What's Cropping Up?

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Impact of N Fertilizer Sources on Corn Silage Yield and Quality

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Introduction

New fertilizer technologies have focused on increasing N use efficiency by reducing N volatilization and leaching losses of fertilizer materials. Two such polymer based technologies are: (1) ESN (Environmentally Smart Nitrogen, developed by Agrium Inc.), and (2) NutriSphere-N (by Specialty Fertilizer Products Inc.). Research plots were established at 3 locations in 2008 and 2009 to study the impact of use of ESN or NutriSphere on nitrogen availability, yield, and quality. Two sites from 2008 are not included in this analysis. One was severely impacted by hail and insect damage and the other was not responsive to N.

Methods

Corn silage trials were located at Cornell research farms in Cayuga (2009), Essex (2008 and 2009) and Columbia (2009) counties. All sites had five treatments:

1. Starter N only;
2. Starter N + UAN at sidedress (150 lbs N/Acre);
3. Starter N + Urea at planting (150 lbs N/Acre);
4. Starter N + NutriSphere-N at planting (150 lbs N/Acre);
5. Starter N + ESN at planting (150 lbs N/Acre).

Table 2: Silage yields for four N source trials. The UAN was sidedressed. All other N sources were applied at planting (150 lbs/N acre) and incorporated. Each plot received 30 lbs N/acre in the starter band.

	Essex	Essex	Cayuga	Columbia	Average
	2008	2009	2009	2009	2008/2009
Treatment	Silage Yield				
	(tons/acre at 65% moisture)				
Starter Only	18.8 b	11.3 b	15.9 b	13.8 b	14.9 b
UAN	21.6 a	20.5 a	23.3 a	22.8 a	22.0 a
Urea	23.5 a	22.0 a	25.9 a	24.7 a	24.0 a
NutriSphere	24.1 a	21.9 a	23.5 a	23.8 a	23.3 a
ESN	22.6 a	23.8 a	26.5 a	25.0 a	24.5 a

Table 1: Soil management groups (SMG), soil series and general soil fertility data at planting for four N source trials in 2008 and 2009. L=low; M=medium, H=high, VH=very high, N=normal, E=excessive and PSNT (from Starter N only plots) at sidedress.

	Essex	Essex	Cayuga	Columbia
	2008	2009	2009	2009
	Stafford fine sandy loam	Stafford fine sandy loam	Kendaia fine loam	Hoosic gravelly sandy loam
SMG	4	4	2	4
pH	6.6	6.3	7.9	6.3
OM (%)	1.6 (2.7% LOI)	1.7 (2.7% LOI)	2.3 (3.7% LOI)	2.6 (4.1% LOI)
P (lbs/acre)	22 (H)	17 (H)	10.0 (H)	11 (H)
K (lbs/acre)	62 (L)	38 (L)	91 (M)	148 (H)
Mg (lbs/acre)	77 (M)	74 (M)	522 (VH)	312 (H)
Ca (lbs/acre)	1964	1920	5400	1650
ISNT (ppm)	180 (D)	166 (D)	165 (D)	155 (D)
PSNT (ppm)	8 (D)	13 (D)	0 (D)	8 (D)

There were 4 repetitions of each treatment. Plots were 8 rows wide and 50 feet long. The urea, ESN and NutriSphere treated urea were broadcast and incorporated just prior to planting. All plots received 30 lbs N/acre in the starter. The UAN treatment was injected when the corn was between 6 and 12 inches tall. Initial soil conditions and presidedress nitrate test (PSNT) results are shown in Table 1.

Sites that required K were fertilized at planting with K2O at

Nutrient Management

Table 3: Impact of N source on forage quality parameters and estimated milk yield for four corn silage trials. The UAN was sidedressed. All other N sources were applied at planting (150 lbs/N/acre) and incorporated. Each plot received 30 lbs N/acre in the starter band.

