

Wisconsin Certified Crop Adviser Performance Objectives



2020

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**WISCONSIN CERTIFIED CROP ADVISER
PERFORMANCE OBJECTIVES**

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FOREWORD

The performance objectives for Wisconsin cover a wide variety of topics in the areas of nutrient management, soil and water management, pest management, and crop production. Crop advisers should be knowledgeable in these areas. Many of the Wisconsin performance objectives overlap with the international objectives. Consequently, some seemingly important subjects may have been omitted from the Wisconsin objectives if they were covered adequately in the international objectives. Overlap with international objectives was inevitable in some areas.

MAJOR WISCONSIN CROPS				
Alfalfa	Corn	Pea	Red Clover	Soybean
Oat	Potato	Snap Bean	Sweet Corn	Winter Wheat

Wisconsin certified crop advisers should be familiar with the crops listed in the table above. Hereafter they will be referred to as “major Wisconsin crops.” Crops grown on fewer than 20,000 acres, such as cranberries and table beets, are not included even though they are very important locally.

Previous versions of the Wisconsin Performance Objectives covered the handling, application, worker protection standards, environmental issues, and other considerations for pesticide management in great detail, overwhelming the more traditional aspects of weed, insect, and disease identification and management. While a CCA should be familiar with certain pesticide management issues many of the CCA categories overlap with the components of Wisconsin’s Pesticide Applicator Training (PAT) certification. The 2019 version of the Performance Objectives has been revised to reflect the key elements of regulatory and pesticide management expected of a Wisconsin CCA. The minority of CCA’s that are also certified applicators are required to complete the PAT education and certification and obtain licensing through the WDATCP.

Current evidence documented by Wisconsin climate scientists shows a trend for greater variability in precipitation, including more high intensity storms; and warmer temperatures, especially higher daily minimum values. Potential impacts include greater potential for soil erosion from high intensity storms, the geographical change in relative crop maturity zones and crop type itself across the state, the need for better N management to limit losses from leaching and denitrification, and the effect changing conditions will have on pest development, type, and distribution. The implications to agriculture now and in the future are significant and span across all the CCA Competency Areas. This version of the Performance Objectives has not incorporated climate change impacts into specific competency areas. However, it is expected that the science-based impact of climate change will be considered when a CCA makes agronomic recommendations for the farmer with the understanding that it will provide economical and environmentally sound farming practices.

WISCONSIN CERTIFIED CROP ADVISER PERFORMANCE OBJECTIVES

Nutrient Management Competency Areas:

- 1. Basic Concepts**
- 2. Soil Acidity and Liming**
- 3. Nitrogen**
- 4. Phosphorus**
- 5. Potassium**
- 6. Calcium, Magnesium, & Sulfur**
- 7. Micronutrients**
- 8. Fertilizer Forms and Application**
- 9. Manure Management**
- 10. Soil Testing and Plant Analysis**
- 11. Nutrient Management Planning**

NUTRIENT MANAGEMENT PERFORMANCE OBJECTIVES

Competency Area 1. Basic Concepts

01. Understand the factors that determine whether an element is essential for plant growth.
02. List the 17 essential plant nutrients, identify the form(s) in which each is taken up by plants, and describe a metabolic role for each nutrient.
03. Discuss the source and the typical range of cation exchange capacity for Wisconsin soils.
04. Describe the influence of soil pH, clay content and organic matter content on cation exchange capacity.
05. Describe how nutrients are delivered to, and absorbed by, plant roots.
06. Describe how the following soil characteristics affect nutrient availability:
 - a. Texture
 - b. Structure
 - c. Drainage/aeration
 - d. Soil moisture
 - e. Organic matter
 - f. CEC
07. Demonstrate an understanding of nutrient removal rates for the major Wisconsin crops.

Competency Area 2. Soil Acidity and Liming

01. Describe the sources of soil acidity.
02. Describe how soil pH affects availability of essential plant nutrients.
03. Describe soil properties that influence soil pH management.
04. Describe the factors used in the lime requirement calculations for Wisconsin soils and how each influences lime requirement and the neutralizing index of a liming material:
 - a. Water pH
 - b. Buffer pH
 - c. Fineness of grind
 - d. Calcium carbonate equivalent
05. Identify the optimum soil pH for major Wisconsin crops on mineral and organic soils.

06. Describe the benefits and drawbacks associated with various liming materials:
- Dolomitic aglime
 - Calcitic aglime
 - Pelletized lime
 - By-product liming materials

Competency Area 3. Nitrogen

01. Describe the role and mobility of nitrogen in plants and identify N deficiency symptoms for major Wisconsin crops.
02. Understand the timing of uptake and utilization of N for major Wisconsin crops that optimizes yield and limits loss.
03. Understand the N cycle and describe the following processes:
- Mineralization
 - Nitrification
 - Volatilization
 - Denitrification
 - Immobilization
 - Leaching
 - Symbiotic N fixation
04. Discuss significance of the carbon:nitrogen (C:N) ratio of crop residue and organic amendments and how they affect nitrogen availability to crops.
05. Describe 4R N management with respect to agronomic, economic and environmental considerations:
- Rate
 - Source
 - Timing
 - Placement
06. Describe nitrification and urease inhibitors, and slow release products used in crop production systems.
- Differentiate between an inhibitor and a slow release product
 - Understand how these products improve N use efficiency
07. Compare advantages and disadvantages of each of the following N fertilizer materials with respect to placement, losses, handling, potential for crop injury, and use in various cropping and tillage systems:
- Anhydrous ammonia
 - Ammonium sulfate
 - Urea
 - Urea-ammonium nitrate (UAN) solution
08. Explain the basis for the Wisconsin N rate guidelines:
- Maximum Return to Nitrogen (MRTN) for corn and wheat
 - Nitrogen rate guidelines for other crops

09. Know how to credit N rate adjustments for previous leguminous crops, manure applications, cover crops, green manures, and soil nitrate tests.
10. Understand the concept of Nitrogen Use Efficiency (NUE).

