

Atlantic Canada Certified Crop Advisor

Performance Objectives

2011/2012

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Introduction

This booklet is intended for two purposes. First it is a guide to help you prepare for the Atlantic Canada Certified Crop Advisor Examination. Second, it describes the content appropriate for continuing education. The performance objectives outline the knowledge and skills that are needed in order to provide sound advice to crop producers.

To become a Certified Crop Advisor (CCA) in Atlantic Canada, it is necessary to pass two exams, in addition to meeting other requirements including experience, references, etc. The first is the International exam, whose performance objectives are set by the American Society of Agronomy and are available in a separate booklet. The second is the Atlantic Canada CCA Examination, whose performance objectives are described in this booklet.

The subject matter is divided into four sections. The percentage of exam questions under each section (weighting) will be as follows:

1.	Nutrient Management	25%
2.	Soil and Water Management	20%
3.	Pest Management	25%
4.	Crop Management	30%

Each of the four sections is broken down into competency areas with specific performance objectives. In preparing for the exam, you can best allocate your time by focusing on areas where your knowledge is weakest relative to what is described in the performance objectives.

These performance objectives were developed by the Ontario and Atlantic Canada Certified Crop Advisor Exam Committees and approved by the Atlantic Canada Certified Crop Advisor Board. In addition, they were reviewed by many people involved in crop advising, university faculty and government staff. The following people have contributed to the development of these performance objectives:

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We invite and encourage you to show your professionalism, integrity and pride. Agriculture - like medicine and law - relies on expertise, information and skill. The CCA designation identifies people who care about their profession and the success of their customers.

Section 1: Nutrient Management

Competency Area NM-1. Basic Soil Concepts

1. Describe the roles of nitrogen, phosphorus, potassium, calcium and magnesium in plants.
2. Define base saturation.
3. Describe the influence of soil pH, clay content and organic matter content on cation exchange capacity and base saturation.
4. Define guaranteed analysis of fertilizers from a grower's perspective.

Competency Area NM-2. Soil Testing and Plant Analysis

5. Describe the soil sampling procedures recommended in provincial publications.
6. Describe methods used for grid soil sampling, and list their advantages and limitations.
7. Describe the tissue sampling procedures recommended in provincial publications for potatoes.
8. List advantages and disadvantages of the following three fertilizer recommendation approaches:
 - a. cation saturation ratio
 - b. nutrient build-up & maintenance
 - c. nutrient sufficiency.
9. Distinguish between extractable amount and total amount of a nutrient in a soil.
10. Describe how nutrient credits from animal manures, biosolids and legumes influence fertilizer recommendations.
11. Interpret the information given on a soil testing laboratory report.
12. Calculate the amounts and rates of fertilizer needed to meet specific soil test recommendations.
13. Describe the role of soil testing, plant tissue testing and visual plant symptoms in a fertilization program.

Competency Area NM-3. Liming and pH

14. Identify the chemical characteristics of an acid soil.
15. Recognize how soil pH changes with topography.
16. Distinguish between soil pH and buffer pH or lime index.
17. Describe how the soil test uses soil pH and buffer pH to determine soil lime requirements.
18. Define neutralizing value and fineness rating of liming materials.
19. Calculate lime application rates using a soil testing report and the neutralizing value and fineness rating of the liming material.
20. Determine when to use dolomitic versus calcitic lime to correct soil pH.
21. List recommended soil pH ranges for: potatoes, corn, soybeans, cereals, and forage grasses and forage legumes.

Competency Area NM-4. Fertilizer Placement

22. Rank the relative toxicity of fertilizer materials to corn, wheat and soybean seedlings.
23. Identify factors affecting the amount of fertilizer that can safely be applied in a band near the seed.
24. Identify safe limits for seed placed fertilizer for corn, soybeans, and cereals.

Competency Area NM-5. Nitrogen

25. Identify how nitrogen is gained, lost and transformed in the soil.
26. Describe how nitrogen gains, losses and transformations in the soil influence nitrogen fertilization practices and nitrogen availability to plants.
27. Describe how topography can influence soil nitrate levels.
28. Recognize nitrogen deficiency symptoms on corn, soybeans, alfalfa, potatoes and cereals.
29. Describe the agronomic advantages and disadvantages of each of the following fertilizer materials in potato, corn, winter wheat, and forage production:
 - urea
 - ammonium nitrate
 - calcium ammonium nitrate
 - ammonium sulfate.

