Nitrogen Sources and Rates for Soft and Hard Red Winter Wheat

Purpose:

The purpose of this study was to determine protein and yield between different nitrogen (N) rates and N sources (mainly ESN and urea) applied to soft red winter wheat (SRW) and hard red winter wheat (HRW).

Methods:

The project started in 2008 with 5 sites comparing spring applied ESN, urea and 28% on SRW. In 2009, there were 3 sites comparing ESN and urea on SRW and 1 site with HRW. In 2010 there were 9 sites of SRW and 2 sites of HRW comparing various rates and timings of ESN and urea.

Results:

In 2008, 5 sites compared spring application of 100 N lb/ac of ESN, urea, and 28% and the impact on yields. Table 1 provides the data. At 3 sites, the ESN yielded marginally higher than the urea. At 2 sites, 28% yielded marginally higher than ESN.

Table 1: Nitrogen source impact on SRW yields at 5 sites in 2008.

Site	Wheat Yield (bu/ac)		
	Spring ESN 100 lb N/ac	Spring Urea 100 lb N/ac	Spring UAN (28%) 100 lb N/ac
1	107.6	103.9	103.6
2	90.9	n/a	97.5
3	102.4	99.5	n/a
4	109.9	109.2	113.6
5	81.9	75.8	n/a

Table 2 presents the yield and protein data for the 1 site in 2009 with SRW. Fall applications of ESN, whether all or some of the N was supplied this way tended to have the lowest wheat yields. The Spring UAN treatment were all the N was applied as UAN tended to out yield the other treatments. Spring ESN applications outperformed the fall ESN applications but were not different than spring applied urea. Spring ESN treatments did tend to have marginally higher protein content than the other N sources or timings.

Table 3 presents different treatments of spring N on SRW. The control treatments (Zero N) had substantially lower yields than the N treatments. Urea and ESN produced essentially the same yields.

The protein levels were not impacted by the source of nitrogen fertilizer. Post harvest soil nitrate levels tended to be slightly higher for the ESN compared to urea.

Table 2: The impact of various N sources and timings on SRW at 1 site in 2009.

Treatment	Yield (bu/ac)	Protein (%)
100 lb N/ac Spring UAN 28%	92.8	9.7
100 lb N/ac Spring Urea	85.8	9.6
100 lb N/ac Spring ESN	86.5	10.0
100 lb N/ac Fall ESN	68.4	9.5
40 lb N/ac Fall ESN + 60 lb N/ac Spring ESN	83.2	9.7
50 lb N/ac Spring ESN + 50 lb/ac Spring Urea	87.9	9.9

Table 3: The impact of N sources on SRW yield and protein and on post-harvest soil nitrate at 2 sites in 2010.

Site	Zero N	Spring Urea 120 lb N/ac	Spring ESN 120 lb N/ac
	Wheat Yield (bu/ac)		
1	69.0	111.1	112.6
2	77.1	96.6	95.6
	Grain Protein (%)		
1	9.3	10.3	10.2
2	10.0	10.7	10.6
	Post Harvest Soil Nitrate (ppm)		
1	10.2	10.2	12.2
2	28.3	22.2	24.3

Table 4 presents the common treatments at all 9 sites on HRW in 2009 and 2010. On average Fall ESN yielded less than any of the spring N treatments. Spring ESN generally yielded the same as Spring Urea and neither of these varied much from the blend that was one-half urea and one-half ESN. Protein content of the grain did tend to be consistently higher with the treatments that contained ESN compared to the all urea treatment. Post harvest soil nitrates were higher for the Spring ESN treatments a two of the 5 sites where this was measured.

Table 5 shows the 2 other treatments that were tested in 2009 and 2010 on HRW. These results indicate that ESN applied in the fall consistently produced lower yields and lower protein than spring applied ESN even when both approaches were combined with companion application of 80 lbs of N as urea in the spring.

Table 4: The impact of N sources and timing on experimental sites in 2009 (sites 7,8,9) and in 2010 (sites 1-6) for on HRW yield, grain protein and post harvest soil nitrate concentrations.

Site	Zero	Fall ESN 120 lb N/ac	Spring ESN + Spring Urea 60 lb N/ac (each)	Spring Urea 120 lb N/ac	Spring ESN 120 lb N/ac
	Yield (bu/ac)				
1	56.6	73.6	86.2	88.3	90.2
2	35.8	62.7	76.9	73.3	72.4
3	88.3	84.7	89.3	91.3	89.7
4	50.9	79.5	78.3	82.6	85.4
5	48.2	66.1	86.3	78.4	78.0
6	n/a	97.2	94.9	93.5	97.5
7	n/a	90.5	95.4	95.6	96.9
8	n/a	67.2	73.3	73.5	75.8
9	n/a	55.2	64.2	60.0	65.1
Avg.	56.0	73.3	83.4	82.8	83.1
	Protein (%)				
1	9.9	10.5	11.7	11.4	12.3
2	10.0	10.2	11.6	11.4	11.7
3	11.6	11.6	12.6	12.7	13.0
4	10.7	11.2	11.7	11.3	12.3
5	9.4	9.8	11.0	10.4	10.9
6		13.3	12.8	11.4	12.2
7		9.9	11.0	10.6	11.1
8		11.5	12.8	11.4	13.0
9		10.7	11.6	11.3	12.9
Avg.	10.3	11.0	11.9	11.3	12.1
	Post Harvest Soil Nitrate (ppm)				
1	16.6	16.1	16.2	16.3	19.4
2	8.1	12.5	10.2	12.5	12.5
3	11.6	11.2	16.2	15.6	15.5
4	13.0	14.4	11.7	11.7	22.3
6		18.4	23.7	21.5	22.2
Avg.	12.3	14.5	15.6	15.5	18.4

Summary:

The results of this project clearly indicate there is often a wheat yield reduction with fall applications of ESN compared to other spring N applications; this was true whether it was all applied in the fall or whether a portion of the total N was fall applied as ESN.

Spring applications of ESN tended to produce yields that were not much different than spring applications of urea or UAN. Blends of ESN and Urea applied in the spring were not consistently higher yielding than either product applied alone.

Table 5: The impact of N sources and timings applied in 2009 and 2010 on HRW yield, grain protein and post harvest soil nitrate concentrations.

Site	Fall ESN 40 lb N/ac + Spring Urea 80 lb N/ac	Spring ESN 40 lb N/ac + Spring Urea 80 lb N/ac
	Yield (bu/ac)	
1	80.0	87.0
3	87.0	89.5
4	84.0	72.3
7	94.3	97.8
8	68.8	74.6
9	57.9	65.2
Average	78.7	81.1
	Protein (%)	
1	10.8	11.1
3	11.9	12.1
4	11.3	10.8
7	10.5	11.3
8	11.6	12.1
9	10.8	11.6
Average	11.1	11.5
	Post Harvest Soil Nitrate (ppm)	
1	16.5	16.3
3	11.1	13.0
4	16.8	13.4
Average	14.8	14.2

Protein content in the HRW wheat did tend to be higher in treatments were some of the N was applied as ESN in the spring compared to other treatments; average increase was approximately 0.5%.

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