Prairie Provinces Certified Crop Adviser Board

Learning Objectives for the 2014 Certification Exam

Introduction

The Certified Crop Adviser (CCA) program requires applicants to pass a combined exam made up of 150 international exam questions, and 50 locally applied Prairie Provinces CCA (PCCA) exam 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 booklet represent the information and skills covered for the PCCA exam questions.

The Exam Committee, under the direction and approval of the PCCA Board, revised and updated the previous 2010 PCCA learning objectives. In addition, numerous people involved in crop advising in the Prairie Provinces reviewed them. This booklet will help you prepare for the PCCA exam questions. All of the PCCA questions on the exam are based on these 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***

A comprehensive review of the Learning Objectives was undertaken in 2013. Each of the following reviewed and updated the objectives matching his/her area of research and or extension.

- *Dr. Bob Blackshaw, Agriculture and Agri-Food Canada*
- *Clark Brenzil, Saskatchewan Ministry of Agriculture*
- *Dr. Hector Carcamo, Agriculture and Agri-Food Canada*
- *Curtis Cavers, Canada-Manitoba Crop Diversification Centre*
- *Holly Derksen, Manitoba Agriculture, Food and Rural Initiatives*
- *Dr. Ty Faechner, Agricultural Research and Extension Council of Alberta*
- *Brent Flaten, Saskatchewan Ministry of Agriculture*
- *Dr. Don Flaten, University of Manitoba*
- *Dr. John Gavloski, Manitoba Agriculture, Food and Rural Initiatives*
- *Dr. Rob Gulden, University of Manitoba*
- *John Heard, Manitoba Agriculture, Food and Rural Initiatives*
- *Dr. Tom Jensen, International Plant Nutrition Institute (IPNI)*
- *Gary Martens, University of Manitoba*
- *Sean Miller, Saskatchewan Ministry of Agriculture*
- *Pam Wilson, Assiniboine Community College*

Prairie Provinces CCA Exam Committee 2013:

Dr. Tom Jensen, IPNI
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Prairie Province Certified Crop Advisor
Learning Objectives
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Nutrient Management

SOIL PROPERTIES AND FERTILITY

1. Explain how soil pH affects symbiotic N fixation.

2. Describe how rhizobium and mycorrhizae contribute to nitrogen and phosphorus uptake in plants.

3. Describe effective practices for managing high and low pH soils.

4. Describe how clay and organic matter affect the cation exchange capacity (CEC) of a soil.

5. Describe how CEC affects inherent soil fertility.

6. Recognize soils with high, medium and low CEC.

7. Describe the soil conditions and fertilizer management practices that stimulate or inhibit nitrogen mineralization, immobilization, nitrification, denitrification, symbiotic N fixation, nitrate leaching and ammonia volatilization.

8. Describe how prairie fall and winter conditions and the spring thaw period affect nitrogen mineralization, immobilization, nitrification and denitrification and nitrate leaching.

9. Describe deficiency symptoms for N, P, K, and S in cereals, canola, flax, peas, alfalfa and forage grasses.

10. Explain how soil physical and chemical properties and environmental conditions affect macro and micro nutrient availability and movement in soil.

11. Describe the roles of N, P, K, and S in plants.

12. Describe micronutrient deficiency symptoms of:
    - zinc in corn, flax and beans
    - boron in alfalfa and canola
    - manganese in cereals
    - copper in cereals
    - iron in soybean and flax

13. Identify soil and environmental factors that cause zinc, manganese, boron, copper and iron deficiencies.

14. List positive and negative impacts of plowed down crops (green manure, forage termination, frosted, hailed, etc).

15. Describe how nutrient credits from animal manure, biosolids, pulse crops, forage legumes, and cover crops influence fertilizer recommendations.

16. Describe the mechanisms of N, P, K, and S uptake by roots, including diffusion, mass flow, and root interception.

17. Explain nutrient (N, P, K, and S) partitioning between grain and residues in a crop plant.

FERTILIZER FORMS AND APPLICATION

18. Explain the advantages and disadvantages of band placed (including pre-plant, side-banding or mid-row banding at planting), broadcast, and seed-row placed fertilizer application methods.