Competency Area 4. Phosphorus

01. Describe the role and mobility of P in plants and identify P deficiency symptoms for major Wisconsin crops.
02. Explain how each of the following affect soil retention or “fixation” of fertilizer P and its availability to plants:
 - a. Soil pH
 - b. Clay content
 - c. Method of placement
 - d. Form of phosphorous applied
03. Describe factors that influence Wisconsin P management guidelines.
04. Know the importance of soil buffering on the buildup and drawdown of soil test P.
05. Explain the major differences between soil test methods to determine available P.

Competency Area 5. Potassium

01. Describe the role and mobility of K in plants and identify K deficiency symptoms for major Wisconsin crops.
02. Describe the conditions under which ion antagonism affects K, Ca, and Mg uptake by plants.
03. Describe the soil conditions in which K is most likely to be deficient.
04. Describe how soil texture affects Wisconsin’s K management guidelines.
05. Compare advantages and disadvantages of each of the following K fertilizer materials with respect to use in various cropping systems:
 - a. Muriate of potash (0-0-60)
 - b. Potassium sulfate (0-0-50)
 - c. Sul-Po-Mag (0-0-22)

Competency Area 6. Calcium, Magnesium, and Sulfur

01. Describe the role and mobility of Ca, Mg, and S in plants and identify the deficiency symptoms of these nutrients for major Wisconsin crops.
02. Understand when to recommend gypsum as a soil amendment or fertilizer.
03. Understand the soil Ca:Mg ratio management issue in Wisconsin.

04. Describe the conditions in which potato may be responsive to Ca fertilization.
05. Describe environmental factors that affect S availability to crops.

Competency Area 7. Micronutrients

01. Describe the role, relative requirements, and deficiency symptoms of:
 - a. B in alfalfa, corn, peas, and soybean
 - b. Mn in corn, sweet corn, small grains, and soybean
 - c. Zn in corn, sweet corn, and soybean
02. Understand that B can be toxic to seedlings.
03. Describe soil conditions conducive to deficiencies of B, Zn, and Mn and the methods and materials used for correcting deficiencies.
04. Understand the conditions where a crop may respond better to either a soil or foliar micronutrient application.

Competency Area 8. Fertilizer Forms and Application

01. Describe the advantages, limitations and precautions associated with the following fertilizer placements methods:
 - a. Injection
 - b. Broadcast
 - c. Band
 - d. Fertigation
 - e. Foliar
 - f. Sidedress
 - g. Topdress
 - h. Seed-placed
 - i. Aerial
02. Describe sources of plant nutrients that are approved for certified organic crop production.
03. Explain how to calibrate different types of fertilizer spreaders or applicators.
04. Define fertilizer grade and analysis.
05. Explain how to calculate amounts and rates of fertilizer needed to meet specified soil test recommendations.
06. Convert P and K from elemental to oxide form and vice versa.
07. Understand conditions where an economic return can be gained from starter fertilizer.
08. Understand how weather conditions affect nutrient loss or carryover.

09. Describe the influence of salt index on starter fertilizer materials and rates of application.

Competency Area 9. Manure Management

01. Understand the relationship between total and available nutrient content for N, phosphate and potash for beef, dairy, poultry, and swine manure.
02. Explain how to calibrate a manure spreader and calculate rates of manure and manure nutrient applications.
03. Describe the different manure application methods and how each affects nutrient availability and the potential for nutrient loss.
04. Discuss the allocation of manure to farm fields based on:
- The Wisconsin P Index
 - Soil test P
 - Crop N requirement
 - Site characteristics
05. Recognize how bedding type, storage, and processing affect manure nutrient value.
06. Describe proper manure sampling and sample-handling procedures.
07. Discuss economic considerations involved in comparing manure and/or other organic wastes with commercial fertilization.

Competency Area 10. Soil Testing and Plant Analysis

01. Describe the University of Wisconsin recommendations for soil sampling and handling:
- Whole-field
 - Grid-point
 - Management zones
 - Contour strips
02. Describe the effect of the following factors on soil test results and interpretations:
- Depth of sampling
 - Frequency of sampling
 - Number of cores per composite sample
 - Number of composite samples per field
 - Areas to be avoided when sampling whole fields
 - Handling of samples for nitrate-N analysis
 - Fall versus spring sampling
 - Tillage management
03. Describe University of Wisconsin recommendation for plant tissue sampling the major Wisconsin crops with respect to:
- Plant part to sample
 - Stage of growth
 - Handling of sample

04. Interpret soil test and plant analysis reports for:
 - a. Level of nutrient deficiency or sufficiency
 - b. Potential for crop response to applied nutrients
 - c. Lime required to adjust soil pH
 - d. Sufficiency level from plant analysis
05. Understand the University of Wisconsin nutrient application guidelines as presented in UWEX publication A2809.
06. Describe the scenarios when it is appropriate to use soil nitrate N availability tests:
 - a. Pre-plant nitrate test
 - b. Pre-sidedress nitrate test

Competency Area 11. Nutrient Management Planning

01. Understand when and what type of nutrient management plan is required for a farm.
02. Understand the USDA NRCS 590 Technical Standard with respect to the:
 - a. Minimum criteria.
 - b. Additional criteria for groundwater protection
 - c. Additional criteria for surface water protection
 - d. Technical notes
03. Discuss the impact of manure management on nutrient management planning:
 - a. Describe the allocation of manure to fields based on:
 - i. Restrictions for frozen or snow-covered soil, slope, proximity to surface water, groundwater access, and wetlands
 - ii. Crop N or P demand
 - iii. Amount of manure produced vs. collected
 - iv. Dry matter content of liquid manure
 - v. P Index versus soil test P
 - b. Explain how manure storage and application method affect nutrient management plans.
 - c. Discuss how required conservation practices affect nutrient management planning:
 - i. Conservation tillage
 - ii. Crop rotation
 - iii. In-field structures
 - iv. Cover crops
 - v. Strip-cropping and contour cropping
 - vi. Filter strips
04. Identify factors that encourage the implementation of nutrient management plans.

