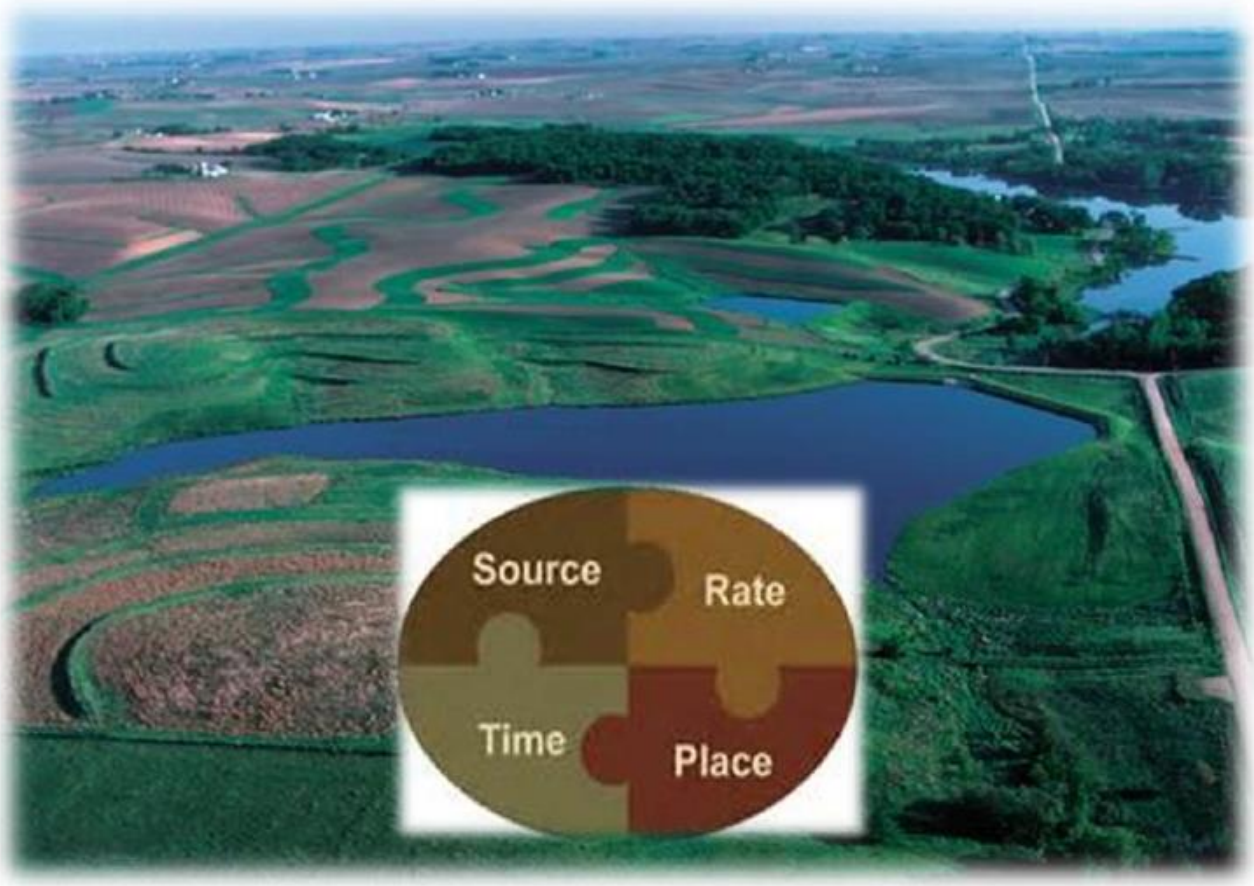
CCA 4R Nutrient Management Specialist Exam

ONTARIO PERFORMANCE OBJECTIVES

The American Society of Agronomy
International Certified Crop Adviser Program



Effective October 2015

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CCA – 4R Nutrient Management Specialist

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FOREWORD

The International Certified Crop Adviser (ICCA) Program developed the 4R Nutrient Management Specialty (4R NMS) Certification to meet the growing demand for qualified advisers with focused knowledge and skills in nutrient management. Not all CCAs do nutrient management work, but focus on other aspects of crop advising. The 4R NM specialty allows those CCAs who advise on nutrient management to become more visible and recognized for their knowledge and skills so they can help meet the need for improved water quality, environmental stewardship and sustainability.

