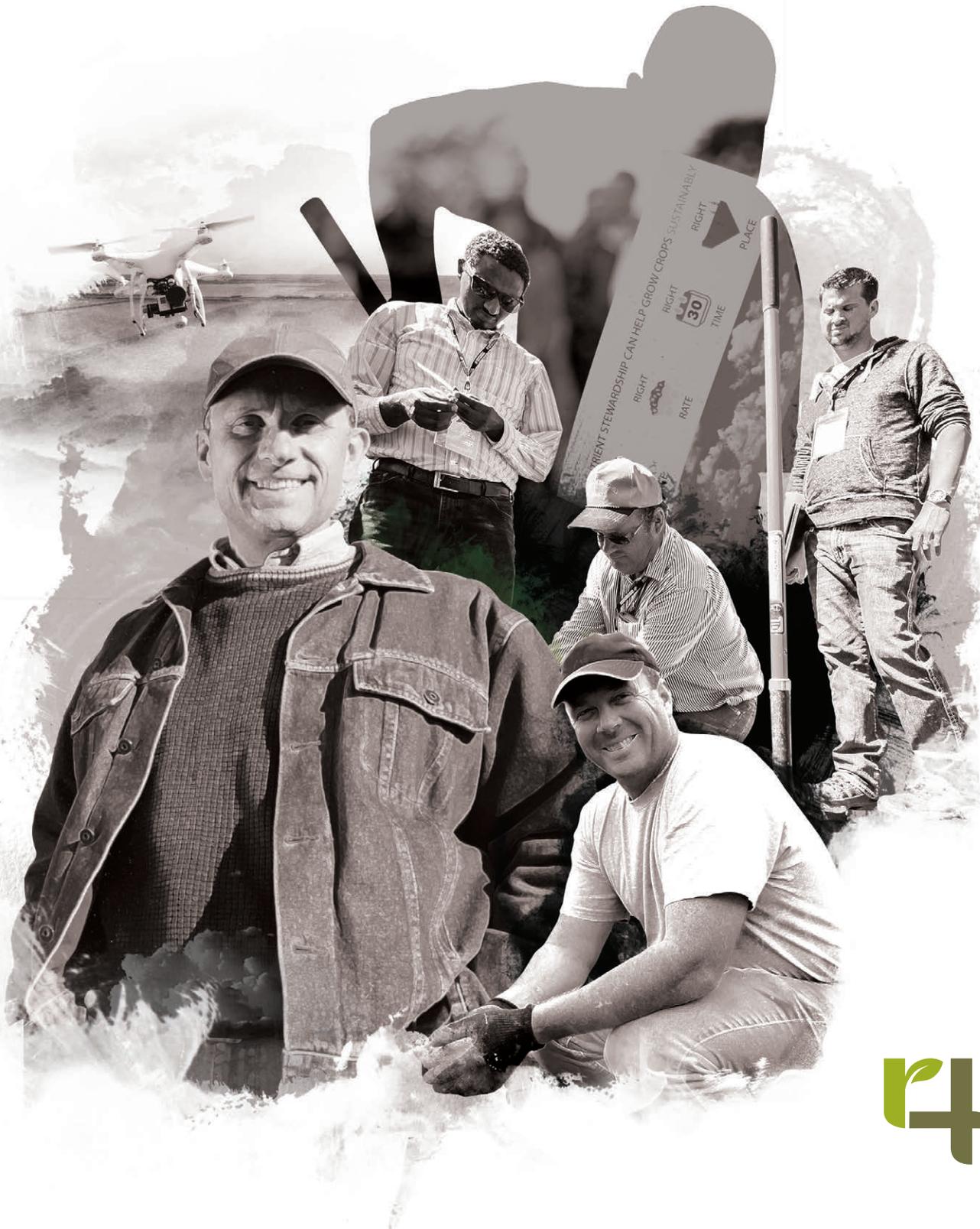


4R Nutrient Stewardship

GROWING ACROSS CANADA



4R Nutrient Stewardship: Measuring Sustainability Across Canada

Canada's agriculture industry is leading the way, providing innovative thinking for the sustainable use of fertilizer, making changes that positively impact the environment, the economy and the social fabrics of Canadian life. Fertilizer Canada promotes the voluntary adoption of **4R Nutrient Stewardship (Right Source @ Right Rate, Right Time, Right Place®)**.

