# Use of Agrotain to Reduce the Seedbed Toxicity of Urea

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Farm operators are searching for better ways to seed their crops in a single pass. One pass seeding requires that higher rates of nitrogen fertilizer placed in the soil during seeding. Increasing the width of the seedrow or being careful to sow into moister soils are low cost solutions. Investing capital in "iron" is another solution such as midrow banding and narrower row spacing configurations can solve the problem but present equipment may be satisfactory if the urea could be "safened" somehow. This approach is especially feasible for cereals where rates of N application just exceed safe levels especially on heavy textured soils. Sensitive crops such as canola and flax are too easily injured to trust a "safening product". Rainfall is essential to provide the necessary safety when using urea in the seedrow with canola or flax.

Agrotain with the active ingredient, N-(n-butyl)-thiophosphoric triamide, "safens" urea by inactivating urease in the soil. This urease inhibitor has no effect on earthworms, or other soil microorganisms. The product is designed to slow the breakdown of urea, and therefore, reduce the loss of N by reducing the rate of volatization of ammonia. The active ingredient is dissolved in a solvent base and quickly evaporates from the treated urea fertilizer. The half-life of bulk impregnated urea is three months. Treating urea with Agrotain adds about a dime per lb N to the cost of urea. Treated urea is therefore similar in cost to ammonium nitrate.
Seed placement of nitrogen fertilizer treated with Agrotain increased yields of barley more than either banded or seed placed urea. Canola fertilized with urea treated with Agrotain yielded similarly to canola fertilized with banded urea (Pauly et al., 1996).

Three experiments were established by the Saskatchewan Soil Conservation Association in the 2000 crop year. The objectives of these experiments was

1. to determine the level of safety provided to wheat and canola stands by treating urea with Agrotain, and
2. to determine if full rate Agrotain is required to provide safety for germinating seedlings in seedrow applications.

The experiments were designed as a modification of the randomized complete block design. The plots were sown with a Flexicoil 5000 research drill with 9" row spacing. Half of the drill was fitted with ¾" stealth openers while the other half had Flexicoil 3" spreader tips. Urea was treated with 3 rates of Agrotain: full rate (5.2 liter/t), 2/3 of full rate, and 1/3 of full rate. The locations and details unique to each trial follow:

1. Aneroid – sandy loam sown to Kyle durum @ 90 lb/ac. N rates from 0 to 125 lb N/ac with 3 replications of each treatment combination. Rain within 2 days of seeding.

2. Swift Current – clay loam sown to LG3345 canola @ 5.5 lb/ac. N rates from 0 to 120 lb N/ac with 3 replications of each treatment combination. Rain within 1 day of seeding.

3. Scott – loam soil sown to LL2273 canola @ 6.5 lb/ac. N rates from 0 to 120 lb N/ac with 4 replications of each treatment combination. Light shower shortly after seeding.

The density of seedlings emerging as well as the final seed yield were determined for each plot. Observations on the effect of the treatments on maturity were not recorded in these trials.

Results and Discussion:

Several trends are evident in the data at all three sites and both crops presented below:

1. The widening of the fertilizer band with the spreader adapter on this drill did not eliminate the injury from seed-placed urea at all three sites. Although the injury in terms of stand density and seed yield for both durum wheat and canola was reduced, the level of seedling safety achieved with this drill was not as great as anticipated by widening the seed row. There was a continual thinning in stand density as fertilizer rates increased.
2. The coating of Agrotain on urea did improve the density of the plant stands. Although statistics could not be conducted, the trend towards a thicker plant stand with treatment of urea with Agrotain was consistent at every rate of applied nitrogen.
3. With each reduction in the rate of Agrotain on the urea applied in the seedrow, there was a strong trend showing a reduction in seeding safety. There was benefit in using the full recommended rate of Agrotain registered for broadcast application of urea with seed-placed application of urea. This observation is not consistent with previous research conducted by Agriculture Canada at Brandon which showed that one-third rate Agrotain was as effective as full rate Agrotain in seed-placed urea applications (Grant et al., 2000).
4. Under dry spring conditions, Agrotain slowed the release of N to canola and appeared to stunt the progress and yield of the crop. (Baldwin, personal communication)

