

CCA 4R Nutrient Management Specialist Exam

REGION 1 PERFORMANCE OBJECTIVES

Alberta
British Columbia (NE Peace River)
Manitoba
Saskatchewan



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

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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 Prairie POs for 4Rs Nutrient Management Planning.

Comments should be sent via email to certification@sciencesocieties.org.

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 Prairie Region version (which includes the three Prairie Provinces and the NE portion of British Columbia) was adapted from the U.S. version by the Prairie 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 with only one correct answer 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: 4R Designation Program

Competency Area 1: Understand the Main Objectives and Organization of the 4R Designation Program

1. Understand the main objectives of the 4R Designation Program.
 - a. Demonstrate on farm stewardship in nutrient management.
 - b. Provide a framework to improve sustainability.
 - c. Quantify adoption of 4R planning tools.
 - d. Provide recognition for farmers and their crop advisors.
 - e. Create useful information for policy planning and supply chain requirements

2. Understand the roles of various stakeholders in the 4R Designation Program.
 - a. Grower.
 - b. 4R Designated Agronomist.
 - c. Agri-retailer.
 - d. Registry Organization (Fertilizer Canada).
 - e. Other Parties (Government, NGOs, Supply Chain).

3. Understand the steps in the 4R Designation process.
 - a. Education.
 - b. Planning.
 - c. Reporting.
 - d. Implementation.
 - e. Recognition.
 - f. Review Progress.

Competency Area 2: Demonstrate Competencies Required to Sign Off as a 4R Designated Agronomist

1. Demonstrate knowledge of the available tools for implementing 4R.
 - a. 4R BMP Guidance Tables.
 - b. Designation Program Toolkit.
 - c. 4R Scorecard.

2. Using the above resources, determine if a field meets the minimum threshold for 4R consistent practices.

PROFICIENCY AREA 2: NUTRIENT MANAGEMENT PLANNING

NOTE: It is understood that the Provinces within Prairie Region (Region 1 NMS) don't necessarily have the same legal framework or regulations. The goal for the examinee is to have an understanding of the general premise of the legal framework with regard to Nutrient Management Planning within Prairie Region. This exam is scenario based and the scenarios will provide information on the legal framework to be considered within the context of the scenario in order to answer questions.

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. International Plant Nutrition Institute (IPNI) 4R Stewardship
 - i. <http://www.ipni.net/4r>
 - b. Fertilizer Canada 4R Nutrient Stewardship
 - i. <http://fertilizercanada.ca/nutrient-stewardship/>
 - ii. <https://fertilizercanada.ca/nutrient-stewardship/4r-designation/>
 - c. The Fertilizer Institute 4R Nutrient Stewardship
 - i. <http://www.nutrientstewardship.com/>
 - d. 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>
 - e. Agriculture and Agri-Food Canada – Agricultural Practices
 - i. <http://www.agr.gc.ca/eng/science-and-innovation/agricultural-practices/?id=1360876327795>
 - f. Alberta Nutrient Management Planning Guide
 - i. [https://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/epw11920](https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/epw11920)
 - g. Tri Provincial Manure Management Guide
 - i. <http://www.manuremanagement.ca/Info-Publications/tri-provincial.html>
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 various Provincial Nutrient Management Regulations, if any.
5. Identify responsible parties and their roles in implementing each component of a nutrient management plan following the nutrient management regulations 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

