

**Iowa Certified Crop Adviser**  
**Performance Objectives**

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# NUTRIENT MANAGEMENT

## Basics of Soil Fertility

1. Know the elements essential for plant growth (listed below). Understand which elements are mobile in the plant.

Carbon	Sulfur	Phosphorous	Iron
Hydrogen	Boron	Potassium	Manganese
Oxygen	Chlorine	Calcium	Molybdenum
Nitrogen	Copper	Magnesium	Zinc

2. Understand the ionic form in which essential elements are taken up by plants from the soil.

3. Define cation exchange capacity (CEC) and understand its relationship with soil properties and base saturation. Understand the relationship between CEC and mobility and plant availability of nutrients in the soil.

4. Understand nutrient movement in soil and water. Understand how the factors listed below influence nutrient movement and availability.

Soil texture, structure, and bulk density	Soil pH
Drainage – surface and subsurface	Soil slope and crop residue cover
Nutrient form – cations and anions	Rate of nutrient application
Time of nutrient application	Precipitation – amount and distribution

5. Understand the nutrients available from materials other than commercial fertilizers, including the following:

Manures	Legumes	Sludges	By-products
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6. Understand the effect of soil pH on nutrient availability and suitability of growing specific crops. Understand the relationship between soil pH and buffer pH.

7. Understand the effect of different fertilizer materials on soil pH

8. Understand the effects of the following factors on liming practices.

Soil characteristics	CEC	Liming material and quality
Depth of incorporation	Cropping system	ECCE

9. Understand the composition and role of gypsum, dolomitic limestone, calcitic limestone, etc in soil management.

10. Recognize deficiency symptoms of the following nutrients in corn, soybean, alfalfa and small grains.

Nitrogen	Potassium	Phosphorous	Magnesium
Sulfur	Zinc	Iron	Boron

## Nitrogen

11. Understand the nitrogen cycle in soils and know the mechanisms and the nitrogen forms involved in each of the following processes.  
Mineralization      Nitrification      Immobilization      Fixation
12. Understand the nitrogen loss pathways and role of nitrification and urease inhibitors.  
Leaching              Denitrification              Volatilization from soils and plants  
Crop removal              Soil erosion/ overland flow
13. Understand the availability of nitrogen from common organic sources and how C/N ratio affects nitrogen availability.
14. Recognize the factors that determine appropriate nitrogen fertilization rates.
15. Recognize the analysis, physical form, and handling precautions of each of the following nitrogen fertilizer materials and understand their effect on soil pH and nitrogen availability. Understand the products advantages and disadvantages in different situations.  
Anhydrous ammonia      Urea              Ammonium nitrate  
MAP and DAP              UAN solutions      Ammonium sulfate
16. Understand the proper methods, benefits and limitations of in-season tests used to assess nitrogen needs or availability (late-spring soil nitrate, late season cornstalk nitrate, chlorophyll readings).

## Phosphorus

17. Recognize how each of the following factors affect phosphorus fertilization.  
Soil properties              Cropping system              Availability of soil phosphorus  
Soil test level              Crop grown              Environmental concerns  
Iowa P Index              Availability of capital
18. Recognize how each of the following factors affect soil retention and fixation of phosphorus and related losses through erosion.  
Soil clay              Soil pH              Soil texture  
Crop residue              Tillage system
19. Recognize the analysis, physical form, handling precautions, and phosphorus availability of each of the following fertilizer phosphorus materials. Understand the advantages and disadvantages of their use in different systems and application methods.  
Diammonium phosphate      Monoammonium phosphate      Triple superphosphate  
Ordinary superphosphate      Ammonium polyphosphate      Manure (by species)

## Potassium

20. Recognize how each of the following factors affects potassium fertilization.  
Soil properties              Availability of soil potassium              Soil test level  
Cropping system              Tillage system      Crop grown              Availability of capital

21. Recognize the analysis, physical form, handling precautions, potassium availability, and relationship to chloride in soils of each of the following potassium fertilizer materials.  
Potassium chloride    Potassium sulfate    Potassium nitrate    Manure (by species)

### Secondary and Micronutrients

22. Identify plant deficiency symptoms of each of the following secondary and micronutrients in corn, soybean, alfalfa, and small grains. Recognize soil properties and nutrient interactions affecting their availability to plants.

