

# 4Rs On Fertile Ground

*A new way of stewardship for improving management of plant nutrition.*

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The Fluid Journal • Official Journal of the Fluid Fertilizer Foundation • Late Spring 2013 • Vol. 21, No. 3, Issue # 81

**Summary:** *Agriculture faces a challenge to increase food production without adversely affecting the environment. As a component of increased yields and as one source of nutrients in the environment, fertilizer inputs receive increased attention and scrutiny. Best management practices, such as the 4R nutrient steward program, are helping assure fertilizer nutrients will be kept in the root zone for plant use and out of surface and ground waters. Preventing nutrient loss protects the environment and the grower's return on investment. Multiple stakeholders are also exploring and creating opportunities to increase the implementation and adoption of fertilizer best management practices, which will benefit agriculture mightily. However, the increased attention to better management practices has also highlighted the need for a greater focus on science and the need to establish metrics and quantification mechanisms to evaluate the impact and performance of industry fertilizer practices on production and the environment.*



World population is expected to increase from seven billion today to nine billion by 2050. The result will be more people to feed and, very likely, fewer acres on which to produce the needed food, ultimately leading to intensified production. Striving to achieve the necessary higher yields will increase attention on inputs (seed, crop protection, and fertilizer). As members of the global community, we are faced with the challenge of increasing food production in an economically viable way while simultaneously retaining the ecological integrity of food systems; that is, we must increase production to feed the world without adversely affecting the environment.

We also must never forget that the public sector at all levels of government and society broadly looks to agriculture to address both perceived and real negative environmental impacts. One has only to look to the various media outlets for available facts and commentary addressing nutrient pollution to realize that these demands are clearly growing in many areas across North America. Pressure on state agencies is increasing

to develop strategies to address nutrient losses from non-point sources, including cropping systems. Litigation by environmental activist groups and actions by the Environmental Protection Agency (EPA) are two sources of that pressure.

In a 2011 memo to its regional administrators, the EPA sought state collaboration and action to protect state waters from nitrogen and phosphorus pollution. Within the memo, the EPA provided a guidance document entitled "Recommended Elements of a State Nutrients Framework." In the memo, the EPA encourages states to work collaboratively with their stakeholders to develop innovative approaches for addressing non-point source runoff of nitrogen and phosphorus pollution.

Fertilizer use is currently responsible for 50 percent of the world's food supply. Unmanaged nutrient applications can increase nutrient losses and potentially degrade air and water quality, yet ignoring fertilizer needs would result in decreased soil fertility and decreased yields. Policymakers, environmental groups, and the media sometimes focus on fertilizers as a problem for the environment while

overlooking the vital role of nutrients to help meet the food needs of a growing world population. There is not a one-size-fits-all answer to this challenge; however, fertilizer best management practices that are good for the grower and good for the environment are clearly one part of the solution.

## USDA findings

In 2011, the United State Department of Agriculture (USDA) Conservation Effectiveness Assessment Program (CEAP) began issuing regional reports evaluating the level of implementation and the effect of practices on nitrogen, phosphorus, and sediment losses (USDA NRCS, 2013). A common finding among the reports was voluntary practices work and practices to reduce erosion help control surface runoff of particulate phosphorus. They further concluded that to reduce nutrient losses, nutrient management addressing fertilizer form, amount, timing, and placement method must be used in combination with other conservation practices.

The USDA findings closely mirror efforts within the fertilizer industry to

increase implementation of fertilizer best management practices (BMPs) through 4R nutrient stewardship. There is an immediate connection between applying the right fertilizer source at the right rate, the right time, and in the right place and their beneficial impacts on crop performance, soil health, and decreased environmental pollution (International Plant Nutrition Institute [IPNI], 2012).

4R nutrient stewardship provides a framework to achieve cropping system goals--increased production, increased farmer profitability, enhanced environmental protection, and improved sustainability. Assessment of any planned nutrient management practice must consider the economic, social, and environmental effects to determine whether or not it is a "right" practice for that system. Because it is not a one-practice or one-plan-for-all-program, the 4R framework is applicable for all cropping systems and nutrients, and it can be applied to a diverse range of agricultural system types and sizes. The overarching goal of 4R is to match nutrient supply with crop requirements and to minimize nutrient loss from farm fields.

#### **NRCS updates**

As a result of the USDA CEAP reports, the Natural Resources Conservation Service (NRCS) updated its existing 590 nutrient management conservation practice standard. The standard was always intended for use with both commercial and organic fertilizers, but in practice it was generally used for manure management. Because the CEAP reports indicated a need to address both manure and commercial nutrients, as well as to address practices tied to form, amount, timing, and placement, the NRCS incorporated 4R language and practices into the revised standard (USDA NRCS, 2012). The 590 standard is used to provide growers incentive payments related to nutrient management implementation, and in the past many states have incorporated the 590 into their animal feeding operation policies for nutrient management. Current incentive programs incorporating 4R related practices include the Environmental Quality Incentive Program and the Conservation Stewardship Program. Both provide payments to farmers on a per acre basis to implement nutrient management plans and related practices.

