Influence of Seedrow-Placed N with Polymer-Coated Urea (ESN) and AgrotainTM-Treated Urea on Emergence, Yield and N Uptake of Canola and Wheat

S. S. Malhi[1], R. Lemke[2] and D. Leach[1]

Agriculture and Agri-Food Canada,
[1] Research Farm, Melfort, Saskatchewan, Canada; E-mail: sukhdev.malhi@agr.gc.ca;
[2] Research Centre, Saskatoon, Saskatchewan, Canada

Introduction

- One pass seeding and fertilizer application (i.e., direct seeding) reduces time, cost and equipment needs for seeding, tillage intensity, and loss of soil and water, but it needs relatively larger, complex and expensive equipment for placement of seed and fertilizer in separate bands.
- To avoid the extra cost on seeding equipment, many producers would like to place the fertilizer in the seedrow, as it allows seeding and fertilizer application in single operation and also reduces soil disturbance, but it generally decreases plant emergence at N rates adequate for optimum crop yield.
- There are many factors, such as soil texture, soil moisture and drying, crop type, row spacing, depth of seeding, and urease inhibitor and/or polymer coating, etc., can influence the rate of N that can be safely placed in the seedrow.

Objective

To determine the influence of different combinations of seed/fertilizer placement methods, and coating/treating urea granules with polymer or urease/nitrification inhibitors on seedling emergence, seed yield (kg ha^{-1}) and N uptake (kg N ha^{-1}) of canola and wheat in the Parkland region of Saskatchewan.

Materials and Methods

- Two 3-year (2007 to 2009) field experiments were conducted on canola (*Brassica napus* L.) and wheat (*Triticum turgidum* L.) at Melfort (thick Black Chernozem soil), Saskatchewan.
- Plots were seeded in late May or early June with a 3.6 m wide ConservaPak drill using 2-cm wide knives in 22.5 cm row spacing.
- Each plot was 7 m long and 4 m wide. All plots received blanket application of P, K and S fertilizers in seedrow.

The treatments were combinations of:

- **N rates:** 40, 80 and 120 kg N ha^{-1}
- **Urea:**
  a) Non-coated/treated (46-0-0)
  b) Coated with polymer (called ESN)

c) Treated with Dicyandiamide (DCD) and N-(n-butyl) thiophosphoric triamide (NBPT or Agrotain^{TM}, called SuperU in 2007)

d) Treated with N-(n-butyl) thiophosphoric triamide (NBPT or Agrotain^{TM} called AgrotainU in 2008 and 2009)

- **Methods of placement**:
  a) side-banded N and
  b) seedrow-placed N,
  c) with knives
- **<u>plus</u> a zero-N control.**
- ESN fertilizer was supplied by Agrium. SuperU and AgrotainU fertilizers were supplied by Agrotain International LLC [urea granules treated with Dicyandiamide (DCD - a nitrification inhibitor) and/or N-(n-butyl) thiophosphoric triamide (NBPT or Agrotain^{TM} - a urease inhibitor)].
- Data were recorded on seedling emergence, seed yield, straw yield, and total N concentration in seed and straw to calculate N uptake.
- The data for each parameter were subjected to analysis of variance (ANOVA) using GLM procedure in SAS and $LSD_{0.05}$ was used for mean separation.

Summary - Canola

Seedling Emergence

- Side-banded urea had no detrimental effect on emergence compared to zero-N control, but emergence was substantially decreased with seedrow-placed N compared to side-banded N for urea and SuperU or AgrotainU, particularly at 80 and 120 kg N ha^{-1} rates.
- For ESN, there was no detrimental effect of seedrow-placed N on emergence in 2007 and 2009, but only slight reduction in emergence in 2008 at the two highest N rates.
- On the average of 3 years, rate of N had no detrimental effect on emergence for side-banded urea, but emergence substantially decreased with increasing N rate for seedrow-placed urea and SuperU or AgrotainU. For ESN, there was no detrimental effect of seedrow-placed N on emergence.

Seed Yield, N Uptake and N Recovery

- Seed yield and N uptake increased with increasing N rate up to 120 kg N ha^{-1}.
- Seed yield and N uptake tended to be lower in 2007 and 2008, and lower in 2009 with seedrow-placed N than side-banded N for urea and SuperU or AgrotainU, but seed yields were similar for both placement methods with ESN.
- On the average of 3 years, the increase in seed yield and N uptake from seed-placed N were lower than side-banded N for SuperU/AgrotainU and more so for urea, but seedrow-placed ESN tended to be more effective than side-banded N at the 80 and 120 kg N ha^{-1} rates.

