

PRAIRIE PROVINCES PERFORMANCE OBJECTIVES

Alberta

Manitoba

Saskatchewan



**The American Society of Agronomy
International Certified Crop Adviser Program**

Effective October 2020

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Prairie Provinces Certified Crop Adviser Board (PCCA)

Performance Objectives for the Prairie Provinces CCA Certification Exam

Introduction

The Certified Crop Adviser (CCA) program requires applicants to write and pass two separate exams. One is the International Certified Crop Adviser (ICCA) exam that has 150 questions, and the second exam is the Prairie Provinces Certified Crop Adviser (PCCA) exam that has 100 questions. The American Society of Agronomy publishes performance objectives outlining the knowledge and skills covered by the International exam questions. The performance objectives outlined in this document represent the knowledge and skills covered in the PCCA exam questions.

The Exam Committee, under the direction and approval of the PCCA Board, revised and updated the previous 2014 PCCA performance objectives in the fall of 2019 and early 2020. This document will help you prepare for the PCCA exam questions. All the PCCA questions on the exam are based on these performance objectives.

Prairie Provinces CCA Board:

A list of current Prairie CCA Board members is located at the following link:
<http://www.prairiecca.ca/contact/board.htm>

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Prairie Province Certified Crop Adviser
Performance Objectives

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Foreword

Agriculture in the Prairie Provinces encompasses several common field crops and various production systems and requires a broad knowledge of agronomic principles, pest management, soil and fertilizer nutrient management, and the interaction among these disciplines. The major crops grown in each of these Provinces is listed in the table below. While the exact management practices used to produce each of these crops may differ from Province to Province, and area to area, the fundamentals of crop management are based on a common set of scientific principles that are outlined in the International Performance Objectives. The local performance objectives outlined in the following document do not repeat the International Performance Objectives but provide situations that relate specifically to the most common agricultural crops and production systems used in the Prairie Provinces. These performance objectives will be periodically reviewed and revised. Constructive feedback regarding the Prairie Provinces performance objectives is welcome and can be directed to the exam committee chair through the PCCA Regional Board office listed on the previous page.

Table 1. Major Crops in the Prairie Provinces			
Oilseeds: Canola, soybean, sunflower, flax, mustard	Pulses: Peas, chickpeas, lentils, faba beans, dry beans	Cereals: Wheat, barley, oats, canary seed, rye, triticale	Specialty Crops: Potatoes, sugar beets, cannabis/hemp, quinoa
Annual forages:	Perennial forages: legumes	Perennial forages: grasses	

Section 1 Nutrient Management

Competency Area 1.1. Soil Properties & Fertility

1. Explain how these soil properties affect symbiotic N fixation.
 - a. Soil pH
 - b. Soil moisture
 - c. Organic matter
 - d. Nutrient availability
2. Describe how rhizobium and mycorrhizae contribute to nitrogen and phosphorus uptake in plants.
3. Compare and contrast effective practice strategies for managing high and low pH soils.
4. Describe how clay and organic matter affect the cation exchange capacity (CEC) of a soil.
5. Explain how CEC affects inherent soil fertility.
6. Differentiate between soils with high, medium, and low CEC.
7. Describe the soil conditions, crop and fertilizer management practices that stimulate or inhibit the following:
 - a. nitrogen mineralization
 - b. immobilization
 - c. nitrification
 - d. denitrification
 - e. symbiotic N fixation
 - f. nitrate leaching
 - g. ammonia volatilization
8. Describe how prairie fall and winter conditions and the spring thaw period affect the following:
 - a. nitrogen mineralization
 - b. immobilization
 - c. nitrification
 - d. denitrification
 - e. nitrate leaching
9. Distinguish deficiency symptoms for N, P, K, and S for crops listed in the table of major crops in the Prairie Provinces including cereals, canola, flax, peas, alfalfa, and forage grasses.
10. Explain how soil physical and chemical properties and environmental conditions affect macro and micronutrient availability and movement in soil.
11. Describe the roles of N, P, K, and S in plants.