WISCONSIN CERTIFIED CROP ADVISER PERFORMANCE OBJECTIVES

Soil and Water Management Competency Areas:

- 1. Basic Properties (Physical and Biological)**
- 2. Soil Erosion**
- 3. Tillage and Crop Residue Management**
- 4. Soil Compaction**
- 5. Site Characterization**
- 6. Site-Specific Soil Management**
- 7. Land Application of Municipal and Industrial Wastes**
- 8. Water and Solute Movement**
- 9. Irrigation**
- 10. Agricultural Drainage**
- 11. Soil Health**
- 12. Water Quality**

SOIL AND WATER MANAGEMENT PERFORMANCE OBJECTIVES

Competency Area 1. Basic Properties (Physical and Biological)

Physical

01. Describe the impact of the five soil forming factors on soil characteristics:
 - a. Climate
 - b. Parent material
 - c. Topography
 - d. Living organisms
 - e. Time

02. Define the following basic soil properties:
 - a. Soil texture
 - b. Soil structure
 - c. Soil bulk density
 - d. Soil porosity

03. Describe how to determine soil texture by the hand texturing method.

04. Understand how soil texture affects:
 - a. Field moisture capacity
 - b. Wilting point
 - c. Plant available water
 - d. Infiltration and water movement through soils
 - e. Soil temperature

05. Differentiate between the following soil structure types:
 - a. Granular
 - b. Platy
 - c. Blocky
 - d. Columnar and prismatic
 - e. Structureless
 - i. Massive
 - ii. Single-grained

06. Describe how the following affect soil structure:
 - a. Soil organisms and organic matter
 - b. Mechanical forces
 - i. Wheel traffic
 - ii. Wetting/drying
 - iii. Freezing/thawing
 - iv. Excessive tillage
 - c. Cropping system
 - d. Soil texture
 - e. Soil additives and amendments

07. Describe the relationship between soil bulk density and soil porosity.

08. List typical values for soil bulk density and porosity as affected by texture.
09. Describe how the following affect soil color:
 - a. Drainage
 - b. Organic matter
 - c. Parent material

Biological

10. Define soil organic matter.
11. Describe the beneficial effects of soil organic matter.
12. Describe factors that cause soil organic matter levels to increase and decrease.
13. Explain how the following agricultural practices influence soil microbial activity:
 - a. Tiling
 - b. Tillage
 - c. Organic matter additions
 - d. Fertilizer and lime applications
 - e. Pesticide use
 - f. Crop rotation
 - g. Grazing
 - i. Fumigation
 - j. Cover crops
14. Explain how the C:N ratio of a material affects organic matter decomposition and nutrient availability.
15. Explain the role of soil microorganisms for:
 - a. Nutrient transformations and cycling
 - b. Soil structure formation and maintenance
 - c. Degradation of pathogens, pesticides, and contaminants
16. Discuss composting as a method to manage organic materials and wastes.
17. Understand the influence and value of plant growth promoting biological compounds.

Competency Area 2. Soil Erosion

01. Describe the soil erosion process for:
 - a. Water
 - b. Wind
02. Differentiate between the following types of water erosion:
 - a. Sheet
 - b. Rill
 - c. Ephemeral gully
 - d. Gully

03. Revised Universal Soil Loss Equation 2 (RUSLE2) predicts rill and inter-rill erosion. Explain how each of the following factors of the RUSLE2 affect the rate of water erosion:
- Duration and intensity of rainfall (R)
 - Soil erosivity (K)
 - Slope length (L)
 - Slope steepness (S)
 - Rotation and tillage (C)
 - Conservation practices (P)
04. Explain how each of the following factors affect the rate of erosion by wind:
- Vegetative and residue cover
 - Wind velocity
 - Shelterbelts and unsheltered distance
 - Soil surface roughness
 - Soil texture
 - Soil additives such as polymers
05. Describe how erosion affects the following:
- Yield potential
 - Water holding capacity
 - Plant available nutrients
 - Organic matter content
 - Infiltration
 - Surface water quality
 - Air quality
06. Describe how each of the following cropland conservation practices decrease water erosion:
- Strip cropping
 - Contour tillage
 - Terraces
 - Grassed waterways
 - Surface crop residues
 - Cover crops
 - Crop rotation
07. Describe the purpose and function of a riparian vegetative filter strip.
08. Understand the purpose and use of the Soil Conditioning Index (SCI).

Competency Area 3. Tillage and Crop Residue Management

01. Discuss how the following influence tillage selection and management:
- Crop rotation
 - Production economics
 - Soil properties
 - Conservation planning

02. List the advantages, disadvantages, and limitations of each of the following tillage systems:
 - a. Moldboard plowing
 - b. Chisel plowing or mulch tillage
 - c. No-tillage
 - d. Zone or strip-tillage
 - e. Vertical tillage

03. List advantages, disadvantages, and limitations of each of the following pieces of tillage equipment:
 - a. Twisted shanks vs. points vs. sweeps for chisel plows
 - b. Planter residue-clearing attachments
 - c. Tandem disk
 - d. Field cultivator
 - e. Combination tillage tools
 - f. Row crop cultivators
 - g. Rotary hoe

04. Describe the influence of tillage system, implement setup, and implement operation on the following:
 - a. Crop residue level
 - b. Soil disturbance
 - c. Incorporation of fertilizer, lime and pesticides
 - d. Manure management
 - e. Pest type and severity
 - f. Water infiltration
 - g. Soil temperature

05. Describe the relationship between deep tillage (sub-soiling) method and crop residue cover after tillage.

07. Discuss the advantages and disadvantages of using land rollers in crop production.

08. Explain how to estimate percent surface crop residue using the line-transect method.

Competency Area 4. Soil Compaction

01. List the causes and significance of the following restrictive soil layers:
 - a. Crusting
 - b. Surface compaction
 - c. Subsurface compaction

02. Describe methods to detect subsurface compaction.

03. List soil and plant symptoms of compaction.

04. Describe methods of preventing and alleviating soil compaction.

05. Understand the benefits and limitations of freezing/thawing, wetting/drying, and deep tillage as methods to remove compaction.