Magnesium    Sulfur    Zinc    Iron    Boron

23. Understand the advantages and disadvantages of each of the following practices for correcting and micronutrient deficiencies and toxicities.

Foliar application    Soil application    Adjusting soil pH

### Soil and Plant Sampling Analysis

24. Understand Iowa industry-standard (ISU), recommended soil sampling and handling procedures and the effect of the following factors on soil test results and interpretations.

Taking consistent, representative samples    Time of sampling  
Depth of sampling    Sample location (within the fields)  
Frequency of sampling    Sampling density (number per acres)

25. Interpret laboratory soil and plant test reports for the following:

Degree of nutrient deficiency or adequacy  
Expected crop response to applied nutrients  
Units of measure and conversion between different units  
The effect of the following extractants on soil test P results  
Bray P-1    Mehlich-3 P    Mehlich-3    ICP Olsen P

26. Know the appropriate plant parts and crop development stage to sample when determining the nutrient status of the following crops.

Corn    Soybean    Alfalfa    Small grains

## **SOIL AND WATER MANAGEMENT**

### Soils and Landscapes

1. Understand how to use Soil Survey maps for identifying the following:  
Soil properties    Suitability of soils for specific purposes  
Soil types    Soil slopes  
Field location and size
2. Understand the relationships among the following:  
Soil order    Soil family    Soil series    Soil type    Soil map unit
3. Understand the major sources of soil parent materials in Iowa. Recognize general management considerations associated with different soil parent materials (loess, glacial till, alluvium, etc.).

## Soil Properties

4. Understand how the following soil properties influence soil performance in terms of nutrient, water and herbicide retention, crop productivity, erosion and compaction.

Soil texture      Organic matter      Soil structure      Parent material      Bulk density

5. Recognize the effects of soil structure, plant cover, plant residue, and tillage system on water infiltration, soil erosion, soil temperature, and soil moisture.

6. Understand the differences between saturated and unsaturated water flow.

7. Understand the advantages and disadvantages of using surface and subsurface drainage to manage excess water.

## Soil Erosion

8. Understand the different phases of water erosion.

Detachment      Transportation      Deposition

9. Understand the different types of wind erosion.

Saltation      Creep      Suspension

10. Understand the relationship between the slope and slope length on erosion losses.

11. Identify and understand the following erosion control practices recommended for use in Iowa

Residue management	Tillage systems
Terracing	Grass waterways
Crop rotation	Vegetative filter strips
Windbreaks	Contouring

12. Understand the variables used in RUSLE2 and the Iowa P Index to assess the risk of erosion and phosphorous losses and how these tools are used.

## Tillage

13. Recognize how each of the following factors influence the selection and use of tillage systems.

Crop rotation/field history      Land shape      Soil properties  
Field design (terrace and waterway spacings, point rows, etc.)  
Governmental program requirements (HEL, nonHEL)

14. Describe the influence of tillage systems and tillage implements on each of the following:

Soil disturbance/compaction/bulk density	Crop residue on the soil surface
Incorporation of fertilizers, lime, and pesticides	Weed control
Soil organic matter	Soil microbiology

## Residue Cover

15. Recognize how each of the following factors affect soil residue cover.
- |                                   |                             |         |                |
|-----------------------------------|-----------------------------|---------|----------------|
| Crop rotation                     | Harvesting methods          | Weather | Tillage system |
| Fertilizer and manure application | Post harvest stover removal |         |                |
| Harvest equipment settings        |                             |         |                |
16. Know how to measure soil residue cover and how to apply the results in a management system.

## **PEST MANAGEMENT**

### General Pesticide Use

1. Know the differences between General and Restricted use pesticides.
2. Understand the basic parts of a pesticide label.
3. Understand label restrictions:

Restricted-entry intervals (R.E.I.s)	Pre-harvest intervals (P.H.I.s)
Worker protection standards (WPS)	Crop rotation intervals
Forage and grazing restrictions	
4. Understand how pesticide resistance develops and where you can find resistance management information on the label.
5. Be familiar with pesticide and pesticide container disposal and pesticide spill cleanup.
6. Be familiar with laws and regulations and terminology related to pesticide use (for example: FIFRA, FFDCA, registration).
7. Understand potential consequences of pesticide use on non-target organisms and the environment. Understand the procedures required by the Iowa Bee Rule.
8. Use information found on pesticide labels to determine appropriate pesticide rates, additives and application timings.
9. Recognize how the following factors affect spray delivery, spray coverage, and off-target movement.