Summary - Wheat

Seedling Emergence

- There was no detrimental effect of seedrow-placed N on emergence for ESN at any N rate, but emergence tended to be (or was) lower with seedrow-placed N compared to side-banded N for urea and SuperU or AgrotainU at 80 and 120 kg N ha^{-1} rates.
- On the average of 3 years, seedling emergence of wheat decreased with increasing N rate with seedrow-placed N compared to side-banded N for urea and more so for SuperU or AgrotainU at the 80 and 120 kg N ha^{-1} rates, but there was no detrimental effect of seedrow-placed N on seedling emergence for ESN at any N rate.

Seed Yield, N Uptake and N Recovery

- Seed yield and N uptake increased with increasing N rate up to 120 kg N ha^{-1}.
- Seed yield and N uptake were lower with seedrow-placed N than side-banded N in all cases for urea, and in 2007 and 2009 for SuperU or AgrotainU at the 80 and 120 kg N ha^{-1} rates, but for ESN seedrow-placed N had no detrimental effect on seed yield and N uptake (in fact seed yield and N uptake tended to improve with seedrow-placement over side-banding, most likely due to the increase in available N because of the close proximity of applied N to seed for effective plant uptake in the early growing season).
- On the average of 3 years, the increase in seed yield and N uptake from seed-placed N were lower for urea, and tended to be lower for SuperU/AgrotainU, than side-banded N, but seedrow-placed ESN tended to be more effective than side-banded N at the 80 and 120 kg N ha^{-1} rates.

Conclusions

- Seedling emergence decreased with increasing N rate for seedrow-placed N, especially for canola. For urea and SuperU or AgrotainU, seedling emergence was lower with seedrow-placed N compared to side-banded N.
- Seedling emergence, seed yield and N uptake were generally greater with ESN than urea and SuperU or AgrotainU, when the N fertilizers were seedrow-placed at high N rates.

Acknowledgements

The author thanks Agrium for financial assistance in all three years and for supplying polymer-coated urea (called ESN) fertilizer, Agrotain International LLC for financial assistance in two years and for supplying SuperU and Agrotain-treated urea fertilizers for this study, and D. Leach, K. Strukoff for technical help.

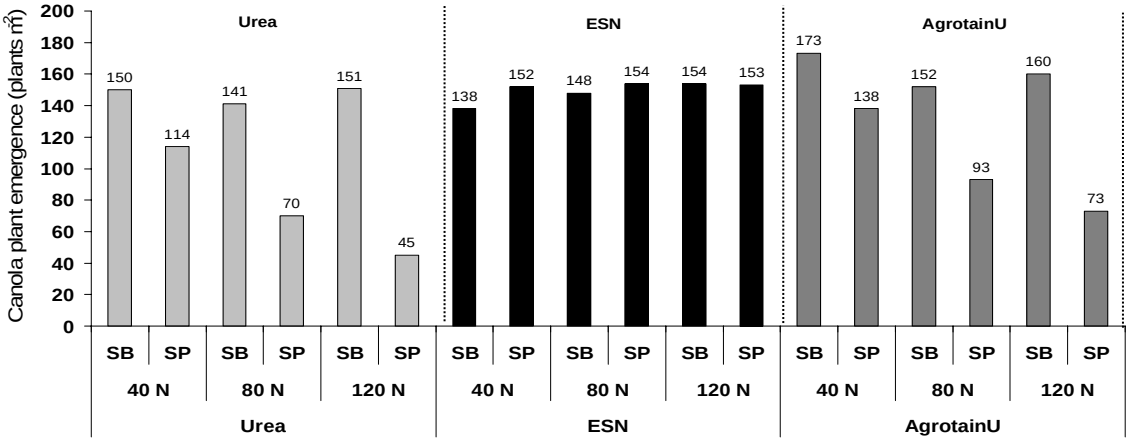

Figure 1. Seedling emergence with urea, polymer-coated urea (ESN) and Agrotain-treated urea (AgrotainU; in 2007, urea was treated with Agrotain and DCD, called SuperU) fertilizers applied to canola (averaged over three years) at different rates using knives at Melfort, Saskatchewan.