Nutrient management is an integrated process that considers not only the agronomic aspects of soil fertility and crop nutrition, but also the social, economic, and environmental relationships with the management system. The 4R concept of nutrient management has been developed and is being implemented world-wide by industry, researchers, government agencies, and farmers and their advisers. It is centered around the goal of building a nutrient management plan that puts the right nutrient sources, at the right rate, at the right time, and in the right place---the 4Rs of nutrient management. 4R nutrient management considers the integration of agronomic practices with economic analysis and environmental interaction, all considered at the local field level, as well as social impacts for the community, and for downstream stakeholders. The CCA 4R Nutrient Management Specialty Area is an additional specialty certification that builds upon the nutrient, soil and water components of the international CCA certification, to demonstrate the CCA's proficiency in working with the 4R concept and building it into nutrient management planning.

Agronomy is a dynamic field where new discoveries and approaches continue to occur at a rapid pace. The ASA and ICCA Program encourages comments and suggestions concerning possible modifications to this first edition of the Ontario POs for 4Rs Nutrient Management Planning. Comments should be sent to: Ontario CCA Association, Exam Committee, 39 William Street, Elmira, Ontario, N3B 1P3.

The ASA and ICCA Program would like to thank the many volunteers who contributed to the writing of this document, which were comprised of a broad-based group of professionals from industry, private consulting, government, and academia. The Ontario version was adapted from the U.S. version by the Ontario CCA Exam Committee. This type of program would not be possible without their dedication to the profession of agronomy and the ICCA program.

Notes on Exam Format and Conversions

- The exam that will be written from this set of Performance Objectives (POs) is a specialty exam and thus will contain questions that are more in depth and complex than the exams that were taken to obtain the CCA. Potential examinees should look at the verbs associated with each PO to determine the type of information that may be asked about each topic area. For example, the verb “list” would be considered a much less complex idea than a verb such as “interpret”. The format of the exam will be 50 multiple choice questions that address scenarios where the examinee will be provided data tables, figures, etc. to work with.

- Examinees should be able to convert between metric and Imperial units and vice versa, as well as understand SI units. Conversion factors will be provided for questions within the exam.

PROFICIENCY AREA 1: NUTRIENT MANAGEMENT PLANNING

Competency Area 1. Roles and Responsibilities of Provincial, Local Public and Private Entities in Nutrient Management Planning

1. Interpret a CCA's roles and responsibilities in nutrient management planning as described in the following references:
    a. Nutrient Management Act, 2002 and subsequent revisions
        i. http://www.ontario.ca/laws/statute/02n04
    b. Nutrient Management Regulation and Protocols
        i. http://www.omafra.gov.on.ca/english/environment/laws.htm#5
    c. Nutrient Management Best Practices
        i. http://www.omafra.gov.on.ca/english/agops/index.html
    d. International Plant Nutrition Institute (IPNI) 4R Stewardship
        i. http://www.ipni.net/4r
    e. 4R Nutrient Stewardship
        i. http://www.nutrientstewardship.com/
    f. Fertilizer Canada Nutrient Stewardship
        i. http://fertilizercanada.ca/nutrient-stewardship/4rs-across-canada/ontario/
    g. Agriculture and Agri-Food Canada – Nutrient Management Planning
        i. http://www.agr.gc.ca/eng/science-and-innovation/agricultural-practices/soil-and-land/soil-nutrients/nutrient-management-planning/?id=1187355760327
    h. Agriculture and Agri-Food Canada – Agricultural Practices
    i. http://www.agr.gc.ca/eng/science-and-innovation/agricultural-practices/?id=1360876327795

2. Interpret roles and responsibilities of provincial, local public and private entities in nutrient management planning.

