

Communicating the 4Rs to farmers: Insights and opportunities

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Plant nutrients are essential to the food, feed, fiber, and fuel supply. Additionally, plant nutrients, no matter the form, can be lost from the plant root zone as water moves through the system. In recent decades, plant nutrients have become the focus of concerns linked to water quality, air quality, greenhouse gas emissions, and supply chain sustainability. For on farm productivity and profitability, as well as the concerns listed above, a common goal is to reduce nutrient movement from the root zone and to further reduce loss from the cropping system with supporting conservation practices.

Through significant outreach, education, and engagement, the fertilizer industry and other stakeholders have created significant awareness of 4R nutrient stewardship. The 4Rs are a suite of best management practices linked to the right nutrient source, applied at the right rate, the right time, and in the right place (Lawrence et al. 2014). While practices such as cover crops, conservation tillage, and drainage water management can be instrumental in retaining applied nutrients within the crop production system, the 4Rs are a key place to start.

Survey data indicate that while the use of 4R practices is on the rise, opportunities for improvement remain. Practice adoption in the western Lake Erie Basin can serve as a snapshot of Midwest cropping systems. In 2016, through the Conservation Effects Assessment Project, the USDA Natural Resources Conservation Service reported on changes in farmer practice adoption resulting from two completed surveys, one for practice use between 2003 to 2006 and one for 2012 (USDA NRCS 2016). Between 2003 to 2006 and 2012 in the western Lake Erie Basin, split nitrogen (N) applications increased from 51% to 63% of the acres, and the use of a N inhibitor increased from 8% to 30% of acres.

Additionally, use of global positioning systems to map soil properties increased from 8% to 36% of cropland acres, and variable rate application increased from 4% to 14%. This snapshot of 4R practices shows increased adoption, but also indicates opportunities for greater implementation.

Increased adoption requires increased awareness and increased information on the effects of practice change. Early adopters of new practices require less convincing than those who take a wait and see approach. For everyone else, what information is needed, how should it be presented, and who should provide it? The answers to these questions are important when we consider the pressures faced by the collective entity of agriculture to reduce nutrient loss.

BACKGROUND

As actions and communications supporting 4R Nutrient Stewardship have increased and awareness of the framework has been elevated, so has the knowledge base assessing the impact of fertilizer practice change on yield, profitability, and the environment. Each month new literature evaluating the implementation and impact of specific practices linked to fertilizer source, rate, time, and place becomes available. Additionally, each season new 4R based trials are placed on experiment stations and in farmer fields. The result is an ever-expanding set of data, results, tools, and knowledge that needs to be shared with those making practice change decisions on the ground.

With an eye toward improving communications to further increase the adoption of 4R implementation on the farm, The Fertilizer Institute (TFI) undertook a two-phase approach to understanding the need, scope, and direction of 4R messaging and outreach. Using a combination of online focus groups and a phone survey, TFI worked with a third party (Public Opinion Strategies, Alexandria, Virginia) to assess the current state of 4R awareness, practice change barriers, preferred information sources, and message receptiveness

to better understand farmers as an audience for future 4R communications.

Two qualitative online surveys were undertaken with farmers and farm managers and then agricultural retailers and crop advisors as participants. Then, with knowledge of the results, a farmer facing phone survey was developed and performed. During both phases of the effort, participants were randomly selected within a third-party database from states whose top crops included alfalfa (*Medicago sativa* L.), barley (*Hordeum vulgare* L.), cotton (*Gossypium hirsutum* L.), dry beans, field corn (*Zea mays* L.), grain sorghum (*Sorghum bicolor* [L.] Moench), hay, oats (*Avena sativa* L.), potatoes (*Solanum tuberosum* L.), rice (*Oryza sativa* L.), rye (*Secale cereale* L.), soybeans (*Glycine max* [L.] Merr.), sugar beets (*Beta vulgaris* L.), sugarcane (*Saccharum officinarum* L.), timothy (*Phleum pretense* L.), or wheat (*Triticum aestivum* L.). Participating farmers had to be growing one of the identified crops.

THE PARTICIPANTS

For the initial online survey, 21 farmers or professional farm managers with responsibilities for 200 ha (500 ac) or more participated, with 86% managing 400 ha (1,000 ac) or more. The age of the respondents was evenly split between two categories, with 57% between 18 and 54 years and 43% 55 years or greater. One-third of the individuals were professional farm managers while the others considered themselves owners or operators. Roughly half of the participants (48%) managed a gross farm income of US\$500,000 to US\$1,999,999, with 38% less than and 14% greater than that amount.

