CERTIFIED CROP ADVISER

Kentucky Performance Objectives

Updated 2018

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.

This revision, which focused on the entire document, was started in 2017 and completed in 2018 and the corresponding POs will be used starting with the 2019 Kentucky Local Board Exam. It should be noted that each exam question is tied back to a performance objective, which makes this booklet invaluable as an indication of concepts that will appear on the exam.

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**
- **Canola**

To the user of this booklet:

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Table of Contents

NUTRIENT MANAGEMENT COMPETENCY AREAS

COMPETENCY AREA 1. Basics of Soil Fertility

1. Be able to identify and discuss the following in terms of plant nutrition and name the ionic forms in which each of these essential elements is taken up by plants from the soil.
    a. Macronutrients: Carbon, Hydrogen, Oxygen, Nitrogen, Phosphorus, and Potassium.
    b. Secondary nutrients: Calcium, Magnesium, and Sulfur.
    c. Micronutrients: Boron, Chlorine, Copper, Iron, Manganese, Molybdenum. Nickel, and Zinc.
2. Recognize and be familiar with the role that the following beneficial elements play in plant nutrition: Cobalt, Sodium, Selenium, Silicon, and Vanadium.
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 and differentiate between nutrient lability and mobility.
6. Identify and give examples for each of the three major components of nutrient cycles:
    a. transformation,
    b. translocation,
    c. soil pool.
7. Define mineralization and immobilization processes and briefly explain the effects of these soil conditions on the mineralization and immobilization processes:
    a. temperature,
    b. water relationships,
    c. O_2 level,
    d. pH,
    e. tillage system.
8. In plant nutrition, mineralization is most important for four nutrient elements. Understand the mineralization and immobilization processes for the Nitrogen, Phosphorus, Sulfur, and Boron cycles.
9. Describe fixation as a process responsible for reducing nutrient availability.
10. 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. Source of nutrients.
    f. Rate of nutrient application.
    g. Time of year of nutrient application.
    h. Placement of nutrients.
    i. Rainfall - amount and distribution throughout the year.
    j. Soil slope and crop residue cover.
    k. Cover crops.
11. Be able to discuss the 4Rs and how the 4R performance objectives influence “selection of (the 4) Rights”.
12. Identify the agronomic and economic advantages and disadvantages of broadcast, foliar and banded (surface or subsurface) fertilizer applications.

13. Describe the management of liquid, semi-solid, and solid manures with regard to how to:
    a. store (if applicable), how to apply, when to apply, and what rate to apply.
    b. calculate the application rate based on nutrient analysis and soil test recommendations.
    c. understand agronomic values and environmental consequences of animal waste, biosolids, compost and other organic amendments.
14. Understand and discuss farm gate nutrient balances.
15. Be able to calculate the amount of N, P, and K removed in harvested crops, based on yields and average concentration.
16. 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.
17. Be able to convert between the oxide and elemental form of P and K.
18. Know the impact of grassland management (grazing, haying, grazing systems) on nutrient removal, distribution and management.
19. Understand the impact of fertilizer cost on the interpretation of the nutrient application rate versus plant productivity relationship.

COMPETENCY AREA 2. Soil pH and Liming

1. Explain the effects of soil pH on plant availability of the essential plant elements.
2. Explain the effects of soil pH on the following soil elements:
    a. Aluminum
    b. Manganese
3. Explain how the following fertilizer materials affect (if at all) soil pH:
    a. Ammonium nitrate
    b. Ammonium sulfate
    c. Anhydrous ammonia
    d. Monoammonium phosphate
    e. Diammonium phosphate
    f. Muriate of potash
    g. Sulfate of potash
    h. Urea
    i. UAN solution
4. Be able to define “acid” and “base” and describe what pH is a measurement of in the soil.
5. Differentiate between calcitic and dolomitic lime.
6. Be familiar with the most common liming materials used in Kentucky and be able to assign them to the following categories:
    a. carbonates.
    b. hydroxides.
    c. oxides of Ca and Mg.
7. Be able to describe how the anion and cation found in common lime materials react with soil acidity to raise soil pH through hydrolysis and acid-base reactions.
8. Explain how composition and fineness determine the quality and effectiveness of ground limestone as a liming material.