19. Describe the physical form, analysis, handling precautions, advantages and disadvantages of the common sources of N, P, K, & S fertilizers applied to prairie crops.

20. Describe the attributes, mechanisms of action, and performance claims of the following fertilizers, fertilizer amendments and or fertilizer additives:
    - polymer coated urea (e.g., ESN)
    - urease inhibitor (e.g., Agrotain)
    - polymer additive for P fertilizers (e.g., Avail)
    - seed inoculant containing *Penicillium bilaii* a soil fungus (e.g., Jumpstart)
    - plant growth promoting soil rhizobacteria (PGPR) (e.g., BioBoost)
    - nitrification inhibitor (e.g., DCD in Super Urea)
    - multiple nutrients combined on one composite granule (e.g., MicroEssentials S15)

21. For N, P, K, and S fertilizers, and possible blends of these fertilizers, on prairie crops, describe factors affecting:
    - pre or post emergent timing
    - placement method (band, broadcast, seed-placed and foliar)
    - application rates

22. Describe the recommendations for effective application of ammonium sulphate versus elemental S versus ammonium thiosulphate.

23. Describe advantages and disadvantages associated with surface broadcast, broadcast and incorporated, seed placed, banded and foliar applications of boron, copper, manganese and zinc fertilizer materials.

24. Describe the principles and processes for nitrous oxide emissions from agricultural sources of N, and practices for mitigation of losses.

25. Describe the effect of nutrient management practices on surface and ground water quality.

26. Describe efficiency of application, potential soil interactions and limitations for seed-placed, band, and broadcast applied P.

27. Explain the factors that limit blend compatibility of common granular fertilizers.

28. Calculate the amount of fertilizer products necessary for preparing a complete blend and the analysis of the blend for granular and liquid fertilizers.

29. .Calculate the cost per pound of a given nutrient or blend from the analysis and cost per tonne.

30. Explain why fertilizer bulk density is important to blender and application equipment calibration.

31. Describe how the following methods can be used to delineate soil management zones for variable rate fertilization.
    - remote sensing
    - electrical conductivity
    - topographic position
    - yield maps

32. Explain how optical sensors can be used to assess N status and yield potential of crops in variable rate N fertilization applications.

33. Explain the principals of 4R Nutrient Management Stewardship and how to implement them on an individual field, namely Right Source, at the Right, Time, and Place.

SOIL AND PLANT ANALYSIS

34. Indicate the type of information obtained from surface and sub-surface soil sampling depths.

35. Explain how farmers and crop advisers use soil sampling and plant tissue analyses to diagnose plant growth problems.

36. Explain the effect of soil electrical conductivity (E.C.) values on plant growth.

37. Use soil test information to make economically and environmentally sound fertilizer recommendations.

38. Describe the three common methods used to manage soil nutrient levels, and make fertilizer recommendations (sufficiency, soil building, and replacement).

39. Describe the following recommended soil sampling and handling procedures:
    - time of sampling
    - depth of sampling
    - frequency of sampling
    - sample density
    - sampling pattern (including random, benchmark, grid and soil management zones.

40. Describe recommended procedures for collecting and handling plant tissue samples for analysis.

41. Distinguish between extractable, plant-available and total soil nutrient levels.

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

43. Interpret a soil test report.

44. Describe the differential nutrient requirements for various crops or market classes:
    a. malt versus feed barley
    b. high protein wheat classes
    c. canola and pea phosphorus uptake versus cereals

REGULATIONS

45. Describe the role of the Canadian Food Inspection Agency in registering nutrient products, ensuring fertilizer product quality, and explain the purpose of the *Fertilizer Act*.

46. From the *Fertilizer Act* define the following:
    - guaranteed analysis
    - mixed fertilizer
    - soil amendment
    - major plant nutrient

Soil & Water Management

SOIL CHARACTERIZATION, CLASSIFICATION AND MAPPING

1. Describe the soil zones, climate and vegetation of the prairie region.

2. Compare the differences in potential crop productivity and crop adaptability among the major soil zones.

3. Describe applications of the following basic coordinate systems:
    - legal survey system used in Canada's Prairie provinces
    - latitude /longitude (their application to GPS and GIS mapping)

4. Describe the characteristics and key distinguishing features of the most common soil orders on the prairies (Chernozemic, Luvisolic, Gleysolic, Solonetzic and Organic).

