

4R Nutrient Management Specialist Exam – Region 6

PERFORMANCE OBJECTIVES

The American Society of Agronomy

International Certified Crop Adviser Program



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CCA Region 6 – 4R Nutrient Management Specialist

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FOREWORD

The International Certified Crop Adviser (ICCA) Program developed the 4R Nutrient Management (4R NMS) Specialist Certification to meet the growing demand for qualified advisers with focused knowledge and skills in nutrient management. The 4R NMS specialty recognizes the skills and experience of CCAs who have specialized knowledge in nutrient management so they can promote environmental stewardship required to achieve and maintain productive crops, fertile soils and high air and water quality by promoting environmental stewardship via sound nutrient management practices.

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 associated with the management system. The 4R concept of nutrient management is being implemented worldwide by industry, researchers, government agencies, farmers and the farm advisers. The goal of 4R nutrient management is centered around building a nutrient management plan that applies the right nutrient sources, at the right rate, in the right place, and at the right time to optimize crop productivity and farm profitability and enhance environmental quality. The 4R Nutrient Management Program 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 Specialia 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.

Region 6 is comprised of nine states including Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and Tennessee with each state having some unique agroecosystems and some systems that are shared among the states. In general, the region shares a warm, humid climate, but the seasonal temperatures, rainfall patterns and landscape use varies within the region. The diverse topography, wide range of soil properties, warm climate, weather phenomena, and agricultural enterprises within Region 6 states offer unique nutrient management challenges and opportunities for CCAs. Despite the diversity within Region 6, the concepts and fundamental science that define sound nutrient management planning required to prevent the degradation of, maintain and/or improve soil fertility and environmental quality are the same. Only the methods of implementing best nutrient management practices to achieve the desired goals for crop productivity, soil fertility and environmental quality may change among the cropping systems common to each state.

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 Region 6 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.

Region 6 – 4R Nutrient Management Specialty

Performance Objective Committee

2017

Notes on Exam Format and Conversions

- The Region 6 Nutrient Management Specialist exam was prepared from this set of Performance Objectives (POs) 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 may include 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 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).
 - a. <http://directives.sc.egov.usda.gov/viewerFS.aspx?hid=27119>
 - b. 590 Nutrient Management Conservation Practice Standard.
 - a. <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/crops/npm/>
 - c. Field Office Technical Guide (FOTG) Section IV.
 - a. http://efotg.sc.egov.usda.gov/efotg_locator.aspx
 - d. The Fertilizer Institute (TFI) - General website/information on Nutrient Stewardship.
 - a. <http://www.tfi.org/>
2. Interpret roles and responsibilities of state, local public and private entities in nutrient management planning.
3. Discuss national, state-specific, and local-specific policies that relate to nutrient management planning.
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.
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. Understand 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 Nutrient Management Plan certification process.
2. 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, and farming situation.

3. Evaluate the considerations to plan logistics for the equipment, labor, and nutrient materials to develop the 4R Nutrient Management Plan for a given operation.
4. Discuss the advantages of using soil test interpretations based on soil test extraction methods calibrated by land grant universities for making nutrient recommendations.
5. Discuss the underlying field research required to calibrate a given soil test extraction method, i.e. to derive nutrient recommendations from the test values.
6. Justify management actions that should be considered if nutrients need to be applied outside the optimum 4R Nutrient Management Plan.
7. Discuss consequences of increasing soil nutrient levels above the crop nutrient response level after implementing a Nutrient Management Plan.
8. Evaluate a CCA's professional risks and responsibilities related to nutrient management planning.
9. Discuss the components of the Nutrient Management Plan that should be monitored and tracked over time and the impacts of any changes.
10. 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.
11. 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.
12. 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.
13. 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).
 - i. residue management and cover crops.
3. Evaluate the incremental 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.
 - a. Soil chemical properties
 - b. Soil physical properties
 - c. Soil biological properties
 - d. Transport factors: topography, length of slope, etc.
 - e. BMPs, implementation, and verification

- f. Environmental regulations and interpretation of how to apply the regulations for soil properties and nutrient management
 - g. Tools used to characterize the soil properties
- 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. Discuss the most common sources of nitrogen fertilizer used in Region 6.
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 surface and groundwater.
 - e. crop stage.
3. Be able to calculate N costs as a cost per pound of N.

