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Field Evaluation of Super Urea^{®1} for Production of No-Till Corn

K.L. Wells, J.E. Dollarhide, and H.E. Burkwhat

Nitrification inhibitors and urease inhibitors have been commercially available to farmers for several years. Nitrification inhibitors are intended to minimize losses of nitrate nitrogen ($\text{NO}_3\text{-N}$) from soil due to leaching and denitrification, by slowing the activity of soil bacteria which convert ammonium nitrogen ($\text{NH}_4\text{-N}$) to the more easily lost $\text{NO}_3\text{-N}$. This has the potential to make $\text{NH}_4\text{-N}$ or urea fertilizer sources of N more effective, particularly during late spring and early summer when soil and climatic conditions are usually more favorable for leaching or denitrification of $\text{NO}_3\text{-N}$. Urease inhibitors slow the activity of the naturally occurring urease enzyme which is necessary for changing urea N to $\text{NH}_4\text{-N}$. This results in less potential volatilization loss of ammonia N ($\text{NH}_3\text{-N}$) from surface applications of urea. A nitrogen fertilizer being offered for sale to Kentucky farmers, Super Urea[®] (Super U), a solid, pelleted urea, contains both the

nitrification inhibitor DCD (dicyandiamide) and the urease inhibitor, NBPT (N-(nbutyl)thiophosphoric triamide). Claim for use of Super U is to reduce volatilization loss of $\text{NH}_3\text{-N}$, released as urea breaks down to $\text{NH}_4\text{-N}$ in the soil, and to reduce losses from $\text{NO}_3\text{-N}$. Potentially, this would improve the efficiency of urea, particularly in topdress applications such as on no-till corn, pastures, hayfields, or lawns. Since Super U contains both DCD and NBPT, it sells for a higher price per pound of N than regular urea.

Field tests were conducted by Frye et al. (1985) on the effectiveness of DCD in maintaining fertilizer $\text{NH}_4\text{-N}$ in the soil for longer than normal periods of time, on the ear-leaf N content and yield of no-till corn. Using ammonium sulfate as the nitrogen source applied at planting, they found that, although $\text{NH}_4\text{-N}$ levels in the soil were kept higher by use of DCD, there was little to no effect on ear leaf N

¹Super Urea[®] is a trademarked product of IMC Agrico, Brannockburn, IL 60015

content or yield of no-till corn grown on a moderately well to somewhat poorly drained soil. Frye et al. (1992), also reported that their field studies using NBPT at 0.7 lb/A with surface applied granular urea and liquid urea ammonium nitrate solution, resulted in improving urea N efficiency, both on no-till corn and fescue. Because of current farmer questions about the effectiveness of Super U as compared to regular urea, we thought it timely to conduct additional studies using this product, to evaluate its agronomic performance.

DESCRIPTION OF STUDIES

Two studies were conducted in Meade Co., KY., one in 1997 and one in 1998, to compare ordinary urea with Super U for no-till corn. The site in 1997 was on a 2 to 6% sloping Crider silt loam soil, testing pH 5.6 and P, 114; K, 375; Ca, 2485; Mg, 183; and Zn, 3.0 lbs/A. The field had been no-tilled in a corn-wheat-double crop soybean rotation since 1979. However, in early March, 1997, an 11-inch rain within a 24 to 36 hour period caused severe rill erosion in the existing wheat cover and the farmer decided to disk up the wheat to smooth the surface and plant corn instead of soybeans. Corn (Pioneer 3394) was then planted into the disked wheat cover during the last week of April, and the N-source study was established. The N treatments were broadcast onto the surface at the time corn was spiking on May 6. Lack of space limited replications to three and limited the use of ammonium nitrate, a standard N source against which to compare both urea and Super U, to one rate of 80 lbs N/A. Treatments tested are shown in Table 1. Rainfall during the growing season was excessive

until the last week of June, after which there was little rainfall until after the corn matured. Ear-leaf samples were collected from each plot at time of pollination on July 23, for analysis of N content. Corn was hand harvested on September 24, at 20% moisture. Harvested plot population ranged from 17,700 to 26,100, and averaged 21,800 plants per acre.