06. Understand the efficacy of using amendments to alleviate soil compaction.
07. Describe the impact of soil compaction on the K availability to crops.

Competency Area 5. Site Characterization

01. Understand the resources that are available to create a soil map for a field and determine soil characteristics (e.g. Web Soil Survey, Snap Plus, county and local GIS).
02. Describe contaminant transport by water and limitations to crop production by the following factors:
 - a. High leaching potential
 - b. Highly erodible land
 - c. Sinkholes and creviced bedrock
 - d. Surface water features
 - e. Natural dense subsoils
 - f. Depth to bedrock
 - g. Depth to groundwater
 - h. Proximity to wells

Competency Area 6. Site-Specific Soil Management

01. Define site-specific management and understand the process to properly assess within-field variability.
02. Understand how to locate a position in a field using latitude and longitude.
03. Explain the function of site-specific management tools:
 - a. Differentially corrected GPS
 - b. Crop yield monitors and yield mapping software
 - c. Variable-rate application for fertilizer, manure, biosolids, and lime; planters; sprayers; and irrigation
 - d. Electrical conductivity mapping
 - e. Mapping and data management software
04. Understand the use and limitations of methods used to assess within-field variability of soil properties:
 - a. Grid-point sampling method and grid size
 - b. Management zones
 - c. Remote sensed and other digital imagery
 - d. On-the-go sensors
 - e. Yield mapping
05. Describe advantages and disadvantages associated with site-specific management.

Competency Area 7. Land Application of Municipal and Industrial Wastes

01. Discuss the agronomic and regulatory considerations for the land application of waste materials.

02. Describe characteristics of the following waste materials:
 - a. Municipal biosolids
 - b. Cheese plant wastewater
 - c. Solid waste compost
 - d. Construction debris
 - e. Papermill fiber sludge
 - f. By-product liming materials
 - g. Industrial wastewater and solids
 - h. Coal-burning powerplant by-products

03. Regarding regulations controlling land application of waste materials:
 - a. List information needed to apply for appropriate permits
 - b. Discuss the factors affecting setbacks required for land applications
 - c. Describe method for determining material application rate
 - d. Discuss potential impacts on environmental quality and human or animal health

Competency Area 8. Water and Solute Movement

01. Explain the importance of the following components with respect to the soil water cycle and Wisconsin's agricultural water budget:
 - a. Precipitation
 - b. Irrigation
 - c. Runoff quantity and velocity
 - d. Soil water storage
 - e. Evapotranspiration
 - f. Percolation
 - g. Tiling and ditching

02. Describe how the following factors influence infiltration:
 - a. Soil texture
 - b. Soil structure
 - c. Crop residue cover
 - d. Crop canopy
 - e. Soil organic matter
 - f. Surface crusting
 - g. Landscape position
 - h. Soil compaction
 - i. Soil pore size distribution
 - j. Soil fauna and microorganisms
 - k. Cover crops

03. Describe the forces that regulate water flow under saturated and unsaturated conditions.

04. Explain the significance of the following factors with respect to the leaching of solutes:
 - a. Depth to groundwater and bedrock
 - b. Soil infiltration rate
 - c. Natural and man-made soil layers
 - d. Macropores
 - e. Evapotranspiration
 - f. CEC

- g. Soil organic matter
 - h. Soil texture
 - i. Material solubility
 - j. Persistence of organic compounds
05. Define preferential flow and its effect on solute movement.
06. Describe how the following management practices affect solute movement:
- a. Application timing
 - b. Application rate
 - c. Erosion control
 - d. Irrigation
 - e. Tillage method
 - f. Presence of tile drainage
07. Describe management practices that minimize N and Ps transport from a field.
09. Describe Wisconsin's agricultural water budget as it relates to crop production and soil and nutrient management.
10. Understand the ability of cover crops to attenuate plant nutrients.

Competency Area 9. Irrigation

01. Describe the following irrigation methods:
- a. Sprinkler
 - b. Low pressure
 - c. Drip/trickle
02. List the factors used in developing an irrigation schedule.
- a. Evapotranspiration (ET)
 - b. Crop canopy
 - c. Soil water holding capacity
 - d. Crop rooting depth
03. Explain regulations associated with placing irrigation systems.

Competency Area 10. Agricultural Drainage

01. Explain regulations associated with installing agricultural drainage systems.
02. Identify characteristics of well-drained and poorly drained soils.
03. Describe the following drainage methods:
- a. Tile
 - b. Open ditch
 - c. Land forming and surface drainage
 - d. Diversions
04. Identify soil data used to determine the effectiveness of tile drainage.

05. Understand the basic design criteria and components for a tile drainage system.
06. Describe field characteristics that identify inoperative tile lines.

Competency Area 11. Soil Health

01. Define soil health in the context of crop production.
02. Describe factors that affect soil health in a crop production system.
03. Describe methods of assessing soil health.
04. Identify soil management practices that can improve soil health.

Competency Area 12. Water Quality

1. Describe how nutrients, pesticides and sediments move off fields and negatively impact water quality.
 - a. Overland in runoff
 - b. Into and through tile lines
 - c. Through macropores and karst features
 - d. Spray drift
2. Discuss the risks and application restrictions for spreading manure on:
 - a. Frozen and snow-covered soils
 - b. Land in karst topography or other features with open access to groundwater
 - c. Sloping land
 - d. Land adjacent to surface water
 - e. Soils with high leaching potential
 - f. Land adjacent to wells
 - g. Tile drained soils
 - h. Poorly drained soils
 - i. Excessively drained soils
 - j. Soils with impervious layers
 - k. Land with shallow depth to bedrock
3. Understand how to use the Manure Management Advisory System.
4. Identify the contaminants in groundwater that may come from agriculture.
5. Describe how agricultural practices may affect drinking water quality.
6. State the nitrate drinking water enforcement standard.
7. Cite the human health consequences of drinking water contaminated with nitrate and coliform bacteria.
8. Describe management practices to minimize groundwater contamination by nitrate and other compounds.

