant ragweed, common ragweed, velvetleaf, eastern black nightshade, smooth pigweed, common lambsquarter, and prickly sida

**Cool season:**

Grasses: Italian ryegrass and cheat

Broadleaf: Common chickweed, henbit, and purple deadnettle

BIENNIALS: Musk thistle

PERENNIALS:

**Warm season:** Johnsongrass, yellow nutsedge, honeyvine milkweed, and bigroot morning-glory, trumpet creeper, common pokeweed

**Cool season:** Wild garlic and curly dock

14. Describe, in general, the following reproduction methods of weeds and understand their importance in designing a weed management program:

a. Seed
b. Rhizomes
c. Stolons
d. Creeping rootstocks
e. Root crowns
f. Bulbs or bulblets
g. Tubers

15. Recognize the importance of the following factors affecting weed-crop competition:

    a. Row spacing
    b. Crop population
    c. Weed density
    d. Duration of competition
    e. Weed distribution

## II. Insects and mites

16. State the reasons why a particular insect would be considered an *important* pest in crop production in Kentucky.

17. Identify the following insect pests, describe their general life cycles, and recognize characteristic damage they cause to the crops listed:

    a. Alfalfa—alfalfa weevil and potato leafhopper
    b. Corn—black cutworm, European corn borer, Southwestern corn borer, and Western corn rootworm
    c. Soybean—Japanese beetle, green clover-worm, and corn earworm (pod-worm)
    d. Tobacco—flea beetle and tobacco aphids
    e. Small grains—aphids

18. Describe how insect biology and behavior affect management practices and decisions.

19. Describe how plant growth stage affects severity of insect damage.

20. Distinguish between damage caused by direct and indirect pests and give an example of each for a particular crop.

## III. Disease pests

21. Explain how pathogen characteristics affect management strategies for crop diseases in Kentucky.

22. Describe how environment, host plant characteristics, and pathogen interact for the following groups of diseases:

    a. Wind/rain dispersed fungal diseases
    b. Insect transmitted viral diseases
    c. Bacterial diseases
    d. Soil-borne fungal diseases
    e. Diseases caused by nematodes

23. Describe the mechanism(s) whereby each of the following types of diseases affects plant health and crop productivity:

    a. Root rots
    b. Stem rots
    c. Leaf spots
    d. Shoot blights
    e. Fruit rots
    f. Vascular wilts
    g. Virus
    h. Nematode root feeding

## COMPETENCY AREA 3. Pest management tactics

### I. Non-pesticide pest management tactics

**Prevention:**

24. Describe methods to prevent introducing pests into non-infested fields.

**Genetic:**

25. List advantages and disadvantages of using herbicide-tolerant crops in weed management.

26. Explain the use and limitations of pest-resistant varieties in insect and disease management.

**Mechanical:**

27. Recognize the role of the following mechanical methods in weed control in Kentucky's crops:

    a. Tillage practices (primary tillage, secondary tillage, selective cultivation)
    b. Hand weeding
    c. Mowing

**Cultural:**

28. Briefly describe how the following cultural practices are used to manage pests:

    a. Field history
    b. Cropping sequence
    c. Variety selection
    d. Seed or plant source
    e. Tillage system
    f. Residue management
    g. Planting date and method
    h. Plant population
    i. Soil fertility
    j. Water management
    k. Pest interactions
    l. Timeliness of harvest

**Biological:**

29. Identify the following beneficial insects and state how they benefit the crops listed:

    a. Lady beetles—corn
    b. Spiders—soybean
    c. Syrphidflies—wheat
    d. Thistlehead weevils

30. Describe how naturally occurring pathogens, predators, and parasites affect insect populations.

## II. Pesticide pest management tactics

31. Recognize how the following factors influence pesticide injury to crops:

    a. Crop species or variety sensitivity
    b. Weather
    c. Persistence
    d. Rate and formulation
    e. Method of application
    f. Incompatibility of pesticides in a mixture

32. Describe how public concern might affect pesticide selection and use in Kentucky.

33. Describe the role of the following adjuvants or additives in pesticide applications:
    a. Surfactants
    b. Oil concentrates
    c. Fertilizer additives
    d. Drift-control agents
    e. Defoamers

34. Explain how the following factors affect spray delivery and spray coverage:

    a. Spray pressure
    b. Application speed
    c. Nozzles:
        1. Type
        2. Spacing
        3. Height

