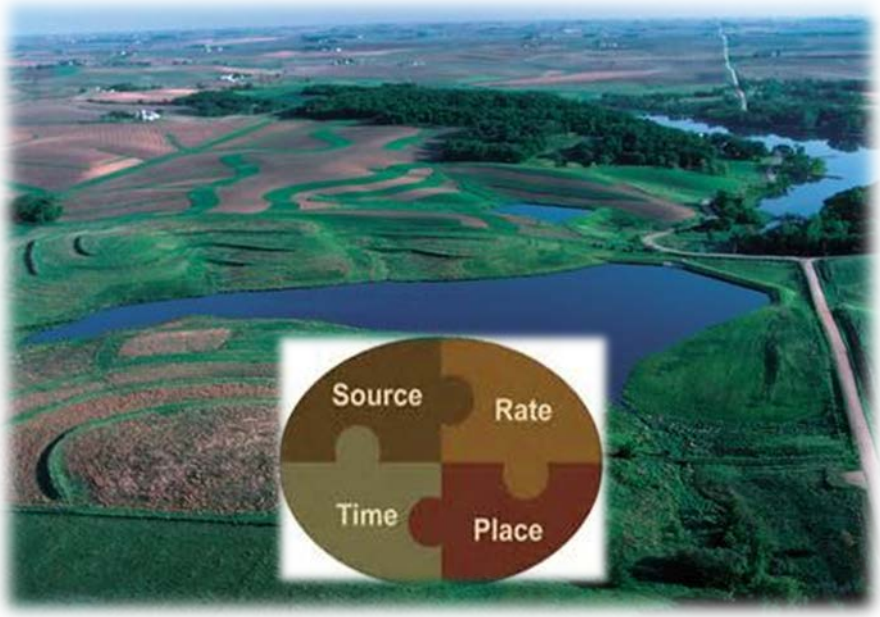
4R Nutrient Management Specialist Exam – Region 4

PERFORMANCE OBJECTIVES

The American Society of Agronomy

International Certified Crop Adviser Program



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4R Nutrient Management Specialist – Region 4

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FOREWORD

The International Certified Crop Adviser (ICCA) Program developed the 4R Nutrient Management (4R NMS) Specialty 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 NMS 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 and environmental stewardship.

Nutrient management is an integrated process that considers not only the agronomic aspects of soil 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, in the right place, and at the right time---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 NMS Specialty Area is an additional specialty certification that builds upon the nutrient, soil and water components of the International CCA Certification, to demonstrate the Crop Adviser'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 POs for 4Rs Nutrient Management Specialist. Comments should be sent to: ASA, ICCA Program, 5585 Guilford Rd., Madison, WI 53711.

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. This type of program would not be possible without their dedication to the profession of agronomy and the ICCA program.

4R Nutrient Management Specialty

Performance Objective Committee

August 2020

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 English units and vice versa, as well as understand SI units. Conversion factors will be provided for questions within the exam.

NUTRIENT MANAGEMENT PLANNING

Competency Area 1. Roles and Responsibilities of Federal, State, 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 documents:
    a. GM 190-402 (Nutrient Management).
        i. http://directives.sc.egov.usda.gov/viewerFS.aspx?hid=27119
    b. 590 Nutrient Management Conservation Practice Standard.
        i. http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/crops/npm/
    c. Field Office Technical Guide (FOTG) Section IV.
        i. https://efotg.sc.egov.usda.gov/#/
    d. The Fertilizer Institute (TFI) - General website/information on Nutrient Stewardship.
        i. https://www.tfi.org/
2. Interpret roles and responsibilities of federal, state, local, public, and private entities in nutrient management planning.
3. Discuss federal, state-specific, and local-specific policies that relate to nutrient management planning and how policies and standards can vary by jurisdiction.
4. Create a Nutrient Management Plan for a given farm that follows the standards set forth in the NRCS 590 Nutrient Management Conservation Practice Standard and supplemental technical notes.
5. Identify responsible parties and their roles in implementing each component of a Nutrient Management Plan following the NRCS 590 Nutrient Management Conservation Practice Standard and the logistics needed to apply nutrients at the right rate, at the right times, using the right sources and the right methods of application.