12. Describe the mechanisms of N, P, K, and S uptake by roots, including diffusion, mass flow, and root interception.
13. Describe micronutrient deficiency symptoms of:
 - a. zinc in corn, flax, and beans
 - b. boron in alfalfa and canola
 - c. manganese in cereals
 - d. copper in cereals
 - e. iron in soybean and flax
14. Identify soil and environmental factors that cause zinc, manganese, boron, copper and iron deficiencies.
15. Explain positive and negative impacts of plowed down crops (green manure, forage termination, frosted, hailed, etc.).
16. Describe how nutrient credits from animal manure, biosolids, pulse crops, forage legumes, and cover crops influence fertilizer recommendations.
17. Explain nutrient (N, P, K, and S) partitioning between grain and residues and how this relates nutrient balance within a cropping system.

Competency Area 1.2. Fertilizer Forms & Application

1. Explain the advantages and disadvantages of the following fertilizer application methods:
 - a. band placed (including pre-plant, side-banding or mid-row banding at planting),
 - b. broadcast, and
 - c. seed-row placed fertilizer application methods.
2. Describe the physical form, analysis, handling precautions, advantages, and disadvantages of the common sources of N, P, K, & S fertilizers applied to prairie crops with respect to:
 - a. physical form
 - b. analysis
 - c. handling precautions
3. Describe the attributes, mechanisms of action, and performance claims of the following fertilizers, fertilizer amendments and or fertilizer additives:
 - a. polymer coated urea (e.g., ESN)
 - b. urease inhibitor (e.g., Agrotain)
 - c. polymer additive for P fertilizers (e.g., Avail)
 - d. seed inoculant containing *Penicillium bilaii* a soil fungus (e.g., Jumpstart)
 - e. plant growth promoting soil rhizobacteria (PGPR) (e.g., BioBoost)
 - f. nitrification inhibitor (e.g., DCD in Super Urea)
 - g. multiple nutrients combined on one composite granule (e.g., MicroEssentials S15)
4. For N, P, K, and S fertilizers, and possible blends of these fertilizers, on prairie crops, describe environmental factors affecting:

- a. pre or post emergent timing
 - b. placement methods (band, broadcast, seed-placed, or foliar)
 - c. application rates
5. Compare the recommendations for effective application of ammonium sulphate, versus elemental S, versus ammonium thiosulphate.
 6. Describe the advantages and disadvantages associated with the following application methods of boron, copper, manganese, and zinc:
 - a. surface broadcast
 - b. broadcast and incorporated
 - c. seed placed
 - d. banded
 - e. foliar
 7. Describe the principles and processes for nitrous oxide emissions from agricultural sources of N, and practices for mitigation of losses.
 8. Describe and recognize how surface and groundwater quality are affected by nutrient management practices.
 9. Describe the efficiency of various phosphorus application methods, and potential soil interactions or movement of phosphorus, and limitations for seed-placed, band, and broadcast applied phosphorus.
 10. Explain the factors that limit blend compatibility of common granular fertilizers.
 11. Calculate the amount of fertilizer products necessary for preparing a complete N-P-K-S blend and the analysis of the blend for granular and liquid fertilizers.
 12. Calculate the cost per pound and/or kilogram of a given nutrient in a blend from the analysis and cost per tonne of the blend components.
 13. Explain why fertilizer bulk density is important to blender and application equipment calibration.
 14. Determine when and where the following methods are appropriate and can be used to delineate soil management zones for variable rate fertilization.
 - a. remote sensing
 - b. electrical conductivity
 - c. topographic position
 - d. yield maps
 15. Explain how optical sensors can be used to assess N status and yield potential of crops in variable rate N fertilization applications.
 16. Explain the principals of 4R Nutrient Management Stewardship and how to implement them on an individual field, namely the Right Source, at the Right Rate, Time, and Place.