1. Differentiate between regulated and unregulated nutrient management planning and how 4R nutrient management principles and strategies fit into each.
 - a. Know the **major** regulatory framework agencies and rules within each Province.
 - b. Know any reporting requirements and approval processes.
2. Be able to advise on 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.
3. Consider in the available equipment, labor, and nutrient sources when implementing a 4R nutrient management plan for a given operation.
4. Discuss the concept of using established and regionally calibrated soil tests for making nutrient recommendations.
5. Identify the best management actions that could be considered if nutrients need to be applied outside the optimum 4R nutrient management plan.
6. Discuss the rationale (agronomic and environmental advantages and consequences) of increasing soil nutrient levels above the crop nutrient response level.
7. Discuss the components of a 4R nutrient management plan that should be monitored and tracked over time and the impacts of any changes.
8. 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;
 - f. equipment;
 - g. technology tools.
9. Discuss the record keeping requirements and responsibilities and the follow-up process with the operator/client and any or all parties involved with components of the plan both annually and over multiple years.
10. Discuss the need for maintaining up to date field map boundaries, records, and field identification systems with government agencies, the client, and the consultant.
11. Understand and describe a CCA's professional risks, responsibilities and mitigating practices related to nutrient management planning.

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

1. Construct a base financial budget for each crop/field.

2. Evaluate short and long-term changes in benefits, costs and risks of implementing 4R practices including:
 - a. changing fertilizer or manure placement methods;
 - b. changing source of nutrients, including manure;
 - c. freight (logistics of handling fertilizer products or manure);
 - d. use of stabilizers and additives;
 - e. choice of timing changes;
 - f. yield changes;
 - g. alternate cropping options;
 - h. crop insurance (regulations and premiums);
 - i. optimal rate to produce maximum economic return.
3. Estimate the costs for nutrient management plans including: plan preparation, record keeping, soil tests, manure tests, and labor.
4. Estimate the financial risk or exposure of not following 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 broader social and local community concerns in nutrient management planning.
4. Discuss how regulatory requirements may supersede the results of a risk assessment.
5. Recognize the value and limitations of using standard soil test results in environmental risk analysis.
6. Be aware of required anhydrous ammonia safety protocols and training.
7. Understand manure handling health and safety risks e.g., H₂S, timing of incorporation after application.
8. Understand the implications of applying fertilizer or manure to saturated, frozen and/or snow-covered ground.

PROFICIENCY AREA 3: NITROGEN

Competency Area 1. Determining the Right Source of Nitrogen

1. Discuss the most common sources of nitrogen used in the Prairie Provinces.
2. Determine the right source of nitrogen based on:
 - a. crop type and cropping system (including drainage and irrigation);
 - b. climate (temperature, precipitation);
 - c. soil and landscape characteristics (leaching, runoff potential);
 - d. potential for environmental loss and/or impact (e.g., surface and groundwater, GHG emissions);
 - e. crop stage.

Competency Area 2. Determining the Right Rate of Nitrogen

1. Interpret soil test nitrogen levels in relation to crop yield response, crop quality, and potential environmental impacts.
2. Discuss the agronomic and environmental risks of applying nitrogen above economic optimums.
3. Explain 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. stored soil moisture;
 - d. irrigation;
 - e. crop type, cultivar, and growth stage;
 - f. yield potential and targeted use of the crop;
 - g. general equipment capabilities and limitations with respect to application rate.
4. Explain the impacts of hail, frost and other environmental stressors on crop growth and forage quality and application of nitrogen.
5. Discuss the considerations for nitrogen application rate based on potential losses associated with leaching, denitrification, immobilization, volatilization:
 - a. soil characteristics;
 - b. crop residue conditions;
 - c. topography and runoff;
 - d. crop type and growth stage;
 - e. seasonal moisture conditions;
 - f. time of application.
6. Estimate nitrogen credits from:
 - a. previous nitrogen application;
 - b. soil organic matter;
 - c. manure;
 - d. biosolids and other organic amendments;

- e. irrigation applications (groundwater, surface water, and wastewater);
 - f. previous crops and cropping practices (e.g., cover crops, legumes, fallow).
7. 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. soil nitrate test;
 - d. plant analysis including post season stalk nitrate test in corn and petiole testing in potatoes;
 - e. grain protein;
 - f. Variable Rate Technology (VRT).