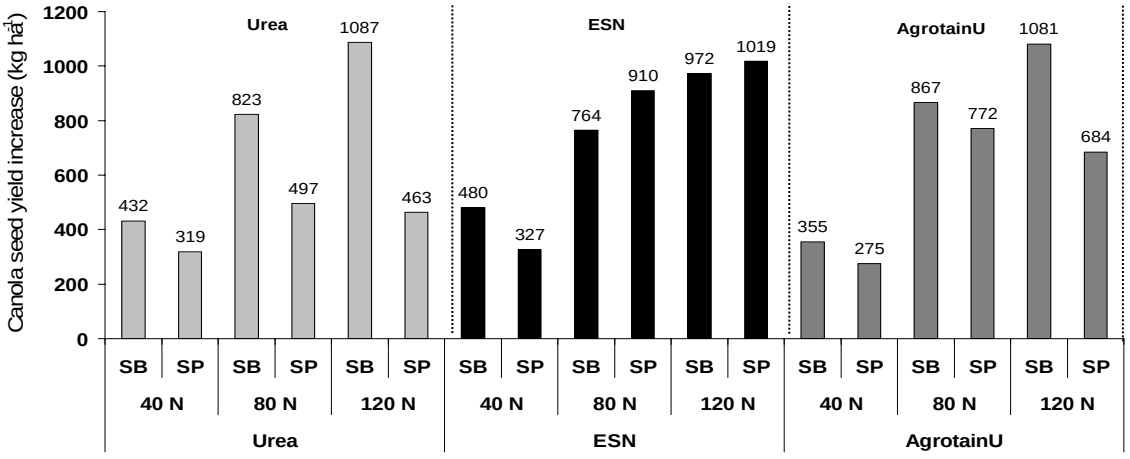

Figure 2. Increase in seed yield from applied N with urea, polymer-coated urea (ESN) and Agrotain-treated urea (AgrotainU; in 2007, urea was treated with Agrotain and DCD, called SuperU) fertilizers applied to canola (averaged over three years) at different rates using knives at Melfort, Saskatchewan.

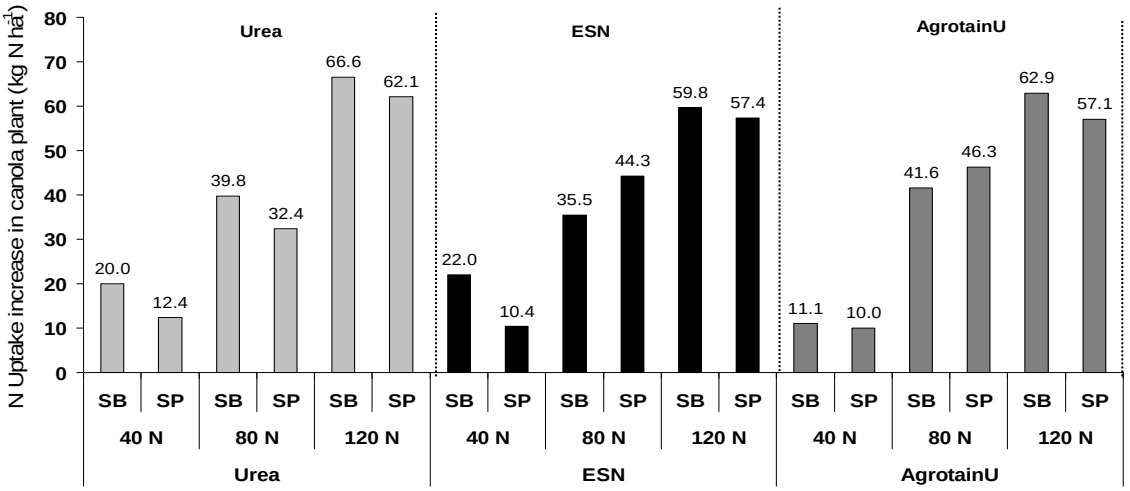

Figure 3. Increase in total N uptake in seed + straw from applied N with urea, polymer-coated urea (ESN) and Agrotain-treated urea (AgrotainU; in 2007, urea was treated with Agrotain and DCD, called SuperU) fertilizers applied to canola (averaged over three years) at different rates using knives at Melfort, Saskatchewan.

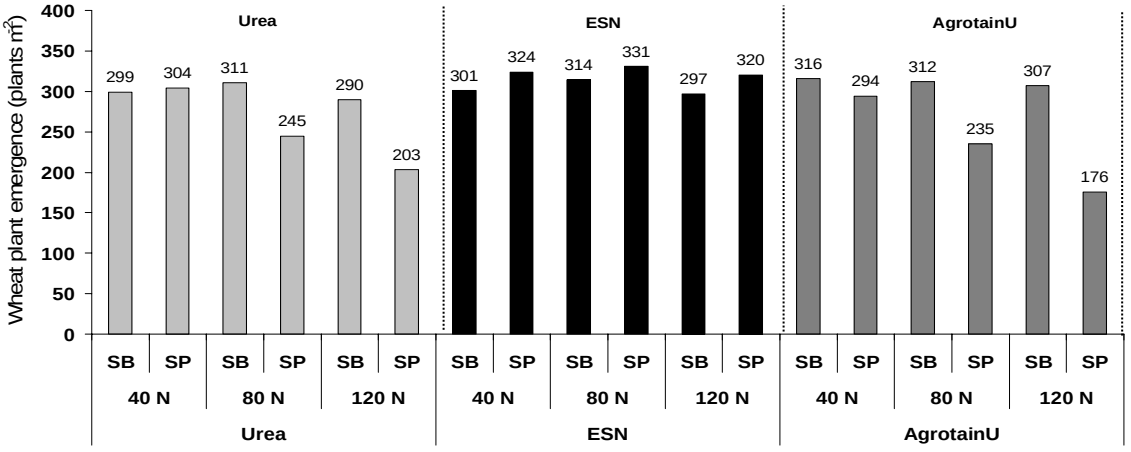

Figure 4. Seedling emergence with urea, polymer-coated urea (ESN) and Agrotain-treated urea (AgrotainU; in 2007, urea was treated with Agrotain and DCD, called SuperU) fertilizers applied to wheat (averaged over three years) at different rates using knives at Melfort, Saskatchewan.

