

# RESILIENT ROTATIONS: NITROGEN USE EFFICIENCY RED RIVER VALLEY



Research has shown the benefits of diversifying crop rotations, and yet most Prairie farmers keep their rotations short and simple with cereals and oilseeds being intensively grown. For the past four years, researchers across Western Canada have compared different crop rotations to measure the drawbacks and benefits. This work is designed to help farmers make crop rotation decisions that are the best fit for their operation, based on local research.

Six different crop rotations were studied in Alberta, Saskatchewan and Manitoba to represent growing conditions in the Canadian Prairies. This factsheet looks at the differences between rotations for **nitrogen use efficiency**.

## NITROGEN USE EFFICIENCY

Nitrogen use efficiency was calculated as the ratio of grain yield (expressed as canola equivalent yield, CEY) to available nitrogen (soil mineral nitrogen + applied nitrogen fertilizer).

The nitrogen fertilizer rates were determined by soil test recommendations except for the market driven rotation treatment which received 1.2 times the recommended nitrogen fertilizer rate to maximize yield.



### SOIL MINERAL NITROGEN + APPLIED NITROGEN FERTILIZER = AVAILABLE NITROGEN (lbs actual N/ac) for the six crop rotation treatments at the Red River Valley experimental site

| Rotation Treatment | Carman, MB     |                      |
|--------------------|----------------|----------------------|
|                    | Soil Mineral N | Applied N Fertilizer |
| Control            | 52             | 88                   |
| Intensified        | 49             | 53                   |
| Diversified        | 48             | 60                   |
| Market Driven      | 31             | 98                   |
| High Risk          | 42             | 69                   |
| Soil Health        | 46             | 40                   |

The **market driven** and **control** rotations had the highest rates of applied nitrogen fertilizer while the **soil health** rotation had the highest proportion (53%) of soil mineral nitrogen.

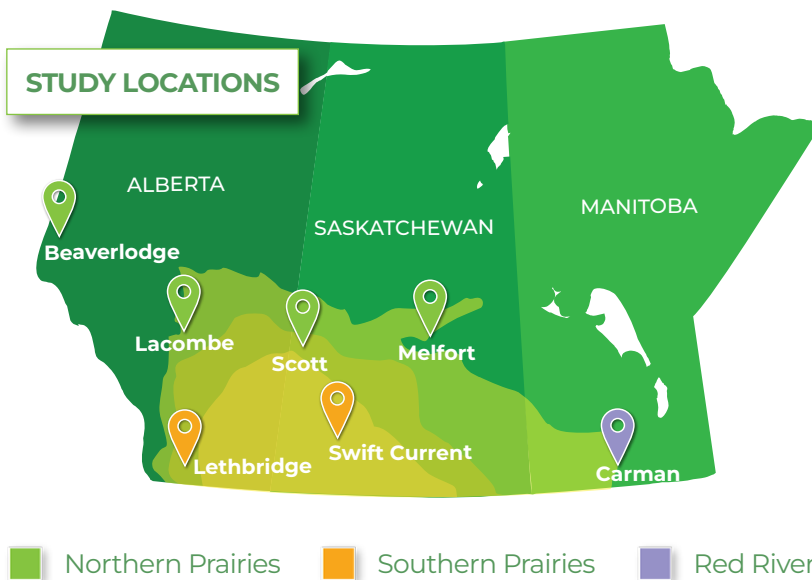


## NITROGEN USE EFFICIENCY (NUE) BY CROP ROTATION IN MANITOBA, 2019-2022

| Rotation Treatment  | Crop Species Used Based on Local Growing Conditions |              |                        |                      | Nitrogen Use Efficiency Ranking of Various Crop Rotations |
|---|---|--------------|------------------------|----------------------|---|
|   | Year 1  | Year 2       | Year 3                 | Year 4               | Carman  |
| The average NUE of all rotations at Carman was 13.5 kg CEY/kg available N (0.27 bu CEY/lb available N). The highest NUE at Carman was for the <b>high risk rotation</b> at 22.5 kg CEY/kg available N (0.45 bu CEY/lb available N). |   |              |                        |                      |   |
| Control   | Wheat   | Soybean      | Wheat                  | Canola               | ●   |
| Intensified   | Soybean   | Wheat        | Soybean                | Canola               | ●   |
| Diversified   | Canola  | Winter Wheat | Soybean                | Canola               | ●   |
| Market Driven   | Corn  | Corn         | Oat                    | Canola               | ●   |
| High Risk   | Corn  | Dry Bean     | Canola                 | Sunflower            | ●   |
| Soil Health   | Green Manure  | Fall Rye     | Corn-Soybean intercrop | Canola-Pea intercrop | ●   |

### Nitrogen Use Efficiency Ranking

● = good nitrogen use efficiency   ● = statistically lower nitrogen use efficiency   ● = statistically lowest nitrogen use efficiency



## THE BOTTOM LINE

- The **high risk** rotation had the highest nitrogen use efficiency in the Red River Valley. This is likely attributed to the high corn and sunflower yields in the rotation for two of four years.
- The **soil health** rotation significantly reduced the amount of nitrogen fertilizer applied by approximately half of what was applied to the control rotation; however, the **soil health** rotation did not have a high nitrogen use efficiency because of its low yield.

## FOR MORE INFORMATION

More information on how these crop rotations stack up in terms of yield and yield stability, precipitation use efficiency and net returns have been covered in separate factsheets as part of this series.

These results are based on the first four years of the study. More robust results are expected if a second four-year cycle of the study is completed.

This factsheet is part of a series by Resilient Rotations – a project of the Integrated Crop Agronomy Cluster – led by Kui Liu, AAFC Swift Current – the project examines the benefits and drawbacks of different crop rotation options for farmers across Western Canada.

To find out more visit

[wgrf.ca/resilient-rotations-factsheet/](http://wgrf.ca/resilient-rotations-factsheet/)