35. Define the following pesticide interactions:
    a. Additive
    b. Synergistic
    c. Antagonistic

36. Describe methods to prevent development of herbicide-resistant weeds and other pesticide-resistant pests.

37. Describe methods to manage pesticide-resistant pests.

38. Identify general plant symptoms (weed and crop) caused by the following herbicide mode-of-action groups and list an example of each:

    a. Contact herbicides, e.g., Gramoxone, Flex Star
    b. Growth regulators, e.g., 2,4-d, Clarity
    c. Photosynthetic inhibitors, e.g., Atrazine, Sencor
    d. Pigment inhibitors, e.g., Command, Balance
    e. Meristematic root and or shoot inhibitors, e.g., Prowl, Dual, Lasso, Harness
    f. Amino acid synthesis inhibitors
        1. EPSP enzyme inhibitors, e.g., glyphosate, Roundup
        2. ALS enzyme inhibitors, e.g., Pursuit, Classic, First Rate

39. Explain how the following factors influence herbicide persistence:

    a. Soil moisture
    b. Soil temperature
    c. Soil pH
    d. Soil microbes
    e. Application rate and timing

40. Recognize potential carryover problems for herbicides belonging to the following herbicide families:

    a. Chloroacetamides
    b. Dinitroanalines
    c. Imidazolinones
    d. Isoxazolidinones

e. Sulfonylureas
f. Triazines

41. List the major benefits and limitations of the following methods of herbicide application:

    a. Early pre-plant
    b. Pre-plant incorporated
    c. Pre-plant or pre-emergence surface-applied
    d. Post-emergence broadcast
    e. Post-emergence directed
    f. Fall-applied

42. Evaluate the potential for use of the above application methods in moldboard-plow tillage, no-tillage, and chisel-plow tillage in Kentucky.

43. Recognize the potential effects that stage of growth of plants and environmental factors have on weed control and herbicide injury to crops in Kentucky.

44. List the major insecticide groups and describe the mode(s) of action of each.

45. List the advantages and disadvantages (efficacy, economic, environmental) of using fungicides in the following categories:

    a. Contact vs. locally systemic vs. systemic
    b. Protective vs. curative
    c. Seed vs. soil vs. foliar applied
    d. Broad spectrum vs. narrow spectrum

46. State how fungicides differ in function from bactericides, nematicides, and soil fumigants.

47. List the factors that affect the activity of soil fumigants.

## COMPETENCY AREA 4. Safety/regulatory aspects

48. Describe how misuse of pesticides can affect the following:

    a. Non-target organisms
    b. Ground and surface water
    c. Food safety

49. Locate the following information on pesticide labels:

    a. Commercial name
    b. Common name
    c. Chemical name
    d. Toxicity hazard (Caution, Warning, Danger, Danger-Poison)
    e. Personal protective equipment (PPE) needed during use
    f. Correct rate for crop and situation

50. Describe the Kentucky and federal pesticide record-keeping requirements.

51. Describe the requirements and best management practices (BMPs) under the Kentucky Agricultural Water Quality Authority.

52. Summarize the rules regarding pesticide use, storage, and distribution in the Kentucky Pesticide and Application Act.

53. Explain the purpose of re-entry and pre-harvest intervals following a pesticide application.

54. Recognize the responsibilities of and the assistance available through the following state and federal agricultural agencies:

    a. University of Kentucky Cooperative Extension Service
    b. Kentucky Department of Agriculture Division of Pesticides
    c. Kentucky Cabinet for Natural Resources and Environmental Protection
    d. USDA Farm Services Agency
    e. USDA Natural Resources Conservation Service
    f. U.S. Environmental Protection Agency
    g. Pesticide Applicator Training

## COMPETENCY AREA 5. Pesticide stewardship

55. Explain how the following factors may affect spray drift and volatilization:

    a. Spray volume
    b. Weather conditions
    c. Pesticide formulation
    d. Additives (drift control agents)
    e. Nozzle height
    f. Droplet size
    g. Pressure