5. Define a soil association and how it is used on a soil map.

6. Describe the effect that topography location has on soil development, horizon thickness, soil organic matter, soil pH, available nutrients and how topographic location can affect management decisions.

WATER

7. Explain the following terms as they apply to irrigation water:
    - leaching requirement
    - sodium adsorption ratio
    - electrical conductivity
    - total dissolved solids

8. Define soil texture, bulk density, structure, soil tilth and explain their relationship(s) to soil porosity and soil water.

9. Explain how the following practices can be used to manage soil water:
    - snow trapping
    - summerfallowing
    - tillage systems
    - crop rotation

10. Describe the advantages and disadvantages of the following practices for managing excess water.
    - surface drainage
    - sub-surface (tile) drainage
    - cropping systems

SOIL PROPERTIES, PROBLEM SOILS AND MANAGEMENT OF PROBLEM SOILS

11. Explain the causes of soil salinization in Prairie soils.

12. Describe the following:
    - sidehill seep salinity
    - regional or artesian discharge salinity
    - bathtub or evaporitic ring salinity
    - irrigation salinity

13. Define soil organic matter and describe its relationship to soil colour, structure, nutrient supply and the soil ecosystem.

14. Explain how environmental conditions and agronomic practices affect the existing level of soil organic matter.

15. Describe symptoms of a compacted soil and surface crusting, and their effects on crop production.

16. Describe the characteristics and management practices of:
    - saline soil
    - sodic (alkali) soil
    - solonetzic soil

TILLAGE AND RESIDUE MANAGEMENT

17. Describe tillage systems and crop rotations that optimize soil residue cover.

18. Describe how texture, tillage and cropping systems affect soil structure.

19. Explain the methods for minimizing soil erosion (wind, water and tillage) and describe their advantages, disadvantages, and relative effectiveness.

20. Describe how nutrient release and fertilizer management differ between conservation and conventional tillage practices.

21. Describe the advantages and disadvantages of straw removal for:
    - industrial use
    - bedding or feeding to livestock
    - burning

MANURE MANAGEMENT

22. Identify nutrient losses associated with different methods of manure handling (including composting), storage and application.

23. Describe the relative amounts, forms (organic vs. inorganic) and relative availability of nutrients in liquid, solid and composted manure.

24. Describe factors influencing the rate of nutrient release from manure and the microbial processes involved.

25. Identify factors that influence the quantity and form of nutrients in manure.

26. List agronomic, environmental and economic advantages and disadvantages of composting manure.

27. Describe manure sampling and handling procedures to obtain a nutrient analysis.

28. Using a manure analysis report, calculate a manure application rate.

29. Explain how soil properties and cropping practices influence the suitability of soils for manure application.

30. Describe the basic characteristics of creating and implementing a nutrient management plan for a) fertilizer only, b) manure only and c) manure plus fertilizer and list the potential benefits.

31. List the provincial acts that regulate the management of manure and siting of livestock operations in each of the three prairie provinces?

Integrated Pest Management

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.

Spray Equipment and Pesticide Safety

5. List the steps involved in calibrating a sprayer and perform calculations to determine sprayer output and pesticide application rate.

6. Describe the environmental and mechanical factors that affect spray drift.

7. Calculate an application rate for a pesticide from a label.

8. List and prioritize in order of toxicity common points of entry of pesticide into the body.

9. Explain recommended methods for pesticide handling, storage, transport, loading, mixing, tank decontamination, spill cleanup, container cleaning and disposal.

10. Categorize pesticide risk based on hazard symbols and LD50.

11. Recognize the personal protective equipment as identified on a pesticide label or material safety data sheet (MSDS).

12. Explain the terms preharvest interval (PHI) and maximum residue limit (MRL). Explain compliance with the *Pest Control Products (PCP) Act* for PHI's and MRL's.

