# Canola Response to Shallow vs. Deep-banded Nitrogen Fertilizer Formulations Relative to other Benchmark Management Practices
# Scott, SK. 2020

**Project Location(s):** Scott Saskatchewan, R.M. #380 Legal land description: SE-19-39-20-W3

**Project start and end dates (month & year):** May 2020 to October 2020

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**Objective:**

The objective of this trial was to demonstrate the potential benefits, under field conditions, of banding a nitrogen use efficiency product at depths of 5 cm or deeper relative to the shallower banding depths commonly achieved with commercial equipment (when side-banding is combined with shallow seeding) and other benchmark practices.

**Methodology:**

The trial was arranged as a randomized complete block design (RCBD) with four replicates of ten treatments at Scott, SK. 2020 (Table 1). Nitrogen (N) fertilizer forms used were untreated urea (46-0-0), SuperU (46-0-0) and UAN (28-0-0). The untreated urea and SuperU were placed as a side-band (2-3.5 cm), mid-row shallow band (2-3 cm), deep-band (>5 cm) and broadcast. UAN was applied as a flat fan foliar application and dribble band foliar application. Each treatment was applied at time of seeding at a rate of 100 lbs N/ac. Mono-ammonium phosphate (MAP; 11-52-0) and ammonium sulfate (AMS; 21-0-0-24) were applied to each treatment at rates of 20 and 15 lbs/ac, respectively. The canola variety selected was L255PC, and was direct seeded into wheat stubble with 10 inch row spacing on May 24$^{th}$, 2020. The canola was sprayed with Liberty at 1.6 L/ac and Centurion at 75 ml/ac on June 26$^{th}$ for weed control. On July 16$^{th}$ the canola was sprayed with Priaxor at 120 ml/ac for disease management. The canola was desiccated on September 9$^{th}$, 2020 with Reglone Ion at 0.83 L/ac and harvested September 18$^{th}$, 2020.

**Table 1.** Treatment list for nitrogen fertilizer form and placement on canola at Scott, SK.

| Treatment # | Nitrogen Fertilizer Form | Fertilizer Placement | Fertilizer Depth (cm) |
|---|---|---|---|
| 1 | Untreated urea | Side-band | 2-3.5 |
| 2 | Untreated urea | Mid-row shallow band | 2-3 |
| 3 | Untreated urea | Deep band | >5 |
| 4 | Untreated urea | Broadcast | |
| 5 | SuperU | Side-band | 2-3.5 |
| 6 | SuperU | Mid-row shallow band | 2-3 |
| 7 | SuperU | Deep band | >5 |
| 8 | SuperU | Broadcast | |
| 9 | UAN | Flat Fan Foliar Applied | |
| 10 | UAN | Dribble Band Foliar | |

**Data Collection:**

Soil samples were collected in the spring of 2020 at two depth increments (0-6 inches and 6-24 inches) to determine background levels of N. Ammonia ($NH_3$) losses were measured by the dositube (D) method, which utilized a gastec passive dosimeter tube (dositube). Dositubes were placed on each plot in reps 1 and 3 immediately after each fertilizer application. Dositubes were read at intervals of 24 hours for

5 days following fertilizer application, and weekly for 4 weeks following application to determine cumulative amounts of $NH_3$ losses (D = ppm x hr). Wind speeds (w = m/s) were averaged between dositube readings and based on an on-site weather station using Farm Command Technology. The following equation was used to determine amount of $NH_3$ losses in lbs N/ac (Heard, n.d.).

$$\text{Estimated total loss (lbs N/ac)} = 0.89 \times ((0.217Dw) - (0.034D) + 0.71)$$

Plant densities were determined by counting numbers of emerged plants on 2 x 1 meter row lengths per plot at one week after crop emergence (WAE). Maturity ratings were recorded before desiccation to determine the relative days to maturity (DTM). Yields were determined from cleaned harvested grain samples and corrected to 10% moisture content. Stubble counts were determined by counting numbers of stems on 2 x 1 meter row lengths per plot immediately after harvest. Grain protein and oil content were collected as indicators of seed quality. Weather data was collected from an on-site weather station using Farm Command Technology. Growing degree days were based on 5ºC.

**Weather:**

The 2020 growing season was 1ºC colder than the long-term average, with the coldest month of April being 4.7°C colder than the respective long-term average (Table 2). The overall 2020 growing season had 33.2 mm greater precipitation compared to the long-term average. However, April was very dry with only 7.8 mm compared to the long-term average of 24.4 mm of precipitation. In contrast, July was a very wet month with a total 129.4 mm of precipitation compared to 69.4 mm of the July long-term average. There were 59 less growing degree days in 2020 compared to the long-term average, with the lowest growing degree days occurring in April (40) and May (159).

