Response of residual soil available N to polymer-coated urea (ESN) application in a canola-barley cropping system

Xiying Hao1*, Chunli Li1, Robert E. Blackshaw1, John O’Donovan2, K. Neil Harker2, Cecil Vera3, and George W. Clayton1

Agriculture and Agri-Food Canada Research Centre, 1Lethbridge, AB 2Lacombe, AB. 3Melfort, SK, *Corresponding author: xiying.hao@agr.gc.ca

Introduction

To attain high crop yields, high rates of commercial N fertilizer are applied to agricultural soils. High rates of N fertilizer use could lead to negative environmental impacts through N leaching and runoff to surface water and gaseous N2O emission. Polymer-coated urea, such as ESN, is a controlled release N fertilizer that synchronizes nutrient release with crop demand, thereby increasing fertilizer efficiency and potentially reducing impacts on the environment.

Objective

Evaluate changes in soil available N following four-years use of ESN in canola-barley production

Materials & methods

Experimental locations and duration

- Melfort, SK, Lethbridge, AB, Lacombe, AB, and Beaverlodge, AB (See Table 1 for basic soil properties)
- 2005-2006 for three Alberta sites
- 2006-2009 Saskatchewan site

Experimental treatment

- Two spring canola (C) varieties (Ac Lacombe and Vivar) in either CBCB or BCBC sequences over four years.
- All crop phases exist each year
- Two types of N fertilizer: urea and polymer-coated urea (ESN)
- Two rates of N application: 1 X and 1.5 X recommended agronomic N fertilizer rates (Table 2)
- 50 and 100% of registered in-crop herbicide rates
- Total of 32 treatments and 128 plots

Residual soil available N assessment

- Soil samples (0 to 120 cm depth) were collected after four years fertilizer application from four sites
- Available N (2M KCl extraction NO3) was measured

Results & discussion

Effect of N fertilizer type and rate on residual soil NO3 concentration after 4-year production

- At the recommended agronomic rate, residual soil NO3 concentration was similar (P>0.05) among ESN and urea treatments for all locations (Fig. 1a-d).
- At the 1.5X recommended agronomic rate, residual soil NO3 concentration was lower (P<0.05) in ESN than urea treatments for Beaverlodge (0-60 cm) and Lacombe (0-5 cm), suggesting ESN fertilizer could reduce the amount of N left in the soil, but the reduction in soil type/location dependent
- For both urea and ESN, residual NO3 concentration was higher (P<0.05) when N fertilizer were applied at 1.5X in surface soil (NO3-N at 23 – 27 mg kg-1) at Lacombe and in 0-30 cm soil (NO3-N at 8 – 46 mg kg-1) at Beaverlodge than applied at the recommended rate (Lacombe: NO3-N at 17 mg kg-1 and Beaverlodge: NO3-N at 3 – 34 mg kg-1) (at Fig. 1c-d).

Conclusions

There is little difference in residual soil NO3 concentration between ESN and urea when applied at the recommended agronomic rate

Higher residual soil NO3 concentrations were observed when applied at 1.5X than the 1X recommended N rate although NO3 levels from in ESN were lower than from urea treatment at Lacombe (0-5 cm soil) and Beaverlodge (0-30 cm soil); over application, particularly urea at Beaverlodge, should be avoided

The similar residual soil NO3 concentrations between the 1.5X and 1X recommended N application rates suggest that the rate of N fertilizer application for canola and barley production could be higher than current recommendation for Melfort, Lethbridge and Lacombe and this was confirmed with greater yield increases for these three sites

References


Acknowledgements

Funding for this study was provided by Agriculture and Agri-Food Canada, and the Canola Council of Canada. We also acknowledge technical assistance from Brent Hill, Greg Travis, Pam Caffyn, Greg Semach, Larry Michelsen, Randall Brandt and Brett Mollison in carrying out field and laboratory work and Toby Etnz in statistical analyses.

Table 1. Soil characteristics at the four study sites.

| Site        | USDA soil description* | Canadian soil classification* | Sand† | Clay† | OC | TN | pH |
g|-------------|-------------------------|--------------------------------|-------|-------|----|-----|----|
| Melfort, SK | Typic Hapludoll          | Black Chernozem                | 170   | 410   | 55.0| -   | 6.1 |
| Lethbridge, AB | Typic Hapludoll          | Dark Brown Chernozem           | 370   | 330   | 17.5| 1.95| 7.7 |
| Lacombe, AB | Typic Hapludoll          | Black Chernozem                | 350   | 250   | 55.1| 5.32| 7.2 |
| Beaverlodge, AB | Mollic Hapludoll          | Dark Gray Luvisol              | 270   | 350   | 34  | 3.67| 5.7 |

† Blackshaw et al. (2010a)

© 2010