Competency Area NM-6. Phosphorus

30. Describe how soil chemical properties affect phosphorus availability and mobility in the soil.
31. Describe the advantages and disadvantages of seed-placed, banded and broadcast fertilizer phosphorus placement methods.
32. Recognize phosphorus deficiency symptoms on corn, soybeans, alfalfa, potatoes and cereals.
33. Describe the agronomic advantages and disadvantages of each of the following fertilizer materials in potato, corn, winter wheat, and forage production:
 - triple superphosphate
 - diammonium phosphate
 - monoammonium phosphate
 - liquid phosphorus (ammonium polyphosphate) fertilizers.

Competency Area NM-7. Potassium

34. Describe how soil chemical and physical properties affect potassium fertilizer availability, mobility and leaching.
35. Recognize potassium deficiency symptoms on corn, soybeans, alfalfa, potatoes and cereals.
36. Recognize potassium luxury consumption and its effects on forage quality for ruminant livestock.
37. Describe the agronomic advantages and disadvantages of each of the following fertilizer materials in potato, corn, winter wheat, and forage production:
 - muriate of potash,
 - sulfate of potash magnesia.

Competency Area NM-8. Secondary and Micronutrients

38. Describe how soil chemical and physical properties affect magnesium availability, mobility and leaching.
39. Recognize magnesium deficiency symptoms on potatoes, corn, soybeans, and forages.
40. Describe the agronomic advantages and disadvantages of each of the following magnesium sources:
 - sulfate of potash magnesia
 - magnesium sulfate
 - dolomitic lime
41. Recognize the deficiency symptoms of:
 - zinc in corn
 - sulfur deficiency in potatoes
 - boron in alfalfa
42. Describe how the interaction between the following can affect crop nutrition.
 - phosphorus and zinc
 - pH and zinc
 - pH and manganese
 - potassium and magnesium
 - weather conditions and boron
43. Describe advantages and limitations of foliar and soil micronutrient applications.
44. Describe the risks associated with over application of micronutrient fertilizers.
45. Describe the role of sulfur in plants and the possible reasons why sulfur deficiency has become more prevalent over the past number of years.
46. Describe the factors that affect Calcium availability for crop uptake.
47. Describe the agronomic benefits for land application of wood ash.

Nutrient Management References

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Soil Fertility Guide. APASCC Publication No. 535-81, Agdex No. 530.

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Section 2: Soil And Water Management

Competency Area SWM-1. Soil Hydrology

1. Describe how spacing and depth of tile drains relate to soil texture and structure, internal drainage, soil trafficability, crop type, and topography.
2. Identify the benefits of tile drainage to crop production.
3. Identify the impacts of tile drainage on the environment.
4. Define watershed.
5. Describe the importance of the Canada Drinking Water Quality Guidelines.
6. Identify the material losses from the soil resulting from crop production and their impacts on nearby aquifers, wetlands, wildlife habitat, and aquatic systems.
7. Describe how the following affect pesticide movement:

method of application	precipitation
pesticide adsorption	soil erosion
pesticide persistence	soil pH
pesticide solubility	soil texture.

Competency Area SWM-2. Manures, Biosolids, and Wastes

8. List advantages and disadvantages of the following methods of manure applications:

solid spreading	drag hose	irrigation.
liquid spreading	injection	
9. List advantages and disadvantages of fall versus spring applied manures.
10. Describe agronomic benefits, risks and precautions for land application of wastes, biosolids, and manure.
11. Describe manure's role in nutrient cycling of carbon, nitrogen, phosphorus, and potassium.
12. Describe the benefits of over-winter cover crops for soil quality and nitrogen management.
13. Describe factors influencing nitrogen release from decomposing organic materials and the microbial processes involved.
14. Identify environmental limitations for applying wastes and biosolids to cropland.
15. List possible methods of reducing the potential of tile and surface water contamination from biosolids and manure applications.

Competency Area SWM-3. Conservation Technology

16. List the benefits of windbreaks to crop production.
17. Identify the functions of grassed buffer strips along natural water courses.
18. Describe the objectives of an Environmental Farm Plan.
19. List the major components of a nutrient management plan.
20. Describe the importance of phosphorus in a nutrient management plan.
21. Identify the potential environmental benefits of Global Positioning Systems and Geographic Information Systems technology.