9. 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.
10. Be able to describe the relationship between soil pH buffer capacity and lime requirement.
11. Compare and contrast reserve acidity, active acidity, and total acidity.
12. 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.
13. Know how these practices impact the relationship between pH and soil depth:
    a. no-till.
    b. chisel plowing.
    c. conventional plowing.
    d. injection of anhydrous ammonia.
14. 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.
15. Be able to explain why making a lime recommendation requires a measurement of soil pH and soil buffer pH.
16. Be familiar with methods commonly used by soil testing labs to estimate soil pH and soil buffer pH in Kentucky and be able to explain how these different methods might influence comparison of soil test reports from different labs:
    a. water pH,
    b. dilute salt pH,
    c. Adams-Evans Buffer pH,
    d. Sikora Buffer pH,
    e. SMP buffer,
    f. Mehlich buffer.
17. Identify optimum timing of lime application with regard to:
    a. crop rotations
    b. time of year
    c. tillage operations

COMPETENCY AREA 3. Nitrogen

1. Understand how the nitrogen cycle influences nitrogen management decisions in modern production agriculture.

2. Recognize nitrogen deficiency symptoms in the crops common in Kentucky including but not limited to:
    a. tobacco.
    b. corn.
    c. small grains.
    d. forage grasses and legumes.
    e. soybean.
3. Rank plant availability of nitrogen from the following organic sources (especially with regard to time to release) according to their C:N ratios:
    a. legume crops residues.
    b. non-legume crop residues.
    c. cover crops.
    d. manures, compost, biosolids and other organic amendments.
4. 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. source, rate, placement and timing (4Rs) of nitrogen fertilization,
    c. environmental conditions (temperature, moisture),
    d. availability of other nutrients,
    e. tillage system,
    f. crop rotation.
5. Recognize how cropping systems and farmers' objectives affect nitrogen management decisions.
6. Understand the factors that cause variability in nitrogen content of animal manures.
7. Identify the advantages and disadvantages of each of the following nitrogen fertilizer materials in relation to soil properties, cropping systems, and tillage systems:
    a. anhydrous ammonia
    b. urea
    c. ammonium nitrate
    d. UAN solutions
    e. ammonium sulfate
    f. nitrate of soda, calcium nitrate, and potassium nitrate
8. Describe how nitrification inhibitors, polymer and other coatings, and urease inhibitors affect the nitrogen cycle.
9. Understand how can nitrogen fertilizer be lost to the atmosphere and be able to discuss:
    a. the gaseous forms that are lost,
    b. environmental and economic impact of these losses,
    c. methods to reduce gaseous losses of nitrogen.
10. Understand how nitrogen can be lost through water movement (above and below ground) describe the forms of nitrogen that are vulnerable to these losses and the mechanisms of loss.
11. Be able to explain how nitrogen fertilizer requirement is a function of plant nutrient requirement, soil nitrogen supply, and delivery efficiency of fertilizer source, timing, and placement.

COMPETENCY AREA 4. Phosphorus

1. Recognize phosphorus deficiency symptoms in the following crops:
    a. tobacco.
    b. corn.
    c. soybean.
    d. small grains.
    e. alfalfa.
    f. red clover.
    g. forage grasses.
2. Explain how each of these factors affect phosphorus availability and mobility:
    a. type of clay.
    b. amount of clay.
    c. iron oxides content.
    d. soil pH.
3. Recognize how each of the following factors affects phosphorus application:
    a. crops and cropping systems,
    b. soil residue cover,
    c. environmental concerns,
    d. distance from a source of water.
4. Explain complications associated with organic amendments and phosphorus management.
5. Describe the concept of critical source areas as they relate to P loss to surface water:
    a. transport,
    b. source,
    c. management,
    d. understand and discuss the use of Kentucky's phosphorus site indexes.
6. 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.
7. Use phosphorus soil tests results to make phosphorus fertilizer recommendations.
8. 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

1. 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.

2. Recognize how each of these factors affects soil plant availability of potassium and the need for potassium fertilizer.
    a. CEC.
    b. soil texture and types of clays.
    c. soil test level.
    d. timing of soil sampling (fall vs. spring).
    e. cropping system.
    f. crop to be grown.
    g. residue management.
3. Know the major components of the potassium soil cycle and how they influence crop management decisions:
    a. soil solution K.
    b. mineral K.
    c. fixed K.
    d. exchangeable K.
4. Recognize the analysis, chemical composition, physical form, and relative cost of each of these potassium fertilizer materials:
    a. Potassium chloride.
    b. Potassium sulfate.
    c. Potassium nitrate.
    d. Animal manures.
5. Understand timing of potassium relative to the cropping system and the potential for luxury consumption.
6. Understand risks associated with the salt index and placement of potassium fertilizer sources.
7. Understand the risk of chloride in potassium fertilizer sources with tobacco and other crops.
8. Use potassium soil test results to make potassium fertilizer recommendations.