3. Discuss national, province-specific, and local-specific policies that relate to nutrient management planning.

4. Interpret and understand the certification process under the province's Nutrient Management Act and Regulations.

5. Identify responsible parties and their roles in implementing each component of a Nutrient Management Plan following the Nutrient Management Act and the logistics needed to apply the right source of nutrients at the right rate, at the right time, and in the right place.

Competency Area 2. CCA's Responsibility in Integrating 4Rs with a Nutrient Management Plan

6. Differentiate between regulated Nutrient Management Planning and 4R nutrient management planning.

7. Plan the right source(s), at the right rate(s), at the right time(s), and the right place(s) to fit the client's cropping system, climate, soils, and farming situation.

8. Evaluate the considerations to plan logistics for the equipment, labor, and nutrient materials to develop a 4R nutrient management plan for a given operation.

9. Discuss the advantages of using soil test interpretations based on accredited soil tests for making nutrient recommendations.

10. Discuss the underlying field research required to calibrate a given soil test extraction method, i.e. to derive nutrient recommendations from the test values.

11. Justify management actions that should be considered if nutrients need to be applied outside the optimum 4R nutrient management plan.

12. Discuss consequences of increasing soil nutrient levels above the crop nutrient response level.

13. Evaluate a CCA's professional risks and responsibilities related to nutrient management planning.

14. Discuss the components of a 4R nutrient management plan that should be monitored and tracked over time and the impacts of any changes.

15. Analyze various changes in the farm operation that will require updates or adjustments to a 4R nutrient management plan such as:
    a. cropping system or rotation;
    b. soil test results;
    c. livestock housing or animal numbers;
    d. application rate;
    e. yields.

16. Demonstrate knowledge of plan implementation, follow-up, and record keeping components of a 4R nutrient management plan.

17. Discuss the record keeping responsibilities and the follow-up process with the operator/client and any or all parties involved with components of the plan.

18. Discuss the advantages of maintaining consistent field map boundaries and field numbering systems with government agencies, the client, and the consultant.

Competency Area 3: Economics of Nutrient Management Planning/Budget for Operation Changes Due to 4Rs

19. Construct an enterprise budget for each crop production system.

20. Evaluate changes in benefits, costs and risks of implementing 4R practices including:
    a. changing fertilizer application methods;
    b. changing forms of nutrients;
    c. freight (logistics of handling fertilizer products);
    d. use of stabilizers and additives;
    e. risk of timing changes;
    f. yield increases;
    g. alternate cropping systems;
    h. crop insurance (regulations and premiums).

21. Evaluate the incremental expected changes in revenue from adopting the 4R practices.

22. Estimate the costs for nutrient management plans including: plan preparation, record keeping, soil tests, manure tests, and labor.

23. Estimate the financial risk or exposure of not following a 4R nutrient management plan.

24. Evaluate the potential financial impact (costs and revenues) to an operation of the short-term and the long-term changes required by a 4R nutrient management plan.

Competency Area 4. Environmental and Social Risk Analysis

25. Justify why nutrient management is important to the environment and public health.

26. Discuss why environmental risk analysis is an important component of nutrient management planning.

27. Discuss the importance of social and interpersonal concerns in nutrient management planning.

28. Discuss how regulatory requirements may supersede the results of a risk assessment.

29. Interpret how to use soil test results in environmental risk analysis.

PROFICIEINCY AREA 2: NITROGEN

Competency Area 1. Determining the Right Source of Nitrogen

1. Discuss the most common sources of nitrogen used in Ontario.

2. Determine the right source of nitrogen based on:
    a. crop type and cropping system;
    b. climate (temperature, precipitation, leaching, and runoff patterns);
    c. soil texture and the effect of surface soil pH;
    d. environmental concerns in the local area (surface and groundwater);
    e. crop stage.

Competency Area 2. Determining the Right Rate of Nitrogen

3. Interpret how soil test nitrogen levels relate to crop yield response and potential environmental impacts.

4. Discuss the environmental risk of applying nitrogen above economic optimums.

5. Justify the considerations for nitrogen application rate based on:
    a. economics;
    b. weather and climate, including;
        i. temperature;
        ii. precipitation amount;
        iii. rainfall intensity;
        iv. precipitation patterns;
    c. crop type and growth stage.