56. Recognize how the following factors may affect movement of pesticides in soil or into surface or groundwater:

    a. Cation exchange capacity (CEC)
    b. Depth of water table
    c. Erosion
    d. Leaching
    e. Pesticide adsorption to soil
    f. Pesticide application rate and timing
    g. Pesticide degradation and persistence
    h. Precipitation and runoff
    i. Soil pH
    j. Soil texture
    k. Plant residue at surface

l. Crop/weed canopy

57. Describe reporting and cleanup procedures when pesticide spills occur in Kentucky.

# CROPPING SYSTEMS MANAGEMENT COMPETENCY AREAS:

## Revised 2004

1. Crop establishment
2. Growth and development
3. Harvest

## COMPETENCY AREA 1. Crop establishment

1. Designate the optimum planting periods and recognize the consequences of planting too early or too late for the following crops in Kentucky.
   a. Corn
   b. Soybeans
   c. Wheat
   d. Alfalfa
   e. Tobacco
   f. Red clover
   g. White clover
   h. Cool season annual grasses
   i. Warm season annual grasses
   j. Perennial grasses

2. Recognize recommended seeding depths of the above listed crops and describe adjustments to the seeding depths in response to the following factors:
   a. Soil conditions (texture, temperature, moisture, and amount of tillage)
   b. Weather outlook
   c. Seed size

3. Describe crop responses to planting too deep or too shallow.

4. Describe crop responses to planting patterns (broadcast, row width, plant spacing, etc.) and plant population (seeding rate).

5. Recognize the effect of seed quality on crop establishment.

6. Describe ways to compensate for poor seed quality.

7. Determine percent pure live seed (PLS) from seed tag information.

8. Recognize the recommended seeding rates for the crops listed in performance objective 1 (above) to achieve optimum plant populations.

9. Calculate plant populations from spacing and area data.

10. Identify factors involved in a replanting decision.

11. Keep current on desirable variety characteristics for the following listed crops in Kentucky.

    a. Corn
    b. Soybeans
    c. Wheat
    d. Tobacco
    e. Forage legumes
    f. Forage grasses

12. Describe the management of the following tobacco transplant production systems.

    a. Conventional plant beds
    b. Direct seeded float systems
    c. Plug and transfer float systems

## COMPETENCY AREA 2. Growth and Development

13. Recognize the minimum and optimum temperatures for growth and development of the following listed crops.

    a. Corn
    b. Soybeans
    c. Wheat
    d. Tobacco
    e. Forage legumes
    f. Forage grasses

14. Describe how the water and nutrient needs of crops change during growth and development.

15. Relate the growing degree days concept (GDD) to crop development, recognize its use in production systems, and calculate GDD for crop development.

16. Identify the stage of growth and development during which each of the following listed crops are most susceptible to environmental stresses with regard to stand and yield reductions.

    a. Corn
    b. Soybeans
    c. Wheat
    d. Tobacco
    e. Forage grasses
    f. Forage legumes

17. Identify characteristics which indicate physical damage to agronomic crops from causes, such as hail, frost, flooding, drought, wind, humans, and wildlife.

18. Recognize climatic, plant, and management factors which influence plant survival and recovery after injury.

19. Determine crop damage levels which may justify replanting.

20. List advantages and limitations of monoculture and rotation cropping systems.

21. For the following listed crops, identify stages of crop development.

    a. Tobacco
    b. Small grains (Feekes scale)
    c. Corn (Iowa State System)
    d. Soybean (Iowa State System)
    e. Forage legumes
    f. Forage grasses

22. Recognize how crops respond to different tillage systems.

23. Describe the endophyte and its effect on the growth and development and stress tolerance of tall fescue.

24. Describe the effect of topping practices and sucker control on burley tobacco yield and quality.

25. Identify management practices in the areas listed below that will help mitigate the problems associated with late planting of double-crop soybeans.

    a. Wheat variety
    b. Soybean variety
    c. Soybean row spacing and seeding rate
    d. Soybean tillage system
    e. P and K fertilizer applications

26. Compare and contrast the forage legumes (alfalfa, red clover, white clover, annual lespedeza) for:

    a. Ease of establishment
    b. Persistence
    c. Yield
    d. Seasonality of growth
    e. Rooting depth
    f. Management requirements
    g. Growth and identification characteristics

27. Compare and contrast forage grasses for:

    a. Ease of establishment
    b. Persistence
    c. Yield
    d. Seasonality of growth
    e. Rooting depth
    f. Management requirements
    g. Growth and identification characteristics

## COMPETENCY AREA 3. Harvest

28. Describe harvest schedules for corn grain, corn silage, soybeans, tobacco, hay (alfalfa, red clover, legume-grass mixture, orchard grass, timothy and fescue) for optimum crop quality and yield.