Competency Area 3. Determining the Right Timing of Nitrogen Application

1. Discuss how the timing of soil nitrogen tests can impact test levels.
2. Estimate the environmental risks in the timing of applying nitrogen based on:
 - a. climate;
 - b. season;
 - c. soil characteristics;
 - d. runoff;
 - e. irrigation;
 - f. leaching potential.
3. Estimate the risks of applying nitrogen on saturated, frozen, or snow covered soils.
4. Discuss how the timing of nitrogen application is dependent upon the nutrient source.
5. Discuss the opportunities and risks that split application offers for 4R nitrogen management by crop type.
6. Discuss how cover crops can affect nitrogen availability in follow-up crops and supplemental nitrogen application timing.
7. Evaluate the principles, appropriate use and impact to timing of nitrogen applications for:
 - a. urease inhibitors;
 - b. nitrification inhibitors;
 - c. controlled and/or slow release nitrogen products.

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

1. Discuss how the source of the nitrogen will determine the best placement or method of application.
2. Discuss how the time of the year, climate, tillage practices, and residue management will impact the proper placement or method of application.
3. Discuss how crop stage and crop type will determine the placement or method of application.
4. Discuss how planting pattern (narrow or wide row/solid seeded or row crop) will determine the placement or method of application.

5. 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 and/or slow release nitrogen products.
6. Evaluate the role of in-crop application, including fertigation, in 4R nutrient management planning.

Competency Area 5. Environmental Risk Analysis for Nitrogen

1. Explain nitrogen management decisions as they affect water quality (groundwater and surface water).
 - a. Eutrophication.
 - b. Aquatic life.
 - c. Drinking water quality relative to the standards.
2. Evaluate management strategies that will reduce nitrogen loss impacts to air, including ammonia volatilization and nitrous oxide emissions, and surface water and groundwater.
3. Discuss the role of nitrogen management in greenhouse gas (GHG) emissions and particulate matter development.
4. Evaluate the influence of soil type, topography, and location of watersheds on the environmental impacts of nitrogen on surface and groundwater resources.

PROFICIENCY AREA 4: PHOSPHORUS

Competency Area 1. Determining the Right Source of Phosphorus

1. Discuss the most common sources of fertilizer phosphorus used in the Prairie Province region of Canada.
2. Discuss considerations to determine the right source of phosphorus.

Competency Area 2. Determining the Right Rate of Phosphorus

1. Interpret how soil test phosphorus levels relate to crop yield response and potential environmental impacts.
2. Evaluate different soil test phosphorus extraction methods.
3. Explain how nutrient stratification in no till or wide placed fertilizer bands for row crops may influence the soil sampling approach for phosphorus.
4. Discuss the pros and cons of applying phosphorus above crop response optimums.
5. Justify phosphorus application rate based on:
 - a. soil characteristics including leaching;
 - b. topography and runoff;
 - c. crop conditions, crop type, and growth stage.
6. Discuss the concepts of build and maintain philosophy, sufficiency, and removal.
7. Recognize phosphorus credits from:
 - a. previous crops
 - b. previous phosphorus application;
 - c. manure, biosolids, and other organic amendments;
 - d. wastewater.
8. Justify the potential need to adjust the phosphorus application rate based on historic phosphorus use.
9. Understand how phosphorus placement affects rate.

Competency Area 3. Determining the Right Timing and Placement of Phosphorus Application

1. Discuss the mechanisms of phosphorus loss to surface water.
 - a. Runoff.
 - b. Leaching.
 - c. Tile drainage.
2. Discuss the relationship between tillage practices/system on phosphorus management.
3. Discuss the importance of the following in determining the optimal timing and placement or method of application of phosphorus:
 - a. precipitation (intensity, type, and duration);
 - b. snowmelt and frozen soil.

4. Discuss the effects of timing and placement short and long term crop response.
 - a. Seed row.
 - b. Side band.
 - c. Mid row.
 - d. Broadcast.
 - e. Foliar.
5. Discuss the implications and interactions of co-banding phosphorus with other nutrients.
6. Compare and contrast reduction strategies and management for particulate phosphorus loss due to soil erosion, and reduction strategies and management for dissolved phosphorus loss.
7. Discuss the considerations for phosphorus timing, placement and method of application based on the risk of phosphorus runoff.
8. Plan the best timing, placement or application method for phosphorus to minimize the transport of phosphorus offsite.