#### **State efforts**

To address nitrogen and phosphorus losses as directed by the 2011 EPA

memo, each state will ultimately decide what approaches to use. Many states, from Florida to Minnesota, are already incorporating the 4Rs within their efforts. Below are examples of state actions using 4R nutrient stewardship in their approach.

**Illinois.** Following receipt of the EPA framework memo, the Illinois EPA approached the state agriculture community to pursue their engagement in addressing non-point source nutrient losses from crop production systems. Through efforts within the Illinois Council on Best Management Practices, several entities have committed to a partnership to make measurable progress in the adoption of enhanced nutrient stewardship practices to protect water quality. The nutrient stewardship program titled "Keep it for the Crop by 2025" (KIC) is supported by the Illinois Corn Growers, Illinois Farm Bureau, Illinois Fertilizer and Chemical Association, Illinois Soybean Association, and the Illinois Pork Producers. KIC (IL CBMP, 2012) seeks to educate the agricultural sector, dedicate significant resources toward research to reduce nutrient losses and enhance nutrient efficiency, educate suppliers and farmers, and measure the adoption of in-field practices to enhance nutrient stewardship beginning in priority watersheds and expanding over years to a state-wide nutrient stewardship program. To fund "KIC by 2025" the stakeholders worked with Illinois legislators to successfully pass an amendment to the Illinois Fertilizer Act to establish a stable, industry-derived funding mechanism for nutrient management research and education and to facilitate industry and farmer involvement on nutrient and water quality issues.

**Ohio.** As a result of nationwide industry efforts to increase the awareness of 4R nutrient stewardship and inclusion of the 4Rs in USDA NRCS messaging, Ohio retailers took action. In the spring of 2011, the Ohio fertilizer industry increased engagement in Ohio state water quality issues using the 4Rs and began spreading the 4R message to their stakeholders. Industry efforts led to recognition by stakeholder groups like The Nature Conservancy and the Sandusky River Watershed Coalition. Meanwhile, the Ohio State Department of Agriculture (ODA), the Ohio Department of Natural Resources (ODNR), the Ohio Governor's office, and the Ohio EPA were considering voluntary ways to address non-point nutrient losses from agriculture in response to state water quality issues

and the EPA guidance memo. As a result of Ohio fertilizer industry efforts and additional stakeholder engagement, the 4Rs were named the foundation of nutrient management efforts in Ohio for non-point sources. Given the announcement by the ODA and the ODNR, 4Rs gained broader recognition. In 2012, the Ohio Governor's office appropriated \$3M to encourage farmer adoption of the 4Rs. Currently, a group of nutrient service providers in the state is working with stakeholders to develop a voluntary 4R certification program that will be used to recognize organizations and individuals capable of assisting growers with 4R implementation.

**Pennsylvania.** In July 2012, the PennAg Industries Association formed an affiliate within PennAg to be designated as the "PA 4Rs alliance." The Alliance was created as a result of dialogue surrounding the revised NRCS nutrient management (590) standard. The goals for the Alliance are for PennAg members and other Pennsylvania agricultural stakeholders to collectively work with farmers to deliver science-based systems that improve crop productivity through increased nutrient use efficiency and to reduce losses of nutrients to the environment. PennAg has engaged farm groups, government agencies, industry, and certified crop advisors. The effort relies on collaboration. The Alliance, with Pennsylvania NRCS and Penn State University extension, is developing a communication strategy. The strategy will identify and publicize farm 4R success stories. Also, 4R fact sheets are being designed for use in a farmer incentive program application/contract process to elevate awareness of 4Rs practices for financial and technical assistance. The Alliance is also working with conservation district nutrient management technicians, private crop consultants, and fertilizer retailers in order to create awareness for crop management systems that will increase nutrient use efficiency.

#### **Industry efforts**

Fertilizer industry organizations are carrying out efforts to promote the 4Rs as a recognizable strategy for the economic, social, and environmental elements of sustainable cropping systems. The goals are to expand implementation of the 4Rs by service providers on the farm, as well as increase awareness of efforts to boost adoption of the 4Rs among the general public and policy developers. This must be done with sound science and research. Also important are educational tools

and resources, partnerships, industry outreach, and advocacy efforts.