9. Identify the contaminants in surface water that may come from agriculture.
10. Understand how the Phosphorus Index can be used to reduce the risk of phosphorus loss to surface water.
11. Explain how sediment in runoff affects water quality.
12. Describe the effect of tillage and timing of manure applications on phosphorus delivery to surface water.
13. Understand the source and difference between soluble and particulate-P.
14. Understand the relationship between soil test P and P loss in runoff and describe management practices that would limit the P loss from high-testing soils.
15. Describe hypoxic zone in the Gulf of Mexico and discuss its relationship to agriculture.
16. Understand the criteria of a Surface Water Quality Management Area and how to create a map showing restrictions.
17. Understand how pharmaceuticals, personal care products, and other chemicals associated with human and livestock health can be found in surface water.
18. Recognize the role of the USDA-NRCS Nutrient Management Standard 590 and WDNR Codes NR 243 and NR 151 for protecting water resources.

WISCONSIN CERTIFIED CROP ADVISER PERFORMANCE OBJECTIVES

Pest Management Competency Areas:

- 1. Integrated Pest Management**
- 2. Weed Management**
- 3. Insect Management**
- 4. Plant Disease Management**
- 5. Pesticides and the Environment**
- 6. Pesticides and Employee and Public Protection**
- 7. Pesticide Use Records**
- 8. Pesticide Labels and Registration**

PEST MANAGEMENT PERFORMANCE OBJECTIVES

Competency Area 1. Integrated Pest Management

01. Identify the different IPM tactics (e.g. cultural, biological, mechanical, etc.) and describe their use in an IPM program.
02. Describe the scouting techniques for the key pests of major Wisconsin crops.
03. Identify what crop and pest management information is needed to develop an IPM program.
04. Define economic threshold and economic injury level, and describe how they can be used in formulating IPM recommendations.
05. List the advantages and limitations of chemical and non-chemical pest control tactics.
06. Relate the importance of Wisconsin's environmental conditions and how it affects pests, pest populations and crop production. (For example, pest migration and time of arrival, disease potential vs. environmental conditions).

Competency Area 2. Weed Management

01. Identify Wisconsin's common weeds:
 - a. Canada thistle
 - b. Common lambsquarters
 - c. Common ragweed
 - d. Crabgrass, large
 - e. Crabgrass, smooth
 - f. Dandelion
 - g. Eastern black nightshade
 - h. Fall panicum
 - i. Field bindweed
 - j. Field pennycress
 - k. Foxtail, giant
 - l. Foxtail, green
 - m. Foxtail, yellow
 - n. Giant ragweed
 - o. Hemp dogbane
 - p. Horseweed (Marestail)
 - q. Palmer amaranth
 - r. Quackgrass
 - s. Redroot pigweed
 - t. Shepherd's purse
 - u. Velvetleaf
 - v. Yellow nutsedge
 - w. Yellow rocket
 - x. Woolly Cupgrass
 - y. Waterhemp
 - z. Wild Proso Millet

02. Explain how herbicide-resistant weed populations develop and describe effective management strategies to control resistance.
03. Know the current herbicide-resistant weeds in Wisconsin.
04. Describe management strategies to limit the spread of herbicide-resistant weeds including herbicide mode of action that support herbicide resistance.
05. Describe the mode of action and injury symptoms for common herbicides used on Wisconsin crops.
06. Outline appropriate management strategies in no-till, minimum till and conventional tillage systems for annual, winter annual, biennial and perennial weeds in Wisconsin crops.
07. Understand the methodology, herbicide selection, and timing of weed management that effectively control weeds.
 - a. Burndown
 - b. Pre-plant incorporation
 - c. Pre- and Post-emergence
 - d. Residual vs. contact herbicide
08. Explain how cultural practices impact weed management.
09. Describe mechanical and other non-herbicide weed control methods.
10. Explain why weed competitive indices and thresholds differ among field, vegetable, and forage crops.
11. Understand the relationship between timing of weed removal and yield in Wisconsin crops.
12. Describe how cover crops can be used to reduce weed pressure.

Competency Area 3. Insect Management

01. Identify each of the following insect, mite, and slug pests, their feeding habits, injury symptoms, life cycle, economic threshold (if available), and appropriate management tactics:
 - a. Alfalfa weevil
 - b. Bean leaf beetle
 - c. Black cutworm
 - d. Colorado potato beetle
 - e. Corn earworm
 - f. Corn rootworm
 - g. European corn borer
 - h. Green peach aphid
 - i. Hop vine borer
 - j. Japanese beetle
 - k. Potato leafhopper

- l. Seed corn maggot
 - m. Slugs
 - n. Soybean aphid
 - o. Stalk borer
 - p. Tarnished and alfalfa plant bugs
 - q. Two-spotted spider mites
 - r. True armyworm
 - s. Variant western corn rootworm
 - t. Western bean cutworm
 - u. White grubs
 - v. Wireworms
02. Identify the common beneficial insects (e.g., lady beetle larvae and adults, damsel bugs) found in Wisconsin cropping systems.
03. Explain the role natural enemies (e.g., predators, parasitoids, and insect pathogens) have in insect pest management programs and how they can affect pest abundance.
04. Describe how crop production, crop sequence, environmental conditions, tillage, and weed control influence the potential for occurrence of insect and mite pests.
05. Outline insect resistance management programs:
- a. Understand why an IPM program is important for resistance management
 - b. Recognize insects which currently have resistance concerns in Wisconsin and understand how to manage them using an IPM approach
 - c. Recognize insects which could potentially have resistance concerns in Wisconsin and how to implement an IPM program that would delay resistance
 - d. Understand why the Insecticide Resistance Action Committee (IRAC) codes are useful and how they should be applied
 - e. Understand insecticide and miticide mode of action for the following classes:
 - i. Carbamates
 - ii. Diamides
 - iii. Microbials
 - iv. Neonicotinoids
 - v. Organophosphates
 - vi. Synthetic pyrethroids
06. Understand how the use of agricultural insecticides can affect honey bees and other insect pollinators and describe appropriate mitigation practices to prevent these impacts.