Competency Area 2. Determining the Right Rate of Nitrogen

1. Know when soil test nitrogen levels may be appropriate and relate to crop yield response and potential environmental impacts.
2. Estimate the environmental risk of applying nitrogen in excess of crop needs.
3. Understand yield goals and how they relate to nitrogen use efficiency, crop response, and soil characteristics.
4. Justify the considerations for nitrogen application rate based on
 - a. economics.
 - b. weather and climate, including
 - i. precipitation amount.
 - ii. rainfall intensity.
 - iii. precipitation patterns.
 - c. Crop conditions including crop type and growth stage.
 - d. Soil characteristics
 - i. leaching.
 - ii. topography and runoff.
5. Calculate nitrogen credits from
 - a. previous nitrogen application.
 - b. soil organic matter.
 - c. manure.
 - d. biosolids.
 - e. irrigation applications (groundwater and wastewater).
 - f. previous crop.

- g. cover crops.
6. Discuss technologies for ongoing adjustments to nutrient rates that may have been identified during the nutrient management planning process such as:
- a. crop canopy sensors.
 - b. NDVI.
 - c. pre-sidedress nitrate test.
 - d. plant analysis such as
 - i. post-season stalk nitrate.
 - ii. leaf tissue sampling.
 - iii. petiole sampling.

Competency Area 3. Determining the Right Timing of Nitrogen Application

1. Estimate the environmental risks in the timing of nitrogen application based on
 - a. climate.
 - b. soil texture.
 - c. runoff.
 - d. irrigation.
 - e. crop growth stage.
2. Estimate the risks of applying nitrogen on saturated or frozen soils.
3. Discuss how the timing of nitrogen application is dependent upon the nutrient source.
4. Understand how the timing of nitrogen application interacts with plant growth stage to influence nitrogen fertilizer recovery by the plants and yield response.
5. Discuss the opportunities that split applications offer for 4R nitrogen management.
6. Calculate how cover crops may 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 release nitrogen products.
 - d. slow release nitrogen products.

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

1. Understand different types of placements:
 - a. banded, surface applied.
 - b. banded, knifed, below surface.
 - c. broadcast, surface applied.
 - d. 2 x 2 starter placement.
 - e. coulter, shallow surface.
 - f. foliar.
2. Discuss how the source of the nitrogen will determine the best placement or method of application.
3. Discuss how the time of the year or climate will impact the proper placement or method of application.
4. Discuss how crop stage 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-release nitrogen.
 - d. slow release nitrogen products.
6. Evaluate the role of fertigation (center-pivot, drip, furrow) in nutrient management planning.

Competency Area 5. Environmental Risk Analysis for Nitrogen

1. Discuss and evaluate how to use water quality vulnerability assessment tools on a site-specific basis for nitrogen nutrient planning.
 - a. Stalk nitrate test.
 - b. Leaching Index (LI) – NRCS tool.
 - c. Be able to use TMDL state impaired water listings for 303(d) and 305(b).
2. Evaluate how changing a specific nitrogen management strategy will affect the outcome of a risk assessment.
3. Evaluate management strategies that will reduce nitrogen loss to surface water, groundwater, and nitrous oxide emissions.

4. 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.
5. Discuss the role of nitrogen in the eutrophication process and the potential consequences of eutrophication.
6. 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 fertilizer 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.
 - b. soil characteristics including leaching.
 - c. topography and runoff.
 - d. crop conditions, crop type, and growth stage.
5. Calculate phosphorus credits and phosphorus availability 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 climate and weather phenomena on phosphorus application timing:
 - a. intensity of rainfall.
 - b. type of precipitation.
 - c. duration of precipitation.
 - d. runoff and erosion.
2. Discuss 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. 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

1. Discuss the importance of the following climate and weather phenomena to determine the optimal placement or method of application of phosphorus fertilizers:
 - a. intensity of rainfall.
 - b. type of precipitation.
 - c. duration of precipitation.
 - d. runoff and erosion.
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 including but not limited to.
 - a. in-furrow
 - b. surface application
 - c. banded application
 - d. subsurface application
4. Plan the best placement or application method for phosphorus to minimize the transport of phosphorus offsite.
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 in water management to reduce phosphorus nutrient losses to surface water.