6. Justify the considerations for nitrogen application rate based on:
    a. soil characteristics including leaching;
    b. topography and runoff;
    c. crop conditions, including crop type and growth stage.

7. Calculate nitrogen credits from:
    a. previous nitrogen application;
    b. soil organic matter;
    c. manure;
    d. biosolids and other organic amendments;
    e. irrigation applications (groundwater and wastewater);
    f. previous legumes.

8. Discuss the use of technologies to make ongoing adjustments to the nutrient rates that may have been identified during the 4R nutrient management planning process such as:
    a. crop canopy sensors;
    b. normalized difference vegetative index (NDVI);
    c. post-season stalk nitrate;
    d. soil nitrate test;
    e. plant analysis.

Competency Area 3. Determining the Right Timing of Nitrogen Application

9. Discuss how the timing of soil nitrogen tests can impact test levels.

10. Estimate the environmental risks in the timing of applying nitrogen based on:
    a. climate;
    b. soil type;
    c. runoff;
    d. irrigation;
    e. leaching potential.

11. Estimate the risks of applying nitrogen on saturated, frozen, or snow covered soils.

12. Discuss how the timing of nitrogen application is dependent upon the nutrient source.

13. Discuss the opportunities that split application offers for 4R nitrogen management.

14. Discuss how cover crops can affect nitrogen availability in follow-up cash crops and supplemental nitrogen application timing.

15. Evaluate the principles, appropriate use and impact to timing of nitrogen applications for:
    a. urease inhibitors;
    b. nitrification inhibitors;
    c. controlled-release nitrogen products;
    d. slow-release nitrogen products.

Competency Area 4. Determining the Right Placement/Method of Application for Nitrogen

16. Discuss how the source of the nitrogen will determine the best placement or method of application.

17. Discuss how the time of the year, climate, tillage practices, and residue management will impact the proper placement or method of application.

18. Discuss how crop stage will determine the placement or method of application.

19. Discuss the role of nitrogen technology products and the considerations for nitrogen placement or method of application for:
    a. urease inhibitors;
    b. nitrification inhibitors;
    c. controlled-release nitrogen;
    d. slow-release nitrogen products.

20. Evaluate the role of fertigation in 4R nutrient management planning.

Competency Area 5. Environmental Risk Analysis for Nitrogen

21. Discuss how to use water quality vulnerability assessment tools (e.g. Source Water Protection Plans) on a site specific basis for nitrogen nutrient planning.

22. Evaluate nitrogen management decisions using a water quality vulnerability assessment (e.g. Nitrogen Index).

23. Be able to evaluate how changing a specific nitrogen management strategy will affect the outcome of a risk assessment.

24. Evaluate management strategies that will reduce nitrogen loss to surface water and groundwater, ammonia volatilization, and nitrous oxide emissions.

25. Compare the differences in the geographic scale, soil, topography, and location of watersheds (e.g. national, regional, local) on the environmental impacts of nitrogen on surface and groundwater resources.

26. Discuss the role of nitrogen in the eutrophication process and the potential consequences of eutrophication.

27. Discuss the role of nitrogen in drinking water standards.

PROFICIENCY AREA 3: PHOSPHORUS

Competency Area 1. Determining the Right Source of Phosphorus

1. Discuss the most common sources of phosphorus used in Ontario.

2. Discuss considerations to determine the right source of phosphorus based on:
    a. crop type and cropping system;
    b. climate (temperature, precipitation, leaching, and runoff patterns);
    c. soil texture and the effect of soil pH;
    d. environmental concerns in the local area (surface and groundwater);
    e. crop stage.

Competency Area 2. Determining the Right Rate of Phosphorus

3. Interpret how soil test phosphorus levels relate to crop yield response and potential environmental impacts.

4. Evaluate how different soil test phosphorus extraction methods affect the interpretation of crop yield response and potential environmental impacts.