**Table 2.** Mean monthly temperature, precipitation and growing degree day accumulated from April to September 2020 at Scott, SK.

| Year | April | May | June | July | August | Sept. | Average/ Total |
|---|---|---|---|---|---|---|---|
| *Temperature (°C)* | | | | | | | |
| **2020** | -0.9 | 10.2 | 14.6 | 17.1 | 16.0 | 10.6 | 11.3 |
| **Long-term[z]** | 3.8 | 10.8 | 14.8 | 17.3 | 16.3 | 11.2 | 12.4 |
| *Precipitation (mm)* | | | | | | | |
| **2020** | 7.8 | 48.3 | 70.2 | 129.4 | 25.8 | 29.3 | 310.8 |
| **Long-term[z]** | 24.4 | 38.9 | 69.7 | 69.4 | 48.7 | 26.5 | 277.6 |
| *Growing Degree Days* | | | | | | | |
| **2020** | 40.0 | 159.0 | 289.0 | 376.0 | 342.0 | 167.0 | 1373.0 |
| **Long-term[z]** | 44.0 | 170.6 | 294.5 | 380.7 | 350.3 | 192.3 | 1432.4 |

[z]Long-term average (1985 - 2014)

## Results

### Soil Sample

Spring soil sample results showed background levels of nitrate ($NO_3$-N) at each depth increment. Nitrate levels at 0-6 inch depth increment were 13 lbs/ac, and 21 lbs/ac for the 6-24 inch depth increment. Organic matter levels were at 4%.

### Dositube Method

There were zero $NH_3$ losses recorded for all fertilizer treatments up to 12 days following application; at which point the $NH_3$ losses increased for surface applications of N and then began to plateau (Figure 1). In theory, the $NH_3$ losses during this timeframe should have been higher than zero. Environmental conditions such as precipitation, temperature, and wind conditions have an impact on the rate of $NH_3$ volatilization (Dari et al., 2019). Conditions during this timeframe were conducive to losses higher than zero. Therefore, it is possible there were small amounts of $NH_3$ losses occurring; however, the losses may have been too low for the dositubes to accurately measure.

At 33 days following application broadcast urea observed the highest amount of cumulative $NH_3$ losses at 46 lbs N/ac; followed by flat fan UAN at 15 lbs N/ac, dribble band UAN at 14 lbs N/ac, and broadcast SuperU at 8 lbs N/ac. Treatments of side-band, mid-row shallow, and deep-band showed minimal losses of $NH_3$, cumulatively 1 lbs N/ac for each treatment. These results indicate the higher risk for losses by surface applications of N. Furthermore, the application of broadcast urea resulted in 38 lbs/ac higher losses than the broadcast application of SuperU. This observation indicates the capability of SuperU in reducing $NH_3$ losses in broadcast applications compared to untreated urea applications.