Competency Area 5. Environmental Risk Analysis for Phosphorus

1. Discuss and evaluate how to use water quality vulnerability assessment tools on a site-specific basis for phosphorus nutrient planning.
 - a. Use TMDL state impaired water listings for 303(d) and 305(b).
2. Evaluate how changing a specific phosphorus management strategy will affect the outcome of a risk assessment.
3. Evaluate management strategies, including modifying phosphorus transport processes, which will reduce phosphorus loss to surface water and groundwater.
4. Discuss how tillage system (including no-till) affects environmental losses of phosphorus.
5. 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.
6. Discuss the role of phosphorus, including legacy phosphorus, in the eutrophication process and the potential consequences of eutrophication.

POTASSIUM, CALCIUM, MAGNESIUM, SULFUR AND MICRONUTRIENTS

Competency Area 1. Determining the Right Source of Potassium, Calcium, Magnesium, Sulfur and Micronutrients

1. Discuss the common sources of potassium, calcium, magnesium, sulfur, and micronutrient fertilizer used in your state.
2. Discuss considerations that may be used to determine the right source of potassium, calcium, magnesium, sulfur, and micronutrients based on:
 - a. crop.
 - 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, calcium, magnesium, sulfur, and micronutrients influences nitrogen and phosphorus losses to surface water and groundwater.
4. Discuss how climate affects the 4Rs management of potassium, calcium, magnesium, sulfur and micronutrients.

Competency Area 2. Determining the Right Rate of Potassium

1. Interpret how soil test potassium levels relate to crop yield response.
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
 - c. CEC.
 - d. organic matter.
 - e. texture.
 - f. clay type.
4. Calculate potassium credits from
 - c. previous potassium application.
 - d. manure.
 - e. biosolids.
 - f. wastewater.

5. Justify 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 placement of potassium application can impact potassium salt considerations and the application method.
2. Discuss how the timing of potassium application is influenced by crop growth stage as related to nutrient uptake.

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

1. Discuss considerations to determine the proper placement of potassium based on the
 - a. crop type.
 - b. cropping system.
 - c. methods of tillage.
2. Estimate the proper placement of potassium based on current potassium soil test levels and CEC.

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

1. Discuss considerations to determine the proper rate, timing and placement of calcium and magnesium based on the:
 - a. crop.
 - b. cropping system (i.e., tillage, rotation).
 - c. crop growth stage.
 - d. soil test or tissue test.
 - e. method of application.
3. Discuss considerations to determine the proper rate, timing and placement of sulfur based on the:
 - a. crop.
 - b. cropping system (i.e., tillage, rotation).
 - c. crop growth stage.
 - d. soil test or tissue test.
 - e. method of application.
 - f. atmospheric deposition of sulfur.

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

1. Understand how the source of micronutrients influences the rate, timing and placement of micronutrients.
2. Discuss considerations to determine the proper rate, timing and placement of boron, manganese, and zinc based on the:
 - a. crop.
 - b. cropping system (i.e., tillage, rotation).
 - c. crop growth stage.
 - d. soil test or tissue test.
 - e. method of application.
3. Discuss considerations to determine the proper rate, timing and placement of copper based on the:
 - c. crop.
 - d. soil texture, SOM, and pH.
 - b. cropping system (i.e., tillage, rotation).
 - c. crop growth stage.
 - d. soil test or tissue test.
 - e. method of application.

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

1. Discuss considerations to determine the proper rate, source, timing and placement of liming material based on:
 - a. target pH by crop.
 - b. soil test pH, buffer pH, and other lime requirement methods.
 - c. timing of application.
 - d. method of application.
 - e. calcitic versus dolomitic lime.
 - f. nutrient contribution from lime.
 - g. components of state regulations or lime laws.

MANURE MANAGEMENT

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

1. Calculate the total number of animal units in an operation.
2. 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>
3. Discuss why it's 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.
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. Determine the effects of accumulation of zinc and copper on crop production and soil health.
6. Use recordkeeping to measure the total manure produced by an operation in a year.

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 phosphorus loss from a field, and how it may exclude some fields from receiving manure and/or required setbacks.
2. Evaluate the adequacy of the cropland available for spreading manure by comparing the total annual manure production to the land base.
3. Use the NRCS leaching index to determine risk of nitrogen loss to groundwater.

Competency Area 3. 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. pre-plant soil nitrate test (PPNT).
 - b. pre-sidedress soil nitrate test (PSNT).
 - c. chlorophyll meter.
 - d. plant analysis such as
 - i. post-season stalk nitrate.
 - ii. leaf tissue sampling.
 - iii. petiole sampling.
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.