5. Estimate the environmental risk of applying phosphorus above crop response optimums.

6. Justify the considerations for phosphorus application rate based on:
    a. soil characteristics including leaching;
    b. topography and runoff;
    c. crop conditions, crop type, and growth stage.

7. Calculate phosphorus credits from:
    a. previous phosphorus application;
    b. manure;
    c. biosolids and other organic amendments;
    d. wastewater.

8. Justify the potential need to adjust the phosphorus application rate based on legacy phosphorus and application method.

Competency Area 3. Determining the Right Timing of Phosphorus Application

9. Discuss the importance of the following on phosphorus application timing:
    a. intensity of precipitation;
    b. type of precipitation;
    c. duration of precipitation;
    d. runoff.

10. Discuss the mechanisms of phosphorus loss to surface water.

11. Discuss reduction strategies and management for particulate phosphorus loss.

12. Discuss reduction strategies and management for dissolved phosphorus loss.

13. Discuss how phosphorus contamination of surface water can occur from tile drainage due to timing of application.

Competency Area 4. Determining the Right Placement/Method of Application for Phosphorus

14. Discuss the importance of the following in determining the optimal placement or method of application of phosphorus:
    a. intensity of precipitation;
    b. type of precipitation;
    c. duration of precipitation;
    d. runoff.

15. Discuss the relationship between tillage practices/system on phosphorus management.

16. Discuss the considerations for phosphorus placement and method of application based on the risk of phosphorus runoff.

17. Plan the best placement or application method for phosphorus to minimize the transport of phosphorus offsite.

18. Discuss how phosphorus contamination of surface water can occur from tile drainage due to placement and method of application.

19. Discuss how to use drainage water management to reduce phosphorus nutrient losses to surface water.

Competency Area 5. Environmental Risk Analysis for Phosphorus

20. Discuss how to use water quality vulnerability assessment tools (e.g. Source Water Protection Plans) on a site specific basis for phosphorus nutrient planning.

21. Evaluate phosphorus management decisions using a water quality vulnerability assessment (e.g. Phosphorus Index).

22. Be able to evaluate how changing a specific phosphorus management strategy will affect the outcome of a risk assessment.

23. Evaluate management strategies, including modifying phosphorus transport processes, which will reduce phosphorus loss to surface water and groundwater.

24. Discuss how tillage system (including no-till) affects environmental losses of phosphorus.

25. Compare the differences in the geographic scale, soil, topography, and location of watersheds (e.g. national, regional, local) on the environmental impacts of phosphorus on surface and groundwater resources.

26. Discuss the role of phosphorus, including legacy phosphorus, in the eutrophication process and the potential consequences of eutrophication.

PROFICIENCY AREA 4: POTASSIUM, SECONDARY MACRONUTRIENTS AND MICRONUTRIENTS

Competency Area 1. Determining the Right Source of Potassium, Secondary Macronutrients and Micronutrients

1. Discuss the most common sources of potassium, secondary macronutrients and micronutrients used in Ontario.

2. Discuss considerations that may be used to determine the right source of potassium, secondary macronutrients, and micronutrients based on:
    a. crop type;
    b. cropping system;
    c. crop growth stage;
    d. soil test or tissue test;
    e. timing of application.

3. Discuss how managing the 4Rs for potassium, secondary macronutrients, and micronutrients influences nitrogen and phosphorus losses to surface water and groundwater.

Competency Area 2. Determining the Right Rate of Potassium

4. Interpret how soil test potassium levels relate to crop yield response and potential environmental impacts.

5. Evaluate how soil moisture content and sampling time may affect soil test potassium levels.

6. Estimate how potassium rates may be affected by soil characteristics, which may include:
    a. cation exchange capacity (CEC);
    b. organic matter;
    c. texture;
    d. clay type.

7. Calculate potassium credits from:
    a. previous potassium application;
    b. manure;
    c. biosolids;
    d. irrigation water;
    e. wastewater.

8. Justify the rate of potassium applied based on potassium placement.

Competency Area 3. Determining the Right Timing of Potassium Application

9. Discuss how the timing and method of potassium application can impact crop response.

Competency Area 4. Determining the Right Placement/Method of Application for Potassium

10. Discuss considerations to determine the proper placement and method of application of potassium based on the:
    a. crop type;
    b. cropping system;
    c. methods of tillage.