Competency Area 1.3. Soil & Plant Analysis

1. Indicate the type of information obtained from surface (e.g. 0-6 in or 0-15cm) and sub-surface soil sampling depths (e.g. 6-24 in or 15 to 60 cm), and deeper soil samples (e.g. 24-48 in or 60-120 cm).
2. Explain how farmers and crop advisers use soil sampling and plant tissue analyses to diagnose plant growth problems.
3. Explain the effect of soil electrical conductivity (E.C.) values levels on plant growth and the tolerance of specific crops (e.g. pulses vs cereals).
4. Know how to interpret a soil test report.
5. Distinguish between extractable, plant-available, and total soil nutrient levels.
6. Describe the differential nutrient requirements for various crops or market classes as follows:
 - a. malt versus feed barley
 - b. high protein wheat classes versus low protein wheat
 - c. canola and pea phosphorus uptake versus cereals
7. Use soil test information to make economically and environmentally sound fertilizer recommendations.
8. Evaluate the three common nutrient management strategies that are used to manage soil nutrient levels, and make fertilizer recommendations (i.e. sufficiency, replacement, and soil building).
9. Describe how the following affect or are considered for recommended soil sampling and handling procedures:
 - a. time of sampling
 - b. depth of sampling (surface vs subsurface)
 - c. frequency of sampling
 - d. sample density
 - e. sampling pattern (including random, benchmark, grid, and soil management zones).
 - f. equipment required for different tests
 - g. processing and shipping
10. Describe recommended procedures for collecting and handling plant tissue samples for analysis.
 - a. timing
 - b. portion of plant sampled
 - c. affected vs unaffected areas of the field
 - d. number plants sampled
 - e. equipment and processes required for different tests
 - f. processing and shipping

11. Explain how root simulating ion exchange membranes are used to estimate nutrient availability.

Competency Area 1.4. Regulations

1. Describe the role of the Canadian Food Inspection Agency in registering nutrient products, ensuring fertilizer product quality, and
2. Explain the purpose of the Fertilizer Act.
3. From the Fertilizer Act, define the following:
 - a. guaranteed analysis
 - b. mixed fertilizer
 - c. soil amendment
 - d. major plant nutrient
 - e. novel supplement

Section 2 Soil & Water Management

Competency Area 2.1. Soil Characterization, Classification & Mapping

1. Describe the characteristics and key distinguishing features of the most common soil orders on the prairies (Chernozemic, Luvisolic, Gleysolic, Solonetzic and Organic).
2. Describe the climate and vegetation of the major soil zones in the prairie provinces.
3. Compare the differences in potential crop productivity and crop adaptability among the major soil zones.
4. Describe and use the basic coordinate systems:
 - a. Dominion Land Survey system used in Canada's Prairie provinces
 - b. Latitude /longitude
5. Interpret a soil survey map, or on-line soil information viewer system, and how it can be used to gain information about soil (soil associations, soil series, phases, and agriculture capability).
6. Describe the effect that topography location has on soil development usually called a "Soil Catena" and how this affects horizon thickness, soil organic matter, soil pH, available nutrients, and how topographic location can affect management decisions.

Competency Area 2.2. Water

1. Explain the following terms as they apply to irrigation water:
 - a. leaching requirement
 - b. sodium adsorption ratio
 - c. electrical conductivity
 - d. total dissolved solids
2. Define soil texture, bulk density, structure, soil tilth and explain their relationships to soil porosity and soil moisture content.
3. Explain how the following practices can be used to manage soil water:
 - a. snow trapping
 - b. summer fallowing
 - c. tillage systems
 - d. crop rotation
4. Describe the advantages and disadvantages of the following practices for managing excess water.
 - a. surface drainage using drainage ditches
 - b. drainage using sub-surface perforated plastic pipe commonly called drainage tile
 - c. crops within crop rotations in relation to rooting depths and moisture use.

Competency Area 2.3. Soil Properties, Problem Soils and Management of Problem Soils

1. Explain the causes of soil salinization in Prairie soils.
2. Describe the following soil salinity situations:
 - a. sidehill seep salinity
 - b. regional or artesian discharge salinity
 - c. bathtub or evaporitic ring salinity
 - d. irrigation practices affecting salinity
3. Define soil organic matter and describe its relationship to soil carbon. Soil colour, soil structure, plant available nutrient supply and the soil ecosystem.
4. Explain how environmental conditions and agronomic practices affect the existing level of soil organic matter.
5. Describe symptoms of both surface and sub-surface soil compaction, and surface crusting, and their effects on crop production.
6. Describe the characteristics of and management practices to control the following:
 - a. saline soil
 - b. sodic (alkali) soil
 - c. solonetzic soil
7. Describe how different approaches are being used to assess soil health. For example, soil tilth, diversity and activity of soil microbes, soil aggregation and aggregate stability, soil bulk density, biochemical activity, and plant nutrient cycling.