For the crop advisor online discussion, the 24 participants represented agronomists or crop advisors who worked for agricultural retailers or co-ops. All participants described themselves as closely or somewhat involved in advising farmers and helping them make decisions or as managers of people who support farmers in making on-farm decisions.

In the phone survey, interviews were performed with 203 farmer participants

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responsible for decision making as it related to farm operations. The majority of participants (66%) were 55 years of age or older, and 86% were male. All participants were operating on 200 ha (500 ac) or more; 24% managed between 200 and 400 ha (500 and 1,000 ac), 61% managed 400 to 2,000 ha (1,000 to 5,000 ac), and 15% managed 2,000 ha (5,000 ac) or more. Sixty-one percent of the farmers operated crop-only systems, while 39% managed mixed cropping and livestock systems.

FINDINGS: ONLINE SURVEY

To better understand the online survey participants, we inquired about “what kept them up at night” and whether or not they took a “wait and see” approach to practice change. For the 21 farmers in the online survey, 57% selected weather or rain (both too much and too little) as their primary concern; the second greatest concern was about markets and crop prices. Both are beyond a farmer’s control but have associated risks that with good decision making can be better managed, potentially creating a 4R message opportunity.

Respondents were divided in their approach to adopting new practices on the farm. Fifty-seven percent indicated preferring to “wait and see” what others are doing and how a practice is working before they adopt it, while the other 43% indicated they were willing to consider new practices as early adopters. Online discussion during the survey indicated a desire to either see something work in practice before implementing it themselves or try a limited “test strip” before investing entirely in the new practice, pointing to a concept crop advisors could incorporate when working with farmers.

Knowing where a farmer seeks information is important for outreach. When asked where they seek information on new best practices, “other farmers” ranked highest as an information source, followed by agricultural publications, farm meetings, and salesmen. However, when asked more specifically about credible information sources for fertilizer practices, fertilizer dealers, agronomists, and consultants received the highest number of votes, followed by other farmers and publications. Relative to providing farm-

ers information on fertilizer, 92% of crop advisors felt farmers were receptive to new science on fertilizer, and 71% indicated that cost or return on investment needed to be part of the “new practice” conversation. In planning communications to farmers on practice change, monetized cost and benefits must be given consideration.

To date, 4R outreach efforts by the industry have primarily focused on retailers and crop advisors, not farmers. Online survey responses were reflective of those communication efforts. When asked about 4R nutrient stewardship awareness, only 38% of the farmers had heard a lot or some about the program compared to 96% of retailers and advisers. While retailers are aware of the program, several crop advisor participants indicated they discuss components of the 4Rs conceptually with their growers, but they don’t specifically present it in the 4R context. Unifying the industry and others who engage with farmers on nutrient management around 4R messaging and concepts could significantly benefit on-farm awareness, which, as the follow-up phone survey considered, may benefit greater practice adoption.

When provided a brief description of the 4Rs, farmers were receptive to the concept. Some initial reservations for practical application linked to cost and knowledge were expressed. The provided description included the guiding principles for the right source, right rate, right time, and right place as well as how they are linked to objectives for nutrient management and sustainable agricultural intensification.

After hearing a description of the 4Rs, survey participants were asked to rank the importance of the potential benefits linked to fertilizer best management practice adoption. The following choices were provided for ranking:

- Better crop performance in good and bad weather
- Improved soil health for long-term use
- Reduced environmental impact
- Increase in farmer profit
- Prevent government regulation
- Reduced prevalence of hunger and malnutrition
- Improved rural livelihoods and stronger farming communities

Farmers ranked “increase in farmer profit” and “improved soil health for long-term use” the highest followed by “better crop performance in good and bad weather.” Retailers selected profit, soil health, and reduced environmental impact as the top three.

Information on the implementation of specific 4R practices and their potential impacts can be quite technical; therefore, it is important to understand the desired level of content to convey and the best context for sharing. For the online discussion, both farmer and advisor participants were asked to review the following four information sources:

- A table of 4R practices to be considered sorted by source, rate, time, and placement
- A one-page profile of a farmer and retailer summarizing their 4R goals and the practices they worked together to implant on the farm
- A magazine article featuring a farmer and retailer partnership and describing practices with impacts on production and environmental benefits
- A technical article prepared for certified crop advisors detailing aspects of enhanced efficiency fertilizer use, including recent research outcomes on productivity and environment benefits

Participants were asked to select the article that was the most helpful. Among farmers, the article with a human feature describing the practices and the benefits of adoption in a real-world scenario was selected as the best article by 50% of the growers, followed by the technical article on enhanced efficiency fertilizers receiving 25% of the votes. For advisors, the same two articles were evenly split with both receiving 38% as the top choice. The value of linking specific practice and benefit information to a real-world example corresponds with responses provided in the first section of the survey. Farmers want to see how practices work for others, they desire specific information on cost and benefits, and they want to hear about it through the voice of other farmers and trusted advisors.