Weed Management

13. Recognize the seedling stage and describe the:
    a) life cycle
    b) means of reproduction
    c) seed longevity
    d) competitive ability

e) key management strategies and control methods

f) distinguishing plant morphological features for the following weed species:

1. wild oat
2. green foxtail
3. wild buckwheat
4. barnyard grass
5. wild mustard
6. annual smartweed
7. lamb's quarters
8. kochia
9. redroot pigweed
10. Canada thistle
11. volunteer canola
12. flixweed
13. stinkweed
14. perennial sowthistle
15. quackgrass
16. stork'sbill
17. hempnettle
18. common chickweed
19. cleavers
20. dandelion
21. foxtail barley
22. downy brome
23. Japanese brome
24. biennial wormwood

14. Describe mechanical, cultural and biological means of weed management and the effects they can have on managing and preventing herbicide resistant weed biotypes.

15. Describe how contact and systemic herbicides common in western Canada differ with regard to:
    - application technique
    - mode of action
    - symptomology
    - weed selectivity

16. Describe how the following factors affect herbicide efficacy:

- weed size and growth stage
- spray volume
- plant density and competitiveness
- water quality
- addition of surfactants and additives rainfree period
- temperature
- relative humidity
- ultraviolet light
- herbicide rate
- compatibility with other herbicides or pesticides
- drought or low soil moisture
- rainfree period

17. Describe how the following factors affect herbicide persistence in the soil:
    - soil pH
    - soil organic matter
    - soil temperature
    - soil moisture
    - clay content
    - herbicide volatility
    - incorporation method

18. Explain the fundamentals of the federal Seeds Act and each provincial noxious weed act (Weed Control Act (Alberta), Noxious Weeds Act (Manitoba and Saskatchewan)) and their role in weed management/containment.

DISEASE MANAGEMENT

19. Recognize the:
    a) symptoms
    b) key management strategies
    c) control methods

    for the following diseases:

    <u>Cereals</u>
    - ergot
    - scald
    - leaf spot complex (tan spot and septoria leaf spot) for different types of wheat
    - loose smut
    - bunt
    - fusarium head blight
    - common root rot
    - takeall root rot
    - leaf rust
    - net blotch
    - glume blotch

- wheat streak mosaic virus
- barley yellow dwarf virus
- bacterial blight

Canola

- blackleg
- sclerotinia (stem rot)
- alternaria (black spot)
- aster yellows
- clubroot

Lentils and Chickpeas

- ascochyta
- botrytis (gray mold)
- anthracnose
- sclerotinia (white mold)

Peas

- mycospherella
- powdery mildew

Soybean

- phytopthora rot
- sclerotinia (white mold)

Corn

- Goss's wilt
- Stalk rot

Flax

- pasmo
- fusarium wilt

Dry beans

- anthracnose
- bacterial blight
- leaf rust
- sclerotinia

Sunflowers

- downy mildew
- verticillium wilt
- rust
- sclerotinia

20. Describe the disease triangle.

21. Describe the differences between contact vs. systemic, and eradicant vs. protectant fungicides.

22. Explain the importance of crop biosecurity and how it helps limit the spread of crop pests and explain how to implement a crop biosecurity plan.

INSECT MANAGEMENT

23. Recognize the:
    - insects
    - symptoms of infestation
    - key management strategies
    - conditions that lead to outbreak

    for the following insects:

    <u>Cereals</u>
    - wheat midge
    - wheat stem sawfly
    - rusty grain beetle
    - cereal leaf beetle

    <u>Canola</u>
    - flea beetle
    - diamond back moth
    - root maggot
    - bertha armyworm
    - cabbage seedpod weevil

    <u>Field pea and Faba bean</u>
    - pea leaf weevil

    <u>General Feeders</u>
    - aphids
    - cutworms
    - grasshoppers
    - lygus bug
    - wireworms

24. Recognize the immature and adult stages of the following beneficial insects and their prey:
    - lady beetle
    - hover fly

- carabid beetle (ground beetle)
- lacewings
- minute pirate bugs
- parasitoid wasp (Bracon cephi) of wheat stem sawfly

25. Explain the difference between a specialized and generalist predator, and provide an example of each.

26. Describe the effect of temperature, moisture and wind on insect dispersal and control measures on: flea beetle, diamondback moth, wheat midge and grasshoppers.

27. List steps to reduce the risk of honeybee death from pesticide application.

PESTICIDE RESISTANCE

28. Explain how to recognize and confirm cases of pesticide resistant weeds, insects and diseases.

29. List the factors that contribute to the development of pesticide resistance in weeds, insects and diseases.

30. Describe management techniques that delay pesticide resistance development, and reduce existing resistant populations.