22. Describe residue and mulch management for reducing soil erosion in potato production.
23. Describe the effects of field operations on soil compaction and the resulting impact on crop growth and nutrient requirements.
24. Describe the advantages and disadvantages of maintaining wildlife habitat.
25. Define soil health/quality
26. Identify common threats to soil quality/health in Atlantic Canada
27. Identify soil quality indicators in Atlantic Canada
28. Recognize improvements to soil quality is an on-going strategy that takes time

Soil and Water Management References

Best Management Practices: Fish and Wildlife Habitat Management - AAFC/OMAFRA Best Management Practice Series. ISBN 0-7778-4906-2.

Best Management Practices: Livestock and Poultry Waste Management. AAFC/OMAFRA Best Management Practices Series, Booklet 2.

Best Management Practices: Nutrient Management Planning - AAFC/OMAFRA Best Management Practices Series. ISBN 0-7778-2684-4.

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Gugino, B.K., Idowu, O.J., Schindelbeck, R.R., van Es, H.M., Wolfe, D.W., Moebius-Clune, B.N., Thies, J.E. and Abawi, G.S. 2009. *Cornell soil Health Assessment Training Manual*, Edition 2.0, Cornell University, Geneva, NY.

OMAFRA Factsheet: Starting an Organic Farm (section 5 – Strategies to Improve Soil)
<http://www.omafra.gov.on.ca/english/crops/facts/09-073.htm#soil>

Section 3: Pest Management

Competency Area PM-1. Principles and Practices

1. List the steps of an integrated pest management process.
2. Describe the importance of each step of an integrated pest management process.
3. Describe sampling methods for monitoring pest populations.
4. Identify the scouting techniques for the following pests: Colorado potato beetle, European corn borer, potato aphids, late blight, pink rot.
5. Outline methods for submitting plant and pest material for diagnosis and laboratory analysis.
6. Describe how to use the following variables to calculate the economic injury level (EIL):
 - cost of control
 - crop value
 - effectiveness of control action
 - pest density/crop damage relationship.
7. Describe the unique characteristics of the following: Bt potatoes or corn, Verticillium resistant alfalfa, virus resistant potato, RR corn or soybeans.

Competency Area PM-2. Weed Management

Predominant weeds in Atlantic Canada:

barnyard grass	lambs-quarters, common
burdock, common	pigweed, redroot and smooth
Canada thistle	quack grass
Chickweed, common & mouse-eared	ragweed, common
cleavers/smooth bedstraw	scentless chamomile
corn spurry	shepherd' s-purse
crab grass, smooth	sow-thistle, annual and perennial
dandelion	velvetleaf
fall panicum	vetch, tufted
field horsetail	wild buckwheat
field mint	wild oats
goldenrod	wild radish
hemp nettle	yellow nut sedge
lady' s-thumb	

8. Identify, by common name, the predominant weeds in Atlantic Canada at the 3 to 6 leaf growth stage.
9. Describe the life cycles of:
 - summer annuals
 - winter annuals
 - biennials
 - perennials.
10. Classify predominant weeds in Atlantic Canada by life cycle (annual, biennial or perennial).
11. Describe growth habit of predominant weeds in Atlantic Canada.

12. Describe the following vegetative reproductive structures: creeping roots, rhizomes, tubers, bulbs and stolons.
13. Identify weeds that exhibit the following structures: creeping roots, rhizomes, tubers, bulbs.
14. Compare and contrast weed control strategies for annual, biennial, and perennial weeds
15. Describe crop injury symptoms of commonly used herbicides on potatoes and cereals:

2,4-D	dimethenamid.
atrazine	metolachlor
bentazon	metribuzin
bromoxynil	nicosulfuron/rimsulfuron
dicamba	
16. Describe how the following may affect pesticide retention and absorption in plant leaves:

type of carrier	weed size
additives	rain-free time
spray volume	plant canopy
leaf orientation	
17. Describe how the following factors affect cuticular penetration:
 - herbicide solubility in water
 - moisture
 - relative humidity
 - temperature.
18. Distinguish between contact and systemic herbicides.
19. Define weed competition and describe factors that influence competition.
20. Recognize how soil organic matter, clay, soil pH, and soil moisture impact degradation and efficacy of herbicides.
21. Describe how herbicide chemical properties, environmental conditions, and application method influence volatilization.