Competency Area 2.4. Tillage & Residue Management

1. Describe tillage systems and crop rotations that optimize soil residue cover.
2. Describe how soil texture, tillage and cropping systems affect soil structure.
3. Explain the methods for minimizing soil erosion whether by wind, water and/or tillage and describe the advantages, disadvantages, and relative effectiveness of the various methods.
4. Describe how nutrient release and fertilizer management differ between various tillage systems i.e. conventional inversion tillage, minimum tillage, reduced tillage, and no-tillage (no-till) or direct seeding.

5. Describe the advantages and disadvantages of straw removal for, or by:
 - a. industrial use
 - b. bedding or feeding to livestock
 - c. burning

Competency Area 2.5. Manure Management

1. Identify nutrient losses associated with different methods of manure handling, storage and application.
2. Describe the relative amounts, forms (organic vs. inorganic) and relative availability of nutrients in liquid, solid and composted manure.
3. Describe factors influencing the rate of nutrient release from manure, and the microbial processes involved.
4. Identify factors that influence the quantity and form of nutrients in manure.
5. List agronomic, environmental, and economic advantages and disadvantages of composting manure.
6. Describe manure sampling and handling procedures to obtain a representative sample for submission to a soil test laboratory in order to obtain a nutrient analysis.
7. Using a manure analysis report, calculate a manure application rate.
8. Explain how soil properties, field topography, and cropping practices influence the suitability of soils for manure application.
9. Describe the procedure of creating and implementing a nutrient management plan for the following listed nutrient sources, and benefits or challenges of using each:
 - a. inorganic fertilizer only
 - b. manure only, and
 - c. manure combined with inorganic fertilizer
10. List the provincial acts that regulate the management of manure and siting of livestock operations in each of the three prairie provinces?

Section 3 Integrated Pest Management

Competency Area 3.1. General Information

1. Explain the principles and practices of integrated pest management (IPM) and list the advantages and disadvantages of adopting an IPM program.
2. Describe the methods for sampling and submitting plant and pest material for diagnosis and laboratory analysis.
3. Define action threshold and economic threshold and identify the factors that determine each in pest management.
4. Describe factors that affect a crop's competitiveness and their role in an IPM system.
5. Explain the importance of implementing a biosecurity plan for the prevention and limitation of crop pest spread.

Competency Area 3.2. Spray Equipment & Pesticide Safety

1. List the steps involved in calibrating a sprayer and perform calculations to determine sprayer output and pesticide application rate.
2. Describe the environmental and mechanical factors that affect spray drift.
3. Calculate an application rate for a pesticide from a label.
4. List and prioritize in order of toxicity common points of entry of pesticide into the body.
5. Explain recommended methods for pesticide handling, storage, transport, loading, mixing, tank decontamination, spill cleanup, container cleaning and disposal.
6. Explain how western Canadian water quality for spray operations can impact efficacy.
7. Categorize pesticide risk based on hazard symbols and LD50.
8. Recognize the appropriate personal protective equipment as based on specific formulations and application scenarios identified on a pesticide label or material safety data sheet (MSDS).
9. Explain the terms preharvest interval (PHI), and maximum residue limit (MRL) as found on a pesticide label.
10. Explain compliance with the Pest Control Products (PCP) Act for PHI's and MRL's.
11. What is pesticide re-entry timing and where can you find the information for it.
12. Explain the importance of re-entry intervals following a pesticide application.

Competency Area 3.3. Weed Management

1. Know the following about weed species in the following table:
 - a. Distinguish plant appearance or morphological features at all major growth stages, e.g. seedling, vegetative, stem elongation, flowering, seed maturation, and senescence.
 - b. Life cycle, i.e. simple annual, biennial, short-lived perennial, and perennial.
 - c. Means of reproduction
 - d. Seed longevity
 - e. Competitive ability
 - f. Key management strategies and control methods