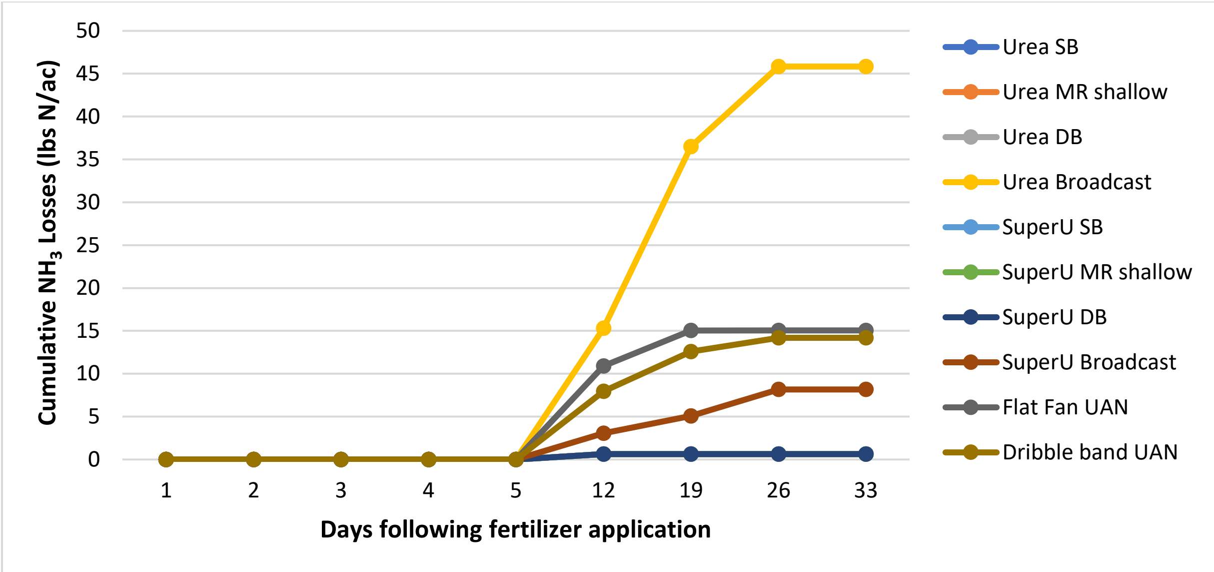


**Figure 1**. Cumulative $NH_3$ losses (lbs N/ac) at days following application of N fertilizers at Scott, 2020.

**Plant Densities**

Lowest plant densities were observed with fertilizer placed in the side-band and resulted in 49 plants/m$^2$ with untreated urea and 55 plants/m$^2$ with SuperU (Figure 2). Highest plant densities were observed in treatments of deep-band and shallow mid-row placement of SuperU at 72 plants/m$^2$ and 70 plants/m$^2$, respectively. Both shallow and deep mid-row placements tended to result in higher plant densities compared to sideband, indicating the mid-row band placement of fertilizer may reduce the risk of seedling burn compared to side-band applications. Plant densities tended to be higher for applications of SuperU (55-72 plants/m$^2$) than urea (49-65 plants/m$^2$) for each respective placement. Plant densities were higher for flat fan foliar UAN applications (67 plants/m$^2$) than dribble band foliar applications (57 plants/m$^2$). Overall, post-harvest stubble counts followed similar trends to the emergence counts, verifying that these trends remained for the duration of the growing season.

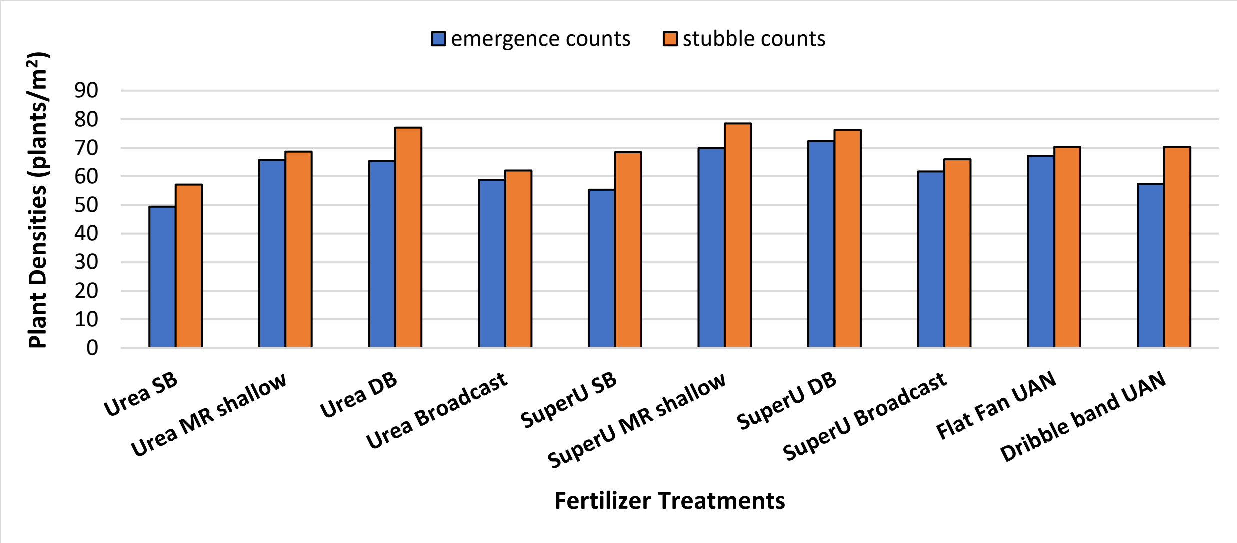


**Figure 2.** Canola plant densities (plants/$m^2$) recorded at 1 week after emergence and post-harvest in response to nitrogen fertilizer formulations and placements at Scott, 2020.

### Days to Maturity

The earliest maturing treatments were urea applied by deep-band and broadcast, and dribble band foliar application of UAN (98 days). The latest maturing treatments included urea applied as side-band, and SuperU applied as side-band, deep-band, and broadcast (100 days). Overall, there was a minimal response in maturity between treatments of nitrogen fertilizer forms and placement (2 days).