Competency Area 2. Integrating 4Rs with a Nutrient Management Plan and the CCA's Responsibility as a Nutrient Management Planner

1. Interpret your state's NRCS 590 Nutrient Management Conservation Practice Standard certification/approval process.
2. Distinguish the differences and similarities between a NRCS 590 Plan and 4R Nutrient Management Plan.
3. Plan the right rate(s), at the right time(s), using the right source(s), and the right method(s) of application to fit the client's cropping system, climate, soils, farming practices, and economic conditions.
4. Evaluate the considerations to plan logistics for the equipment, labor, and nutrient materials to develop the 4R Nutrient Management Plan for a given operation.
5. Compare and contrast various soil test interpretations based on soil test extraction methods calibrated by land grant universities, Department of Agriculture state approved labs, or private sector labs for making nutrient recommendations.

6. Understand the underlying field research required to calibrate a given soil test extraction method, i.e. to derive nutrient recommendations from the test values in different geographic regions.
7. Justify management actions that should be considered if nutrients need to be applied outside the optimum 4R Nutrient Management Plan.
8. Discuss consequences of increasing soil nutrient levels above the crop nutrient response level after implementing a 4R Nutrient Management Plan.
9. Evaluate a CCA's professional risks and responsibilities related to nutrient management planning.
10. Discuss the components of the 4R Nutrient Management Plan that should be monitored and tracked over time and the impacts of any changes.
11. 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 and timing.
    e. yields.
12. Demonstrate knowledge of plan implementation, follow-up, and record keeping components of a 4R Nutrient Management Plan, and what must be achieved to be in line with the NRCS 590 Nutrient Management Conservation Practice Standard.
13. 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.
14. Discuss the advantages of maintaining consistent field map boundaries and field numbering systems with USDA agencies, the client, and the consultant.

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

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 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).

3. Evaluate the expected changes in revenue from adopting the 4R practices.
4. Estimate the costs for nutrient management plans including plan preparation, record keeping, soil tests, manure tests, and labor.
5. Estimate the financial risk or exposure of not following the 4R Nutrient Management Plans, including regulatory compliance.
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 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.
6. Explain the concepts of the 303(d) list and its relation to Total Maximum Daily Loads (TMDLs).
7. Use appropriate sources to identify which watersheds have an assigned Total Maximum Daily Load (TMDL) that could affect the Nutrient Management Plan.
8. Evaluate how the TMDL of a specific watershed may impact the Nutrient Management Plan.

NITROGEN

Competency Area 1. Determining the Right Source of Nitrogen

1. Understand the most common sources of nitrogen used in your state.
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

1. Interpret how soil test nitrogen levels relate to crop yield response and potential environmental impacts.
2. Estimate the environmental risk of applying nitrogen above economic optimums.
3. 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. soil characteristics including leaching.
    d. topography and runoff.
    e. crop conditions, including crop rotation, crop type and growth stage.
4. Calculate nitrogen credits from
    a. previous nitrogen application.
    b. soil organic matter.
    c. manure.
    d. biosolids.
    e. irrigation applications (groundwater and wastewater).
    f. previous legumes.
5. Discuss the use of technologies to make ongoing adjustments to the nutrient rates that may have been identified during the nutrient management planning process such as:
    a. crop canopy sensors.
    b. NDVI.
    c. post-season stalk nitrate.
    d. pre-sidedress soil nitrate test (PSNT).
    e. plant analysis.

Competency Area 3. Determining the Right Timing of Nitrogen Application

1. Discuss how soil nitrogen test levels relate to crop yield response and potential environmental impacts.
2. Estimate the environmental risks in the timing of applying nitrogen based on
    a. climate.
    b. soil type.
    c. crop and crop stage
    d. runoff.
    e. irrigation.
    f. leaching potential on groundwater and surface water resources.
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 that split application offers for 4R nitrogen management.
6. Calculate how cover crops can affect nitrogen availability in follow-up cash 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/slow release nitrogen products.