Fertilizer Canada is improving the Canadian agriculture industry's ability to report on sustainable nutrient stewardship practices. By linking commercial interest in the food sector, 4R Nutrient Stewardship can capture market opportunities arising from the food industry's demand for information on how their food is being grown.

Fertilizer retailers and farmers across Canada have adopted this framework to achieve cropping system goals and demonstrate enhanced environmental protection and improved sustainability, helping to maintain our soil, air, and water.

This summary document provides key information on crops and fertilizer practices captured in the Fertilizer Use Survey, led by Pulse Canada, as they relate to 4R Nutrient Stewardship. The survey aims to build a national database of fertilizer management practices from 2014-2018, including source, rate, time and place of fertilizer applications, general fertilizer practices, and demographics. Since the survey's development in 2014, 1,940 growers nationwide have participated. The survey captured fertilizer use trends in 2014 for corn, soybean, canola, spring wheat and pea production; and corn, soybean, canola, winter wheat and barley production in 2015.



4R Nutrient Stewardship: Awareness and Impact

Fertilizer Canada is actively promoting the adoption of 4R Nutrient Stewardship across Canada through provincial and regional initiatives.



8 of 10
Growers are aware of
4R Nutrient Stewardship



Agronomic Advice from a Trusted Source



Implementing 4R Nutrient Stewardship across Canada

4R Nutrient Stewardship requires the implementation of site-specific best management practices (BMPs) that optimize the efficiency of fertilizer use. The goal of fertilizer BMPs is to match nutrient supply with crop requirements and to minimize nutrient losses from fields. Selection of BMPs varies by location, and those chosen for a given farm are dependent on local soil and climatic conditions, crop, management conditions and other site-specific factors.



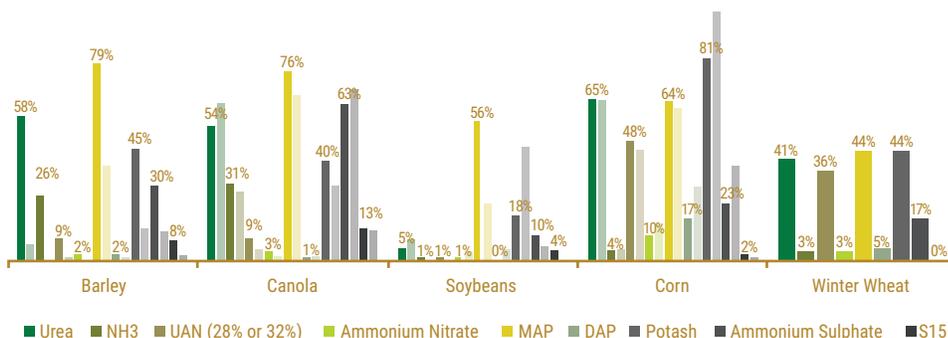
RIGHT SOURCE

Matches fertilizer type to crop needs

Applying the **Right Source** of Fertilizer ensures that a balanced supply of essential plant nutrients are supplied to the crop. Many factors, including Right Rate, Time, and Place, are incorporated into the Right Source. Among these, it is important to consider the crop nutrient requirements, soil and environmental conditions, and economic factors.

The Fertilizer Use Survey captured the percentage of each crop that was treated with each macronutrient, Nitrogen, Phosphorus, Potassium and Sulphur (NPKS).

Main Fertilizer Sources - 2015 - Percent of acres of each crop treated with each source
(2014 results are shown on right)



Example of a Right Source Best Management Practice: Tailoring Field by Field and Receiving Advice

The extent to which growers tailor their fertilizer program field by field varies considerably by crop. Growers used the same fertilizer program on all fields for most crops studied, corn being the exception.

The degree of grower familiarity with 4R Nutrient Stewardship correlated with some differences in nutrient usage. For example, those very familiar with 4R Nutrient Stewardship were more likely to use Nitrogen and Phosphorus on soybean and wheat crops.



RIGHT RATE

Matches amount of fertilizer to crop needs

Applying the **Right Rate** of fertilizer supplied just enough nutrients to meet crop needs while accounting for nutrients that are already present in the soil. If nutrients are applied at insufficient or excessive rates, it can result in detrimental effects on farm profitability or the environment.

Fertilizer rates of the macronutrients (NPKS) vary considerably by crop, province, eco-zone, and farm size. This variability supports the notion of the Right Rate of nutrient application being adapted for specific conditions.