COMPETENCY AREA 6. Secondary and Micronutrients

1. Identify plant deficiency symptoms of each of the following secondary and micronutrients:
    a. magnesium (for example corn and tobacco),
    b. sulfur (for example wheat and alfalfa),
    c. zinc (for example corn),
    d. boron (for example alfalfa, corn and tobacco),
    e. manganese (for example soybean),
    f. molybdenum (for example soybean, tobacco, and alfalfa).
2. Identify toxicity symptoms of each of the following elements:
    a. aluminum (for example small grains, soybean, and tobacco),
    b. manganese (for example tobacco, and soybean).
3. Identify conditions that may lead to temporary deficiencies of certain nutrients
    a. sulfur,
    b. zinc,
    c. boron.

4. 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 Testing/Sensing

1. 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.
2. Describe the recommended procedures for handling soil and plant samples to protect their integrity for accurate analysis.
3. 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.
4. 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.
    e. understand methods used by different labs and how/if results from different labs can be compared.
5. 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,
    h. grain and forage sorghum.
6. Discuss sampling for nutrient value in hay or forage.
7. Be able to discuss and interpret base saturation units and values as they occur on soil test reports.
8. Be able to explain each of the following methods to indirectly measure or map soil properties:
    a. Electrical conductivity (e.g. Veris).
    b. Electromagnetic response (e.g. EM-38).
    c. Optical sensors (Veris OM sensor).
    d. Mechanical sensors (e.g. soil resistance or compaction mapping).
    e. Electrochemical sensing (Veris pH sensor).

9. Understand and be able to explain what is being measured by the following reflectance sensors:
    a. active/passive sensors (Yara, Greenseeker, OptRX),
    b. UAV sensors,
    c. leaf chlorophyll meters.

SOIL AND WATER MANAGEMENT COMPETENCY AREAS

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,
    e. land uses and limitations.
2. Distinguish among the following:
    a. soil series.
    b. land capability classes.
    c. soil map unit.
3. Explain the limitation of soil surveys regarding map scales and interpretation of information, and relation to temporal information.
4. Describe the general location of each of the following positions on the landscape:
    a. upland,
    b. footslope,
    c. depression,
    d. terrace,
    e. toeslope,
    f. floodplain.
5. 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.
6. 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 and total water holding capacity.

COMPETENCY AREA 2. Soil Properties

1. Distinguish among sand, silt, and clay with regard to particle size, and describe the feel that each size group imparts to a moist soil.
2. Describe granular, blocky, subangular blocky, and platy types of soil structure, and state where in a soil profile each type is most likely to be found.
3. 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.
4. Define soil organic matter and distinguish between plant residues, particulate organic matter (POM), and soil humus.

5. Describe how soil organic matter affects
    a. soil color.
    b. soil structure.
    c. nutrient supply.
    d. water holding capacity.
    e. bulk density.
    f. CEC.
    g. microbial communities.
6. List the major soil properties and management factors that affect
    a. water infiltration.
    b. profile hydraulic conductivity.
    c. soil temperature.
    d. plant available water capacity.
    e. antecedent soil moisture.
7. Relate the potential for compaction to soil texture, soil organic matter, and soil water content.
8. Recognize the general features of well-drained, moderately well drained, and somewhat poorly drained soils with respect to color, redoxymorphic features, and depth to gray.
9. Recognize the general features (color, brittle fracture, bulk density) of a fragipan and its effect on drainage and rooting depth.