	Essex 2008	Essex 2009	Cayuga 2009	Columbia 2009
	NDF (% of DM)			
Starter Only	44.1 a	47.3 a	41.9 a	41.2 a
UAN	41.7 a	45.3 a	38.8 a	38.1 b
Urea	41.5 a	46.9 a	39.2 a	38.8 ab
NutriSphere	43.4 a	44.9 a	41.5 a	39.6 ab
ESN	40.4 a	44.5 a	41.7 a	39.5 ab
	dNDF (% of NDF)			
Starter Only	64.9 a	66.0 a	70.2 a	69.0 a
UAN	64.9 a	62.8 a	69.7 a	64.8 b
Urea	62.4 b	62.1 a	66.4 b	63.9 b
NutriSphere	62.4 b	62.2 a	65.6 b	64.2 b
ESN	64.3 ab	63.2 a	66.1 b	63.0 b
	Starch (% of DM)			
Starter Only	35.1 a	29.6 a	37.2 a	37.4 a
UAN	35.1 a	31.6 a	40.1 a	40.4 a
Urea	35.7 a	31.1 a	40.5 a	39.2 a
NutriSphere	33.7 a	31.3 a	37.7 a	39.0 a
ESN	36.9 a	31.4 a	37.7 a	39.6 a
	Crude Protein (% of DM)			
Starter Only	5.2 b	5.5 b	5.0 b	5.5 b
UAN	6.6 a	7.1 a	6.9 a	6.8 a
Urea	6.3 a	6.5 ab	6.6 a	7.0 a
NutriSphere	6.4 a	6.9 a	6.7 a	7.1 a
ESN	6.2 a	7.5 a	6.4 a	7.1 a
	Milk per Ton (lbs/ton)			
Starter Only	3,305 a	3,412 a	3,269 a	3,055 a
UAN	3,374 a	3,501 a	3,238 a	2,977 a
Urea	3,322 a	3,435 a	3,208 a	2,999 a
NutriSphere	3,269 a	3,334 a	3,235 a	2,983 a
ESN	3,400 a	3,327 a	3,291 a	2,997 a
	Milk per Acre (lbs/acre)			
Starter Only	21,692 b	19,014 b	12,913 b	14,597 b
UAN	25,526 ab	28,600 a	23,151 a	23,742 a
Urea	27,352 a	31,119 a	24,701 a	25,901 a
NutriSphere	27,518 a	27,425 a	24,729 a	24,898 a
ESN	26,959 a	30,861 a	27,404 a	26,190 a

rates of 60 lbs/acre (Essex) and 48 lbs/acre (Cayuga). Initial ISNT values indicated all sites needed additional N to support optimal corn yields beyond what the soil could supply through soil organic matter mineralization. The PSNT values for the starter only plots confirmed extra N was needed for all sites. Silage plots were hand harvested (2 rows of 40 feet each) and sub-samples were taken to determine moisture content and silage quality.

Yield and Quality

All sites showed a yield response to N addition beyond the starter in both years (Table 2). There were, however, no significant differences among N sources or timing of application at any of the locations. On average, the yield response to extra N beyond the starter was 8.6 tons per acre. There were few differences in forage quality (Table 3). Crude protein content increased with N addition beyond the starter but there were no differences among the N sources. None of the differences in forage quality significantly impacted the overall silage quality as expressed in estimated milk per ton of silage. The increase in estimated milk per acre upon N addition was attributed to the yield response.

Conclusion

All sites were N deficient yet failed to show any significant increase in yield or improvement in forage quality from the two enhanced efficiency fertilizers. Broadcast incorporation of urea was as effective as application of ESN or NutriSphere or sidedressing of UAN. A cool dry spring in 2008 and a cold wet growing season in 2009 resulted in reduced mineralization. The potential value of these products would be better tested in a warm wet spring. Given the weather conditions and the limited number of sites, more trials are required to generate recommendations. We advise growers interested in these products to put test strips in their fields to assess their effectiveness.

For More Information

For more information on the New York State Nitrogen for Corn project and other work, see our project website: http://nmsp.cals.cornell.edu/. For a fact sheet on enhanced efficiency N sources: http://nmsp.cals.cornell.edu/publications/factsheets/factsheet45.pdf.

Corn at the Aurora Research Farm at harvest 2009. No visible differences were seen between treatments that received additional N beyond the 30 lbs N/acre in the starter.

Nutrient Management Spear Program
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A collaboration among the Department of Animal Science, Pro-Dairy, and Cornell Cooperative Extension.