Table 2. Major Weed Species in the 3 Prairie Provinces (these are the most common weeds and includes developing weed issues)						
Family						
Amaranth	Buckwheat	Grass	Mustard	Pink	Sunflower	Other
<i>*Palmer amaranth</i>	Pale smartweed	Barnyard grass	Flixweed	Common Chickweed	Biennial wormwood	Cleavers
Redroot pigweed	Wild buckwheat	Brome spp. (Japanese, Downy)	Volunteer canola	Night Flowering Catchfly	Canada Thistle	Field Horsetail
<i>*Water hemp</i>		Foxtail barley	Wild mustard	White Cockle	Dandelion	Hemp nettle
		Green foxtail	Shephard's Purse		Narrow Leaved Hawk's- Beard	Kochia
		Quack grass	Stinkweed		Scentless Chamomile	Lamb's Quarters
		Volunteer cereals (wheat, barley, oats)			Sow thistle (annual, perennial, spiny)	Round- leaved mallow
		Wild oat				Storks bill
		Yellow foxtail				

*Species indicated are emerging weed concerns

2. Describe mechanical, cultural, and biological means of weed management and the effects they can have on managing and/or preventing herbicide resistant weed biotypes.
3. Describe how contact and systemic herbicides common in western Canada differ with regards to:
 - a. application technique
 - b. mode of action
 - c. symptomology
 - d. weed selectivity
4. Describe how the following factors affect herbicide efficacy:
 - a. weed size and growth stage
 - b. spray volume
 - c. plant density and competitiveness
 - d. water quality
 - e. addition of surfactants and additives rain free period
 - a. temperature
 - b. relative humidity
 - c. ultraviolet light
 - d. herbicide rate
 - e. compatibility with other herbicides, pesticides, or foliar fertilizers
 - f. drought or low soil moisture
 - g. rain free period
5. Describe how the following factors affect herbicide persistence in the soil:
 - a. soil pH
 - b. soil organic matter
 - c. soil temperature
 - d. soil moisture
 - e. clay content
 - f. herbicide volatility
 - g. incorporation method
 - h. ground cover
6. Explain the fundamentals of the Federal Seeds Act, and each Provincial Noxious Weed Acts I.e. Weed Control Act (Alberta), Noxious Weeds Acts (Manitoba and Saskatchewan)) and their role in weed management/containment.

Competency Area 3.4. Disease Management

1. Describe these points for the following diseases grouped by crop and area of infection:
 - a. life cycle
 - b. disease symptoms
 - c. key management strategies
 - d. control methods

Cereals

Roots	Vegetation	Head
Common Root Rot	Bacterial Blight	Common bunt
Take-all Root Rot	Barley Yellow Dwarf	Ergot
	Net blotch	Glume blotch
	Tan Spot	Fusarium Head Blight
	Rust (leaf, crown, stem, stripe)	Loose Smut
	Scald	
	Septoria Leaf Blotch	
	Wheat Streak Mosaic	

Canola

Roots	Vegetation	Pods
Clubroot	Blackleg	Aster Yellows
Rhizoctonia	Sclerotinia (stem rot)	
	Alternaria (black spot)	
	Verticillium Wilt	

Lentils and Chickpeas

Roots	Vegetation	Pods
	Anthraco nose	
	Ascochyta	
	Botrytis	
	Sclerotinia (white mold)	

Peas

Roots	Vegetation	Pods
Root rot complex (Fusarium and Aphanomyces)	Mycosphaerella Blight/Ascochyta Foot Rot	
	Powdery mildew	

Soybean

Roots	Vegetation	Pods
	Phytophthora Rot	
	Sclerotinia (white mold)	

Corn

Roots	Vegetation	Ear
	Goss's Wilt	
	Stalk Rot	
		Smut

Flax

Roots	Vegetation	Bolls
		Pasmo
	Fusarium Wilt	

Dry beans

Roots	Vegetation	Pods
		Anthracoze
		Bacterial Blight
		Rust
	Sclerotinia	

Sunflowers

Roots	Vegetation	Head
	Downy mildew	
	Verticillium Wilt	
	Rust	
		Sclerotinia

Other – multiple crops affected

1. Rhizoctonia
2. Pythium
3. Alternaria
4. Fusarium Foot Rot

2. Describe the three elements of the disease triangle and how each can contribute to the severity of crop diseases.
3. Describe the differences between contact vs. systemic, and eradicant vs. protectant fungicides.