COMPETENCY AREA 3. Soil Erosion

1. Explain how soil erosion affects air and water quality.
2. Recognize the components of an effective NRCS conservation plan and/or a Kentucky agriculture water quality plan.
3. Be able to discuss NRCS tools to predict erosion (e.g. RUSLE2 and WEPP).
4. Explain how the following soil properties affect potential erosion:
    a. texture.
    b. organic matter.
    c. surface cover (rock, bare, plant, and plant residue).
    d. slope - percent and length.
    e. permeability, infiltration rate.
    f. structure.
    g. surface bulk density.
    h. grazing intensity – stocking rate.
5. Describe the following practices, and recognize how each impacts soil erosion:
    a. conservation tillage.
    b. vegetative cover—crop selection (annual vs perennial), crop residues.
    c. cover crop.
    d. strip-cropping.
    e. terracing.
    f. vegetative filter strips.
    g. grass waterways.
    h. livestock management including seasonal impacts (freeze/thaw cycles).
6. Discuss the relationship between climate, weather, and soil erosion.
7. Understand the different types of erosion by water as they relate to Kentucky soils.

8. Understand the Highly erodible land (HEL) and Not HEL (NHEL) designations and their impact on land use and management.

Competency Area 4 – Water Quantity and Quality Management

1. Understand considerations associated with irrigation with both surface and groundwater sources.
2. Understand agricultural benefits and environmental implications of tile drainage.
    a. Discuss tile drainage systems in relation to water quality (point and non-point sources).
3. Recognize the components of, and tools available for, the development of Kentucky Agriculture Water Quality Plans.
    a. Understand Nutrient Management Plans (NMP): KYNMPs vs Comprehensive NMP.
    b. Determine when a Kentucky No Discharge Operational Permit (KNDOP) is necessary.
    c. Have a working knowledge of cost-share opportunities (federal, state, and local) to implement practices within the KY Ag Water Quality Plan and conservation plans.
    d. Understand, and be able to compare and contrast Best Management Practice (BMP) options for the KY Ag Water Quality Plan.
4. Describe the importance of maintaining a farmgate nutrient balance as it relates to water quality.
5. Understand and discuss riparian area management, specifically maintaining riparian areas for multiple uses including flash grazing and hay harvest while maintaining ecosystem functions and services:
    a. nutrient cycling.
    b. flood control.
    c. contaminant filtering.
    d. wildlife habitat.
    e. streambank protection.
    f. water temperature regulation.
    g. invasive species control.
    h. societal perceptions.
    i. appropriate use of chemicals.
6. Restriction of livestock from riparian areas and water bodies (including compliance with the Kentucky Agriculture Water Quality Act).
7. Understand special consideration for karst landscapes including cropping systems, livestock operations, fertilizer and pesticide storage.
8. Discuss harmful algal blooms, causes and ramifications, on Kentucky farms and local watersheds.
    a. Understand Kentucky's contribution to water quality in the Mississippi/Atchafalaya River Basin (MARB).
    b. Be aware of the Clean Water Act (CWA) and what a Total Maximum Daily Load (TMDL) is, and the 303(d) listings.

COMPETENCY AREA 5. Tillage and Crop Residue Cover

1. Define plow-tillage, reduced tillage, and no-tillage.
2. Distinguish between primary and secondary tillage.

3. Recognize implements commonly used for each of the following tillage systems:
    a. plow-tillage.
    b. disk tillage.
    c. no-tillage.
    d. chisel-plow tillage.
4. 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.
5. Explain how each of the following factors affects crop residue cover:
    a. crop rotation.
    b. crop yield.
    c. harvesting method.
    d. weather.
    e. fertilization.
6. Explain how to measure crop residue cover.

INTEGRATED PEST MANAGEMENT (IPM) COMPETENCY AREAS:

COMPETENCY AREA 1. IPM Concepts

1. State the premise on which IPM is based, including its relationship to economically and environmentally sound pest management.
2. Recognize and distinguish how economic injury level, economic threshold, and treatment guidelines are used in making pest control decisions.
3. Explain how environmental and cultural factors influence pest populations.
4. State why it is important to use correct pest monitoring procedures based on the host plant and pest behavior and/or the pest's biologic development stage.
5. Describe the general methods for sampling and submitting plant, soil, and pest materials for analysis and diagnosis.
6. Discuss the necessity for correct pest identification and describe the consequences of making pest management decisions based on incorrect pest identification.
7. 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/post implementation scouting.
    f. record-keeping.
8. Briefly describe management tactics for the following difficult-to-control pests as applicable to corn, soybeans, wheat, tobacco, and alfalfa:

    Weeds

    Johnsongrass
    common waterhemp
    Palmer amaranth
    musk thistle
    horseweed
    giant ragweed
    Italian ryegrass

    Insects

    alfalfa weevil
    European corn borer
    armyworms
    flea beetle
    cutworms
    thrips

    Diseases

    <u>Soybean</u>

    soybean cyst nematode
    frogeye leaf spot
    stem canker
    sudden death syndrome
    Septoria brown spot
    seedling and root rot diseases

Corn

stalk and ear rots
gray leaf spot
northern leaf blight
southern rust
seedling diseases

Tobacco

black shank of tobacco

Small Grains

barley yellow dwarf
Fusarium head blight
leaf blotch complex
glume blotch
powdery mildew

9. State the benefits of listing and mapping weed species in each field.
10. Describe how to monitor European corn borer and black cutworm using pheromone traps and degree-days.

