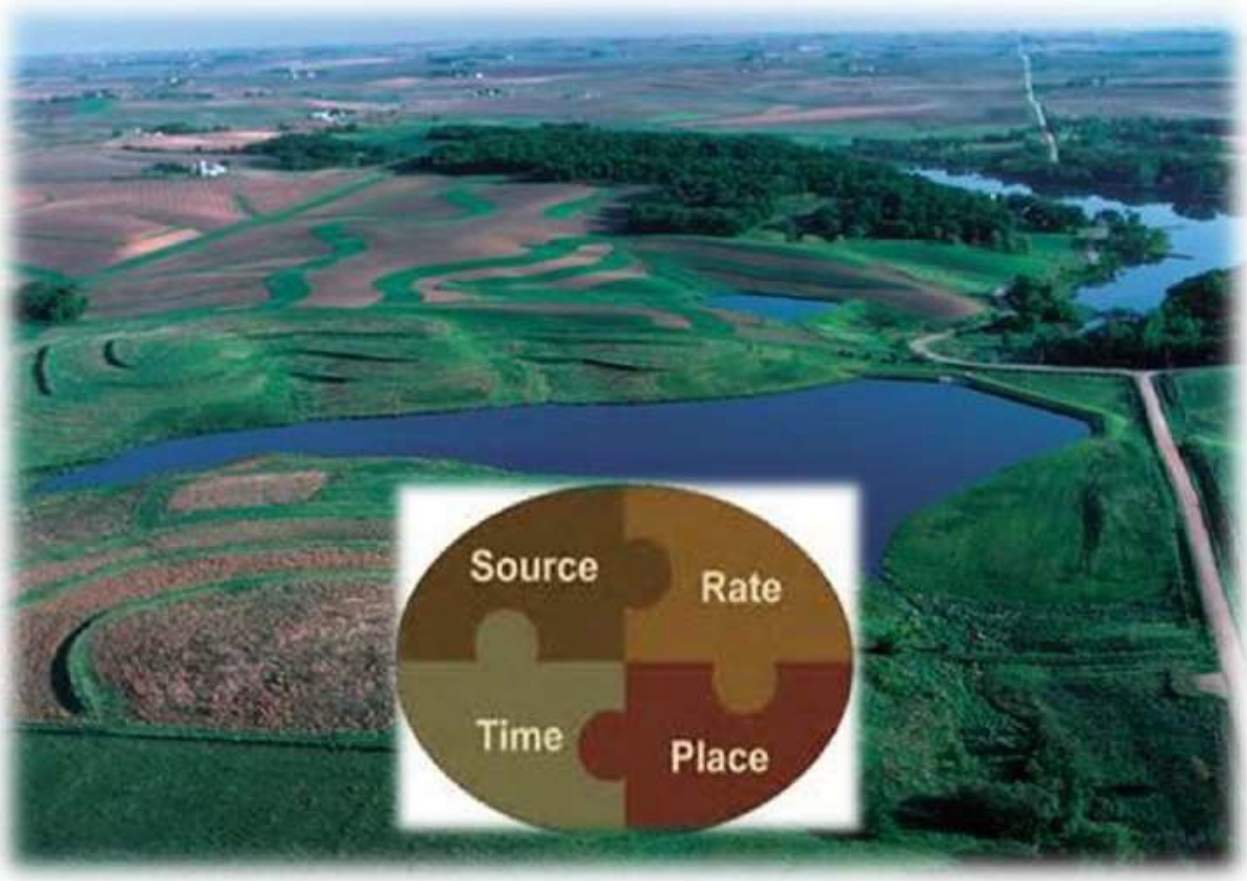
CCA 4R Nutrient Management Specialist Exam

REGION 2 ONTARIO
PERFORMANCE OBJECTIVES

The American Society of Agronomy
International Certified Crop Adviser Program



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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; some focus more 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 agricultural 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 applies 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 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

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

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

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

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

1. Interpret a crop adviser'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. 4R Plant Nutrition Manual
        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. Differentiate between a regulated Nutrient Management Plan and a 4R nutrient stewardship plan as outlined in the 4R Plant Nutrition Manual, Chapter 9.