Competency Area 4. Environmental Risk Analysis for Phosphorus

1. Discuss how to use water quality vulnerability or risk assessment tools (e.g. Environmental Farm Plans) on a site specific basis for phosphorus nutrient planning.
2. Be able to evaluate how changing a specific phosphorus management strategy will affect the outcome of a risk assessment.
3. Evaluate management strategies and BMPs, which will reduce phosphorus loss to surface water and groundwater:
 - a. tile drainage;
 - b. buffer strips;
 - c. cover crops;
 - d. wetlands;
 - e. application strategies.
4. Discuss how to use drainage water management to reduce phosphorus nutrient losses to surface water.
5. Discuss how tillage system (including no-till) affects environmental losses of phosphorus.
6. Compare the differences in soil, topography, and location of watersheds (e.g. local, regional, national) 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 5: POTASSIUM, SULPHUR, CALCIUM, MAGNESIUM, AND MICRONUTRIENTS

Competency Area 1. Determining the Right Source of Potassium

1. Discuss the availability/potential deficiency of potassium in the Prairie Region.
2. Discuss the most common sources of potassium used in the Prairie Region.
3. Discuss considerations that may be used to determine the right source of potassium, sulphur, calcium, magnesium, and micronutrients based on:
 - a. crop type;
 - b. tillage and cropping system;
 - c. crop growth stage;
 - d. soil test or tissue test;
 - e. timing and placement of application.
4. Discuss how managing the 4Rs for potassium, sulphur, calcium, magnesium, and micronutrients influences nitrogen and phosphorus losses to surface water and groundwater.

Competency Area 2. Determining the Right Rate of Potassium

1. Interpret how soil test potassium levels relate to crop yield response and potential environmental impacts.
2. Describe 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.
3. Discuss contribution of potassium from:
 - a. previous potassium application;
 - b. manure;
 - c. biosolids;
 - d. previous crop residue;
 - e. wastewater.
4. Discuss the impact of timing and placement on the rate of potassium applied.
5. Recognize how environmental conditions may modify the need for potassium, including soil temperature and moisture.

Competency Area 3. Determining the Right Timing and Placement/Method of Potassium Application

1. Discuss how the timing and method of potassium application can impact crop response.
2. Recognize toxicity concerns with excess rates of seed row placed potassium.

3. 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.
4. Recognize the options for placement and method of application of potassium based on current potassium soil test levels and soil texture.

Competency Area 4. Determining the Right Source, Rate, Timing and Placement/Method of Sulphur

1. Discuss the availability/potential deficiency of sulphur in the Prairie Region.
2. Discuss the most common sources of sulphur in Prairie Region.
 - a. Sulfate based (recognizing solubility differences).
 - b. Elemental (recognizing particle size, dispersibility, and oxidation rate).
 - c. Liquid ammonium thiosulfate (ATS).
 - d. Combined sulfate and elemental products.
 - e. Recognize interactions among sources, timing and placements.
3. Discuss considerations that may be used to determine the right source of sulphur based on:
 - a. crop type;
 - b. tillage and cropping system;
 - c. crop growth stage;
 - d. soil test or tissue test;
 - e. timing and placement of application.
4. Discuss how managing the 4Rs for sulphur influences nitrogen and phosphorus losses to surface water and groundwater.
5. Discuss considerations that may be used to determine the right rate of sulphur:
 - a. source of sulphur
 - b. crop type;
 - c. tillage and cropping system;
 - d. crop growth stage;
 - e. soil test or tissue test;
 - f. timing and placement of application;
 - g. irrigation;
 - h. atmospheric deposition of sulphur.
6. Discuss how managing the 4Rs for sulphur influences nitrogen and phosphorus losses to surface water and groundwater.