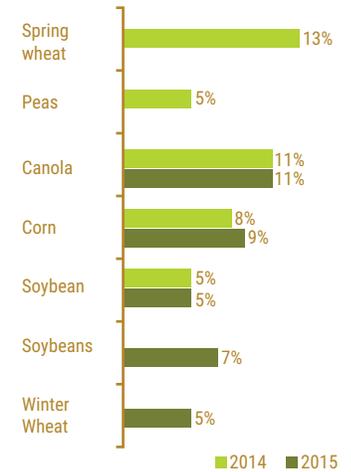
- Among those very familiar with 4R Nutrient Stewardship, 19% use variable rate application in barley (vs. 7% - 9% of those less familiar) and 25% tailor their fertilizer on barley by field (vs. 7% - 15% of those less familiar).
- 18% of those very familiar with 4R Nutrient Stewardship use variable rate application in corn vs. 5% - 8% of those less familiar with 4R Nutrient Stewardship.

Those growers more familiar with 4R Nutrient Stewardship are generally more likely to tailor their fertilizer program by field, compared to those less familiar.

Right Rate - Using Variable Rate

Only 5 -11% (2015) use variable rate on any of their fields, across the five crops.

Growers were asked each year "For your fertilizer application on your specific crop, did you use variable rate technology based on prescription maps?"



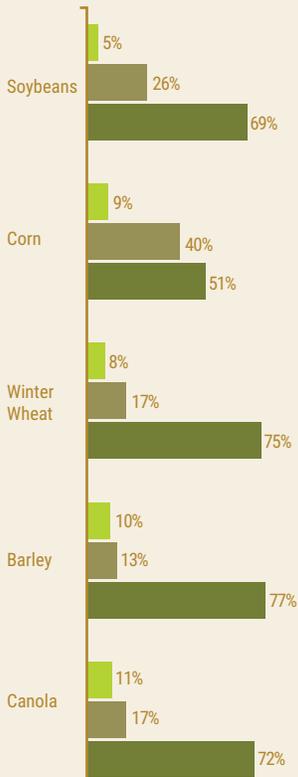
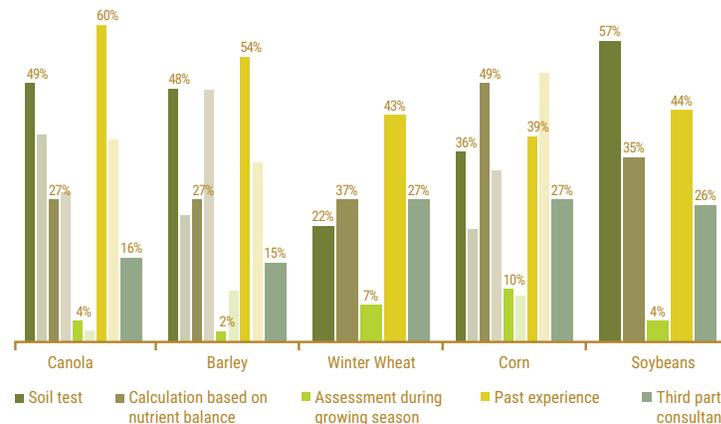
Average NPKS rates used on canola in 2015

N	P	K	S
100 lb/ac	31 lb/ac	7.1 lb/ac	18 lb/ac

How are Right Rate decisions being made?

Performing annual soil testing can help determine the Right Rate of fertilizer applications.

Right Rate - Approaches Used to Determine Fertilizer Rate in 2015 (2014 results are shown on right)



■ Same on all fields ■ Tailor by field ■ Variable rate

Example of a Right Rate Best Management Practice: Soil Testing Each Field, Every Year

Only 22-23% of growers had soil tests performed annually on each field in 2015, 5% more than in 2014. Over half of growers have soil tests performed on each field every third year, and sometimes less frequently. The main barriers to soil testing (N) were cost and usefulness.

While 22% - 23% have each field soil tested every year, those who are very familiar with 4R Nutrient Stewardship program are significantly more likely to have each field soil tested every year, with about 4 in 10 doing so, and about 7 in 10 every 3 years.



RIGHT TIME

Makes nutrients available when crops need them

Crops benefit the most from fertilizer applications at the peak crop demand period. Using Right Time principles will optimize the crop nutrient uptake and avoid unnecessary loss to the environment. Selecting the **Right Time** is crop-specific and site-specific; working with the other principles in 4R Nutrient Stewardship, growers may consider factors such as the fertilizer source, crop nutrient uptake, soil conditions, weather, and logistics of farming operations.