11. Estimate the proper placement and method of application of potassium based on current potassium soil test levels and soil texture.

Competency Area 5. Determining the Right Rate, Timing and Placement of Secondary Macronutrients

12. Discuss considerations to determine the proper rate, timing and placement of magnesium based on the:
    a. crop type;
    b. cropping system;
    c. crop growth stage;
    d. soil test or tissue test;
    e. timing of application;
    f. method of application.

13. Discuss considerations to determine the proper rate, timing and placement of calcium based on the:
    a. crop type;
    b. cropping system;
    c. crop growth stage;
    d. soil test or tissue test;
    e. timing of application;
    f. method of application.

14. Discuss considerations to determine the proper rate, timing and placement of sulphur based on the:
    a. crop type;
    b. cropping system;
    c. crop growth stage;
    d. soil test or tissue test;
    e. timing of application;
    f. method of application.
    g. atmospheric deposition of sulfur.

Competency Area 6. Determining the Right Rate, Timing and Placement of Micronutrients

15. Discuss considerations to determine the proper rate, timing and placement of zinc based on the:
    a. crop type;
    b. cropping system;
    c. crop growth stage;
    d. soil test or tissue test;
    e. timing of application;
    f. method of application.

16. Discuss considerations to determine the proper rate, timing and placement of manganese based on the:
    a. crop type;
    b. cropping system;
    c. crop growth stage;
    d. soil test or tissue test;
    e. timing of application;
    f. method of application.

17. Discuss considerations to determine the proper rate, timing and placement of boron based on the:
    a. crop type;
    b. cropping system;
    c. crop growth stage;
    d. soil test or tissue test;
    e. timing of application;
    f. method of application.

Competency Area 7. Determining the Right Rate, Timing and Placement of Lime for pH adjustment

18. Discuss considerations to determine the proper rate, timing and placement of agricultural lime based on:
    a. target pH by crop;
    b. soil test pH and buffer pH, and magnesium;
    c. timing of application;
    d. method of application;
    e. sources of lime;
    f. major nutrient contribution from lime.

PROFICIENCY AREA 5: MANURE MANAGEMENT

Competency Area 1. Whole-Herd or Whole-Flock Total Annual Manure and Nutrient Production

1. Calculate the total number of nutrient units in an operation.

2. Distinguish the difference between animal units and nutrient units.

3. Discuss the use of NMAN software to calculate the total amount of manure produced in a year by an operation.
    a. http://www.omafra.gov.on.ca/english/nm/nman/nman3.htm

4. Discuss why it is necessary to build up a set of manure nutrient tests in order to develop reliable average values for a particular operation that can eventually be substituted for published values.

5. Calculate the total nitrogen, phosphorus and potassium in the manure produced by an operation in a year using published or test values of manure nutrients.

6. Use record keeping to measure the total manure produced by an operation in a year.

Competency Area 2. Adequacy of the Land Base for Applying Manure

7. Use the Phosphorus Index to assess the risk of loss of phosphorus from a field and how it may exclude some fields from receiving manure and/or require setbacks.

8. Evaluate the adequacy of the cropland available for spreading manure by comparing the total annual manure production to the land base.

Competency Area 3. Crediting the Nutrients in Manure for Crop Production

9. Use the availability factors for the nitrogen (current and previous applications), phosphorus and potassium in manure (e.g. published in Agronomy Guide for Field Crops and NMAN3).

10. Describe how to credit the phosphorus and potassium in manure for the crop requirements recommended by soil tests using the nutrient recommendations of the Ontario Soil Management Research and Services Committee (OSMRSC) and how to adjust manure spreading rates accordingly for each field.

11. Evaluate the strengths and weaknesses of each tool listed below and the situations in which it is appropriate to use each tool:
    a. pre-plant soil nitrate test (PPNT);
    b. pre-sidedress soil nitrate test (PSNT);
    c. chlorophyll meter;
    d. post-season stalk nitrate.