**Outreach.** Educational tools and resources are increasingly available. Some examples follow.

In 2012, IPNI released the 4R Plant Nutrition Manual, which addresses the scientific principles behind each of the 4Rs, adoption of farm practices, approaches to nutrient management planning, and measurement of sustainability performance.

Three times this year the Certified Crop Advisor organization is offering an eight-week webinar series entitled “4R Approach to Soil and Water Quality.” Furthermore, The Fertilizer Institute (TFI), in conjunction with Iowa State University, IPNI, and NRCS, will soon be releasing a set of online learning modules focused on the 4Rs.

Outreach to industry peers, federal and state agencies, growers, and the general public is important to the success of 4R and visibility of the 4Rs across the agricultural landscape is necessary to show a unified effort. Partnerships are key to outreach and visibility. Becoming a 4R Partner better enables an entity to act as an influencer and educator among employees, grower customers, and members of the community by providing tools and resources needed to spread the word regarding benefits associated with the 4Rs. Partners embrace 4R Nutrient Stewardship, promote the 4R initiative, and implement the 4R scientific principles.

The 4Rs provide a clear framework, a succinct message, and the opportunity to address water quality and crop production concerns. Opportunities for engagement are abundant:

- Expand your 4R knowledge with available tools
- Be a 4R advocate at local watershed and state agency meetings
- Engage with NRCS and conservation districts and explore opportunities for using the 4Rs
- Increase implementation of 4Rs on the farm by broadening suites of practices and services offered through your organization
- Raise the visibility of the 4Rs while marketing your services and products
- Educate other agricultural stakeholder groups about 4R nutrient stewardship
- Encourage participation and advocacy and be a voice for

agriculture.

**4R fund.** As a result of increasing 4R outreach and implementation efforts, there is a heightened awareness of research gaps regarding fertilizer practices in cropping systems and the effects of those practices on the environment. More than ever, there is a need for agricultural stakeholders to work together to establish metrics and quantification mechanisms to evaluate the impact and performance of our practices on production and the environment. Presently, the industry is exposed to risks stemming from:

- Incomplete research and science regarding environmental effects of nutrients implemented with appropriate best management practices (BMPs)
- Erosion of the agronomy and soil science research community necessary to maintain the science supporting fertilizer use
- Reduction of governmental funding in agronomic areas.

This year, TFI, the Canadian Fertilizer Institute (CFI) and IPNI collaboratively created a northern American 4R Research Fund. The fund was established to advance growth of nutrient stewardship, enhance credibility of the 4R framework, develop performance indicators and environmental impact data, and leverage government and stakeholder funds to expand the research agenda. The program will also enable industry to expedite BMP technology transfer, outreach, and education to achieve a broader and sustained 4R implementation.

TFI and CFI membership will collectively contribute seven million dollars to the 4R Research Fund over a five-year period, and contributions from other stakeholders are sought. Collected funds are being maintained by the Foundation for Agronomic Research (FAR), which is responsible for the Research Fund, including its administration and management.

To briefly summarize, the IPNI, through FAR, is responsible for management of the Fund and the research activities initiated under it. An industry-led Fund Management Committee has been established to provide policy direction and is responsible for final selection of the projects to be undertaken. A Technical Advisory Group consisting of industry agronomists, academics, and agency personnel from the United States and Canada will advise and provide support

to the management committee. For the technical group, individuals were selected with expertise in agronomic practices that include soil, air and water, cropping systems and ecological sustainability, modeling, and monitoring.

Initial high priority research needs evolved from a survey of IPNI scientists in North America and needs were further refined through discussions at an organizational meeting held in 2012. With input from a cross-section of the North American fertilizer industry, research objectives were identified and specific issues were discussed. Factors considered in these discussions included potential impact of the specific researchable issue based on fertilizer tonnage, the acreage and crop value involved, ecosystem vulnerability, political capital and leveraging potential, collaboration potential (universities and government), and collateral benefits.

The overarching objectives for funded projects are to:

- Validate efficacy of practices resulting from combinations of source, rate, timing, and placement decisions
- Evaluate environmental impact per unit of production in high yield systems
- Integrate, publish, and disseminate research results to substantiate to stakeholders that practice changes will provide genuine environmental and economic benefits.

### Looking ahead

A comprehensive literature analysis regarding 4R practices is expected to be performed during the first year of the research fund. Results of the analysis will help inform decisions made regarding use of the research fund. Specifically, the analysis will likely identify data gaps, including specific information to be collected for determination of performance indicators and environmental impacts.

There are significant opportunities to leverage funds with both government and non-governmental partners. The USDA and Agriculture and Agri-Food Canada have indicated a willingness to work collaboratively on this effort. Furthermore, there are opportunities to help inform state fertilizer assessment and commodity group research programs.

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