



## Reduced emissions with EEF fertilizer but little agronomic benefit

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At 4 of 6 site-years, SuperU reduced  $N_2O$  emissions by 30% to 57% compared to conventional urea, for all placement methods. However, there was no yield or economic benefit derived from the use of the enhanced efficiency fertilizer (EEF).

Nitrous oxide ( $N_2O$ ) is a major greenhouse gas (GHG), and Canada has set a target to reduce  $N_2O$  emissions associated with fertilizer application by 30% below 2020 levels by 2030. The use of enhanced efficiency fertilizers (EEF) could be one tool to help reduce emissions as part of a 4R nutrient stewardship framework.

Research was conducted by the University of Manitoba to investigate whether placement and depth of granular urea or an EEF product affect  $N_2O$  emissions and yield for canola production in Manitoba. Field trials were conducted in southern Manitoba over 3 years from 2014 to 2016. There were 2 sites per year at Carman and Kelburn in 2014, Carman and Oak Bluff in 2015, and Brunkild and Domain in 2016. Environmental conditions were drier than normal in 2014 and slightly wetter than normal in 2015 and 2016.

Fields had soybean grown the previous year, and were chosen because of low carryover soil nitrate-N resulting in greater potential yield response to nitrogen (N) fertilizer. Canola was seeded on 8 inch

(20 cm) rows at one-half inch (1.3 cm) depth. Phosphorus, potassium and sulfur fertilizers were applied according to soil test recommendations as a pre-plant broadcast/incorporated treatment.

Nitrogen fertilizer placement treatments included broadcast/incorporated, shallow banded and deep banded fertilizer. Broadcast N was incorporated to a 5.9 inch (15 cm) depth with a rotary tiller. Shallow banded placement was 0.75 to 1 inch (2.0 to 2.5 cm), and the deep banded placement ranged from 1.6 to 4 inch (4 to 10 cm) depths depending on the site. Banded treatments were applied with a mid-row disk bander.

Untreated urea and Super U (46% N), a commercially available granular urea product containing a urease inhibitor and a nitrification inhibitor, were compared.

Nitrogen fertilizer rates were 70% and 100% N supply based on soil test recommendations. These rates ranged from 80 pounds per acre (90 kg/ha) at Carman and Oak Bluff in 2015 to a high of 129 lbs/ac (145 kg/ha) at Domain in 2016. The target grain yield was 53.5 bushels per acre (3.0 tonne/ha). There was also a 0 N fertilizer control at each site.

Canola yield and nitrogen recovery efficiency (NRE) were calculated. Nitrous oxide emissions were measured for the treatments receiving 100% N from planting to freeze-up at 1 to 3 times per week. Daily and cumulative emissions were calculated. Yield-based N<sub>2</sub>O emission intensity (EI) for each treatment was calculated.

### **Few differences in canola yield**

Overall yields were comparable to commercial fields in the area, excluding Carman 2015 which had low yield because of poor germination. Two of the sites had yields higher than the 53 bu/ac target and 4 were lower.

There was a good yield response to fertilizer N. At the 70% recommended rate there was a significant yield increase at 3 of 6 site-years for Urea and 4 of 6 site-years for SuperU over the control.

Yield increases over the control were observed at 5 of 6 site-years at the 100% recommended N rate. At the 100% fertilizer rate, there were few yield differences in fertilizer source or placement. This indicated that SuperU offered few agronomic benefits under the conditions of this trial.

In the drier 2014 year at both sites, shallow band treatments tended to have lower yields than broadcast/incorporate or deep band. In the wetter 2016 year at Domain, the two banded treatments trended towards higher yield than the broadcast/incorporated treatment.

Fertilizer nitrogen recovery efficiency was not affected by N treatments at any site at the 100% N rate. This again indicated that there was no agronomic benefit that was obtained with the use of SuperU.

### **Nitrous oxide emissions reduced with SuperU**

The 0 N control had the lowest daily and cumulative emissions of any treatment at all site-years. There were spikes in daily emissions coinciding with heavy rainfall events. At site years with lower rainfall, shallow and/or deep band N had reduced N<sub>2</sub>O emissions, but had higher emissions at site-years with more rainfall after seeding. Under these wetter conditions, N<sub>2</sub>O production could have more readily occurred from the concentrated bands in the shallow and deep banded treatments compared to the more dispersed N fertilizer in the broadcast/incorporated treatment. Even though there were higher N<sub>2</sub>O emissions under wetter conditions, banding N tended to increase yield and fertilizer recovery, implying N<sub>2</sub>O emission losses were too small to reduce N availability, uptake or yield.

At 4 of 6 site-years, SuperU reduced N<sub>2</sub>O emissions by 30% to 57% compared to conventional urea, for all placement methods. Since reductions were observed for all placement methods, the researchers felt that delayed nitrification was the reason for the reductions. They indicated that SuperU was effective in retaining soil N in the NH<sub>4</sub><sup>+</sup> form longer and therefore provided more opportunities for crops to take up NH<sub>4</sub><sup>+</sup> and reduce losses through N<sub>2</sub>O emissions.

Shallow banded N at 0.75 to 1 inch had higher emissions than broadcast/incorporated or deep banded N. This occurred across all 6 site-years. The researchers indicated that since there wasn't an agronomic benefit to shallow band over other placement methods, it should be avoided otherwise N<sub>2</sub>O emissions may increase.

The overall results of this research study showed that urea treated with a dual inhibitor such as Super U can reduce N<sub>2</sub>O emissions in canola production in southern Manitoba. However, little agronomic benefit was observed with similar yields between SuperU and untreated urea. The additional costs of EEF without a corresponding economic benefit will remain a barrier to their adoption unless the additional cost is shared by society.

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