Spray pressure	Application speed
Nozzle type & spacing	Spray droplet size
10. Recognize how movement of pesticides in soil or into surface or groundwater may be affected by the following pesticide and soil properties.

Soil texture/organic matter	Erosion and erosion control practices
Depth of water table	Precipitation and runoff
Pesticide application	Pesticide degradation and persistence

11. Differentiate between point and non-point sources of pollution and describe practices that reduce point and non-point source contamination.

### Weed Management

12. Identify the following weeds at all growth stages by common name. Know the characteristics of different life cycles and classify each weed by life cycle.

**Grass family:** quackgrass downy brome field sandbur large crabgrass  
barnyardgrass woolly cupgrass wirestem muhly witchgrass  
fall panicum giant foxtail green foxtail yellow foxtail shattercane

**Smartweed family:** Pennsylvania smartweed swamp smartweed curly dock  
smooth dock wild buckwheat

**Spurge family:** leafy spurge toothed spurge

**Lambsquarter family:** lambsquarters kochia russian thistle

**Pigweed family:** redroot pigweed waterhemp smooth pigweed Palmer amaranth

**Mustard family:** wild mustard field pennycress

**Mallow family:** velvetleaf Venice mallow

**Carrot family:** wild carrot wild parsnip poison hemlock

**Milkweed family:** common milkweed hemp dogbane

**Morningglory family:** field bindweed hedge bindweed tall morningglory

**Nightshade family:** jimsonweed smooth groundcherry horsenettle black nightshade

**Sunflower family:** giant ragweed common ragweed cocklebur common  
sunflower musk thistle bull thistle Canada thistle horseweed dandelion

**Other weeds:** Horsetail scouring rush common mullein henbit  
wild hemp Asiatic dayflower yellow nutsedge

14. Understand the following principles relating to weed management:

Weed seed bank dynamics

Competitive interactions between crops and weeds

15. Understand the effects of tillage on weed populations and herbicide effectiveness.

16. Understand the factors that affect the effectiveness of rotary hoeing and inter-row cultivation and their roles in weed management.



17. Understand the interactions between herbicides, soil colloids and water in determining the effectiveness and fate of herbicides in the soil.
18. Understand the advantages and disadvantages of herbicide application timing:
- |                |                       |
|----------------|-----------------------|
| Early preplant | Preplant incorporated |
| Preemergence   | Postemergence         |
19. Understand how environment and spray additives influence the effectiveness of postemergence herbicides.
20. Know the factors that influence the development of herbicide resistance and ways to reduce the risk of selecting herbicide resistant weed biotypes.
21. For the following herbicide groups, be able to identify injury symptoms, potential risks for herbicide resistant weeds, carryover and crop injury, off-target injury potential, and major factors that influence their performance. Know the major herbicides from these classes, how they are used, and their site of action.
- |                             |                             |
|-----------------------------|-----------------------------|
| Group 1 (ACCase inhibitors) | Group 2 (ALS inhibitors)    |
| Group 3 (dinitroanilines)   | Group 4 (growth regulators) |
| Group 5 (triazines)         | Group 9 (glyphosate)        |
| Group 14 (PPO inhibitors)   | Group 15 (amide, etc.)      |
| Group 27 (HPPD inhibitors)  |                             |

### Plant Disease Management

22. Identify each of the following diseases and nematodes and how and when it infects crop Plants (corn, soybean and alfalfa). Recognize host-plant symptoms, classify each by type of causal organism, and know when and how to scout. Know what environmental conditions favor each disease.