COMPETENCY AREA 2. Pest Characteristics

I. Weed pests

1. The following weeds are grouped according to life cycle. Define the life cycles and identify the weeds at the seedling and reproductive stages. **Also see**: *Appendix I. Common Weeds in Kentucky Crops*.

ANNUALS:

Warm season:

Grasses:

giant foxtail
large crabgrass
fall panicum
shattercane
broadleaf signalgrass

Broadleaf:

cocklebur
morningglory species
giant ragweed
common ragweed
velvetleaf
eastern black nightshade
smooth/redroot pigweed
common lambsquarter
common waterhemp
palmer amaranth
prickly sida

Cool season:

Grasses:

Italian ryegrass
annual bluegrass
cheat

Broadleaf:

common chickweed
henbit
purple deadnettle

BIENNIALS:

Musk thistle

PERENNIALS:

Warm season:

Johnsongrass
yellow nutsedge
honeyvine milkweed
bigroot morningglory
trumpet creeper
common pokeweed

Cool season:

Wild garlic
curly dock

2. 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. root crowns.
    e. bulbs or bulblets.
    f. tubers.
3. 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.
    f. weed emergence date.
    g. crop emergence date.

II. Insects and Mites

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

2. Identify the following insect pests, describe their general life cycles, and recognize characteristic damage they cause to the crops listed **Also see:** *Appendix II. Common Insects in Kentucky Crops*.

Tobacco

tobacco and tomato hornworms
tobacco budworm
aphids
flea beetles
thrips

Corn

black cutworm
cornflea beetle
corn rootworms
armyworms
European corn borer
Southwestern corn borer
fall armyworm
seedcorn maggot

Soybean

seed corn maggot
bean leaf beetle
dectes stem borer
cutworm
Mexican bean beetle
Japanese beetle
grasshopper
green cloverworms
green stinkbug
brown stink bug
brown marmorated stink bug
soybean aphid
soybean podworm
three cornered alfalfa hopper

Wheat

aphids
armyworms
cereal leaf beetle
Hessian fly

Sorghum

sugarcane aphid
sorghum webworm
sorghum midge

Alfalfa

alfalfa weevil
potato leafhopper

3. Describe how insect biology and behavior affect management practices and decisions.
4. Describe how plant growth stage affects severity of insect damage.
5. Distinguish between damage caused by direct and indirect pests and give an example of each for a particular crop.

III. Disease pests

1. Explain how pathogen characteristics affect management strategies for crop diseases in Kentucky.
2. 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.
3. Describe the mechanism(s) whereby each of the following types of diseases affect plant health and crop productivity **Also see:** *Appendix III. Common Diseases in Kentucky Crops*.
    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. Prevention

1. Describe methods to prevent introducing pests into non-infested fields.
2. Understand the importance of equipment sanitation.
3. Understand the use weed free and pathogen free seed in prevention.
4. List advantages and disadvantages of using herbicide-resistant crops in weed management.
5. Explain the use and limitations of pest-resistant varieties in insect and disease management.
6. Variety selection
7. Understand regulatory and biological implications of refuges and genetically modified crops.
8. Recognize the role of the following mechanical methods in weed control in Kentucky's crops:
    a. tillage.
    b. hand weeding.
    c. mowing.
9. Briefly describe how the following cultural practices are used to manage pests:
    a. field history.
    b. cropping sequence.
    c. tillage system/residue management.
    d. planting date and method.

e. plant population.
f. soil fertility.
g. water management.
h. row spacing.
i. timeliness of harvest.
j. cover crops.

10. Identify the following beneficial insects:
    a. lady beetles.
    b. spiders.
    c. syrphid flies.
    d. thistlehead weevils.
    e. parasitoids.
11. Describe how naturally occurring pathogens, predators, and parasites affect insect populations.