Competency Area 4. Plant Disease Management

01. Identify symptoms, environmental factors, and appropriate management options for the following diseases and pathogens for Wisconsin crops:
- a. Alfalfa
 - i. Anthracnose
 - ii. Aphanomyces root rot
 - iii. Downy mildew
 - iv. Fusarium wilt
 - v. Phytophthora root rot

- vi. Root-knot nematode
 - vii. Spring black stem
- b. Soybean
- i. Bacterial blight
 - ii. Bean pod mottle virus
 - iii. Brown stem rot
 - iv. Charcoal rot
 - v. Frog eye leaf spot
 - vi. Phytophthora rot and stem rot
 - vii. Pod and stem blight
 - viii. Septoria brown spot
 - ix. Soybean mosaic
 - x. Soybean cyst nematode
 - xi. Stem canker
 - xii. Sudden death syndrome
 - xiii. Tobacco streak virus
 - xiv. White mold
- c. Corn
- i. Anthracnose leaf blight and stalk rot
 - ii. Ear rot (Gibberella, Fusarium)
 - iii. Eyespot
 - iv. Gibberella stalk rot
 - v. Goss's wilt
 - vi. Gray leaf spot
 - vii. Northern corn leaf blight
 - viii. Root lesion nematode
 - ix. Rust, common
 - x. Rust, southern
 - xi. Seedling blight
 - xii. Stewart's wilt
 - xiii. Tar spot
- d. Small Grains
- i. Barley yellow dwarf/oat red leaf
 - ii. Ergot
 - iii. Fusarium head blight (Scab)
 - iv. Powdery mildew
 - v. Rust, leaf
 - vi. Rust, stripe
 - vii. Septoria leaf blotch
 - viii. Take-all root rot
- e. Potatoes
- i. Common scab
 - ii. Late blight
 - iii. Early blight
 - iv. Early dying (Verticillium and root lesion nematode)
 - v. Potato Y virus

- f. Snapbean and Peas
 - i. Aphanomyces root rot
 - ii. Bacterial brown spot
 - iii. Pythium
 - iv. Rhizoctonia root rot
 - v. White mold
02. Identify how environmental and host factors relate to disease development.
 03. Recognize clues as to whether a problem is caused by an abiotic agent or pathogen.
 04. Identify strategies to manage pesticide resistance in pathogen populations that reduce the risk of selecting resistant strains.
 05. Describe nematode biology and management practices for Wisconsin crops.
 06. Discuss the use of fungicides for disease control and how to prevent resistance from developing.
 07. Identify computer models or smartphone apps that can be used to assess the risk of plant disease development and severity.

Competency Area 5. Pesticides and the Environment

01. Understand the difference between “drift” and “overspray”, describe Wisconsin’s regulations regarding them, and discuss appropriate prevention methods.
02. Describe the relation of each of the following to drift:
 - a. Weather conditions
 - b. Spray particle size, including those factors which influence particle size
 - c. Method of application, nozzle type, and nozzle height
03. List ways in which a pesticide can move from the site of application.
04. Describe each of the following and its effect on the movement of a pesticide from a target site:
 - a. Adsorption
 - b. Solubility
 - c. Volatility
 - d. Degradation
 - e. Persistence
05. Discuss management practices that prevent groundwater and surface water contamination from pesticide use.
06. Identify point and nonpoint sources of pollution.
07. Distinguish between preventative action limits and enforcement standards with respect to groundwater contamination from pesticides.

Competency Area 6. Pesticides and Employee and Public Protection

01. Identify when employers, employees and pesticide applications are covered by the Worker Protection Standard (WPS).
02. Identify who must receive WPS safety training and when.
03. Identify who can be in a treatment area during an application that is covered by the WPS.
04. Identify who may enter a treated site during a restricted-entry interval.
05. Know the conditions and restrictions for early entry with no contact and early entry with contact into a treated site.
06. Understand the role of State and Federal agencies with respect to pesticide application regulations.

Competency Area 7. Pesticide Use Records

01. Determine when and for how long pesticide application records must be kept.
02. Understand Wisconsin's atrazine use law.
03. Describe when state and federal regulatory agency personnel may request pesticide application records.
04. Recognize that pesticide application under emergency exemption (Section 18) or local need (Section 24 {C}) will require additional record keeping and reporting requirements.

Competency Area 8. Pesticide Labels and Registration

01. Understand that the label and supplemental labeling are legally binding documents.
02. Explain what to do if state laws are stricter than label directions.
03. Specify which directions should be followed when using a product whose label has changed since it was purchased.
04. Know how to determine if a pesticide is registered for use in Wisconsin through the WDATCP.
05. Describe and locate the kinds of information that appear on a pesticide label.
06. List the four ways in which a person may legally deviate from pesticide label directions.
07. Explain how a pesticide product's signal word and relative toxicity are related.

WISCONSIN CERTIFIED CROP ADVISER PERFORMANCE OBJECTIVES

Crop Management Competency Areas:

- 1. Soil Adaptation for Major Wisconsin Crops**
- 2. Cropping Systems**
- 3. Crop Establishment**
- 4. Crop Management during Growth and
Development**
- 5. Harvest Factors**

CROP MANAGEMENT PERFORMANCE OBJECTIVES

Competency Area 1. Soil Adaptation for Major Wisconsin Crops

01. Explain the optimum pH range for the major Wisconsin crops and how these crops respond to pH modification.
02. Describe the relative nutrient requirements of the major Wisconsin crops.
03. Explain the specific environmental and soil conditions that influence the selection and production strategies for the major Wisconsin crops.

Competency Area 2. Cropping Systems

01. Understand the management, environmental, and economic considerations in making crop rotation decisions involving major Wisconsin crops.
02. Understand management, environmental, and economic consequences of forage-based versus cash grain rotations.
03. Recognize the ramifications associated with introduction of a processing crop into a cash grain or forage system.
04. Identify the advantages and limitations of using cover crops as related to species selection, establishment, and termination.
05. Explain the advantages and limitations of organic crop production systems.
06. Understand the ramifications of minimum-till and no-till strategies as they relate to cropping system and rotation decisions.

