Field Scale Evaluations of Nitrogen Sources, Timing and Placement for Zero-tilled Winter Wheat

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Background

- Nitrogen continues to be the most important and costly input for production of high yielding and high quality winter wheat.
- Producers continue to search out lower cost alternatives to the standard of spring broadcast ammonium nitrate (34-0-0).
- The Manitoba Zero Till research Association (MZTRA) has conducted 6 field scale studies over the past 5 years to address these questions.

Particularly enticing is the possibility of late fall anhydrous ammonia (NH_3) injection vs surface or broadcast N applications, since:

- fall NH_3 is the least cost N source
- application to cold soils should keep N in the NH_3 form so leaching and denitrification loss is minimal
- injection will eliminate volatilization or spring run-off losses

Materials and Methods

- Studies were done on a Newdale clay loam soil at the MZTRA in 1997-99 and Jim Nevin farm in 2000-2001.
- Individual treatments were 30' wide and 200-440' long in a RCB design replicated 3-4 times (Table 1).
- Seeding, fertilizing, spraying and harvest operations were done with commercial farm equipment. Yields were recorded by yield monitor and weigh wagon. Samples were tested for protein.

Table 1. Site data summarized

Study	1997	1998	1999a	1999b	2000	2001
Location	MZTRA	MZTRA	MZTRA	MZTRA	Nevin	Nevin
Plot size	30x440	30x195	30x230	30x500	30x300	30x300
# reps	3	3	3	4	4	4
N rate lb N/ac	100	100	100	100	100	120
Fall N dates	-	-	Oct 27/98	Oct 27/98	Nov 2/99	-
Spring N dates	Apr 30	Apr 30	Apr 27	Apr 28	Apr 18	May 4

Analysis

Yield and protein results were analyzed using ANOVA and tested for significance at the 5% probability level.

In Figures 2-3 and 6-9 different letters above bars in charts indicate significant differences at the 5% level, "ns" indicates no significant differences.

Fertilizer Application

- Granular fertilizer (ammonium nitrate and urea) was applied with a 15' wide Valmar applicator
- UAN solution (28-0-0) was applied in a dribble on 12" spacings (Fig 1)
- spokewheel UAN solution was applied to 2001 crop with a commercial applicator from Redfern's Farm Supply
- anhydrous ammonia (NH_3) was fall applied to the 1999 crop with Atom Jet Knives in 16" row spacings perpendicular to the direction of seeding
- NH_3 was applied to the 2001 crop in the spring with Ponik disc openers in 8" row spacings since fall 2000 was too wet

Figure 1. Dribble banded UAN on 12" centres (left) and spoke wheel applicator (right).

Results

Nitrogen Sources

- There were no significant yield or protein differences among ammonium nitrate, urea or dribble UAN at any sites (Figure 2-3).
- UAN spoke wheel application performed equal to UAN dribbled and granular form in 2001.
- NH_3 performed poorer than other N forms in 1999a and 2001 in yield and protein.
- Wheat protein levels were high (>11.5%) in 1997-2000, suggesting sufficient N was applied to optimize yield regardless of source, which may have masked any N source differences.