II. Pesticide pest management tactics

1. Recognize how the following factors influence pesticide injury to crops:
    a. crop species or variety sensitivity.
    b. crop growth stage.
    c. weather (temp, wind speed, humidity, precipitation etc).
    d. persistence.
    e. rate and formulation.
    f. method of application.
    g. incompatibility of pesticides in a mixture.
    h. interactions between applied pesticides.
    i. soil properties.
2. Describe how the following might affect pesticide selection and use in Kentucky:
    a. presence/proximity of specialty crops.
    b. presence/proximity of sensitive crop species.
    c. presence/proximity of non-target organisms.
    d. field location/adjacent property/proximity to water bodies.
    e. presence or occurrence of temperature inversions.
    f. wind speed and direction.
    g. forecast for rainfall.
3. Describe the role of the following adjuvants or additives in pesticide applications:
    a. surfactants.
    b. oil concentrates.
    c. fertilizer additives.
    d. drift-reduction agents.
    e. defoamers.
    f. ammonium sulfate.
4. Explain how the following factors affect spray delivery and spray coverage:
    a. application speed.
    b. droplet size.
        1. nozzles design
            i. air induction
            ii. pre-orifice
            iii. turbulence chamber

iv. nozzle angle
2. spray pressure.
3. nozzle orifice size.

c. boom height
d. carrier volume
e. nozzle spacing

5. Describe general factors that would influence choice of nozzle design, spacing and size for different pesticide formulations (herbicide vs insecticide vs fungicide).
6. Define the following pesticide interactions:
    a. additive.
    b. synergistic.
    c. antagonistic.
7. Explain how the following factors influence decisions regarding resistance management:
    a. the selection of herbicide-resistant weeds and other pesticide-resistant pests.
    b. rotation of pesticides groups.
    c. understand what is meant by mode of action, mechanism of action, and site of action.
    d. understand how mode of action, mechanism of action and site of action influence.
8. Describe methods to manage pesticide-resistant pests.
    a. Rotation of pesticide groups.
9. Identify general plant symptoms (weed and crop) caused by the following herbicide mode-of-actions, list the site(s) of action and corresponding WSSA group number(s) within each, and list an example herbicide of each:
    a. Lipid Synthesis Inhibitors.
        i. ACCase inhibitors, Group 1, eg. Clehodim, quizalofop
    b. Amino Acid Synthesis Inhibitors.
        i. ALS inhibitors, Group 2, e.g. rimsulfuron, imazethapyr, cloransulam
        ii. EPSP Synthase inhibitors, Group 9, e.g. glyphosate
    c. Growth Regulators.
        i. Synthetic auxins, Group 4, e.g. dicamba, 2,4-D
    d. Photosynthesis Inhibitors.
        i. Photosystem II inhibitors, groups 5, 6, &7, e.g. atrazine, bromoxynil, linuron
    e. Nitrogen Metabolism Inhibitors.
        i. Glutamine synthetase inhibitor, group 10, e.g. glufosinate
    f. Pigment Inhibitors.
        i. HPPD inhibitors, group 27, e.g. isoxaflutole, mesotrione, topramezone
    g. Cell Membrane Disruptors.
        i. PPO inhibitors, group 14, e.g. fomesafen, acifluorfen
        ii. Photosystem I inhibitors, group 22, e.g. paraquat
    h. Seedling root growth inhibitors.
        i. microtubule inhibitors, group 3, e.g. pendimethalin, trifluralin
    i. Seedling shoot growth inhibitors.
        i. Long-chain fatty acid inhibitors, group 15, e.g. s-metolachlor, acetochlor, pyroxasulfone.
10. Explain how the following factors influence herbicide persistence:
    a. soil moisture.
    b. soil temperature.

c. soil texture.
d. soil organic matter content.
e. soil pH.
f. soil microbes.
g. application rate and timing.

