Implementing 4R Nutrient Stewardship on the Farm

Implementing the 4Rs

Agriculture is being challenged to maintain profitable farm economics, while meeting the increased product demands of a growing population, and responding to increased scrutiny of land an d resource management. Agricultural sustainability addresses economic, environmental , and social goals . The 4Rs imply there are four aspects to every fertilizer application and it provides a framework to assess whether a given crop has access to the necessary nutrients. To help identify opportunities to improve fertilizer efficiency and prevent nutrient movement from each field, ask:

> Was the **RIGHT FERTILIZER SOURCE** ***given to the crop at the*** **RIGHT RATE, RIGHT TIME,** ***and in the*** **RIGHT PLACE?**

4R Principles

The principles are the same globally, but how they are used locally varies depending on field and site specific characteristics.

RIGHT SOURCE

Ensure a balanced supply of essential nutrients. Specifically -consider nutrient supply in plant available forms, ensure nutrient suits soil properties, and recognize the synergisms among elements.

RIGHT RATE

Assess and make decisions based on soil nutrient supply and plant demand. Specifically – appropriately assess soil nutrient supply (including those from organic sources and existing soil levels), assess plant demand, and predict fertilizer use efficiency.

RIGHT TIME

Assess and make decisions based on the dynamics of crop uptake, soil supply, nutrient loss risks, and field operation logistics. Specifically – assess the timing of crop uptake, assess the dynamics of the soil's nutrient supply, recognize weather factors, and consider logistics.

RIGHT PLACE

Address root-soil dynamics and nutrient movement, and manage spatial variability within the field to meet site-specific crop needs and limit potential losses from the field. Specifically – recognize root – soil dynamics, manage spatial variability issues, consider the tillage system, and limit potential off-field transport.

Steps to Implementing 4Rs on the Farm

1. Identify economic, social and environmental goals that cropping system objectives should address specific to each field and operation.
2. Select BMPs that are specific to the soil, climate, cropping system and goals identified by the grower.
3. Integrate BMPs for all goals an d adjust as needed.
4. Document the 4R nutrient stewardship plan.

Example Goals

Economic Goals

- Improve net farm income
- Contribute to improved regional economic development

Social Goals

- Improve the quality of farm family housing, diet, and education
- Improve the productivity of farm labor by appropriate use of emerging technolo gies that increase efficiencies of field operations and reduce costs per unit of crop harvested
- Improve assess to sources of information to assist in farm management decision making

Environmental Goals

- Maintain or reduce unwanted losses of nutrient s to the environment:
  - Reduce soil erosion of nutrient containing soil particles;
  - Reduce volatile ammonia (NH_3) emissions;
  - Reduce nitrification/de-nitrification losses of nitrous oxide (N_2O) and di-nitrogen (N_2).
- Reduce energy use per harvested unit of farm production.
- Improve recycling of crop nutrien5s from crop residues and livestock manures.

Example BMPs

Right Source

- Select appropriate fertilizer and on-farm nutrient sources for the cropping system including consideration for commercial fertilizer form, enhanced efficiency fertilizer products, manure or biosolids.

Right Rate

- Utilize grid or zone soil testing and rate recommendations
- Use nutrient budgets to plan management and application schemes (including yield goal analysis, crop removal balance and plant tissue analysis)
- Utilize variable rate application technologies to address spatial variability
- Use in-season methods to make in season decisions such as leaf color charts, chlorophyll meters, or optical sensors.

Right Time

- Follow recommended times for nutrient applications
- When necessary utilize enhanced efficiency fertilizers for controlled nutrient release and urease or nitrification inhibition
- Utilize split applications to improve crop nutrient uptake.

Right Place

- Utilize application methods that limit nutrient losses
- Incorporate fertilizers
- Adjust applications to avoid unnecessary applications to non-crop areas
- Couple applications with appropriate soil conservation practices
- Utilize controlled drain management in tile drained fields.

THE *RIGHT TIME* FOR *NUTRIENT STEWARDSHIP* IS *RIGHT NOW*