Competency Area 3.5. Insect Management

1. Describe these points for the following insects grouped by crops they infest:
 - a. characteristics of insect morphology
 - b. symptoms of infestation
 - c. conditions that lead to outbreak

Cereals

- i. cereal leaf beetle
- ii. rusty grain beetle
- iii. thrips
- iv. wheat midge
- v. wheat stem sawfly

Canola

- i. bertha armyworm
- ii. cabbage seedpod weevil
- iii. canola midge
- iv. diamond back moth
- v. flea beetle (striped, cruciferous, hop)
- vi. root maggot

Corn

- i. European corn borer

Legumes

- i. nematodes (Soybean)
- ii. pea leaf weevil

General Feeders

- i. aphids
- ii. cutworms
- iii. grasshoppers
- iv. lygus bug
- v. wireworms

Insect Vectors

- i. leafhoppers
- ii. wheat curl mite

2. Recognize the immature and adult stages of the following beneficial insects and their prey:
 - a. lady beetle
 - b. hover fly
 - c. carabid beetle (ground beetle)
 - d. lacewings
 - e. minute pirate bugs
 - f. parasitoid wasp (*Bracon cephei*) of wheat stem sawfly
 - g. parasitoid wasp (*Macroglenes penetrans*) of wheat midge
3. Explain the difference between specialized and generalist predators and provide an example of each.
4. Describe the effect of temperature, moisture and wind trajectories on the dispersal and control of the following insects:
 - a. flea beetle
 - b. diamondback moth
 - c. wheat midge
 - d. grasshoppers
5. Identify the practises that reduce the risk to pollinators and honeybees from pesticide application.

Competency Area 3.6. Pesticide Resistance

1. Explain how to recognize and confirm cases of pesticide resistant weeds, insects, and diseases.
2. List and understand the factors that contribute to the development of pesticide resistance in weeds, insects, and diseases.
3. Describe management techniques that delay pesticide resistance development and reduce existing resistant populations.
4. Define multiple resistance in pests, including volunteer GMO crops.
5. Describe herbicide, fungicide and insecticide groups based on modes of action (MOA) and list an example of a product and active ingredient in each group. Explain MOA factors that affect the risk of resistance development.

Competency Area 3.7. Regulations

1. Explain the sections of a pesticide label as described under the Pest Control Products (PCP) Act.
2. List sources of information about your province's pesticide laws.
3. List record keeping requirements for the growers and for the custom applicator related to pesticide application. Are there provincial requirements for your province to document pesticide spray records?

Section 4 Crop Management

Competency Area 4.1. General

1. Recognize and prioritize the soil and environmental factors limiting prairie crop production.
2. Recognize the advantages and disadvantages of fall versus spring field management operations or practices.
3. Recognize the relationship between maximum economic yield and use of fertilizers and pesticides, or maximum economic yield in organic crop production.

Competency Area 4.2. Seeding

1. List the factors that influence the seeding date, rate, row spacing, seedbed utilization, and seeding depth for small grains, oilseeds, pulses, grasses, corn, soybeans, and legumes.
2. Calculate seeding rates for desired plant populations, and different target plant stands by varying seeding rate.
3. Describe the purpose of various seed treatments.
4. Describe the various *Rhizobia* species, inoculation types and inoculation methods and handling requirements for forage legumes and pulse crops.
5. Describe factors affecting crop variety selection.
6. Recognize the advantages and disadvantages of fall seeded crops.

Competency Area 4.3. Seeds Act

1. Distinguish among bin run, common, and certified seed as defined in the Seeds Act. There are differences between crop species groups. (i.e. Corn, soybeans, canola, pulses, and small grains) and to know the differences in the seed classifications used for each crop species group.
2. Interpret a seed analysis report from an accredited laboratory and define percent germination and seed vigor. Describe the limitations and difficulties in interpreting seed vigor tests.
3. List the rights and limitations of the Plant Breeders Rights Act on breeders, seed retailers and crop producers.
4. Describe the role of each of the following participants in the seed industry: Agriculture and Agri-Food Canada (AAFC) - Canadian Food Inspection Agency, AAFC – Research Division, Provincial Crop Development (in Alberta), Canadian Seed Growers Association, Canadian Seed Institute, private seed companies, and Universities.