Competency Area PM-3. Disease and Nematode Management

22. For each of the following field crop diseases (see table on page 8):
 - a) describe symptoms and plant parts affected
 - b) identify conditions that favor pathogen development
 - c) identify appropriate management responses
 - d) identify the category of the pathogen (viruses, bacteria, fungi, nematodes)

Potatoes	Cereals	Forage Legumes
Bacterial ring rot	Barley yellow dwarf virus (BYVD)	Clover cyst nematode
Bacterial soft rot	Ergot	Verticillium wilt in alfalfa
Blight, early and late	Fusarium head blight	
Clover cyst nematode	Loose smut	
Fusarium wilt	Net blotch	
Potato cyst nematode	Powdery mildew	
Potato leaf roll virus (PLRV)	Scald	
Potato virus Y (PVY)	Septoria leaf & glume blotch	
Root knot nematode	Snow mould	
Root lesion nematode	Spot blotch	
Scab, common and powdery		
Verticillium wilt		
Water (pink) rot		

23. Define mycotoxin.
24. List the mycotoxins commonly found in cereal grains, and describe how they are detected.
25. Describe the impact of mycotoxins on crop quality.
26. Describe strategies for minimizing contamination of commodities by mycotoxins.

Competency Area PM-4. Insect and Slug Management

Important Insects Pests of Atlantic Canada:

armyworm	green peach aphid
buckthorn aphid	potato aphid
cereal aphids	potato flea beetle
cereal leaf beetle	potato leafhopper
Colorado potato beetle	tarnished plant bug
cutworm	white grub
European corn borer	wireworm
European skipper (timothy)	

27. Identify the pest and the crop injury symptoms for important insect pests of Atlantic Canada.
28. Identify appropriate management responses to important insect pests of Atlantic Canada.
29. Describe how heat, photoperiod, competition, and moisture influence insect populations.

30. List advantages and limitations of the following cultural controls for insect and slug crop pests:
- | | |
|---------------------|---------------|
| resistant cultivars | rotation |
| sanitation | tillage |
| planting date | harvest date. |

Competency Area PM-5. Pesticide Resistance Management

31. Define pesticide resistance and cross resistance.
32. Describe how a pest population develops resistance to pesticides.
33. Distinguish among the following plant responses to pests or pesticides:
 resistance
 susceptibility
 tolerance.
34. Describe how to minimize pesticide resistance development.
35. Identify Atlantic Canada weeds, insects and fungal diseases with resistance to pesticides.

Competency Area PM-6. Pesticide Stewardship & the Environment

36. Describe best management practices for pesticide mixing, loading, application, transportation, disposal and storage.
37. Describe government and industry regulations and guidelines for safe handling, storage, application, transportation and disposal of pesticides.
38. Describe components of a pesticide label.
39. Distinguish between spray drift and volatilization.
40. Describe how the following factors affect spray delivery, coverage and drift:
- | | |
|----------------|---------------------|
| boom height | nozzle orifice size |
| droplet size | spray pressure |
| ground speed | spray viscosity |
| nozzle spacing | spray volume |
| nozzle type | wind speed |

Pest Management References

Atlantic Canada Potato Guide. APASCC Publication 1300, Agdex #257/13.

Best Management Practices: Integrated Pest Management. AAFC/OMAFRA Best Management Practices Series. ISBN 0-7778-4495-8.

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Diseases of Field Crops in Canada. Martens, J.W., Seaman, W.L., Atkinson, T.G. 1988. Canadian Phytopathological Society. 160 pp.

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Resources for Weed Management Website. Ontario Ministry of Agriculture, Food and Rural Affairs <http://www.ontarioweeds.com/>

Weed and Pest Control Factsheets Website. P.E.I. Department of Agriculture and Forestry. <http://www.gov.pe.ca/agriculture/index.php3?number=69585&lang=E>

Identification Guide to the Weeds of Quebec. (available in French and English) - <http://www.craaq.qc.ca/Publications?p=32&l=fr&IdDoc=932>

AgraPoint – Extension Central Website – Factsheets, Crop Production Guides, Pest Management Guides. <http://www.extensioncentral.com/eng/>

Section 4: Crop Management

Competency Area CM-1. Crop Adaptation

1. Describe corn and soybean responses to a late spring or early fall frost that is severe enough to kill the above ground portion of the plants.
2. Describe how Crop Heat Units differ from Growing Degree Days (GDD).
3. Use a Crop Zone map to select areas in which corn and winter wheat varieties are adapted.
4. Factors to consider when using reduced tillage or no-till corn strategies.
5. Use the critical fall harvest period map to determine harvest management for alfalfa.
6. Describe soil and climatic factors responsible for successful winter survival of forage legumes, perennial forage grasses and winter wheat.
7. Describe the relative growing characteristics of perennial forage grass species:
 - jointing versus non-jointing
 - bunching versus spreading
 - seedling vigour
 - maturity
 - yield and regrowth
 - tolerance to close grazing
 - sensitivity to poor drainage, drought, and low soil pH.