29. Describe the effects of grazing system on forage growth, quality, persistence and subsequent animal performance.

30. Describe the effects of the endophyte in tall fescue on the performance of beef and dairy cattle and horses.

31. List the factors at harvest (timing, method of harvest, losses) that influence crop quality and yield.

# APPENDIX

# COMMON WEEDS IN KENTUCKY'S CROPS

| COMMON NAME | SCIENTIFIC NAME | LIFE CYCLE* |
|---|---|---|
| **CORN** | | |
| **Grasses & Grass-like Plants (Monocots)** | | |
| broadleaf signalgrass | *Brachiaria platyphylla* | A |
| crabgrass, large | *Digitaria sanguinalis* | A |
| foxtail, giant | *Setaria faberi* | A |
| johnsongrass | *Sorghum halepense* | P |
| fall panicum | *Panicum dichotomiflorum* | A |
| ryegrass, Italian | *Lolium multiflorum* | A |
| shattercane | *Sorghum bicolor* | A |
| **Broadleaf Plants (Dicots)** | | |
| burcucumber | *Sicyos angulatus* | A |
| cocklebur, common | *Xanthium strumarium* | A |
| milkweed, honeyvine | *Ampelamus ambidus* | P |
| morningglory, bigroot (wild sweet potato) | *Ipomoea pandurata* | P |
| morningglory, ivyleaf | *Ipomoea hederacea* | A |
| pigweed, smooth | *Amaranthus hybridus* | A |
| pokeweed, common | *Phytolacca americana* | P |
| ragweed, giant (horseweed) | *Ambrosia trifida* | A |
| trumpetcreeper | *Campsis radicans* | P |
| **SOYBEANS** | | |
| **Grasses & Grass-like Plants (Monocots)** | | |
| broadleaf signalgrass | *Brachiaria platyphylla* | A |
| crabgrass, large | *Digitaria sanguinalis* | A |
| foxtail, giant | *Setaria faberi* | A |
| johnsongrass | *Sorghum halepense* | P |
| fall panicum | *Panicum dichotomiflorum* | A |
| shattercane | *Sorghum bicolor* | A |
| **Broadleaf Plants (Dicots)** | | |
| burcucumber | *Sicyos angulatus* | A |
| cocklebur, common | *Xanthium strumarium* | A |
| copperleaf, hophornbeam | *Acalypha ostryifolia* | A |
| lambsquarters, common | *Chenopodium album* | A |
| marestail (horseweed) | *Conyza canadensis* | A |
| morningglory, ivyleaf | *Ipomoea hederacea* | A |
| nightshade, eastern black | *Solanum ptycanthum* | A |
| pigweed, smooth | *Amaranthus hybridus* | A |
| pokeweed, common | *Phytolacca americana* | P |
| ragweed, giant (horseweed) | *Ambrosia trifida* | A |
| sicklepod | *Cassia obtusifolia* | A |
| sida, prickly (teaweed) | *Sida spinosa* | A |
| trumpetcreeper | *Campsis radicans* | P |

| COMMON NAME | SCIENTIFIC NAME | LIFE CYCLE* |
|---|---|---|
| **TOBACCO** | | |
| **Grasses & Grass-like Plants (Monocots)** | | |
| crabgrass, large | *Digitaria sanguinalis* | A |
| foxtail, giant | *Setaria faberi* | A |
| johnsongrass | *Sorghum halepense* | P |
| nutsedge, yellow | *Cyperus esculentus* | P |
| **Broadleaf Plants (Dicots)** | | |
| galinsoga, hairy | *Galinsoga ciliata* | A |
| horsenettle | *Solanum carolinense* | P |
| jimsonweed | *Datura stramonium* | A |
| lambsquarters, common | *Chenopodium album* | A |
| milkweed, honeyvine | *Ampelamus albidus* | P |
| morningglory, ivyleaf | *Ipomoea hederacea* | A |
| pigweed, smooth | *Amranthus hybridus* | A |
| ragweed, common | *Ambrosia artemisiifolia* | A |
| sida, prickly (teaweed) | *Sida spinosa* | A |
| **WHEAT** | | |
| **Grasses & Grass-like Plants (Monocots)** | | |
| cheat | *Bromus secalinus* | A |
| chess, hairy | *Bromus commutatus* | A |
| ryegrass, Italian | *Lolium multiflorum* | A |
| garlic, wild | *Allium vineale* | P |
| **Broadleaf Plants (Dicots)** | | |
| bittercress, hairy | *Cardamine hirsuta* | A |
| chickweed, common | *Stellaria media* | A |
| cornflower (bachelor's-button) | *Centaurea cyanus* | A |
| deadnettle, purple | *Lamium purpureum* | A |
| dock, curly | *Rumex crispus* | P |
| fleabane, Philadelphia | *Erigeron philadelphicus* | P |
| henbit | *Lamium amplexicaule* | A |
| pennycress, field | *Thlaspi arvense* | A |
| pepperweed, field | *Lepidium campestre* | A |
| shepherd's-purse | *Capsella bursa-pastoris* | A |
| speedwell, ivyleaf | *Veronica hederifolia* | A |
| thistle, musk (nodding thistle) | *Carduus nutans* | B |