<b>Corn</b>	<b>Soybean</b>	<b>Forage</b>	<b>General</b>
Stalk rots	Brown stem rot	Black stem	Pythium
Common rust	Phytophthora	Rhizoctonia	
Southern rust	Brown spot (Septoria)		
Eyespot	Soybean mosaic		
Crazy top	Soybean cyst nematode		
Anthraxnose	Soybean rust		
Northern leaf blight	Sudden death syndrome		
Stewart's wilt	White mold		
Gray leaf spot	Charcoal rot		
Anthraxnose:	Bean pod mottle virus		
-Top dieback	Frogeye leaf spot		
- Leaf spot	Bacterial blight		
- Stalk rot	Bacterial pustule		
- Root rot	Cercospora leaf spot		
Corn nematodes	Downy mildew		
	Fusarium		
	Colletotrichum		
	"Damping-off"		

23. Recognize cultural techniques that can influence plant diseases and may be used for management of plant diseases.

24. Recognize genetic techniques for management of plant diseases.  
 General resistance    Race-specific resistance    Tolerance
25. Know the fungicide families and primary fungicides used to manage crop diseases in Iowa.
26. Understand the appropriateness and timing of applications. Know the difference between preventative and curative applications.
27. Understand crop tolerance concerns with different fungicide families and related off- target concerns.

### Insect and Mite Management

28. Identify each of the following field crop insects and mites, recognize each of their associated crop injury symptoms, and understand each of their life cycles. Identify the primary strategy for the primary pests\*.

#### **Corn**

Armyworm  
 Corn earworm  
 Corn leaf aphid  
 Corn rootworms\*  
 Cutworms (black\* & dingy)  
 European corn borer\*  
 Fall armyworm  
 Grasshoppers  
 Colaspis beetles  
 Seedcorn maggot  
 Stalk borer  
 Spider mites  
 Seedcorn beetles

#### **Soybean**

Bean leaf beetle\*  
 Soybean aphids\*  
 Green cloverworm  
 Potato leafhopper  
 Seedcorn maggot  
 Spider mites\*  
 Thistle caterpillar  
 Grasshoppers\*  
 Whitefly  
 Stink bugs  
 Japanese beetles

#### **Alfalfa**

Alfalfa weevil\*  
 Cloverleaf weevil  
 Aphids (pea & cowpea)  
 Blister beetles  
 Plant bugs  
 Potato leafhopper\*  
 Spittlebugs  
 Grasshoppers

29. Identify common predators and parasitoids and their potential impact on pest insects.  
 Beetles    Lacewings    Flies    Bugs    Wasps
30. Describe standard scouting procedures for major pests in different crops.
31. Relate the degree-day concept to insect development and be able to calculate degree-days for insect development. Understand how degree-days are used in insect management.
32. Know the concepts of economic threshold and economic injury level and how they are used in decision-making for insect control.
33. Recognize how cultural practices (e.g. crop rotation, date of planting, tillage, weed infestations, refuges, transgenic traits, etc.) can influence the potential for the occurrence of insects in crops.

## **CROP MANAGEMENT**

### Crop Establishment, Growth, and Development

1. Understand how the following factors influence and affect success in crop establishment and growth.

Planting date	Soil conditions
Weather outlook	Planting depth
Variety selection	

2. Describe crop responses to planting patterns and plant populations (seeding rates).

Understand how to calculate seeding rates and crop stands, and determine planting depth.

3. Explain the effect of seed quality on crop growth and development.

4. Determine pure live seed (PLS) from seed sample analyses and know how to calculate desired seeding rates.

5. Describe the effect of time and temperature on growth and development of crops.

6. Relate the growing degree day concept (GDD) to corn development, recognize its function in production systems, and be able to calculate growing degree days for corn.

7. Understand the different vegetative and reproductive stages of corn and soybean and the systems used to describe them.

8. Distinguish the growth stages during which crops are most susceptible to environmental stress or pest related injury.

9. Identify damage to agronomic crops from hail, frost, flooding, drought, and wind.

Understand the impact of this damage on future development of the crop.

10. Determine crop damage levels that justify replanting and interpret the following factors that influence replant decisions:

Calendar date	Environmental conditions	Stand count
Uniformity of stand	Plant stage	

11. Understand the benefits and drawbacks of different crop rotations

12. Understand how harvest timing influences grain or forage quality for silage and forage crops, alfalfa, corn and soybean.

### Biotechnology

13. Understand the differences between traditional crop breeding and the use of biotechnology to generate crop varieties.

14. Understand the factors that influence movement of traits among different populations of plants (gene flow).

15. Know the following terms and their significance to biotechnology in agriculture:

DNA	chromosome	gene
gene expression	gene flow	hybrid
outcrossing	protein	recombinant DNA
species	transgenic organism	mutation
yield drag	yield lag	

### Data Analysis

16. Understand how to interpret data and basic statistics.