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

1. Determine the best placement or method of application based on the nitrogen source.
2. Discuss how the time of the year or climate will impact the proper placement or method of application.
3. Explain how crop stage will determine the placement or method of application.
4. 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/slow release nitrogen products.
5. Assess the role of fertigation in nutrient management

Competency Area 5. Environmental Risk Analysis for Nitrogen

1. Discuss how to use water quality vulnerability assessment tools on a site-specific basis for nitrogen nutrient planning.
2. Evaluate nitrogen management decisions using a water quality vulnerability assessment.
3. Be able to evaluate how changing a specific nitrogen management strategy will affect the outcome of a risk assessment.

4. Evaluate management/conservation strategies that will reduce nitrogen loss to surface water, groundwater, and nitrous oxide emissions.
5. 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.
6. Discuss the role of nitrogen in the eutrophication process and the potential consequences of eutrophication.
7. Discuss the role of nitrogen in drinking water standards.

PHOSPHORUS

Competency Area 1. Determining the Right Source of Phosphorus

1. Discuss the most common sources of phosphorus used in your state.
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 surface soil pH.
    d. environmental concerns in the local area (surface and groundwater).
    e. crop stage.

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 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. weather and climate,
        i. including temperature,
        ii. precipitation amount,
        iii. rainfall intensity,
        iv. precipitation patterns, and
        v. wind erosion and soil deposition
    b. soil characteristics including leaching.
    c. topography and runoff.
    d. crop conditions, crop type, and crop stage.
5. Calculate phosphorus credits from
    a. previous phosphorus application.
    b. manure.
    c. biosolids.
    d. wastewater.
6. 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

1. Discuss the importance of the following climate and weather phenomena on phosphorus application timing:
    a. intensity.
    b. type of precipitation.
    c. duration of precipitation.
    d. runoff.
    e. frozen ground considerations.
2. Explain the mechanisms of phosphorus loss to surface water.
3. Discuss reduction strategies and management for particulate phosphorus loss.
4. Discuss reduction strategies and management for dissolved phosphorus loss.
5. Explain 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

1. Discuss the importance of the following climate and weather phenomena to determine the optimal placement or method of application of phosphorus:
    a. intensity.
    b. type of precipitation.
    c. duration of precipitation.
    d. runoff.
2. Discuss the relationship between tillage practices/system on phosphorus management.
3. Discuss the considerations for phosphorus placement and method of application based on the risk of phosphorus runoff.
4. Plan the best placement or application method for phosphorus to minimize the transport of phosphorus offsite considering
    a. soil texture
    b. pH
    c. type of phosphorus
5. Discuss how phosphorus contamination of surface water can occur from tile drainage due to placement and method of application.
6. Discuss how to use 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 on a site-specific basis for phosphorus nutrient planning.
2. Evaluate phosphorus management decisions using a water quality vulnerability assessment.
3. Be able to evaluate how changing a specific phosphorus management strategy will affect the outcome of a risk assessment.
4. Evaluate management/conservation strategies, including modifying phosphorus transport processes, which will reduce phosphorus loss to surface water and groundwater.
5. Discuss how tillage system (including no-till) affects environmental losses of phosphorus.
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.

POTASSIUM, SECONDARY MACRONUTRIENTS AND MICRONUTRIENTS

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

1. Discuss the most common mineral and organic sources of potassium, secondary macronutrients used in the Region.
2. Discuss considerations that may be used to determine the right source of potassium and secondary macronutrients, based on:
    a. crop type;
    b. cropping system;
    c. crop stage;
    d. soil test or tissue test;
    e. timing of application.
3. Explain how managing the 4Rs for potassium and secondary macronutrients, 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. 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. 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. Recommend the rate of potassium applied based on potassium placement.