| COMMON NAME | SCIENTIFIC NAME | LIFE CYCLE* |
|---|---|---|
| **ALFALFA** | | |
| **Grasses & Grass-like Plants (Monocots)** | | |
| crabgrass, large | *Digitaria sanguinalis* | A |
| foxtail, giant | *Setaria faberi* | A |
| fescue, tall | *Festuca arundinacea* | P |
| johnsongrass | *Sorghum halepense* | P |
| nutsedge, yellow | *Cyperus esculentus* | P |
| **Broadleaf Plants (Dicots)** | | |
| chickweed, common | *Stellaria media* | A |
| dandelion | *Taraxacum officinale* | P |
| deadnettle, purple | *Lamium purpureum* | A |
| dock, curly | *Rumex crispus* | P |
| fleabane, Philadelphia | *Erigeron philadelphicus* | B |
| henbit | *Lamium amplexicaule* | A |
| horsenettle | *Solanum carolinense* | P |
| mustard, wild | *Brassica kaber* | A |
| pigweed, spiny (spiny amaranth) | *Amaranthus spinosus* | A |
| plantain, broadleaf | *Plantago major* | P |
| thistle, musk (nodding thistle) | *Carduus nutans* | B |
| **PASTURES** | | |
| **Grasses & Grass-like Plants (Monocots)** | | |
| broomsedge | *Andropogon virginicus* | P |
| crabgrass, large | *Digitaria sanguinalis* | A |
| foxtail, yellow | *Setaria glauca* | A |
| nimblewill | *Muhlenbergia schreberi* | P |
| purpletop (grease grass) | *Tridens flavus* | P |
| **Broadleaf Plants (Dicots)** | | |
| blackberry spp. | *Rubus* spp. | P |
| buckbrush | *Symphoricarpos orbiculatus* | P |
| buttercup spp. | *Ranunculus* spp. | A/B/P |
| dock, broadleaf | *Rumex obtusifolius* | P |
| ironweed, tall | *Vernonia altissima* | P |
| pigweed spiny (spiny amaranth) | *Amranthus spinosa* | A |
| ragweed, common | Ambrosia artemisiifolia | A |
| ragweed, lanceleaf | *Ambrosia bidentata* | A |
| redcedar, eastern | *Juniperus virginiana* | P |
| rose, multiflora | *Rosa multiflora* | P |
| sumpweed, rough | *Iva ciliata* | A |
| thistle, musk (nodding thistle) | *Carduus nutans* | B |