Competency Area 3. Crop Establishment

01. Understand the role of plant breeding for establishing traits in major Wisconsin crops and recognize major advances that affect modern crop production.
02. Describe the environmental and cultural factors influencing seeding depth, seeding rate, and row spacing for common Wisconsin planting systems.
03. Discuss how tillage management considerations may impact crop establishment for various cropping systems.
04. Identify principles underlying optimum planting time, the consequences of planting too early or too late, and the effect of relative maturity for major Wisconsin crops.
05. Explain how each major crop responds to changes in row spacing (including twin rows) and plant population.
06. Describe the value of inoculation of legume seed and the environments in which it should be done.

07. Know how to calculate seeding rates and plant populations.
08. Describe the effect of seed quality on germination and crop growth.
09. Know the conditions where seed treatments for insects, diseases, growth regulators, micronutrients, inoculants, and animal repellents will provide an economic benefit.
10. Identify and utilize the information required on seed tags.
11. Understand the criteria for selecting adapted crop varieties and hybrids:
 - a. Emergence
 - b. Disease and pest resistance
 - c. Population and row spacing
 - d. End use
 - e. Soil type
 - f. Location in state
 - g. Drought tolerance
 - h. Resistance to lodging
 - i. Yield performance across multiple locations
12. Explain the advantages and limitations of planting transgenic crops.
13. Understand the various GMO events and how they impact management.
14. Identify the advantages and disadvantages of value-added crops.
15. Explain the basic components of precision agriculture and its advantages and disadvantages including variable-rate application of inputs, variable seeding, and yield mapping.

Competency Area 4. Crop Management During Growth and Development

01. Recognize and utilize growth staging systems for the major crops.
02. State the factors influencing winter hardiness of forages and winter wheat and the effect management practices have on winter survival.
03. Demonstrate awareness of diagnostic techniques such as soil and plant analysis; nematode testing; insect, weed and disease identification; and proper sample submission to diagnostic laboratories.
04. Calculate growing degree-days and relate the growing degree-day concept to corn and other crop development.
05. Describe how environmental, water, and nutrient needs of crops change during crop growth and developmental stages and how these factors affect maximum crop yield.
06. Identify the factors used to determine delayed planting or replant decisions.

07. Understand diagnostic methods to assess the impact of, and options for addressing the following:
- a. Winter kill
 - b. Hail
 - c. Frost
 - d. Fertilizer/chemical damage
 - e. Wildlife damage
 - f. Insect or disease injury
 - g. Flooding
 - h. Drought stress

Competency Area 5. Harvest Factors

01. Explain the optimum stage at which to harvest the major Wisconsin crops for grain, forage, or edible plant part and understand how harvest management and timing affects yield and quality.
02. Explain the consequences relative to soil conservation nutrient management for baling, grazing, or chopping crop residue.
03. Explain how fall harvest management of alfalfa affects yield, winter survival and feed value of the following year's crop.
04. Cite the appropriate moisture ranges for forages stored in various structures (upright silos, bunkers, bags, etc.).
05. Understand crop drying and processing systems.
06. Describe harvest and grading factors for crop use.
07. Know the harvest and storage factors that impact crop quality and yield losses for the major Wisconsin crops:
- a. Cut/chop length
 - b. Ensiling and fermentation
 - c. Packing and sealing in storage structures
08. Understand methods to estimate crop yield and determine harvest losses for various crops.

WISCONSIN CERTIFIED CROP ADVISER PERFORMANCE OBJECTIVES

References:

- 1. Nutrient Management**
- 2. Soil and Water Management**
- 3. Pest Management**
- 4. Crop Management**
- 5. Other University of Wisconsin Cooperative
Extension Publications**
- 6. Other Publications**
- 7. Websites**

REFERENCES

The following publications are available from the Division of Extension, University of Wisconsin-Madison Publications:

**Division of Extension
University of Wisconsin-Madison
432 N. Lake St., Madison, WI 53706
877-947-7827
<http://learningstore.uwex.edu/>**

Nutrient Management

- Sampling Soils for Testing. (UWEX publication # A2100)
- Understanding Plant Nutrients Series –
Soil and Applied:
 - Nitrogen. (UWEX publication # A2519)
 - Phosphorus. (UWEX publication # A2520)
 - Potassium. (UWEX publication # A2521)
 - Boron. (UWEX publication # A2522)
 - Calcium. (UWEX publication # A2523)
 - Magnesium. (UWEX publication # A2524)
 - Sulfur. (UWEX publication # A2525)
 - Manganese. (UWEX publication # A2526)
 - Copper. (UWEX publication # A2527)
 - Zinc. (UWEX publication # A2528)
 - Iron. (UWEX publication # A3554)
 - Molybdenum. (UWEX publication # A3555)
 - Chlorine. (UWEX publication # A3556)
- Nutrient Application Guidelines for Field Vegetable and Fruit Crops in Wisconsin. (UWEX publication # A2809)
- Management of Wisconsin Soils. (UWEX publication # A3588)

Soil and Water Management

- Management of Wisconsin Soils. (UWEX publication # A3588)
- Estimating Residue Using the Line Transect Method. (UWEX publication # A3533)
- Irrigation Management in Wisconsin – The Wisconsin Irrigation Scheduling Program (WISP). UWEX publication # A3600