Competency Area 5. Determining the Right Source, Rate, Timing and Placement of Calcium and Magnesium

1. Discuss the availability/potential deficiency of calcium and magnesium in the Prairie Region.

2. Discuss the most common sources of calcium and magnesium used in Prairie Region.
3. Discuss considerations that may be used to determine the right source of calcium and magnesium based on:
 - a. crop type;
 - b. tillage and cropping system;
 - c. crop growth stage;
 - d. soil test or tissue test;
 - e. timing and placement of application.
4. Discuss how managing the 4Rs for calcium and magnesium influences nitrogen and phosphorus losses to surface water and groundwater.
5. Discuss considerations to determine the proper rate, timing and placement/method 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.
6. Discuss considerations to determine the proper rate, timing and placement/method 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.

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

1. Discuss the availability/potential deficiency of micronutrients in the Prairie Region.
2. Discuss the most common sources of micronutrients used in Prairie Region.
3. Discuss considerations that may be used to determine the right source of micronutrients based on:
 - a. crop type;
 - b. tillage and cropping system;
 - c. crop growth stage;
 - d. soil test or tissue test;
 - e. timing and placement of application.
4. Discuss how managing the 4Rs for micronutrients influences nitrogen and phosphorus losses to surface water and groundwater.

5. Discuss considerations to determine the proper source, rate, timing and placement of copper based on the:
 - a. crop type and variety;
 - b. cropping system;
 - c. crop growth stage;
 - d. soil test or tissue test;
 - e. timing of application.

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

7. Discuss considerations to determine the proper source, rate, timing and placement of iron based on the:
 - a. crop type and variety;
 - b. cropping system;
 - c. crop growth stage;
 - d. soil test or tissue test;
 - e. timing of application.

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

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

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

PROFICIENCY AREA 6: Determining the Right Rate, Timing and Placement of Soil Amendments and their Effects on Management of Nutrients

Competency Area 1: Determining the Proper Source, Right Rate, Timing and Placement of Liming Materials for pH Adjustment

1. Understand reasons to use liming materials.
2. Discuss suitability of sources of liming materials:
 - a. industrial byproducts used for liming;
 - b. ag liming materials;
 - c. wood ash;
 - d. cost/benefit;
 - e. contaminants;
 - f. particle size;
 - g. calcium carbonate equivalent (CCE).
3. Discuss considerations to determine the proper rate, timing and placement of liming materials (e.g. agricultural lime, industrial byproducts, and wood ash) 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. major nutrient contribution from lime.

Competency Area 2. Determining the Proper Source, Right Rate, Timing and Placement of Amendments for Sodic and Solonetzic Soils

1. Gypsum
 - a. Understand the soil and site properties where gypsum use is beneficial.
 - b. Indicate the additional requirements and mechanisms for remediation of sodic and solonetzic soils when using gypsum.
2. Elemental Sulphur
 - a. Understand soil properties that are conducive to effective elemental sulphur application.
 - b. Indicate the additional requirements and mechanisms for remediation of sodic and solonetzic soils when using elemental sulphur.

Competency Area 3. Be Aware of Considerations in Using Soil Amendments and Soil/Plant Additives and the Role They May Play in Management of Soil and Plant Nutrients

1. Understand the role the following amendments can play in nutrient management and soil health.
 - a. Biochar.
 - b. Humic materials.
2. Know the different classes of soil/plant additives, if they need to be registered, and how to check if they are registered:
 - a. biological;
 - b. nutritional;
 - c. enzymes/proteins;
 - d. health, environmental, and efficacy requirements.

PROFICIENCY AREA 7: MANAGEMENT of MANURE, COMPOST, BIOSOLIDS, and WASTEWATER

Competency Area 1. Source, of Manure, Biosolids and Wastewater

1. Discuss the availability of manure, compost, biosolids and wastewater in the Prairie Region.
2. Discuss the most common sources of manure, compost, biosolids and wastewater used in Prairie Region.
3. Discuss considerations that may be used to determine the right source of manure, compost, biosolids, and wastewater based on:
 - a. crop type;
 - b. tillage and cropping system;
 - c. crop growth stage;
 - d. soil test or tissue test;
 - e. analysis of manure, biosolids and wastewater;
 - f. timing and placement of application.
4. Discuss how managing the 4Rs for manure, compost, biosolids and wastewater influences nitrogen and phosphorus losses to surface water and groundwater.