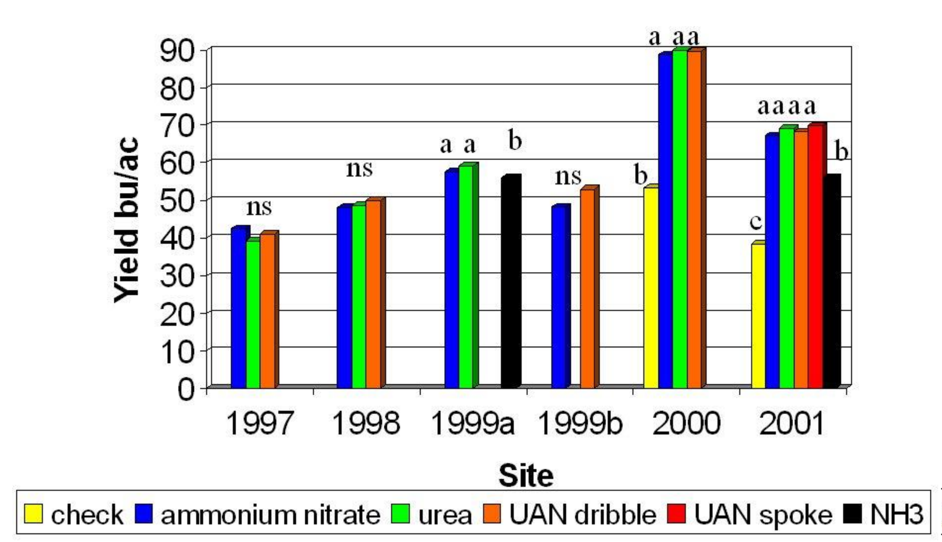

Figure 2. N source and placement on yield

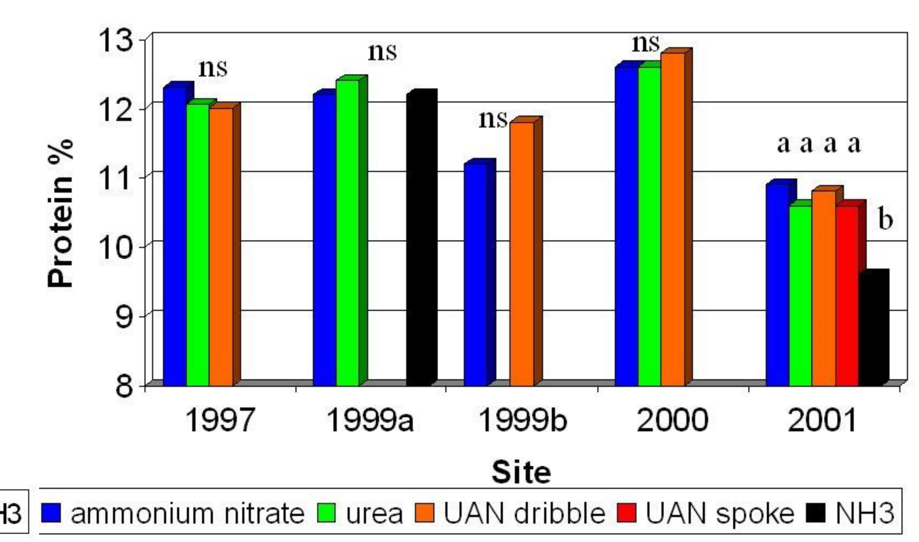

Figure 3. N source and placement on Protein

Why the problem with NH_3?

- In fall 1998 knife application of NH_3 threw soil on established wheat and reduced spring emergence by 25% (Figure 4). Despite aggressive tillering there were still yield differences.
- In spring 2001 disc application of NH_3 into very moist soil had inadequate slot closure, and apparent N loss sufficient to reduce yield and protein (Figure 5).

Figure 4. Reduced plant stands on right with fall knifed NH_3

Figure 5. NH_3 placement with Ponik disc opener in spring 2001

N Timing

- Fall applied N was always inferior to spring applications in yield (7% less for urea and 6% less for UAN) and protein (Figures 6-7).
- In fall 1999 (site 2000) it remained warm and dry after application on Nov 2, which may have permitted volatilization loss of urea portions of urea and UAN.
- Split N applications (1/2 in fall + 1/2 in spring) were intermediate in yield and protein between fall and spring applications.

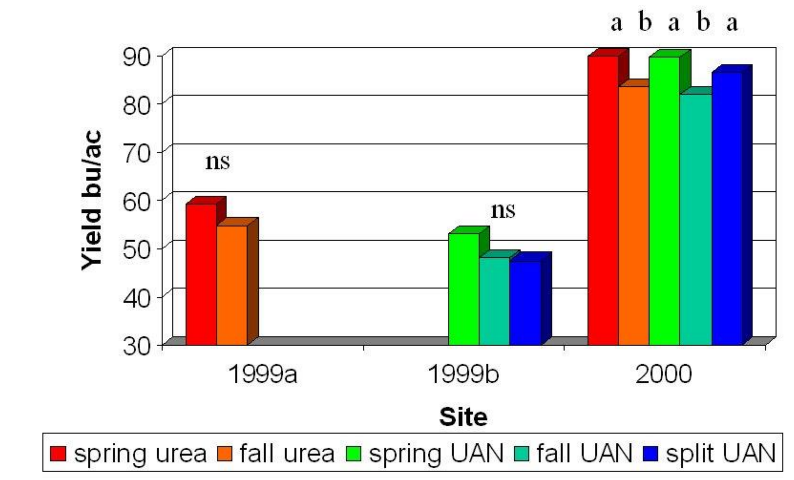

Figure 6. Effect of N timing and splitting on yield

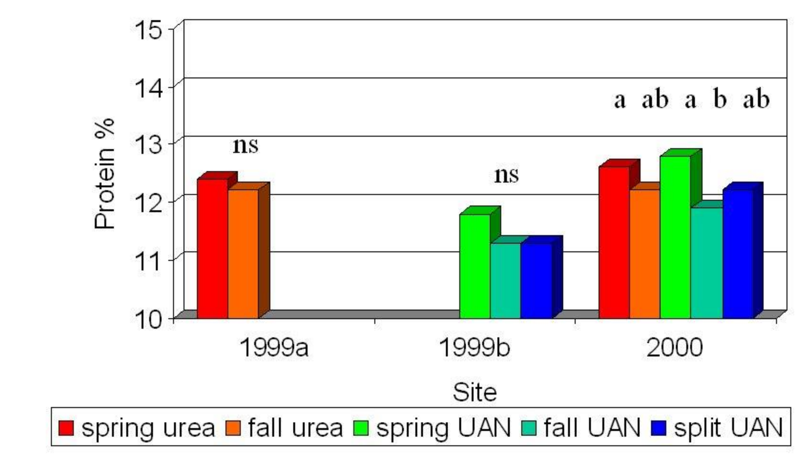

Figure 7. Effect of N timing and splitting on protein.