3. Describe the scientific principles integrating 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.

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

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

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

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

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

9. Assess components of a nutrient management plan and equipment needs that change when the following aspects of a farm operation are changed:
    a. tillage and crop residue management
    b. crop rotation including cover crops
    c. livestock species, inventory, or confinement facilities

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

11. 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.

12. Demonstrate the advantages of maintaining consistent field map boundaries and field numbering systems among government agencies, the client, and the consultant.

Competency Area 3: Economics

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

2. Evaluate changes in benefits, costs, and risks of implementing 4R practices including:
    a. changing nutrient source application timing and placement
    b. changing sources (forms) of nutrients
    c. freight (logistics of handling nutrient sources)
    d. use of stabilizers and additives
    e. yield increases
    f. alternate cropping systems
    g. crop insurance (regulations and premiums)

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

4. Estimate the costs for nutrient management plans including:
    a. plan preparation
    b. record keeping
    c. soil tests
    d. manure tests
    e. labor

5. Explain the financial risk or exposure of not following a 4R nutrient management plan.

6. 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

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

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

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

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

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

PROFICIENCY AREA 2: NITROGEN

Competency Area 1. Right Source of Nitrogen

1. Discuss the most common sources of nitrogen (mineral and organic) 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
    f. relative cost of available nitrogen sources

Competency Area 2. Right Rate of Nitrogen

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

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

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

4. Justify the considerations for nitrogen application rate based on:
    a. economics
    b. weather and climate, including:
        i. temperature
        ii. precipitation amount, intensity, and patterns
    c. crop type and growth stage
    d. expected yield

5. Justify the considerations for nitrogen application rate based on:
    a. soil characteristics including leaching potential
    b. topography and runoff
    c. groundwater vulnerability (permeability of overburden and depth to groundwater)

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

7. Evaluate the strengths and weaknesses of each tool listed below for determining the right rate of nitrogen to apply:
    a. crop canopy sensors and remote sensing technology, e.g., normalized difference vegetative index (NDVI), chlorophyll meter, etc.
    b. post-season stalk nitrate
    c. preplant soil nitrate test (PPNT)
    d. pre-sidedress soil nitrate test (PSNT)
    e. plant analysis/tissue test

Competency Area 3. Right Timing of Nitrogen Application

1. Estimate the environmental risks in the timing of nitrogen application based on:
    a. climate
    b. soil texture and drainage
    c. runoff
    d. irrigation
    e. leaching potential

2. Describe the risks of applying nitrogen on saturated, frozen or snow-covered soils.

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

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

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

6. Describe appropriate use and impact on nitrogen application timing for:
    a. urease inhibitors;
    b. nitrification inhibitors;
    c. controlled release nitrogen products;
    d. slow release nitrogen products.

Competency Area 4. Right Place for Nitrogen Application

1. Discuss how the source of the nitrogen affects the best placement for nitrogen application.

2. Discuss how proper placement or method of application will be influenced by:
    a. time of the year
    b. crop stage
    c. climate
    d. tillage practices
    e. residue management

3. 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

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

Competency Area 5. Environmental Risk Analysis for Nitrogen

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

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

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

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

5. Describe the geographic features that influence the environmental impact of nitrogen on aquifers and surface water.

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

7. Discuss the forms and levels of nitrogen in drinking water standards.

PROFICIENCY AREA 3: PHOSPHORUS

Competency Area 1. Right Source of Phosphorus

1. Discuss the most common sources of phosphorus (mineral and organic) used in Ontario.

2. Discuss considerations to determine the right source of phosphorus based on:
    a. crop type (food versus feed)
    b. cropping system
    c. soil texture
    d. soil pH
    e. environmental concerns in the local area
    f. crop stage
    g. relative cost of available phosphorus sources

Competency Area 2. Right Rate of Phosphorus

1. Describe how soil test phosphorus levels relate to probabilities of crop yield response and risks of environmental impacts.