11. Recognize potential carryover problems for herbicides belonging to the following herbicide families:
    a. Chloroacetamides.
    b. Dinitroanalines.
    c. Imidazolinones.
    d. Isoxazolidinones.
    e. Sulfonylureas.
    f. Triazines.
12. List the major benefits and limitations of the following methods of herbicide application:
    a. pre-plant foliar burndown.
    b. pre-plant incorporated.
    c. pre-plant or pre-emergence surface-applied.
    d. post-emergence broadcast.
    e. post-emergence directed.
    f. fall-applied.
13. Evaluate the potential for use of the above application methods in moldboard-plow tillage, no-tillage, and chisel-plow tillage in Kentucky.
14. Recognize the potential effects that stage of growth of plants and environmental factors have on weed control and herbicide injury to crops in Kentucky.
15. List the major insecticide groups and describe the mode(s) of action of each.
16. 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.
17. State how fungicides differ in function from bactericides, nematicides, and soil fumigants.
18. List the factors that affect the activity of soil fumigants.

COMPETENCY AREA 4. Safety/Regulatory Aspects

1. Describe how misuse of pesticides can affect the following:
    a. non-target organisms.
    b. ground and surface water.
    c. food safety.
2. 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 application timing.
g. resistance management.
h. off target movement.

3. Describe the Kentucky and federal pesticide record-keeping requirements.
    a. required records.
    b. length of time to retain records.
4. Describe the requirements and best management practices (BMPs) under the Kentucky Agricultural Water Quality Authority.
5. Summarize the rules regarding pesticide use, storage, disposal and distribution in the Kentucky Pesticide and Application Act.
6. Explain the purpose of re-entry, pre-harvest, and grazing intervals following a pesticide application.
7. Recognize the responsibilities of and the assistance available through the following state and federal agricultural agencies:
    a. University of Kentucky Cooperative Extension Service including Pesticide Applicator Training.
    b. Kentucky Department of Agriculture Division of Environmental Services.
    c. Kentucky Cabinet for Natural Resources and Environmental Protection.
    d. Kentucky Agricultural Water Quality Authority.
    e. Kentucky Division of Water.
    f. USDA Farm Services Agency.
    g. USDA Natural Resources Conservation Service.
    h. U.S. Environmental Protection Agency.

COMPETENCY AREA 5. Pesticide Stewardship

1. Explain how the following factors may affect spray drift and volatilization:
    a. spray volume.
    b. weather conditions.
    c. pesticide formulation.
    d. nozzle height.
    e. droplet size.
        i. pesticide formulation
        ii. additives
        iii. pressure
        iv. nozzle design
        v. orifice size
2. Recognize how the following factors may affect movement of pesticides in soil or into surface or groundwater:
    a. cation exchange capacity (CEC).
    b. depth to water table.
    c. depth to bedrock/type of bedrock (e.g. karst topography).
    d. erosion.
    e. leaching.
    f. pesticide adsorption to soil.
    g. pesticide application rate and timing.
    h. pesticide degradation and persistence.

i. precipitation and runoff.
j. soil pH.
k. soil texture.
l. plant residue at surface.
m. crop/weed canopy.

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

CROPPING SYSTEMS MANAGEMENT COMPETENCY AREAS:

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. alfalfa.
    b. canola.
    c. corn.
    d. grain sorghum..
    e. grasses.
        i. cool season annual
        ii. perennial grasses
        iii. warm season annual
    f. red clover.
    g. small grains.
    h. soybeans.
    i. tobacco.
    j. white clover.
2. Recognize recommended seeding depths of the above listed crops. Describe adjustments to the seeding depths in response to the following factors:
    a. soil conditions (texture, temperature, moisture, and amount of tillage).
    b. environmental conditions.
3. Describe crop responses to planting too deep or too shallow.
4. Recognize recommended establishment practices for the crops listed in Objective #1 above.
5. Describe crop responses to different establishment practices (tillage system, broadcast versus planted, row width, plant spacing, etc.) and optimum plant populations (seeding rate).
6. Recognize the importance and methods of planter and drill calibrations and understand the consequences of miscalibration.
7. Recognize the effect of seed quality (seed vigor) and seed size on crop establishment.
8. Describe ways to compensate for poor seed quality (seed vigor).
9. Recognize benefits of using certified seed.
10. Determine percent pure live seed (PLS) from seed tag information.
11. Recognize the importance of information on the seed tag such as:
    a. noxious weeds.
    b. inert matter.
    c. other crops.
    d. weed seed.
    e. seeds per unit or pound.
12. Calculate plant populations from spacing and area data.
13. Identify factors involved when determining profitability and/or feasibility in a replanting decision.
14. Keep current on desirable variety characteristics for the crops listed above in Objective #1 above.
15. Describe the management for tobacco transplant production systems.