### Yield

The lowest yielding treatments were the broadcast applications of urea and SuperU at 59 bu/ac (Figure 3). These treatments also experienced high amounts of cumulative $NH_3$ losses at 46 lbs/ac for broadcast urea, and 8 lbs/ac for broadcast SuperU. The decrease in yield for broadcast applications of urea and SuperU in comparison to all fertilizer treatments could be attributed to the amount of $NH_3$ losses. Despite higher amounts of $NH_3$ losses (14-15 lbs N/ac), both foliar applications of UAN yielded 63 bu/ac. Applications of side-band, mid-row shallow, and deep-band N each resulted in the lowest amount of cumulative $NH_3$ losses (1 lbs/ac), and experienced slightly higher yields than broadcast applications (62-64 bu/ac). The highest yielding treatment was the application of Super U as a mid-row shallow placement at 64 bu/ac. Overall, there were minimal yield differences between forms of N (urea, SuperU and UAN), indicating yield response was more dependent on type of placement than fertilizer formulation.

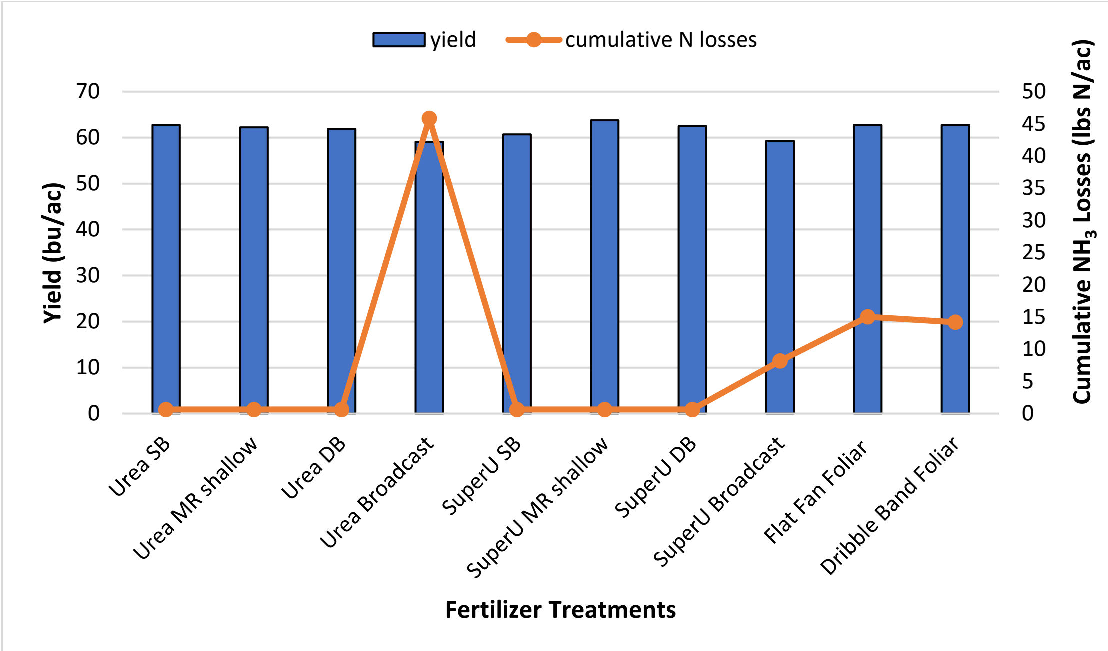


**Figure 3**. Yield (lbs/ac) of canola and amount of cumulative $NH_3$ losses (lbs N/ac) in response to nitrogen fertilizer formulations and placements at Scott, 2020.

### Grain Oil and Protein Content

Oil content among all fertilizer treatments was relatively similar, with the highest recorded at 52.3% (flat fan foliar UAN) and the lowest at 51.5% (deep-band SuperU) (Figure 4). On average, oil content tended to be higher for treatments of urea and UAN (52.2%) and lower for treatments of SuperU (51.8%). There were minimal differences in protein levels between fertilizer treatments, with the highest protein content at 18% (deep-band SuperU) and the lowest at 17.2% (mid-row shallow, deep-band, and broadcast urea). On average, protein levels tended to be highest for applications of SuperU (17.7%), followed by UAN (17.3%), and urea (17.2%). Overall, a trend appeared indicating an inverse relationship between oil and protein content in canola.