Competency Area 2. Rate, Timing and Placement/Method of Manure, Compost, Biosolids and Wastewater

1. Interpret how soil test levels relate to crop yield response and potential environmental impacts.
2. Describe how rates may be affected by soil characteristics, which may include:
 - a. cation exchange capacity (CEC);
 - b. organic matter;
 - c. texture;
 - d. clay type.
3. Discuss considerations to determine the proper source, rate, timing and placement based on the:
 - a. crop type and variety;
 - b. cropping system;
 - c. crop growth stage;
 - d. soil test or tissue test;
 - e. timing of application;
 - f. method of application;
 - g. relative balance of available nutrients.

Competency Area 3. Whole-Herd or Whole-Flock Total Annual Manure and Nutrient Production

1. Recognize differences in calculating animal units for different Provinces and be able to calculate the total number of animal units in an operation given appropriate information.
2. Discuss the use of software and/or charts to estimate the total amount of manure produced in a year by an operation.

3. Discuss the pros and cons of operation specific nutrient tests versus book values with respect to developing a nutrient management plan.
4. 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.
5. Use record keeping to measure the total manure produced by an operation in a year.

Competency Area 4. Adequacy of the Land Base for Applying Manure, Compost, Biosolids, and Wastewater

1. Discuss the risk of loss of nutrients (N, P) and odour from a field, how it may be assessed, and how it may exclude some fields from receiving manure, compost, biosolids, and wastewater and/or require setbacks.
2. Evaluate the adequacy of the cropland available for spreading manure, biosolids, and wastewater by comparing the total available product to the land base.
3. Understand restrictions on crops, vegetables, or forages based on application of manure, biosolids or wastewater due to build-up of nutrients, metals, pathogens, and salinity.

Competency Area 5. Crediting the Nutrients in Manure for Crop Production

1. Use the availability factors for the nitrogen (current and previous applications), phosphorus and potassium in manure as outlined in the Tri-Provincial Manure Application and Use Guidelines.
2. Describe how to credit the phosphorus and potassium in manure for the crop requirements recommended by soil tests using the nutrient recommendations of Tri-Provincial Manure Application and Use Guidelines and how to adjust manure spreading rates accordingly for each field.
3. Evaluate the strengths and weaknesses of each tool listed below and the situations in which it is appropriate to use each tool:
 - a. fall soil nitrate test (PPNT);
 - b. pre-sidedress soil nitrate test (PSNT);
 - c. post-season stalk nitrate for corn;
 - d. grain protein content for wheat;
 - e. virtual soil test with historical application documentation;
 - f. residual nutrients (P, K, S, and micronutrients);
 - g. nutrient balance.

Competency Area 6. Other Management Considerations

1. Understand practices that contribute to lodging and how this is related to the 4Rs NM concepts.
2. Explain the relationship between grass tetany and manure application.
 - a. Define and be able to apply the tetany ratio to understand the relationship between K and grass tetany.

3. Recognize the contribution of soluble salts to soils and crops.
4. Be able to understand the restrictions on heavy metal accumulation when using manure, compost, biosolids, wastewater, and fertilizers.
5. Discuss unique considerations of manure, compost, biosolids and wastewater application in terms of runoff risk of nutrients and pathogens.
 - a. Edge of field effects.
 - b. Downstream impacts.
 - c. Tillage and incorporation.
 - d. Use of buffer and filter strips.
 - e. Management of adjacent riparian areas.
 - f. Timing of application.
 - g. Placement of manure in accordance with setback requirements.
6. Explain the relationship between manure and other organic amendments and soil organic matter content.