THE EFFECT OF SLOW-RELEASE N FERTILIZER RATE AND TIMING ON WHEAT GRAIN YIELD COMPARED TO OTHER N SOURCES

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Management strategies to reduce soil N loss include improved timing of N fertilizer applications, better use of soil and plant testing procedures to determine N availability, application of nitrification or urease inhibitors, and use of N fertilizer sources that are suitable for local environmental conditions (Dinnes et al., 2002). Use of slow-release urea fertilizer sources is a common strategy to reduce N leaching losses in horticultural crops, but its agronomic performance and cost-effectiveness has not been well established. Recent research at over 42 research sites in the Midwest indicated that average corn yield response to polymer-coated urea was 5 bu/acre higher compared to conventional urea or UAN solution, especially during years of normal or high rainfall (Blaylock, 2003). Use of slow-release N fertilizer for wheat may be a cost-effective management practice to improve crop performance and possibly allow custom applicators to apply a single fertilizer application in the fall for wheat. The extra cost of this N source (approx. 10¢ more per lb urea N) must be evaluated relative to its potential benefits under field conditions in Missouri due to wet fall and spring conditions commonly encountered by Missouri farmers. Limited research has examined the agronomic performance of wheat in response to polymer-coated urea. The objective of this research was to determine the impact of polymer-coated urea rates and application timings on wheat grain and frost-seeded clover forage yields in Northeast Missouri.

Research was conducted at the Greenley Research Center near Novelty, MO in 2004, 2005, 2006, and 2007. This research was arranged as a randomized complete block design with four replications in plots 10 by 45 ft in 2004 and 2005, and six replications in plots 10 by 35 ft in 2006 and 2007. 'Ernie' was no-till drilled on 23 October 2003, 8 November 2004, 1 October, 2005, and 6 October, 2006 at 150 lbs/acre in 7.5 in. rows. N fertilizer rates were applied at fall and split-application timings (Tables 1-4). Fall N treatments were applied 1 November 2003, 3 December 2004, 11 October, 2005, and 2 November, 2006 while the spring N treatment was applied 19 March 2004, 3 March 2005, 28 February 2006, and 23 February 2007. Red clover was also frost-seeded to the entire plot area on 19 March 2004, 8 March 2005, 27 February 2006, and 23 February 2007 to simulate a broadcast application of fertilizer and clover seed. Wheat fresh weights were measured at physiological maturity (data not presented), plots harvested with a small-plot combine, and clover yield determined after grain harvest (data not presented). Grain moisture was adjusted to 13% prior to analysis. All data were subjected to analysis of variance and means separated using Fisher's Protected LSD (P=0.05).

Wheat grain yield was similar among nitrogen source application rates and timings in 2004 (Table 1). Wheat treated with fall applied ESN at 50 lb N/acre had grain yields 6 and 4 bu/a greater than 32% urea ammonium nitrate at 50 lb N/acre and ammonium nitrate at 50 lb N/acre, respectively, in 2004.

In 2005, fall applied ESN increased wheat grain yield 8 to 22 bu/a when compared to urea or urea plus Agrotain applied in the fall (Table 2). Ammonium nitrate, 32% urea ammonium nitrate, and ESN fall applied had similar grain yields at 50 and 75 lbs N/a; however, ESN fall applied at 100 lbs/a had grain yields greater than all other fall applied N sources in 2005. Grain yield was similar among ESN, urea, urea plus Agrotain, 32% urea ammonium nitrate, or ammonium nitrate when these treatments were split-applied in 2005.

Fall applied ammonium nitrate at 100 lb N/acre had the greatest grain yield at 88 bu/a in 2006 which was similar to urea + Agrotain or 32% urea ammonium nitrate split-applied at 50 fb 50 lb N/acre (Table 3). Wheat grain yield was greater when ESN and ammonium nitrate were fall applied at 100 lbs N/acre compared to a split application while grain yields were greater when 32% urea ammonium nitrate was split applied at 50 fb 50 lbs N/acre when compared to a fall applied only application. However, wheat grain yields with urea + Agrotain or urea alone at 100 lbs N/acre were similar when fall or split-applied. Wheat grain yield was 43 bu/acre when ESN was fall applied at 75 lbs N/acre in 2007 which was similar to urea + Agrotain, ammonium nitrate, and split applications of urea, urea + Agrotain, or 32% urea ammonium nitrate (Table 4).