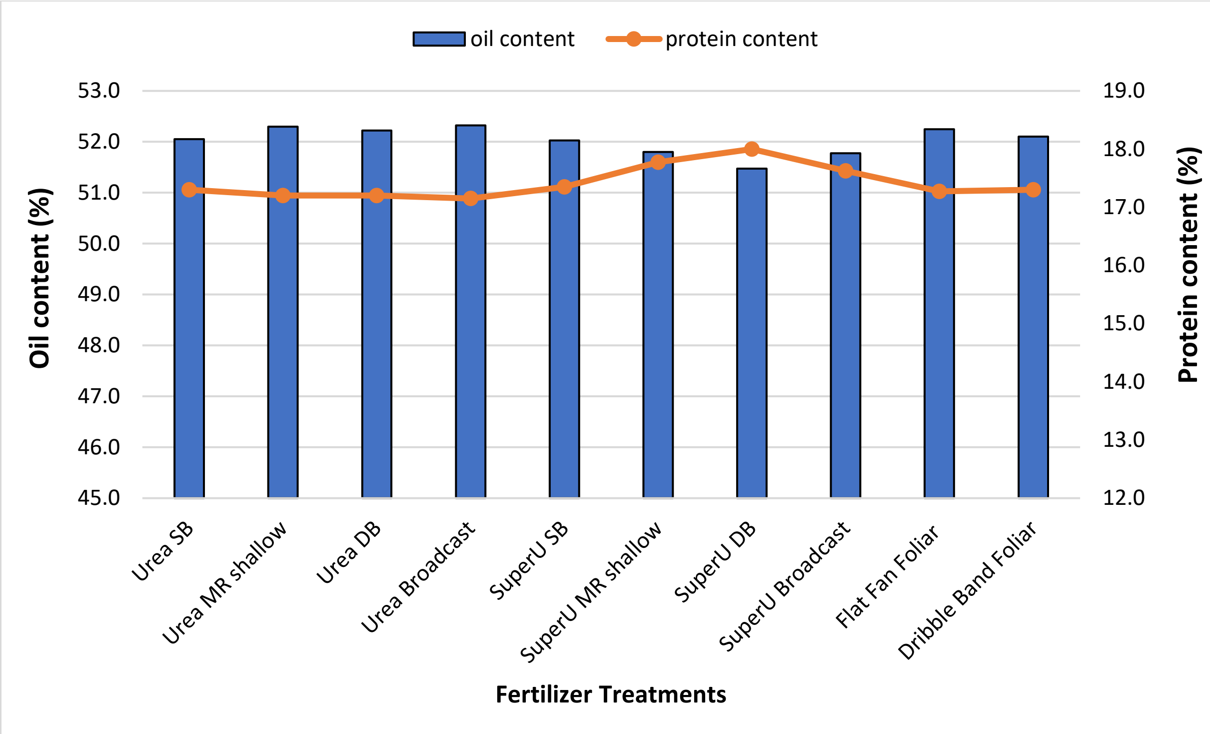


**Figure 4.** Percent oil and protein content of canola in response to nitrogen fertilizer formulations and placements at Scott, 2020.

## Conclusion

Overall, results showed the treatments of surface application of N fertilizer resulted in higher amounts of $NH_3$ losses; with broadcast urea having the highest amount of cumulative $NH_3$ losses (46 lbs N/ac). Broadcast SuperU resulted in lower $NH_3$ losses (8 lbs N/ac) indicating the products ability to reduce the risk of N losses compared to untreated urea in the same application method. Mid-row applications at shallow (2-3 cm) and deep (>5 cm) placements tended to result in higher plant densities compared to sideband, indicating the mid-row placements of fertilizer may be at lower risk of seedling burn than the side-band placements. There was a minimal response in maturity between treatments of N fertilizer forms and placement (2 days). The lowest yields were observed by broadcast applications of urea and SuperU (59 bu/ac), which also experienced higher amounts of $NH_3$ losses (8 and 46 lbs N/ac). The highest yielding treatment was the application of Super U as a mid-row shallow placement at 64 bu/ac. There were minimal yield differences between urea, SuperU, and UAN, indicating yield response was more dependent on placement than fertilizer formulation. Results for seed quality showed that on average urea resulted in higher percent oil content than SuperU. Inversely, SuperU resulted in a higher average percent protein than urea. Overall, there were significant responses of $NH_3$ losses and yield to placement of N fertilizers.

**References**

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Dari, B., Rogers, C.W., Walsh, O.S. (2019). *Understanding Factors Controlling Ammonia Volatilization from Fertilizer Nitrogen Applications.* Retrieved from: https://www.extension.uidaho.edu/publishing/pdf/BUL/BUL926.pdf