FINDINGS: PHONE SURVEY

The phone survey was to further assess and better quantify online survey findings.

Initially, similar questions were pursued to understand the participants. As in the online discussion, 58% of participants indicated they like to “wait and see” if new farming practices work before making a practice change, while the remaining indicated a willingness to “adopt new farming practices pretty quickly.” Analysis of the respondent demographics indicated that within the 58% that self-identified as slow to adopt new practices, 69% farm fewer than 400 ha (1,000 ac), 68% generate less than US\$500,000 in gross farm income, and 65% are over 65 years of age.

During the online discussion, farmers indicated they do talk to other farmers about agricultural best management practices. Similarly, in the phone interviews, 76% of farmers say speaking to other farmers about fertilizer and fertilizer practices is something they do frequently or occasionally, with 24% indicating rarely or never. However, again, when asked specifically to select their top fertilizer information sources, agronomists and fertilizer representatives received 76% of the responses, with magazines, websites, and trade shows collectively receiving 19%.

Similar to the online discussion, grower awareness of the 4Rs was low, with only 26% of farmers having heard a lot or some about the program; a response result that is 12 percentage points lower than in the online discussion. Seventy-two percent indicated they had heard “not much” or “nothing” about 4R.

Farmers who indicated at least some awareness of the 4Rs generally had a favorable opinion of the program. For those who lacked awareness, introducing the basic and brief description below elicited a favorable response, with 70% having a favorable reaction, 26% neutral, and 4% unfavorable.

Nutrient stewardship refers to a combination of fertilizer best management practices that can optimize yields and reduce environmental impact. The 4Rs means applying the right nutrient source, at the right rate, the right time, and in the right place. Practices are site specific, and an example could include a nitrogen stabilizer with urea, selecting application rate based on soil tests and harvested yield, performing an in-season nitrogen appli-

cation, and using variable rate fertilizer application technology.

In open-ended comments following the description, farmers indicated the 4Rs are a logical and common sense approach to farming and being successful. They see it as a good program that will provide real results and benefit their entire operation. Relative to profitability, specific comments note “it is a cost-effective program that will prevent wasting money since their bottom line is very important,” “the 4R program could help them to use the ‘right amount’ to produce the best yield at the most efficient price,” and “it will prevent wasteful spending of money and overuse of fertilizer, which are interconnected.” Relative to the environment, farmers also see the 4R program as beneficial. Respondents indicated wanting to maintain “good stewardship” of their land to protect their fields as well as the environment around them.

After receiving a description of the 4Rs, participants were also asked how likely they were to try new fertilizer practices linked to source, rate, time, or place in the next year. Sixty-seven percent indicated they were “very or somewhat likely” to do so, while 32% indicated they were “not very or at all likely.” Corresponding data to the not likely to change response indicate those individuals may need extra convincing to change. Of the 32% “not likely” respondents, 63% don’t currently conduct soil tests, 60% don’t believe they are currently implementing many of the 4Rs, 40% wait awhile to see what works, and 40% never talk to other farmers about fertilizer. Among those not likely to try new fertilizer practices, the need to change or modify existing equipment and extra time required were noted as the top perceived barriers, 44% and 23% respectively.

Through open-ended comments, participants were asked to provide insight into additional information they would like to know if they were to consider implementing the 4Rs. Most of the responses were focused on price and cost of implementation. However, they also wanted to see data on past results and to hear more about how 4Rs are working for other farmers, to better understand logistics and equipment needs, to hear details on timing and

how weather impacts results, and to be provided information on products and literature supporting 4R practice adoption.

In the interviews, we also tested five broad message statements that were each designed to cover a specific point about the 4R program. The messages in table 1 focused on soil health, minimizing environmental impact, deterring regulation, managing weather risks, and improving yields and profit. Participants were asked to rank each statement as very important, somewhat important, not very important, or not at all important. The linkage of 4Rs to improving soil health and subsequently improving crop performance ranked the highest of the tested messages (table 1). However, issues addressed in the other statements were also of value, receiving a combination of 86% to 98% of the votes as either somewhat or very important.