The test in 1998 was conducted on a farm adjacent to the site used in 1997. The field was in a no-till corn-wheat-soybean rotation. The soil resembled a Nicholson silt loam, having a fragipan which began at a depth of 34 to 36 inches. The site was on a 5 to 6% uniform, convex slope. Soil test levels of the test site were: pH 6.2 and P, 101; K, 432; Ca, 2908; Mg, 216; and Zn, 4.6 lbs/A. Corn (Pioneer 3140) was no-till planted into existing soybean residues on April 14, 1998. The N-source study was laid out and N treatments (see Table 2), replicated 4 times, were broadcast onto the surface on April 23, when corn had just emerged. Rainfall was excessive from time of planting until late July, after which there was very little rain until after the corn matured. Ear-leaf samples for N analysis were collected from each plot on July 9, when corn was pollinating. Corn was hand harvested on September 14, at 13.5% moisture. Harvested plot population ranged from 18,500 to 24,700 plants per acre, and averaged 22,000.

RESULTS

1997. Both 80 and 160 lbs N/A significantly increased ear leaf content of N (Table 1), with 160 lbs N/A also being significantly higher than 80 lbs N/A. However, there was no difference among N sources despite the excessive rainfall

during May and June. This could possibly have resulted from greater early season microbial fixation of fertilizer N during decomposition of the disked-in wheat, with subsequent release of N by the microbial population later in the season when dry soil conditions would have prevented leaching or denitrification loss of $\text{NO}_3\text{-N}$. Even though treatment yield differences were non-significant at $p = .05$ (it required a difference of 41 bu/A for significant treatment effects), Super U and ammonium nitrate yields were about the same and both were considerably higher than urea at the 80 lbs N/A rate. Although this would indicate volatilization loss of N from ordinary urea, as compared to Super U, ear-leaf N content was the same for both sources. Unexplained yield variability (coefficient of variation = 17.4%) was high, probably due to stand variability among plots and only 3 replications of treatments.

1998. There was a significant effect of fertilizer N on both ear-leaf N content and yield (Table 2). Ear-leaf N content was significantly increased at each rate of N applied with Super U increasing more than ordinary urea at the 60 lbs N/A rate. There were little differences between ammonium nitrate and Super U at all N rates tested.

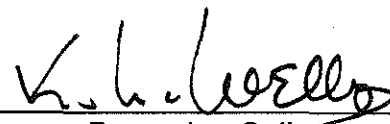
Yields were significantly affected by rates and sources. Maximum yield level was in the 150 to 160 bu/A range and was obtained from Super U at 60 lbs N/A. It took 120 lbs N/A from ammonium nitrate to reach that level, and was not attained with ordinary urea at any N rate. Even though there were large differences among N sources at 120 and 180 lbs N/A, they were not significant (it

required a difference of 28 bu/A for significance at $p = .05$). The much lower yield (although non-significant at $p = .05$) from ammonium nitrate than from Super U at 60 lbs N/A was possibly due to early season leaching loss of $\text{NO}_3\text{-N}$ from ammonium nitrate due to excessive rainfall.

Under the weather conditions at this site in 1998, Super U performed as advertised, assumedly by reducing volatilization and leaching losses of N from urea during periods of excessive rainfall which occurred early in the growing season, soon after surface broadcast application of fertilizer N.

REFERENCES

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Extension Soils Specialist

Table 1. Effect of N-Source and Rate on Ear-Leaf N and Yield of Corn in 1997

N lbs/A	Ammonium Nitrate		Urea		Super U®	
	Ear Leaf N %	Yield bu/A	Ear Leaf N %	Yield bu/A	Ear Leaf N %	Yield bu/A
0	2.61 d	105 a	--	--	--	--
80	2.93 bc	136 a	2.79 cd	116 a	2.79 cd	139 a
160	--	--	3.13 a	143 a	3.03 ab	136 a
L.S.D. (.05)	0.19	41	0.19	41	0.19	41