* A = annual, B = biennial, P = Perennial

# COMMON INSECTS IN KENTUCKY'S CROPS

| COMMON NAME | SCIENTIFIC NAME | LIFE CYCLE* |
|---|---|---|
| **CORN** | | |
| **Moth / Caterpillar (Lepidoptera)** | | |
| Armyworm | *Pseudalctia unipuncta* | C |
| Black cutworm | *Agrotis ipsilon* | C |
| Corn earworm | *Helicoverpa zea* | C |
| Common stalk borer | *Papaipema nebris* | C |
| European corn borer | *Ostrinia nubilalis* | C |
| Fall armyworm | *Spodoptera frugiperda* | C |
| Southwestern corn borer | *Diatraea grandiosella* | C |
| **Beetle / grub or wireworm Coleoptera)** | | |
| Western corn rootworm | *Diabrotica virgifera virgifera* | C |
| Northern corn rootworm | *Diabrotica barberi* | C |
| Southern corn rootworm | *Diabrotica undecimpunctata howardi* | C |
| Japanese beetle | *Popillia japonica* | C |
| Wireworm | Several - in family Elateridae | C |
| White grub | Several - in family Scarabidae | C |
| **Fly / maggot (Diptera)** | | |
| Seed corn maggot | *Delia platura* | C |
| **Aphids (Homoptera)** | | |
| Corn leaf aphid | *Rhopalosiphum maidis* | G |
| **Bugs (Hemiptera)** | | |
| Green stink bug | *Acrosternum hilare* | G |
| Brown stink bug | *Euschistus seruus* | G |
| **FORAGES** | | |
| **Moth / Caterpillar (Lepidoptera)** | | |
| Armyworm | *Pseudaletia unipuncta* | C |
| Fall armyworm | *Spodoptera frugiperda* | C |
| **Beetle / grub or wireworm (Coleoptera)** | | |
| Alfalfa weevil | *Hyper postica* | C |
| Blister beetles | Several - *Epicauta* sp. | C |
| Clover root curculio | *Sitona hispidulus* | C |
| **Grasshopper (Orthoptera)** | | |
| Redlegged grasshopper | *Melanoplus femurrubrum* | G |
| Two-striped grasshopper | *Melanoplus bivittatus* | G |
| Differential grasshopper | *Melanoplus differentialis* | G |
| **Plant bugs and aphids (Homoptera)** | | |
| Potato leafhopper | *Empoasca fabae* | G |

| COMMON NAME | SCIENTIFIC NAME | LIFE CYCLE* |
|---|---|---|
| **SMALL GRAINS** | | |
| **Moth / Caterpillar (Lepidoptera)** | | |
| Armyworm | *Pseudaletia unipuncta* | C |
| Fall armyworm | *Spodoptera frugiperda* | C |
| **Beetle / grub or wireworm (Coleoptera)** | | |
| Cereal leaf beetle | *Oulema melanopus* | C |
| **Fly / maggot (Diptera)** | | |
| Hessian fly | *Mayetiola destructor* | C |
| **Grasshopper (Orthoptera)** | | |
| Redlegged grasshopper | *Melanoplus femurrubrum* | G |
| Two-striped grasshopper | *Melanoplus bivittatus* | G |
| Differential grasshopper | *Melanoplus differentialis* | G |
| **Plant bugs and aphids (Homoptera)** | | |
| Bird cherry-oat aphid | *Rhopalosiphum padi* | G |
| English grain aphid | *Sitobion avenac* | G |
| Corn leaf aphid | *Rhopalosiphum madis* | G |
| **SOYBEAN** | | |
| **Moth / Caterpillar (Lepidoptera)** | | |
| Black cutworm | *Agrotis ipsilon* | C |
| Fall armyworm | *Spodoptera frugiperda* | C |
| Soybean podworm | *Helicoverpa zea* | C |
| Green cloverworm | *Plathypena scabra* | C |
| **Beetle / grub or wireworm (Coleoptera)** | | |
| Bean leafbeetle | *Cerotoma trifureata* | C |
| Japanese beetle | *Popillia japonica* | C |
| Mexican bean beetle | *Epilachna varivestis* | C |
| **Fly / maggot (Diptera)** | | |
| Seed corn maggot | *Delia platura* | C |
| **Grasshopper (Orthoptera)** | | |
| Redlegged grasshopper | *Melanoplus femurrubrum* | G |
| Two-striped grasshopper | *Melanoplus bivittatus* | G |
| Differential grasshopper | *Melanoplus differentialis* | G |
| **Plant bugs and aphids (Homoptera)** | | |
| Three-cornered alfalfa-hopper | *Spissistilus festinus* | G |
| **Stinkbugs (Hemiptera)** | | |
| Green stink bug | *Acrosternum hilare* | G |
| Brown stink bug | *Euschistus seruus* | G |