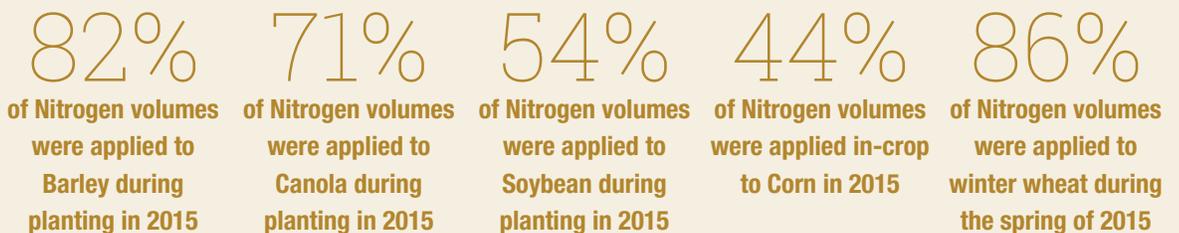
Example of a Right Time Best Management Practice: Split Application

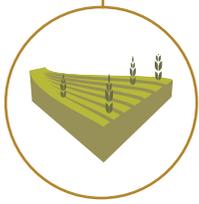
One sample best management practice for Right Time is split application of fertilizer to decrease nutrient loss to leaching and increase plant uptake. From the Fertilizer Use Survey, variations were identified within each of the crops studied on fertilizer timing:

- Split applications were highest in corn crops; applied before and during planting, or during planting.
- In Canola and Barley, the vast majority is applied during planting.
- In Winter wheat, the vast majority of P and K was applied at the time of planting during the fall or summer while the majority of N and S was applied the spring following planting.

Example of a Right Time Best Management Practice: Apply nutrients during times of high crop uptake

Barley growers who are very familiar with 4R Nutrient Stewardship are 23.4% more likely to apply Nitrogen to their crop at planting during the spring compared to growers who aren't familiar with 4R Nutrient Stewardship. The majority of Nitrogen fertilizer volumes (from all sources) are applied during planting, or in-crop, to maximize crop uptake.





RIGHT PLACE

Keeps nutrients where crops can use them

As with the other three principles of 4R Nutrient Stewardship, applying fertilizer in the **Right Place** involves Source, Rate, and Time considerations. It is important to apply nutrients where the crop roots can access them at the time of uptake. The survey data revealed notable differences between provinces for the placement of fertilizer, varying by crop.

Example of a Right Place Best Management Practice: Banding Fertilizer Application

Broadcasting nutrients without incorporation leaves them at a higher risk for loss into the environment, and reduces the nutrients that are taken up by the crop. A suggested BMP is to incorporate, or place fertilizers under the soil.

- Most common 'Place' of fertilizer applications in each crop: barley and canola (side and mid-row banded during planting); soybeans (Side banded at planting and seed placed); corn (side banding); Winter wheat (seed placed or broadcast during following spring).
- Broadcasting without incorporation is more common for corn, however decreased from 18% of corn acres subject to broadcasting without incorporation last year to just 3%

Having the Technology to Band Fertilizer:

The placement of fertilizer is often limited by access to the required technology. For example, equipment is required to perform side- or mid-row banding.

- Equipment and cost are two barriers identified to Right Place 4R Nutrient Stewardship BMPs, ie: for required technology for side- or mid-row banding.

Tailoring Fertilizer Programs Field by Field

Growers who implement 4R Nutrient Stewardship consider the site-specific variability of a cropping system. Tailoring a fertilizer program field by field can help ensure the crop nutrient demands are met while mitigating site-specific risks for environmental losses.

- Canola growers who are familiar with 4R Nutrient Stewardship are nearly **4X** more likely to tailor their fertilizer program field by field (40% of those very familiar and 11.1% of those who have never heard of 4R).
- Soybean growers who are familiar with 4R Nutrient Stewardship are about **2X** as likely to tailor their fertilizer program field by field (39.5% of those very familiar tailor field by field but only 18.8% of those who have never heard of 4R do it)
- Barley growers who are very familiar with 4R Nutrient Stewardship are about **3X** more likely to tailor their fertilizer program field by field than growers who have never heard of 4R.

Soil Conservation Practices:

The use of appropriate soil conservation methods and controlled drain management are related to the placement of fertilizer.

- Zero till practices are most common in Saskatchewan (79%) and Alberta (73%); less common in Manitoba (25%) and Quebec (32%).

For access to the full results of the fertilizer use survey, please visit : fieldprint.ca