c.v. for ear leaf N = 3.7%; for yield = 17.4%

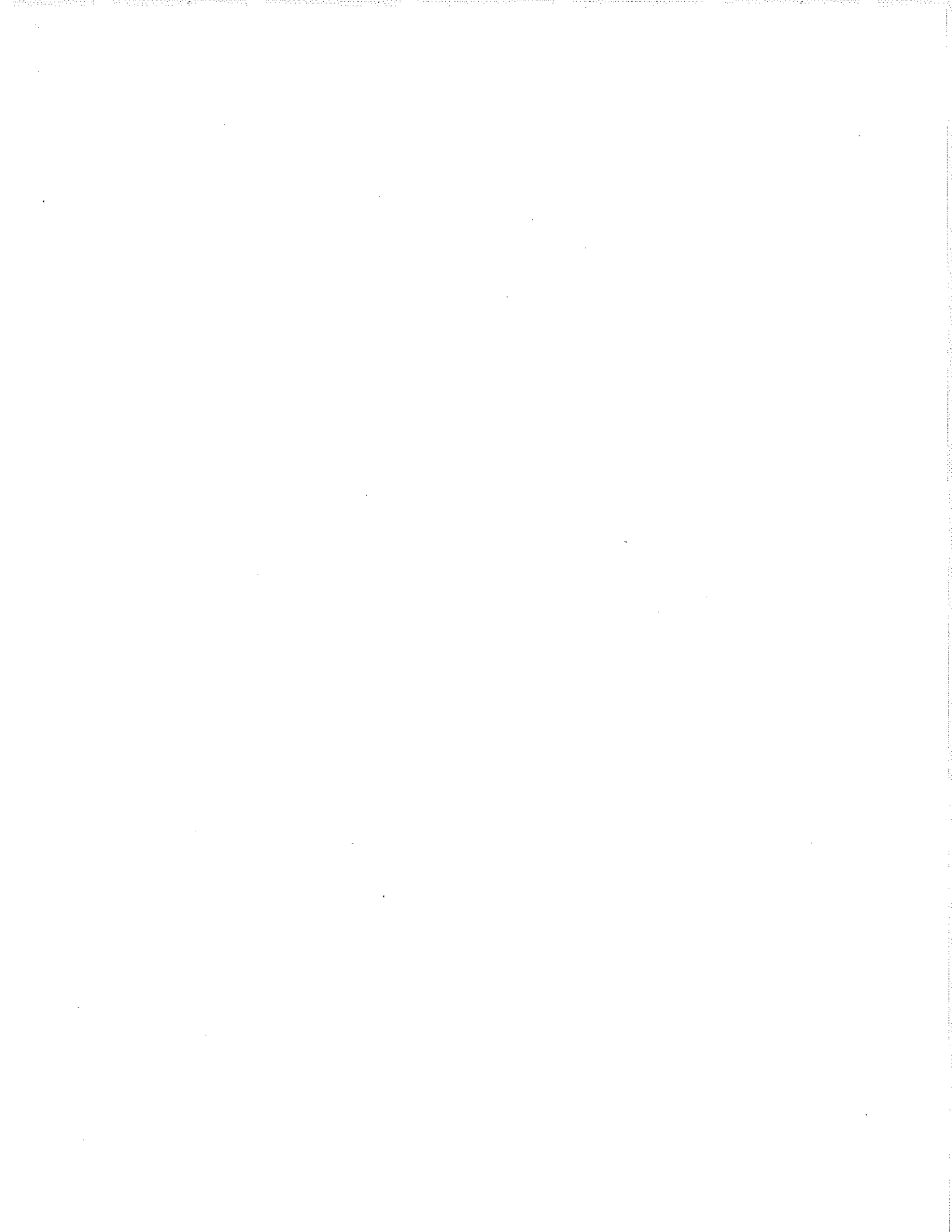
Treatment averages followed by the same letter are not significantly different (p = .05).

Table 2.**Effect of N-Source and Rate on Ear-Leaf N and Yield of No-Till Corn in 1998**

N lbs/A	Ammonium Nitrate		Urea		Super U®	
	Ear Leaf N %	Yield bu/A	Ear Leaf N %	Yield bu/A	Ear Leaf N %	Yield bu/A
0	2.01 g	82 d	--	--	--	--
60	2.91 ef	128 bc	2.72 f	118 c	2.97 e	151 ab
120	3.32 bc	161 a	3.10 de	138 abc	3.25 cd	159 a
180	3.52 ab	153 ab	3.36 abc	141 abc	3.54 a	158 a
L.S.D. (.05)	0.21	28	0.21	28	0.21	28

c.v. for ear leaf N = 4.7%; for corn yield = 13.8%

Treatment averages followed by the same letter are not significantly different (p = .05).



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