| COMMON NAME | SCIENTIFIC NAME | LIFE* CYCLE |
|---|---|---|
| **TOBACCO** | | |
| **Moth / Caterpillar (Lepidoptera)** | | |
| Black cutworm | *Agrotis ipsilon* | C |
| Tobacco budworm | *Helicoverpa virescens* | C |
| Tobacco hornworm | *Manduea sexta* | C |
| **Beetle / grub or wireworm (Coleoptera)** | | |
| Tobacco flea beetle | *Epitrix hirtipennis* | C |
| Wireworms | Several in family *Elateridae* | C |
| **Grasshopper (Orthoptera)** | | |
| Redlegged grasshopper | *Melanoplus femurrubrum* | G |
| Two-striped grasshopper | *Melanoplus bivittatus* | G |
| Differential grasshopper | *Melanoplus differentialis* | G |
| **Aphids (Homoptera)** | | |
| Tobacco aphid | *Myzus nicotianae* | G |
| **Bugs (Hemiptera)** | | |
| Green stink bug | *Acrosternum hilare* | G |
| Brown stink bug | *Euschistus seruus* | G |
| **NATURAL ENEMIES** | | |
| **Beetle / grub (Coleoptera)** | | |
| Multicolored Asia Lady Beetle | *Harmonia axyridis* | C |
| Convergent Lady Beetle | *Hippodamia convergens* | C |
| Seven-spotted Lady Beetle | *Coccinella septernpunctata* | C |
| Pink Lady Beetle | *Coleomagila maculata* | C |
| **Fly / maggot (Diptera)** | | |
| Syrphid flies | Several in the family Syrphidae | C |
| Tachinid flies | Several in the family Tachinidae | C |
| **Bugs (Hemimoptera)** | | |
| Big-eyed bug | Several - *Geocoris* sp. | G |
| Damsel bug | Several in family Nabidae | G |
| **Spiders** (Araneida) | Several | |
| **Lacewing (Neuroptera)** | | |
| Green lacewing | *Chrysaperda carnea* | C |

*Life Cycles -

C = Complete life cycle consists of: egg, larva (like caterpillar, wireworm, grub or maggot) pupa and adult

G = Gradual life cycle consists of: egg, juvenile, adult (except aphids born live, no egg)

# COMMON DISEASES IN KENTUCKY'S CROPS

| COMMON NAME | SCIENTIFIC NAME | TYPE OF PATHOGEN |
|---|---|---|
| **ALFALFA** | | |
| Anthracnose | *Colletotrichum trifolii* | Fungus |
| Aphanomyces root rot | *Aphanomyces euteiches* | Fungus |
| Crown rot complex | Various | Bacteria and fungi |
| Lepto leaf spot | *Leptosphaerulina briosiana* | Fungus |
| Phytophthora root rot | *Phytophthora megasperma* | Fungus |
| Sclerotinia crown and stem rot | *Sclerotinia trifoliorum* | Fungus |
| Spring black stem and leaf spot | *Phoma medicaginis* | Fungus |
| Web blight | *Rhizoctonia solani* | Fungus |
| **BARLEY** | | |
| Barley yellow dwarf | *Barley yellow dwarf virus* | Virus |
| Head scab | *Fusarium graminearum (Gibberella zeae)* | Fungus |
| Leaf rust | *Puccinia hordei* | Fungus |
| Loose smut | *Ustilago tritici* | Fungus |
| Net blotch | *Helminthosporium teres* | Fungus |
| Scald | *Rhynchosporium secalis* | Fungus |
| Leaf and glume blotch | *Stagonospora nodorum* | Fungus |
| **CORN** | | |
| Anthracnose leaf blight, top dieback and stalk rot | *Colletotrichum graminicola* | Fungus |
| Charcoal stalk rot | *Macrophomina phaseoli* | Fungus |
| Common rust | *Puccinia sorghi* | Fungus |
| Common smut | *Ustilago maydis* | Fungus |
| Fusarium stalk and ear rot | *Fusarium monilforme* | Fungus |
| Gibberella stalk and ear rot | *Gibberella zeae* | Fungus |
| Gray leaf spot | *Cercospora zeae-maydis* | Fungus |
| Northern corn leaf blight | *Exserohilum turcicum* | Fungus |
| Pythium seed and seedling blight | *Pythium* spp. | Fungus |
| Southern leaf blight | *Bipolaris maydis* | Fungus |
| Southern rust | *Puccinia polysora* | Fungus |
| Stenocarpella (Diplodia) stalk and ear rot | *Stenocarpella maydis* | Fungus |
| Virus complex | *Maize chlorotic dwarf virus*<br>*Maize dwarf mosaic virus* | Viruses |