There was no effect of Agrotain + urea on wheat grain yields when compared to urea applied alone in the fall or split-applied in 2004 or 2005, and when split-applied in 2006 and 2007 (Tables 1-4). However, Agrotain + urea increased grain yield 5-7 bu/a at the 75 and 100 lb N/a rates when compared to urea alone in 2006 and 2007. Wheat grain yield with ESN was equal 11 of 20, greater than 6 of 20 (fall applied in 2005), and less than 3 of 20 (split-applied in 2006 and fall applied in 2007) rate-application timing-years when compared with urea alone from 2004 to 2007. Differences in crop response may be related to surface drainage issues since 2004, 2005, 2006, and 2007 had moderate, poor, excellent, and moderate surface drainage, respectively. Nitrogen sources may need to vary depending on the amount of surface drainage when fall or early spring applications are desired.

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References:

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Table 1. The effect of N fertilizer source, rate, and application timing on no-till wheat grain yield in 2004 (moderate surface drainage)[a].

	Fall applied				Split-applied	
Nitrogen source	0 lb N/acre	50 lb N/acre	75 lb N/acre	100 lb N/acre	25 fb 50 lb N/acre	50 fb 50 lb N/acre
	Yield (bu/acre)					
Untreated	41					
ESN		48	45	47	45	45
Urea		46	47	47	46	47
Urea + Agrotain (1 gal/ton)		45	43	44	44	44
32% urea ammonium nitrate		42	45	43	44	45
Ammonium nitrate		44	47	46	47	45
LSD (p=0.05)	4					

Table 2. The effect of N fertilizer source, rate, and application timing on no-till wheat grain yield in 2005 (poor surface drainage)[a].

	Fall applied				Split-applied	
Nitrogen source	0 lb N/acre	50 lb N/acre	75 lb N/acre	100 lb N/acre	25 fb 50 lb N/acre	50 fb 50 lb N/acre
	Yield (bu/acre)					
Untreated	24					
ESN		35	39	43	39	41
Urea		26	23	21	43	37
Urea + Agrotain (1 gal/ton)		24	27	26	40	35
32% urea ammonium nitrate		27	33	27	44	42
Ammonium nitrate		30	33	33	39	36
LSD (p=0.05)	7					

Table 3. The effect of N fertilizer source, rate, and application timing on no-till wheat grain yield in 2006 (excellent surface drainage)[a].

	Fall applied				Split-applied	
Nitrogen source	0 lb N/acre	50 lb N/acre	75 lb N/acre	100 lb N/acre	25 fb 50 lb N/acre	50 fb 50 lb N/acre
	Yield (bu/acre)					
Untreated	45					
ESN		66	73	80	64	75
Urea		62	71	77	77	81
Urea + Agrotain (1 gal/ton)		68	78	82	77	84
32% urea ammonium nitrate		55	63	66	76	84
Ammonium nitrate		66	77	88	68	70
LSD (p=0.05)	5					

Table 4. The effect of N fertilizer source, rate, and application timing on no-till wheat grain yield in 2007 (moderate surface drainage)[a].

	Fall applied				Split-applied	
Nitrogen source	0 lb N/acre	50 lb N/acre	75 lb N/acre	100 lb N/acre	25 fb 50 lb N/acre	50 fb 50 lb N/acre
	Yield (bu/acre)					
Untreated	25					
ESN		26	43	40	41	40
Urea		36	36	36	36	41
Urea + Agrotain (1 gal/ton)		36	41	41	37	41
32% urea ammonium nitrate		29	35	34	39	42
Ammonium nitrate		37	40	41	29	33
LSD (p=0.05)	4					

[a]Abbreviations: 25 fb 50, 25 lbs N/acre fall applied followed by 50 lbs N/acre spring applied; 50 fb 50, 50 lbs N/acre fall applied followed by 50 lbs N/acre spring applied; ESN, polymer-coated urea.