Competency Area CM-2. Seed Quality

8. List advantages of pedigreed seed.
9. List factors used to select hybrids or varieties of corn, soybeans, wheat, barley, forage legumes, and forage grasses.
10. Describe differences between seed germination and seedling vigour.
11. Identify the factors important in determining seed potato quality.

Competency Area CM-3. Crop Growth And Development Staging

12. Describe the major growth scales commonly used to identify crop development stages of potatoes and cereals (e.g., Zadok's).
13. Identify critical crop development stages for fertilizer application to increase protein in bread wheat.
14. Describe growth phases critical for drought tolerance for potatoes, corn, and soybeans.

Competency Area CM-4. Tillage Systems

15. Describe how the following affect feasibility of conservation tillage systems:
 - topography,
 - soil type and texture,
 - heat unit availability,
 - crop species,
 - cropping sequence

16. Describe how soil fertility management changes when adopting conservation tillage systems.
17. Describe how pest management changes when adopting conservation tillage systems.
18. List soil textures suited to fall and spring primary tillage.
19. Describe advantages and disadvantages of fall and spring primary tillage.
20. Describe advantages and disadvantages of rotary hoeing and inter-row cultivation after planting.

Competency Area CM-5. Seeding Factors

21. List factors determining seeding rates or spacings for potatoes, cereals, corn, soybeans and forages.
22. Describe the effect of plant population and row spacing on sunlight interception, weed competition, diseases, lodging and yield.
23. Describe the purposes of seed treatments.
24. Describe appropriate inoculant materials and inoculant handling methods for soybeans and forage legumes.
25. List criteria to consider when assessing whether to replant corn, soybeans or winter wheat.
26. List criteria to consider when choosing seeding depth for corn, soybeans, winter wheat, forage grasses, forage legumes, spring cereals.
27. List factors to consider when deciding whether to drill or broadcast seed for forage grasses and legumes.
28. Describe how to adjust seeding rate if environmental conditions cause a planting delay or a replant.
29. List factors that determine optimum seeding dates for potatoes, corn, soybeans, winter wheat, spring cereals, and forage legumes.
30. Describe the relationship between seeding date and yield potential for potatoes, corn, corn silage, soybeans, winter wheat, and barley.

Competency Area CM-6. Crop Utilization and Harvesting Quality

31. List optimum development stages to harvest potatoes, corn, corn silage, soybeans, winter wheat and barley.
32. List development stages for harvesting forage legumes and forage grasses at optimum forage quality (crude protein, acid detergent fibre, neutral detergent fibre) and at optimum dry matter yield.
33. Describe the unique characteristics of the following potato types:
table, processing (French fry and chip), seed, count packed
34. Describe how to adjust a combine for optimum harvest efficiency of corn, cereals and soybeans.
35. Describe how to adjust a potato harvester to minimize bruising and prevent losses.

Competency Area CM-7. Cropping Systems

36. Describe the advantages and disadvantages of a monoculture versus a crop rotation system.
37. Describe the advantages and disadvantages of direct seeding forages compared to seeding with a companion crop.

38. Describe grazing systems that optimize livestock production on pastures.
39. List advantages and limitations of the following cultural practices with respect to control of weeds, pests and diseases:

crop rotation	planting time	use of tramlines.
cover crops	soil fertility	
nurse crops	tillage	

Competency Area CM-8. Safe Storage And Quality

40. List the safe moisture levels to store corn silage, haylage, wrapped bales, and cereal silage.
41. List the conditions necessary for grains to retain optimum quality in storage.
42. Describe the factors involved in evaluating grade quality of potatoes, corn, soybeans, wheat, and barley.
43. Describe the causes and the effects of silo gases.

Competency Area CM-9. Economics

44. Define maximum economic yield in terms of the law of diminishing returns.
45. Use Crop Budgets to estimate costs and evaluate cropping alternatives.

Competency Area CM-10. Regulatory

46. Recognize key components of Crop Insurance programs.
47. Recognize stipulations of the Seeds Act that pertain to crop production.

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