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

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

4. Justify the considerations for phosphorus application rate based on:
    a. topography and runoff
    b. crop conditions, crop type, and growth stage
    c. application method (timing and placement)

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

Competency Area 3. Right Timing of Phosphorus Application

1. Discuss the importance of the following on phosphorus application timing:
    a. intensity, type, and duration of precipitation events
    b. seasonal variation in risk of runoff
    c. weather forecasts

2. Explain the mechanisms of phosphorus loss to surface water.

3. Evaluate reduction strategies and management for particulate phosphorus loss.

4. Evaluate reduction strategies and management for dissolved phosphorus loss.

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

Competency Area 4. Right Place of Application for Phosphorus

1. Discuss the importance of the following in determining the optimal placement of phosphorus:
    a. intensity, type, and duration of precipitation
    b. risks of runoff and erosion
    c. stratification of soil phosphorus

2. Discuss the impacts of tillage practices on phosphorus management and stratification of soil phosphorus.

3. Discuss the considerations for phosphorus placement based on the risk of phosphorus runoff.

4. Plan the best placement for phosphorus to minimize the transport of phosphorus offsite.

5. Discuss how placement affects loss of phosphorus in surface water through tile drainage.

6. Describe the opportunities and limitations of using drainage water management to reduce phosphorus nutrient losses to surface water.

Competency Area 5. Environmental Risk Analysis for Phosphorus

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

2. Evaluate phosphorus management decisions using a water quality vulnerability assessment (e.g., Phosphorus Loss Assessment Tool for Ontario (PLATO)).

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

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

5. Discuss how tillage system (including no-till) affects magnitude and form of phosphorus losses to the environment.

6. 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.

7. 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. Right Source of Potassium, Secondary Macronutrients, and Micronutrients

1. Discuss the most common mineral and organic 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
    f. relative cost of available sources of potassium, secondary macronutrients or micronutrients

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. Right Rate of Potassium

1. Interpret how soil test potassium levels relate to crop yield response and potassium concentrations in crop tissue.

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

3. 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

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

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

Competency Area 3. Right Timing of Potassium Application

1. Discuss how the timing of potassium application can impact crop response.

2. Discuss how the timing of application can impact concentration of potassium in forages and pastures.

3. Discuss how the timing of application can influence winter hardiness of forages.

Competency Area 4. Right Place of Application for Potassium

1. Discuss considerations to determine the proper place of application of potassium based on the:
    a. crop type
    b. cropping system
    c. methods of tillage

2. Estimate the proper place of application of potassium based on current potassium soil test levels and soil texture.

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

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

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

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

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

1. 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

2. 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

3. 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. Right Rate, Timing, and Placement of Lime for pH Adjustment

1. Discuss considerations to determine the proper timing and placement of agricultural lime.

2. Calculate lime rate based on:
    a. target pH by crop
    b. soil test pH and buffer pH and magnesium
    c. timing of application
    d. placement of application
    e. sources of lime
    f. major nutrient contribution from lime

3. Discuss application of other nutrients that may be affected by the application of lime, such as the addition on manganese after liming.

4. Discuss the consequences of over-application of lime.

PROFICIENCY AREA 5: MANAGEMENT OF ORGANIC AND RECYCLED SOURCES

Competency Area 1: Use of Organic and Recycled Sources

1. Distinguish between the various sources of liquid and solid organic amendments in the following categories:
    a. livestock manures
    b. biosolids
    c. organic or recycled materials registered as fertilizers
    d. anaerobic digestates
    e. compost
    f. other recycled materials

2. Describe important management consideration of each of the above categories (a-f) and where their use best fits.

3. Describe the potential risks associated with the use of each of the above categories:
    a. micronutrient interactions
    b. trace elements
    c. salts
    d. pathogens
    e. antibiotics

4. Understand how the Canadian Food Inspection Agency – Fertilizer Section (CFIA) regulates fertilizer, including registration of materials derived from organic and other sources as fertilizers.

Competency Area 2. 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. Apply methods to calculate the total amount of manure produced in a year by an operation.

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

6. Describe recommended record keeping practices for a livestock farm as they pertain to nutrient management.

Competency Area 3. Adequacy of the Land Base for Applying Manure

1. Use a recognized phosphorus loss risk assessment tool 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.

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

3. Explain opportunities and technologies for optimizing beneficial use of manure nutrients generated on a livestock farm including but not limited to:
    a. solid separation
    b. manure trading
    c. nutrient extraction technologies
    d. optimal on-farm distribution
    e. optimal timing within the crop rotation

Competency Area 4. Crediting the Nutrients in Organic Sources for Crop Production

1. 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).

2. 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.

3. Discuss the impact of C:N ratio of applied materials on N availability and timing of release.

4. Evaluate the impact of organic and recycled materials on secondary macronutrient and micronutrient availability.