Competency Area 3. Determining the Right Timing of Potassium Application

1. Discuss how the timing and method of potassium application can impact potassium salt considerations and the application method.
2. Understand considerations of how the time of application and soil texture affect how K moves through the soil profile.
3. Describe how K is immobilized by structure of the clay lattice (i.e. 1:1 (kaolinite) versus 2:1 (montmorillonite) clays).

Competency Area 4. Determining the Right Place of Application for Potassium

1. 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.
    d. crop growth stage

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

Competency Area 5. Determining the 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. 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 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.

3. Discuss considerations to determine the proper rate, timing and placement of sulfur 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 Source, Rate, Timing and Placement of Micronutrients

1. Discuss the most common mineral and organic sources of micronutrients used in the Region.
2. Discuss considerations that may be used to determine the right source of 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 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.
4. 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.
5. 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 Source, Rate, Timing and Placement of Lime for pH adjustment

1. Discuss considerations to determine the proper source, rate, timing, and placement of agricultural lime based on:
    a. target pH by crop;
    b. soil test pH and buffer pH, magnesium;
    c. timing of application;
    d. method of application;
    e. solubility/reactivity/effectiveness of the source;
    f. major nutrient contribution from lime.
2. Understand economic considerations based on the type of lime being used and be able to calculate a price comparison based on the source and the following information:
    a. Pelletized versus quarry-based lime sources
    b. Price and ECCE
    c. Logistics (hauling costs, available application equipment)
    d. Cost/economics of tillage operations
    e. Farm budget and investment (owned or leased)
3. Understand how the placement of lime, the cropping system, and tillage affects stratification.

MANURE MANAGEMENT

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

1. Understand the components of a manure management plan.
2. Calculate the total number of animal units in an operation.
3. Discuss the NRCS Agricultural Waste Management Field Handbook guidance or approved software to calculate the total amount of manure produced in a year by an operation.
    a. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/water/quality/?cid=stelprdb1044732
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 recordkeeping to measure the total manure produced by an operation in a year.
7. Be able to calculate the economics between manure application from manure produced on your farm vs purchased manure vs commercial fertilizer.

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

1. Use the phosphorus risk assessment tool identified by your state's 590 Standard 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 and sensitive areas.
2. Evaluate the adequacy of the cropland available for spreading manure by comparing the total annual manure production to the land base.
3. Be able to determine if there are areas of the land base that are not available for manure application based on P levels in the soil.

Competency Area 3. 4Rs Related to Manure Management

1. Source of nutrients
    a. Animal species
    b. Type/texture of manure
    c. Manure analysis and sample procedures
2. Timing of manure application
    a. Time of year
    b. Temperature considerations including spreading on frozen ground.
    c. Stabilization products

3. Method/Placement
    a. Application: surface broadcast, broadcast and incorporated, or injection
    b. Know how to calibrate equipment for manure application
    c. Understand how type of manure (e.g., slurry vs dry) affects the method and placement of manure.
    d. Understand how the placement of manure above or below the surface affects N volatilization and mineralization and phosphorus loss potential.
4. Environmental
    a. Understand how to use risk assessment tools for manure application with respect to N and P.
    b. Be able to apply state and local regulations for manure application.
    c. Be aware of generally accepted practices for manure application.
    d. Understand the implication of TMDLs in relation to manure application, including phosphorus, bacteria, nitrates, and other impairments.

Competency Area 4. Crediting the Nutrients in Manure for Crop Production

1. Use the availability factors for the nitrogen, phosphorus and potassium in manure published by the land grant university in your state.
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 land grant university in your state, and how to adjust manure spreading rates accordingly for each field.
3. Discuss the following tools to estimate the nitrogen available from manure and to adjust nitrogen applications by field:
    a. shallow preplant soil nitrate test (PPNT).
    b. pre-sidedress soil nitrate test (PSNT).
    c. chlorophyll meter.
    d. post-season stalk nitrate test.
4. Evaluate the strengths and weaknesses of each tool listed above (PO #3) and the situations in which it is appropriate to use each tool.
5. Understand how to credit the nutrient content in composted manure or other natural materials such as biosolids and municipal compost.