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2014 Corn Nitrogen Trials

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Introduction

Most corn grown on the heavy clay soils in the Lake Superior region of Wisconsin is for corn silage for dairy cows. The corn fields typically receive annual liquid manure applications of at least 8,000 gallons per acre and often supplemental solid manure. In addition, nutrient management planning has shown that most corn in the region is receiving pre-plant nitrogen, starter nitrogen, and sometimes top-dressed nitrogen if the corn shows signs of chlorosis.

Previous work on optimization of nitrogen fertilization in the region (Fischbach, 2011-2013) suggests that high organic matter inputs from manure combined with the heavy cool soils minimizes nitrogen losses, likely resulting in a flux of available nitrogen during the warm growing months of June-August. In addition, pre-sidedress nitrate tests indicate chlorosis is likely a symptom of soil compaction and temperature rather than nitrogen deficiency.

Photo 1. Ongoing nitrogen fertilization trials in Ashland and Bayfield Counties seek to determine the ideal rates, form, and timing of nitrogen applications for corn silage production.

With a short growing season and difficult soil conditions to start with, producers in the region must maximize return on fertilizer investment to achieve profitability. Recommended nitrogen rates are based on trials in regions with better growing and soil conditions, thus, the recommended nitrogen rate of 120-140 lbs actual N per acre for corn silage may be too high for the Lake Superior region. To continue the work to optimize nitrogen fertilization of corn in the region, a trial was established at two locations in 2014 to evaluate corn silage production in response to five nitrogen rates.

Methods

The trial was planted at two locations and designed as a randomized complete block with three replications of each of six nitrogen treatments as listed in Table 1. At Site 1, each plot was 20' long and 4 rows wide with 20" corn row spacing. At Site 2, each plot was 20' long and 4 rows wide with 30" row spacing. The nitrogen treatments were applied as urea top-dressed on each plot immediately after planting. Rain fell at both sites 2 days after application of the urea. For the split applied treatment, the second application was applied 4

	Site 1		Site 2	
	DM	65%	DM	65%
Nitrogen Treatment	--------------------------tons/ac--------------------			
No added fertilizer	6.84	19.6	7.28	20.8
90 lbs urea at planting (40 lbs N/ac)	6.66	19.0	9.32	26.6
180 lbs urea at planting (80 lbs N/ac)	7.40	21.2	10.07	28.8
260 lbs urea at planting (120 lbs N/ac)	8.35	23.9	9.99	28.5
130 lbs urea at planting and 4 weeks	9.46	27.0	9.15	26.2
350 lbs urea at planting (160 lbs N/ac)	8.11	23.2	8.20	23.4
P-Value	0.070		0.110	
LSD(0.05)	**1.99**	**5.7**	**2.25**	**6.4**

Table 1. Corn silage yields in response to nitrogen applications.

weeks later at both locations. At Site 1, no manure had been applied for at least two years prior to planting and the trial area received no fertilizer except for starter applied at seeding that included 5 lbs actual N per acre. At Site 2, solid manure was applied the fall prior to planting at a rate of 8 tons/acre. The trial area received no fertilizer in the planting year except for a top-dressing of 150 lbs/acre of urea and 50 lbs/acre of ammonium sulfate 5 weeks after planting, which was applied to the entire field.

To determine total biomass yield all plants within a 4’ x 2 row quadrant from the center of each plot were harvested and weighed. A four stalk sub-sample pulled at random from the harvested quadrant was immediately chopped, weighed, and dried to determine dry matter. Analysis of variance was conducted with a 0.05 significance level and Fishers Least Significant Difference test was used to separate means. Treatment means would have to differ by more than the LSD value to be considered statistically significant at the 0.05 level.

Results and Discussion

Table 1 shows the corn silage yields for each treatment on a dry matter and 65% moisture basis. At Site 1, the nitrogen rate of 120 lbs N/acre when applied in two equal applications increased silage yields by roughly 2.6 dry tons per acre compared to the control. Although not statistically significant, the splitting of the nitrogen into two equal applications tended to increase yields compared to a single application. There was no additional yield benefit at the 160 lbs per acre rate. At Site 2, addition of 40, 80, or 120 lbs N/acre increased yields by an average of 2.35 dry tons/acre. Although not statistically significant, the highest nitrogen rate of 160 lbs N/acre tended to have less benefit compared to the lower rates.

The results at Site 1 support a total nitrogen rate of 120 lbs actual N per acre when no manure has been applied. Likewise, splitting the application may also result in higher yields. At Site 2, there was no benefit of adding more than 40 lbs actual N per acre, but this is likely due to the nitrogen from the manure applied in the fall the year before and the top-dressed nitrogen applied to the entire trial. With the manure credit of 24 lbs N/acre and the top-dressed nitrogen at 80 lbs N/acre, the total rate applied by the producer was 104 lbs N/acre. As such, no additional yield increase was expected or measured beyond the 40 lbs actual N per acre rate.

Conclusions

Corn producers in the clay plain of Lake Superior are faced with a number of nitrogen management questions: 1) How much total nitrogen should be applied? 2) What form of nitrogen should be applied? 3) Should nitrogen be applied via split applications or as protected nitrogen? 4) Should nitrogen be top-dressed if it turns yellow a few weeks after planting?

The plot-level trials conducted by UW-Extension in cooperation with area producers are starting to answer these questions. The rate validation trial in 2009 and this trial in 2014 suggest there is no benefit to applying more than 120 lbs actual N per acre per year. Likewise, nitrogen from manure and legumes should be credited and fertilizer applications reduced accordingly. Protected or split applications of nitrogen appear to only be worth it when the field has not received manure in the spring prior to planting or the fall before. The 2013 PSNT validation trial suggest that chlorotic corn common in the clay plain is likely due to cool, saturated soils after spring rain events. Supplemental top-dressed nitrogen is not likely necessary if manure had been applied, as once the soils dry and warm up adequate nitrogen becomes available from the nitrogen.

The next step in the ongoing nitrogen optimization work will be field-scale trials to validate the results coming from the plot-level trials.

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