Urease inhibitor

- Urea and UAN may be treated with the urease inhibitor Agrotain to delay or minimize hydrolysis and volatilization losses
- Agrotain produced a slight, but insignificant increase in yield and no effect on protein (Figures 8-9)

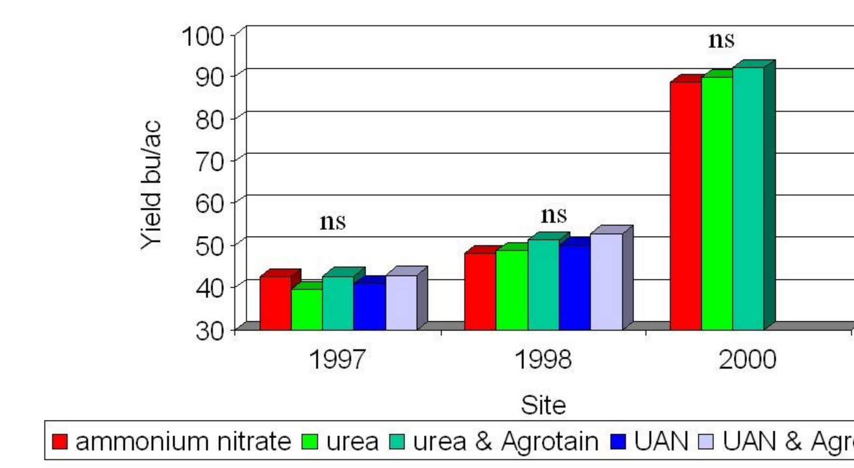

Figure 8. Effect of Agrotain treatment on yield

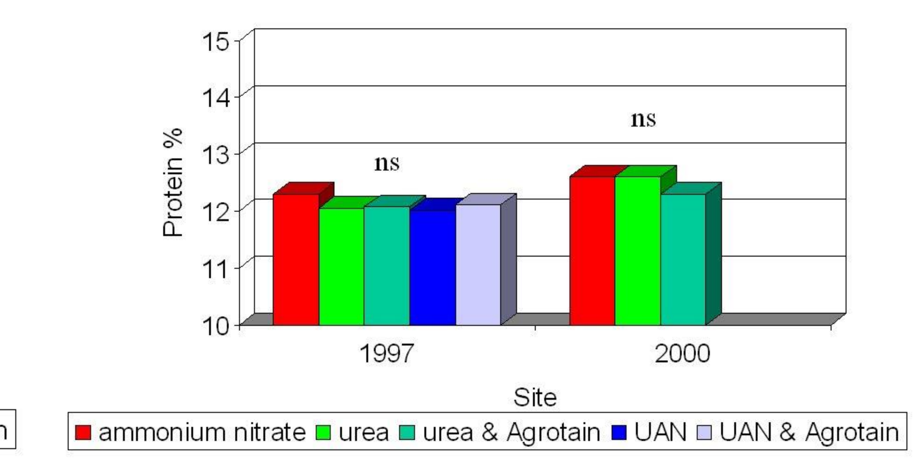

Figure 9. Effect of Agrotain treatment on protein

Summary

- All sources of N performed equally. Volatilization losses of urea-N forms appear to be minimal with early spring application under cool conditions. There was no benefit to Agrotain.
- The poor performance with NH_3 was related to stand damage and loss of N from unsealed slots.
- Equipment modifications should overcome these NH_3 challenges, and are being documented in whole field applications (Figures 10-12)

Figure 10. Bourgault mid-row banding injection of NH_3

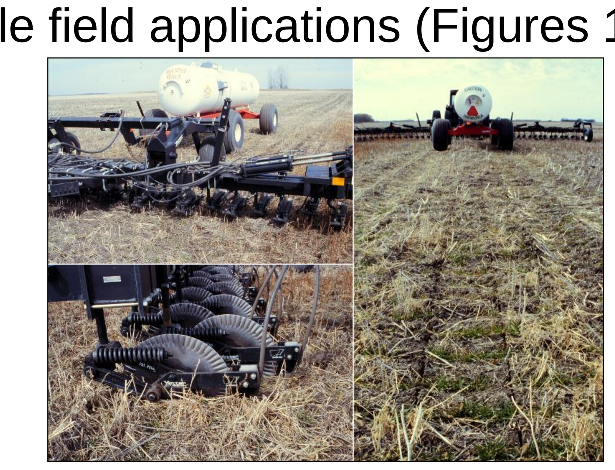

Figure 11. Yetter coulter injection of NH_3


Figure 12. Dutch Industries injection units for NH_3

Acknowledgements

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