Competency Area 4.4. Growth & Development

1. Describe plant growth and development stages of small grains, oilseeds, and pulse crops.
2. Distinguish the morphology of the different growth stages for the common annual crops in Western Canada (wheat, canola, peas, lentils, oats, soybeans, barley, potatoes, and corn).
3. Define "growing degree day". Describe its use in crop production and calculate growing degree days for cool season small grains, pulses, and oilseeds.
4. Define heat units for corn or soybean and describe its calculations.
5. Identify crop damage due to heat, cold, drought, wind, and flooding.
6. Identify factors that need to be considered in a replant decision.
7. Describe root pattern differences between cereals and oilseeds.
8. List factors affecting final grain protein content.
9. Explain a falling number and its importance in grading wheat.
10. List factors affecting lodging and management methods to minimize lodging. (Nitrogen and potassium rates, manure application, PGR, landscape positions, plant counts, variety selection, and environmental conditions)

Competency Area 4.5. Harvest Management

1. Determine when small grains, oilseeds and pulses are physiologically mature, determine specific timings for the crop groups and their registered products to be used in desiccation. Understand the preharvest interval for desiccation or preharvest.
2. Know the difference between preharvest glyphosate and various desiccation products. (e.g. Diquat)
3. Describe harvest management systems for cereals, oilseeds, and pulses. Know the differences between the timings for swathing and straight-cut harvesting for each of the crop groups.
4. Recognize how harvesting equipment operations, drying temperatures, handling, storage time and storage conditions affect seed quality.
5. List moisture levels for the long-term safe storage of cereal, oilseed and pulse crops and identify strategies for managing tough and damp grain.

Competency Area 4.6. Crop Rotations

1. Compare the advantages and disadvantages of a monoculture cropping system compared to a crop rotation, and with multiple cropping systems including intercropping and cover crops.
2. List the advantages and disadvantages within the various soil zones for summer fallow, green manuring, and legume or other plant species cover crops, or multi-species cover crops.

Competency Area 4.7. Forage Management

1. Compare and contrast seeding a forage crop with and without a companion crop.
2. Define forage quality and recognize when to harvest for maximum quality and /or dry matter production.
3. Identify forage harvesting and storage systems used in Western Canada, and the losses that occur in each.
4. Identify the value of grass and legume mixtures in a pasture stand, silage, and forage crop.
5. Describe how allelopathic properties can affect forage crop establishment.
6. Describe the relationship between a forage crop's maturity, nutrition, and digestibility, as it affects animal consumption & utilization.

Competency Area 4.8. Precision Farming

1. Define the term Global Positioning System (GPS) and list the components of GPS.
2. Define the term Geographic Information System (GIS), describe the forms of information that may comprise a GIS, and how it can be used to create efficiency and analysis of data in agriculture applications.
3. Describe the operation of a typical yield monitor or a mapping system and its association with GPS and GIS.
4. List the possible roles and uses of precision farming tools in field scouting, agronomic analytics, and field management. (e.g.: The use of GIS Web ware applications)
5. Describe the difference between GNSS (Global Navigation Satellite System), GPS, and GLONASS (Globalnaya Navigatsionnaya Sputnikovaya Sistema) as pertaining to constellation configuration and performance.
6. Describe differential global positioning system (DGPS, RTK {Real Time Kinematics} Lidar {Light detection ranging}) and the different levels of accuracy available to the agricultural industry.

7. Describe variable rate technology (VRT) and explain the components of VRT including management zones, applications, and their relationships to inputs.
8. List and describe the applications associated with variable rate or as applied (i.e. in terms of nutrients, pesticides, quality of grain and soil amendments)

Competency Area 4.9. Regulations

1. Recognize what it means to be a "Professional Agrologist (PAg.)", or a Registered Technologist in Agrology (RTAg.). Define "the practice of agrology" as outlined by Prairie Provinces provincial legislations and recognize the legislated rights of what constitutes practicing agrology.

FOR INFORMATION CONTACT:

Alberta Institute of Agrologists	(780) 432-0663	http://www.albertaagrologists.ca/
Saskatchewan Institute of Agrologists	(306) 242-2606	http://www.sia.sk.ca/
Manitoba Institute of Agrologists	(204) 275-3721	http://mia.mb.ca/default.aspx

Additional information can be obtained from provincial agricultural department web sites, and numerous industry web sites. You are encouraged to explore and discover current resources to aid you in your preparation.