Table 1: Emerged seedlings of durum (plants/m2) at Aneroid, SK

| | Urea (untreated) | | Full rate Agrotain | | 2/3 rate Agrotain | | 1/3 rate Agrotain | |
|---|---|---|---|---|---|---|---|---|
| | Knife | Spread | Knife | Spread | Knife | Spread | Knife | Spread |
| 0 N | 92.8 | 100.7 | NR** | NR | NR | NR | NR | NR |
| 25 N | 79.9 | 96.6 | 86.0 | 95.2 | 83.2 | 88.5 | 81.0 | 85.6 |
| 50 N | 41.3 | 53.2 | 82.8 | 95.0 | 77.0 | 88.5 | 69.3 | 82.8 |
| 75 N | 30.3 | 39.0 | 68.8 | 89.9 | 68.7 | 87.5 | 63.9 | 75.5 |
| 100 N | 26.4 | 33.9 | 58.1 | 77.6 | 53.4 | 75.9 | 57.4 | 69.9 |
| 125 N | 24.1 | 33.3 | 51.6 | 71.3 | 50.2 | 69.9 | 50.2 | 65.2 |
| Mean* | 40.4 | 51.2 | 69.5 | 85.8 | 66.5 | 82.0 | 64.4 | 75.8 |

* Mean of 30N, 60 N, 90 N and 120 N treatments

** Not recorded

Table 2: Grain yield of durum (bu/ac) at Aneroid, SK

| | Urea (untreated) | | Full rate Agrotain | | 2/3 rate Agrotain | | 1/3 rate Agrotain | |
|---|---|---|---|---|---|---|---|---|
| | Knife | Spread | Knife | Spread | Knife | Spread | Knife | Spread |
| 0 N | 10.8 | 11.7 | NR | NR | NR | NR | **NR** | NR |
| 25 N | 21.7 | 22.7 | 27.0 | 27.9 | 27.4 | 26.9 | 24.8 | 27.0 |
| 50 N | 17.3 | 17.5 | 32.2 | 34.8 | 29.9 | 33.5 | 24.4 | 26.2 |
| 75 N | 15.4 | 16.6 | 36.8 | 39.7 | 31.4 | 34.0 | 24.5 | 26.8 |
| 100 N | 15.0 | 15.6 | 34.0 | 36.4 | 32.0 | 35.6 | 22.7 | 26.1 |
| 125 N | 12.9 | 13.6 | 30.2 | 38.6 | 28.9 | 34.9 | 18.4 | 21.4 |
| Mean* | 16.5 | 17.2 | 32.0 | 35.5 | 29.9 | 33.0 | 23.0 | 25.5 |

* Mean of 30N, 60 N, 90 N and 120 N treatments

** Not recorded

Seed yields responded strongly to the application of nitrogen at both Aneroid and Swift Current, but the extra nitrogen did not increase seed yields of canola at Scott. Although fertility prior to the experiment was not documented by soil testing, residual nitrogen at Scott was likely adequate for the canola crop grown.

Mixing urea with phosphate fertilizer reduces the critical relative humidity of the blend. The initial wetness of Agrotain treated urea may contribute to sticking of the fertilizer blend to auger flighting during the metering of fertilizer in seed row applications. Applying Agrotain to urea on days with low relative humidity will limit the potential for this difficulty. Following the recommendation by Agrotain International to add a finely ground sorptive free-flowing powder such as attapulgite clay at a rate of 0.25% by weight would also control this risk.

Table 3: Emerged seedlings of canola (plants/m2) at Swift Current, SK

| | Urea (untreated) | | Full rate Agrotain | | 2/3 rate Agrotain | | 1/3 rate Agrotain | |
|---|---|---|---|---|---|---|---|---|
| | Knife | Spread | Knife | Spread | Knife | Spread | Knife | Spread |
| 0 N | 83.3 | 80.8 | NR | NR | NR | NR | NR | NR |
| 30 N | 37.4 | 43.8 | 60.1 | 67.8 | 57.0 | 62.1 | 59.7 | 60.6 |
| 60 N | 28.0 | 46.3 | 76.4 | 76.8 | 59.8 | 58.4 | 50.0 | 50.4 |
| 90 N | 22.0 | 26.9 | 46.3 | 50.8 | 38.5 | 45.7 | 35.7 | 36.9 |
| 120 N | 10.0 | 15.8 | 36.1 | 36.2 | 29.6 | 32.9 | 22.3 | 25.9 |
| Mean* | 24.3 | 33.2 | 57.0 | 63.7 | 54.7 | 57.9 | 46.2 | 49.8 |