31. Define multiple resistance in pests, including volunteer GMO crops.

32. Describe herbicide, fungicide and insecticide groups based on modes of action (MOA) and list an example of a product in each group. Explain MOA factors that affect the risk of resistance development.

REGULATIONS

33. Explain the sections of a pesticide label as described under the *Pest Control Products (PCP) Act*.

34. List sources of information about your province's pesticide laws.

35. List record keeping requirements related to pesticide application.

Crop Management

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 practices.

3. Recognize the relationship between maximum economic yield and use of fertilizers and pesticides, and different target plant stands by varying seeding rate.

SEEDING

4. List the factors that influence the seeding date, rate, row spacing, seedbed utilization, and depth small grains, oilseeds, pulses, grasses and legumes.

5. Calculate seeding rates for desired plant populations.

6. Describe the purpose of seed treatments.

7. Describe inoculant materials and handling methods for forage legumes and pulse crops.

8. Describe factors affecting crop variety selection.

9. Recognize the advantages and disadvantages of fall seeded crops

SEEDS ACT

10. Distinguish among bin run, common, pedigreed, certified, registered, foundation, breeder and select seed as defined in the S*eeds Act*.

11. Interpret a seed analysis report from an accredited laboratory and define percent germination and seed vigor. Describe the difficulties in interpreting seed vigor tests.

12. List the rights and limitations of the *Plant Breeders Rights Act* on breeders, seed sellers and crop producers.

13. Describe the role of each of the following participants in the seed industry: Agriculture and Agri-Food Canada, Canadian Food Inspection Agency, Canadian Seed Growers Association, Canadian Seed Institute, private seed companies, Universities.

GROWTH AND DEVELOPMENT

14. Describe plant growth and development stages of small grains, oilseeds and pulse crops.

15. Define "growing degree day", describe its use in crop production and calculate growing degree days for small grains and oilseeds.

16. Identify crop damage due to heat, cold, drought, wind and flooding.

17. Identify factors that need to be considered in a replant decision.

18. Describe root pattern differences between cereals and oilseeds.

19. List factors affecting final grain protein content.

20. List factors affecting lodging and management methods to minimize lodging.

HARVEST MANAGEMENT

21. Determine when small grains, oilseeds and pulses are physiologically mature, ready to desiccate and ready to swath.

22. Describe harvest management systems for cereals, oilseeds and pulses.

23. Recognize how harvesting equipment operation, drying temperature, handling, storage time and storage conditions affect seed quality.

24. List moisture levels for the safe storage of cereal, oilseed and pulse crops and identify strategies for managing tough and damp grain.

CROP ROTATIONS

25. Compare the advantages and disadvantages of a monoculture cropping system with multiple cropping systems.

26. Identify cropping systems most appropriate for the major soil zones.

27. List the advantages and disadvantages of summer fallow, green manures, and legume or other cover crops.

FORAGE MANAGEMENT

28. Recognize conditions when seeding a companion crop with a forage crop is appropriate.

29. Define forage quality and recognize when to harvest for maximum quality and /or dry matter production.

30. Identify forage harvesting and storage systems used in Western Canada, and the losses that occur in each.

31. Identify the value of grass and legume mixtures in a pasture stand.

32. Describe the relationship between a forage crop's maturity and animal consumption & utilization.

PRECISION FARMING

33. Define the term Global Positioning System (GPS) and list the components of GPS.

34. 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.

35. Describe the operation of a typical yield monitor and its association with GPS and GIS.

36. List the possible roles of precision farming tools in field scouting.

37. Describe the difference between GNSS (Global Navigation Satellite System), GPS, and GLONASS (Globalnaya Navigationnaya Sputnikovaya Sistema) as pertaining to constellation configuration and performance.

38. Describe differential global positioning system (DGPS) and the different levels of accuracy available to the agricultural industry.

39. Describe variable rate technology (VRT) and explain the components of VRT.

REGULATIONS

40. Recognize what it means to be a "Professional Agrologist (P.Ag.)", define "the practice of agrology" as outlined by provincial legislation 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

Resources

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