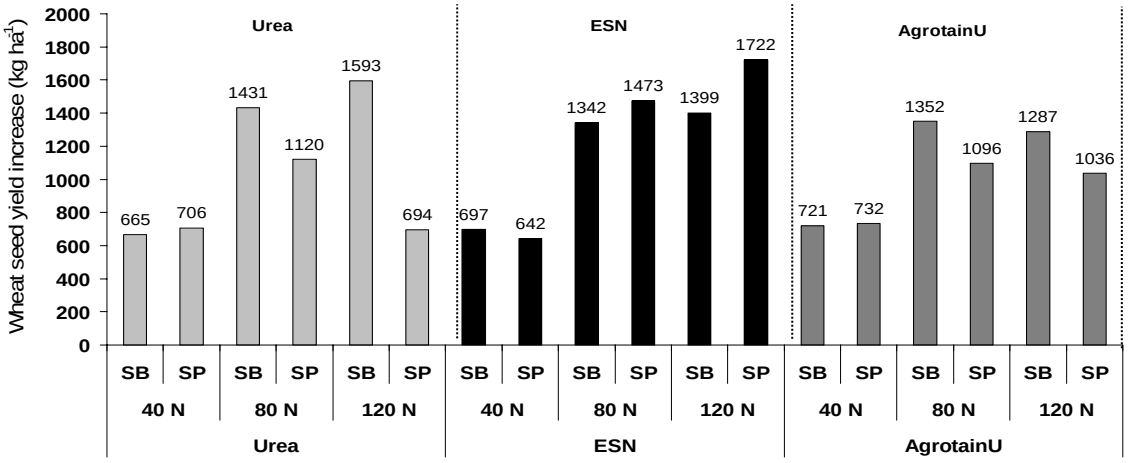

Figure 5. Increase in seed yield from applied N with urea, polymer-coated urea (ESN) and Agrotain-treated urea (AgrotainU; in 2007, urea was treated with Agrotain and DCD, called SuperU) fertilizers applied to wheat (averaged over three years) at different rates using knives at Melfort, Saskatchewan.

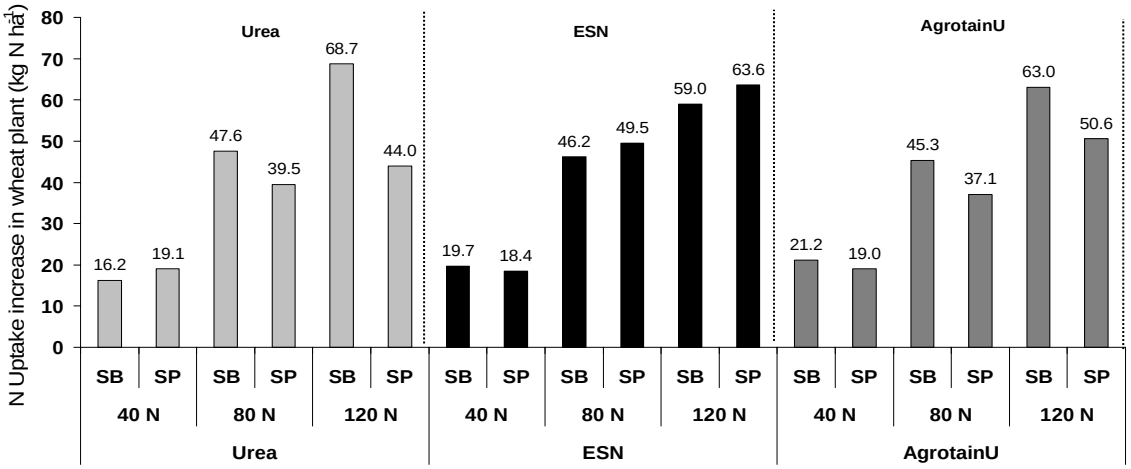

Figure 6. Increase in total N uptake in seed + straw from applied N with urea, polymer-coated urea (ESN) and Agrotain-treated urea (AgrotainU; in 2007, urea was treated with Agrotain and DCD, called SuperU) fertilizers applied to wheat (averaged over three years) at different rates using knives at Melfort, Saskatchewan.