| COMMON NAME | SCIENTIFIC NAME | TYPE OF PATHOGEN |
|---|---|---|
| **SOYBEAN** | | |
| Anthracnose | *Colletotrichum dermatum* var. *truncata* | Fungus |
| Bacterial blight | *Pseudomonas glycinea* | Bacterium |
| Bean pod mottle | *Bean pod mottle virus* | Virus |
| Brown spot | *Septoria glycines* | Fungus |
| Cercospora leaf blight (purple seed stain) | *Cercospora kikuchii* | Fungus |
| Charcoal rot | *Macrophomina phaseolina* | Fungus |
| Downy mildew | *Peronospora manshurica* | Fungus |
| Phytophthora root and stem rot | *Phytophthora sojae* | Fungus |
| Pod and stem blight | *Diaporthe phaseolorum* var. *sojae* (*Phomopsis spp.*) | Fungus |
| Rhizoctonia stem rot | *Rhizoctonia solani* | Fungus |
| Seed and seedling blights | Various | Fungi |
| Soybean cyst nematode | *Heterodera glycines* | Nematode |
| Soybean mosaic | *Soybean mosaic virus* | Virus |
| Stem canker | *Diaporthe phaseolorum* var. *caulivora* | Fungus |
| Sudden death syndrome | *Fusarium solani* f.sp. *glycines* | Fungus |
| **TOBACCO** | | |
| Alfalfa mosaic | *Alfalfa mosaic virus* | Virus |
| Anthracnose | *Colletotrichum gloesporioide*s | Fungus |
| Bacterial (angular) leaf spot | *Pseudomonas syringae* p.v. *angulata* and *P.syringae* p.v. *tabaci* | Bacteria |
| Black leg/hollow stalk | *Erwinia carotovora* | Bacterium |
| Black root rot | *Thielaviopsis basicola* | Fungus |
| Black shank (Phytophthora root rot) | *Phytophthora parasitica* var. *nicotiania* | Fungus |
| Blue mold (downy mildew) | *Peronospora tabacina* | Fungus |
| Botrytis blight | *Botrytis* spp. | Fungi |
| Broomrape | *Orobanche ramosa* | Parasitic higher plant |
| Brown root rot (lesion nematode) | *Pratylenchus* spp. | Nematodes |
| Brown spot | *Alternaria alternata* | Fungus |
| Collar rot | *Sclerotinia sclerotiorum* | Fungus |
| Dodder | *Cuscuta pentagonia* | Parasitic higher plant |
| Frogeye leaf spot | *Cercospora apii* f.sp. *nicotianae* | Fungus |
| Fusarium wilt | *Fusarium oxysporum* f.sp. *nicotianae* | Fungus |
| Poty-virus complex | *Tobacco vein mottling virus*<br>*Tobacco etch virus*<br>*Potato virus Y* | Viruses |
| Root knot nematodes | *Meloidogyne* spp. | Nematodes |
| Root rot complex | Various | Bacteria and fungi |
| Seedling root and stem rots | Various | Bacteria and fungi |
| Soreshin | *Rhizoctonia solani* | Fungus |
| Southern stem blight | *Sclerotium rolfsii* | Fungus |
| Target spot | *Thanatephorus cucumeris* | Fungus |
| Tobacco ring spot | *Tobacco ring spot virus* | Virus |
| Tobacco streak | *Tobacco streak virus* | Virus |
| Tobacco stunt | *Glomus* spp. | Fungi |
| Tomato spotted wilt | *Tomato spotted wilt virus* | Virus |

| COMMON NAME | SCIENTIFIC NAME | TYPE OF PATHOGEN |
|---|---|---|
| **WHEAT** | | |
| Barley yellow dwarf | *Barley yellow dwarf virus* | Virus |
| Black chaff (bacterial streak) | *Xanthomonas campestris* p.v. *translucens* | Bacterium |
| Head scab (head blight) | *Fusarium graminearum (Gibberella zeae)* | Fungus |
| Leaf rust | *Puccinia recondita* f.sp. *tritici* | Fungus |
| Loose smut | *Ustilago tritici* | Fungus |
| Powdery mildew | *Erysiphe graminis* f.sp. *tritici* | Fungus |
| Seed and seedling blights | *Fusarium* spp. and *Pythium* spp. | Fungi |
| Septoria tritici leaf blotch | *Septoria tritici* | Fungus |
| Soil-borne wheat mosaic | *Soil-borne wheat mosaic virus* | Virus |
| Stagonospora nodorum leaf and glume blotch | *Stagonospora nodorum* | Fungus |
| Take-all | *Gaeumannomyces garmminis* var. *tritici* | Fungus |
| Tan spot | *Pyrenophora tritici-repentis* | Fungus |
| Wheat spindle streak mosaic | *Wheat spindle streak mosaic virus* | Virus |