COMPETENCY AREA 2. Growth and Development

1. Recognize the minimum and optimum temperatures for growth and development of the following listed crops:
    a. corn for grain and silage.
    b. forage grasses and legumes.
    c. soybean.
    d. tobacco.
    e. small grains.
    f. canola.
2. Describe how the water and nutrient needs of crops change during growth and development.
3. Understand and be able to use the growing degree days concept (GDD) to predict crop development, recognize its use in production systems, and calculate GDD for crop development.
4. Be able to describe the different base temperatures for each crop and identify when to use modified GDDs versus GDDs.
5. Identify the growth stage or stages of the following crops that most susceptible to environmental stresses with regard to stand and yield reductions:
    a. corn for grain and silage.
    b. forage grasses and legumes.
    c. soybean.
    d. tobacco.
    e. small grains.
    f. canola.
6. Identify and recognize characteristics of physical damage to agronomic crops caused by hail, frost, flooding, drought, wind, humans, and wildlife, etc.
7. Recognize environmental, plant, and management conditions that influence plant survival and recovery after injury.
8. Determine the factors that justify replanting crops.
9. List advantages and limitations of monoculture and rotation cropping systems.
10. For the following listed crops, identify stages of crop development.
    a. corn for grain and silage.
    b. forage grasses and legumes.
    c. soybean.
    d. tobacco.
    e. small grains.
    f. canola.
11. Understand the endophyte and its effect on the growth and development and stress tolerance of tall fescue.
12. Describe the effect of topping and sucker control at different growth stages on burley tobacco yield and quality.

13. Identify management practices in the areas listed below that will help mitigate stand and/or yield problems associated with late planting of double-crop soybeans.
    a. wheat variety.
    b. soybean variety.
    c. soybean row spacing and seeding rate.
    d. fertilizer applications.
14. 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.
15. 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

1. Describe harvest schedules for optimum crop quality and yield for:
    a. corn grain.
    b. corn silage.
    c. soybeans.
    d. tobacco.
    e. forage grasses and legumes (alfalfa, red clover, legume-grass mixture, orchard grass, timothy and fescue).
    f. small grains.
    g. canola.
    h. wheat hay.
2. Understand consequences of delayed harvest on the above list of crops.
3. Describe the effects of grazing system on forage growth, quality, persistence and subsequent animal performance.
4. Describe the effects of the endophyte in tall fescue on the performance of beef and dairy cattle and horses.
5. List the factors at harvest (timing, method of harvest, losses, and grain moisture) that influence crop quality and yield.

APPENDIX I: 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

APPENDIX II: 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*	C
Japanese beetle	*howardi*	C
Wireworm	*Popillia japonica*	C
White grub	Several - in family Elateridae	C
	Several - in family Scarabidae	
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)

APPENDIX III: 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*	Viruses
	Maize dwarf mosaic virus	

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
	Macrophomina phaseolina	Fungus
Charcoal rot	*Peronospora manshurica*	Fungus
Downy mildew	*Phytophthora sojae*	Fungus
Phytophthora root and stem rot	*Diaporthe phaseolorum* var.	Fungus
Pod and stem blight	*sojae* (*Phomopsis spp.*)	
	Rhizoctonia solani	Fungus
Rhizoctonia stem rot	Various	Fungi
Seed and seedling blights	*Heterodera glycines*	Nematode
Soybean cyst nematode	*Soybean mosaic virus*	Virus
Soybean mosaic	*Diaporthe phaseolorum* var.	Fungus
Stem canker	*caulivora*	Fungus
Sudden death syndrome	*Fusarium solani* f.sp. *glycines*	

COMMON NAME	SCIENTIFIC NAME	TYPE OF PATHOGEN
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*	Viruses
Root knot nematodes	*Tobacco etch virus*	Nematodes
Root rot complex	*Potato virus Y*	Bacteria and fungi
Seedling root and stem rots	*Meloidogyne* spp.	Bacteria and fungi
Soreshin	Various	Fungus
Southern stem blight	Various	Fungus
Target spot	*Rhizoctonia solani*	Fungus
Tobacco ring spot	*Sclerotium rolfsii*	Virus
Tobacco streak	*Thanatephorus cucumeris*	Virus
Tobacco stunt	*Tobacco ring spot virus*	Fungi
Tomato spotted wilt	*Tobacco streak virus*	Virus
	Glomus spp.	
	Tomato spotted wilt 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