THE 4R MESSAGE WORKS

After phone interviewees learned more about the 4Rs through the survey mechanism, the interviews were concluded by repeating earlier questions linked to favorability towards the program and likelihood of implementing new practices related to source, rate, time, and place. As the phone survey progressed, the overall favorability ranking increased slightly from 70% to 74%, but more importantly, favorability increased significantly among those initially less familiar with the program. For example, favorability among farmers with smaller operations (farm income under US\$500,000) increased from 67% to 76%, and for those who indicated implementing some of the 4Rs on their farm, the increase was from 57% to 70%.

At the end of the survey, the likelihood of trying new practices was also revisited. For participants who initially identified as implementing a majority of the 4Rs, the likelihood of trying even more practices increased from 76% to 84%, and for those implementing some of the 4Rs, the likelihood to try new practices increased from 65% to 76%. Most importantly, however, for participants who initially identified as implementing not much or not of the 4Rs, the likelihood jumped from 35% to 61%. Using a consistent and specific 4R message has the potential to increase on-farm

Table 1**Tested 4R messaging statements.**

Statement	Identified as very important (%)	Identified as very and somewhat important (%)
Getting the 4Rs right means improving soil health, and that means improving crop performance.	67	98
Adopting nutrient stewardship through the 4R program can help minimize the impact to the environment, which means growing more on less land and retaining nutrients within a field's boundaries.	50	93
Not acting now means more government regulation later. The 4R program is a scientifically tested approach, which optimizes fertilizer inputs for farmers and their crops and reduces the need for government to implement more regulations.	45	86
Farmers have enough to worry about with unpredictable weather and price fluctuations. The 4R program helps take some of the unpredictability out of farming by recognizing risks associated with good and bad weather, and improving crop yields overall.	39	93
There is more we can all do to improve our crop yield and profit. The 4R program is not a one-size-fits-all approach. Instead, it is specifically tailored to different regions of the country and different crops, and the result of implementation is well documented.	37	90

practice adoption. In the survey mechanisms, content addressing cost and benefits was somewhat generalized; imagine what could be achieved with more specific content linked to real world examples.

CONCLUSIONS

First, the following list provides a quick recap of the results:

- Farmer participants were split between those who are willing to try new practices (42%) versus those who take a wait and see approach (58%).
- Farmers talk to other farmers about their fertilizer practices (76%), but agronomists, retailers, or fertilizer representatives are considered key information sources.
- Generally, the farmer participants were not aware of the 4R nutrient stewardship program; in the two surveys only 26% and 38% had knowledge of the 4Rs.
- The 4Rs make sense, but there is desire to know more about implementation cost, equipment needs, logistics, and impacts.
- Farmer participants responded positively to communication that linked information to other farmers and provided specific details for better on-farm decision making.
- As participant awareness of 4R increased throughout the survey, favorability and likelihood of trying new practices also increased.

To date, the fertilizer industry has primarily focused 4R education and outreach communications toward the crop advisor and retailer community. However,

as the level of farmer 4R awareness suggests, there is a need to pivot (or expand) communications toward the farmer community. Importantly, survey results indicate the content and delivery pathway of those communications is crucial to acceptance of the information.

While farmers talk to each other about on-farm practices, they view their crop advisor as an important information source when it comes to fertilizer best management practices. Organizations like TFI, as well as other stakeholders engaged in the space, have an important role in delivering 4R messages to farmers. They can place and provide content at a national and regional scale, convene and coordinate engagements, and facilitate a consistent and informed message, but when it comes to implementing specific actions on the ground, crop advisors, agronomists, and practitioners are the trusted voice. Their voice is needed, not just on specific practices, but to carry the broader message of how utilizing suites of practices linked to source, rate, time, and place is the goal.

There is an advantage to referencing the 4Rs collectively along with messaging on the benefits in communications rather than focusing on individual fertilizer practices. Not only are the 4Rs favorably viewed when described, but also the likelihood of individual practice adoption was linked to expanding 4R awareness. In the survey, when more was learned about the 4Rs as a collective framework, the interest in adopting specific source, rate, time, and place practices

increased whether the farmer participant believed they were already implementing many of the 4Rs or hardly implementing any of them. For retailers and crop advisors, an increase in practice adoption has implications for offered services and technologies, and for the watershed, increased adoption contributes to success of state nutrient loss reduction strategies and implementation plans.

Content provided to the farming community should be detailed and specific relative to making a fertilizer practice change on the farm. Communications, whether written or verbal should address the cost of practice change, equipment and labor needs, and potential impact on yield and profitability. Also, case studies, examples, and results achieved by other relatable farmers are a useful tool for communication; farmer participants responded positively to information relayed from their perspective.

The results of this survey can be used to help shape future 4R communications, but they may also be applicable to other topics linked to practice adoption on the farm.

REFERENCES

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