* Mean of 30N, 60 N, 90 N and 120 N treatments

** Not recorded

Table 4: Seed yield of canola (bu/ac) at Swift Current, SK

| | Urea (untreated) | | Full rate Agrotain | | 2/3 rate Agrotain | | 1/3 rate Agrotain | |
|---|---|---|---|---|---|---|---|---|
| | Knife | Spread | Knife | Spread | Knife | Spread | Knife | Spread |
| 0 N | 6.0 | 7.7 | NR | NR | NR | NR | NR | NR |
| 30 N | 17.4 | 18.8 | 16.9 | 20.0 | 16.6 | 19.3 | 17.7 | 19.4 |
| 60 N | 16.3 | 18.8 | 25.1 | 31.6 | 23.4 | 28.6 | 21.5 | 25.9 |
| 90 N | 15.6 | 16.2 | 31.7 | 34.4 | 27.5 | 30.5 | 24.0 | 27.5 |
| 120 N* | 12.7 | 14.3 | 33.7 | 36.7 | 25.9 | 29.0 | 22.7 | 25.1 |
| Mean | 15.5 | 17.0 | 27.4 | 31.1 | 26.8 | 30.7 | 23.4 | 26.9 |

* Mean of 30N, 60 N, 90 N and 120 N treatments
** Not recorded

Table 5: Emerged seedlings of canola (plants/m2) at Scott, SK

| | Urea (untreated) | | Full rate Agrotain | | 2/3 rate Agrotain | | 1/3 rate Agrotain | |
|---|---|---|---|---|---|---|---|---|
| | Knife | Spread | Knife | Spread | Knife | Spread | Knife | Spread |
| 0 N | 36.0 | 38.4 | NR | NR | NR | NR | NR | NR |
| 30 N | 32.3 | 31.7 | 26.4 | 31.9 | 26.5 | 36.2 | 29.2 | 32.8 |
| 60 N | 18.1 | 16.1 | 26.9 | 25.2 | 20.8 | 24.4 | 14.1 | 18.3 |
| 90 N | 6.0 | 13.1 | 17.8 | 12.7 | 17.2 | 15.6 | 11.3 | 11.8 |
| 120 N | 9.3 | 5.0 | 7.7 | 15.4 | 13.5 | 15.1 | 8.3 | 12.0 |
| Mean* | 16.4 | 16.5 | 19.7 | 21.3 | 19.5 | 22.8 | 15.7 | 18.7 |

* Mean of 30N, 60 N, 90 N and 120 N treatments
** Not recorded

Table 6: Seed yield of canola (bu/ac) at Scott, SK

| | Urea (untreated) | | Full rate Agrotain | | 2/3 rate Agrotain | | 1/3 rate Agrotain | |
|---|---|---|---|---|---|---|---|---|
| | Knife | Spread | Knife | Spread | Knife | Spread | Knife | Spread |
| 0 N | 24.0 | 28.7 | NR | NR | NR | NR | NR | NR |
| 30 N | 35.1 | 41.7 | 33.6 | 41.6 | 32.0 | 37.3 | 30.8 | 38.1 |
| 60 N | 35.4 | 37.2 | 36.4 | 40.9 | 37.4 | 39.3 | 36.4 | 36.8 |
| 90 N | 24.6 | 33.1 | 36.0 | 40.3 | 35.7 | 36.1 | 35.1 | 34.4 |
| 120 N | 24.6 | 34.3 | 38.0 | 35.7 | 34.9 | 33.7 | 34.6 | 36.9 |
| Mean* | 29.9 | 36.6 | 36.0 | 39.6 | 35.0 | 36.6 | 34.2 | 36.6 |

* Mean of 30N, 60 N, 90 N and 120 N treatments
** Not recorded

**Conclusions:**

1) Agrotain reduces the seedling toxicity of seed-placed urea and improves the efficiency of seed-placed nitrogen. Reducing the rate of Agrotain reduced the effectiveness of the treatment.

2) Seed placed urea reduces the stand establishment of both canola and durum at relatively low rates of nitrogen (25-30 N/ac). Compensation of plants for reduced plant stand masks the effect of reduction in plant density on crop yield in both canola and durum.

3) The benefit of an increase in seedbed utilization for fertilizer application may not be achieved with specific implements or as tillage tools wear from usage.

**References:**

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