Pest Management

- Field Crop Scout Training Manual, <https://ipcm.wisc.edu/download/pubsPM/UW-IPM-ScoutingManual-web.pdf>
- Pest Management in Wisconsin Field Crops (UWEX publication # A3646)
- Commercial Vegetable Production in Wisconsin (UWEX publication #A3422)
- Weeds of the North Central States (UWEX publication # NCR 281)
- Reduced Herbicide Rates: Aspects to Consider (UWEX publication # A3563)
- Common Weed Seedlings of the North Central States (UWEX publication # NCR 607)
- Corn Rootworm (UWEX publication # A3328)
- The European Corn Borer (UWEX publication # A1220)
- Alfalfa Management Guide (UWEX publication # NCR 547)
- Red Clover-Establishment, Management and Utilization (UWEX publication # A3492)
- Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)
- Wisconsin Pesticide Law (Chapter 94. 67-71)
- Wisconsin Groundwater Law (Chapter 160)
- Wisconsin Spill Law (Chapter 144.76)
- Pesticide Use and Control (Chapter ATCP 29)
- Pesticide Product Restrictions (Chapter ATCP 30)
- Worker Protection Standard How to Comply Manual
- Training Manual for the Commercial Pesticide Applicator: Field & Vegetable Crops (available from UWEX Pesticide Applicator Training Program)
- Training Manual for the Private Pesticide Applicator (available from your county Extension office)

Contact the UWEX Pesticide Application Program for current pesticide rule publications (608-262-7588)

Crop Management

- Alfalfa Management Guide. (UWEX publication # NCR 547)
- Commercial Vegetable Production in Wisconsin. (UWEX publication # A3422)
- Small Grain Varieties for Grain and Forage in Wisconsin. (UWEX publication # A3397)
- Selecting Corn Hybrids (UWEX publication # A3265)
- Uneven Emergence in Corn (UWEX publication # NCR 344)

Other University of Wisconsin Cooperative Extension Publications

- Field Crop Scouting Manual (available from UWEX IPM Program, 608-263-4073, also available at: <http://ipcm.wisc.edu/>)
- Vegetable Crop Scouting Manual (available from UWEX IPM Program, 608-263-4073, also available at: <http://ipcm.wisc.edu/>)

- Training Manual for the Commercial Pesticide Applicator: Field & Vegetable Crops, 4th edition (available from UWEX Pesticide Applicator Training Program, 608-262-7588)
- Pest Management Principles for the Private and Commercial Applicator: Agriculture Fumigation, 2nd edition (available from UWEX Pesticide Applicator Training Program, 608-262-7588)

Other Publications

- Identification of Aphids on Small Grains (Washington State University, publication # EB0003, Telephone: 1-800-723-1763)
- Vegetable Insect Management with Emphasis on the Midwest (Meister Publishing Company, Willoughby, Ohio)
- Ontario Weeds (Publications Ontario, 416-326-5300)
- Weeds of Nebraska and the Great Plains (Nebraska Dept. of Agriculture, Bureau of Plant Industry, P.O. Box 94756, Lincoln, NE 68509)
- Weeds of the Northeast (CUP Services, Telephone 607-277-2211)
- Waterhemp Management in Agronomic Crops (publications # X855, Communication Services, University of Illinois at Urbana-Champaign, telephone 217-333-2007)
- Guide to Herbicide Injury Symptoms in Corn (Agri-Growth Research, telephone 507-889-4371)
- Guide to Herbicide Injury Symptoms in Soybean (Agri-Growth Research, telephone 507-889-4371)
- Crop Protection Reference (C & P Press, <http://www.greenbook.net>)
- Church, G.A. (Mgr.). 1992. Conservation Tillage Systems and Management. MWPS-45. Midwest Plan Service. Ames, Iowa
- USDA-NRCS Nutrient Management Standard 590 (Sept. 2005)
- USDA-NRCS Wisconsin Conservation Planning Technical Note WI-1
- WDATCP Soil and Water Resource Management Chapter ATCP 50
- WDNR Runoff Management Chapter NR 151

Websites:

<http://www.weeds.iastate.edu/> Iowa State University Weed Science Program, Department of Agronomy

Wisconsin Department of Agriculture, Trade and Consumer Protection, Agriculture Resource Management Division

https://datcp.wi.gov/Pages/Programs_Services/NutrientManagement.aspx

https://datcp.wi.gov/Pages/Programs_Services/PesticidesFertilizersCertificationLicensing.aspx

University of Wisconsin Extension and College of Agricultural and Life Sciences websites

http://www.uwex.edu/ces/crops/uwforage/uwforage.htm	University of Wisconsin-Extension Team Forage
http://www.uwex.edu/ces/forage/	University of Wisconsin Forage Research and Extension
http://ipcm.wisc.edu/	UW Integrated Crop and Pest Management Programs (NPM, IPM, PAT)
http://www.wiscweeds.info	UW-Weed Science
http://www.plantpath.wisc.edu/soyhealth/	UW-Soybean Plant Health web site
http://soybean.uwex.edu/	UW Soybean Extension
http://corn.agronomy.wisc.edu/	Wisconsin Corn Agronomy
https://coolbean.info/	Wisconsin Soybean Agronomy
http://ipcm.wisc.edu/wcm/	Wisconsin Crop Manager
http://www.uwex.edu/ces/ag/teams/grains/	Extension, Team Grains
http://fyi.extension.wisc.edu/fieldcroppathology	Wisconsin Field Crop Pathology
http://wivegdis.plantpath.wisc.edu/	Plant Disease Diagnostics Clinic
http://fyi.extension.wisc.edu/pat/	Pesticide Applicator Training
http://labs.russell.wisc.edu/vegento/	Vegetable Crop Entomology
http://www.entomology.wisc.edu/diaglab/entodiag.html	Insect Diagnostic Lab
http://agronomy.wisc.edu/	UW Department of Agronomy
http://www.entomology.wisc.edu/	UW Department of Entomology
http://www.horticulture.wisc.edu/	UW Department of Horticulture
http://www.plantpath.wisc.edu/	UW Department of Plant Pathology
http://www.soils.wisc.edu/extension/	UW Soil Science Research and Extension
http://uwlab.soils.wisc.edu/	Wisconsin Soil and Plant Analysis Lab
http://www.soils.wisc.edu/wimnext/	UW-MN Cooperative Extension Agricultural Weather
http://fyi.uwex.edu/fieldcroppathology/	UW Field Crop Pathology
http://www.plantpath.wisc.edu/wivegdis/	UW Vegetable Pathology
https://datcp.wi.gov/Documents/NM590Summary2015.pdf	DATCP 590 Nutrient Management
http://www.uworganic.wisc.edu/	UW Organic Production