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Yellow Corn and the PSNT

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Introduction

Corn production in the Lake Superior Counties of Wisconsin can be a challenge due to the heavy clay soils and short growing season. Soil saturation after heavy rains in late-May and early-June often leads to chlorosis in the corn plants. A combination of de-ntrification and leaching in the saturated soils likely is the cause of the chlorosis. Once the soils dry and warm, nitrogen again becomes available and the plants recover and continue to grow.

Photo 1. Chlorotic corn a few weeks after planting is common in the wet clay soils of Ashland and Bayfield County.

Of primary concern to growers is loss of nitrogen from leaching and de-nitrification during these wet periods in the early summer. Typically, the growers will top-dress with nitrogen once the soils are dry enough to replace lost nitrogen. But, how much is lost and how much to apply is unknown.

The pre-sidedress nitrate test (PSNT) is an excellent tool for such a scenario as it can provide a real-time measure of how much nitrate-nitrogen is in the soil at the time of sampling and can be used to guide additional applications if necessary. Table 1 shows how much nitrogen to credit based on the PSNT result. For example, if the PSNT test is 15 ppm on medium yield potential soils, a nitrogen credit of 80 lbs actual N per acre can be credited against the total crop need. If the crop need is 130 lbs actual N, then the results of the PSNT would suggest applying an additional 50 lbs of actual N per acre.

PSNT Result	High	Medium
ppm N	N credit lbs/ac	
>21	No additional N is needed	
18-20	100	80
15-17	60	80
13-14	35	40
11-12	10	40
<10	0	0

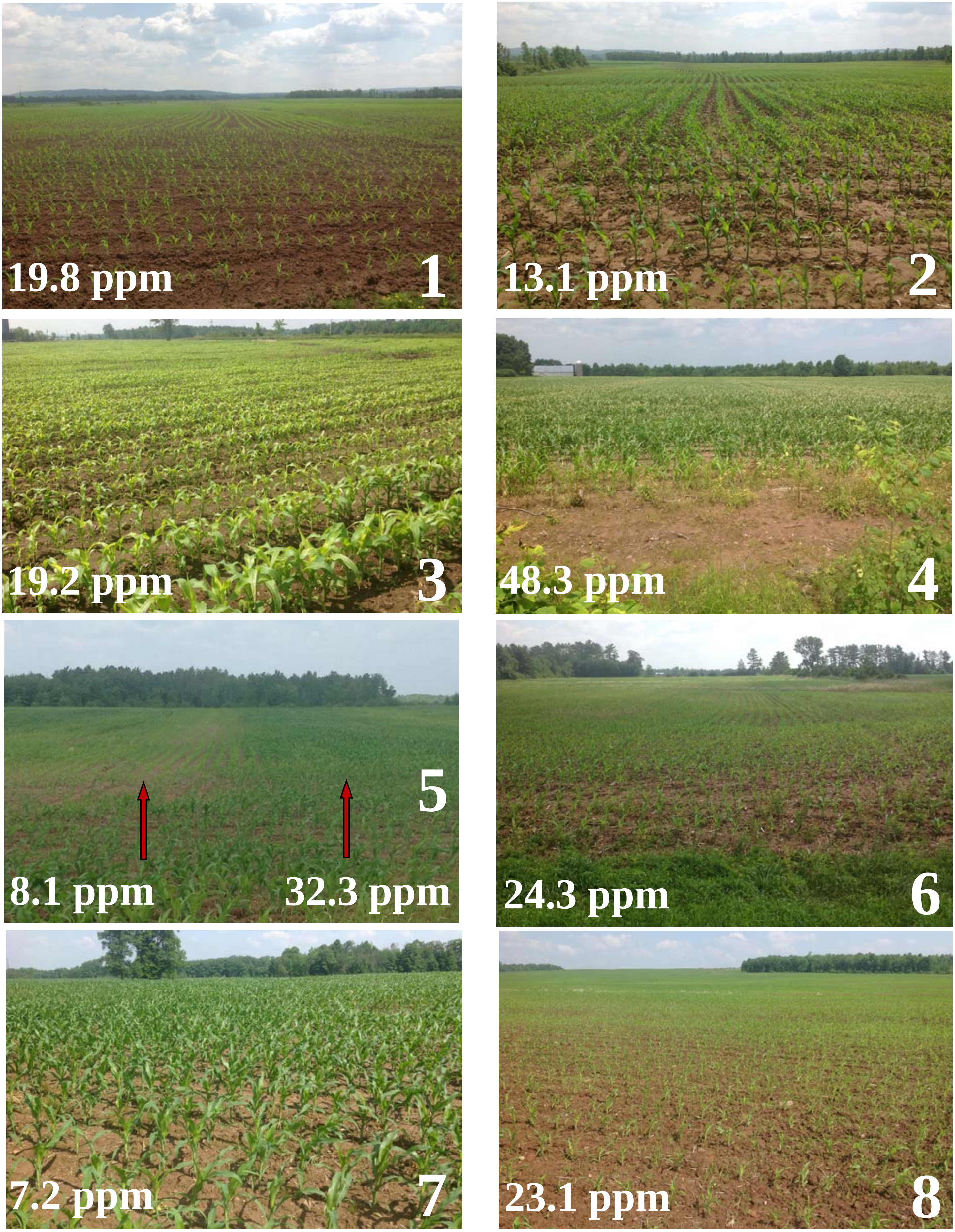
Table 1. Nitrogen credits based on results of the pre-sidedress nitrate test (PSNT).

Most corn production on the heavy soils in the region is corn silage for dairy cows and the corn fields are receiving 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.

Previous work on optimization of nitrogen fertilization in the region (Fishcbach, 2012, Fischbach, 2011) 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 short but warm growing months of June-August. Thus, to validate the use of the PSNT for the corn growers in the region a trial was conducted during the 2013 growing season.

Methods

Soil samples were pulled from 8 separate corn fields on July 11, 2013. The season was exceptionally late due to late spring snowstorms. The corn in each field was between 6” and 18” tall at the time of soil sampling due to variation in planting times and subsequent growth rates. Only fields with obvious chlorosis were chosen for sampling. Soils were


19.8 ppm
1
13.1 ppm
2
19.2 ppm
3
48.3 ppm
4
5
8.1 ppm
32.3 ppm
24.3 ppm
6
7.2 ppm
7
23.1 ppm
8

saturated on July 8 and had been that way for at least 10 days prior. After three days of warm and sunny conditions it was possible to walk in the fields to pull samples and within 3 days after sampling most growers were able to access the fields to apply supplemental nitrogen. Soil samples were shipped the same day to the laboratory and results were received on July 16. Based on the PSNT results, a single field (Field 2) was chosen for the nitrogen trial, primarily because the PSNT result was only 13.1 ppm.

The trial in Field 2 was designed as a randomized complete block with four replications of each of three treatments (0, 40, 80 lbs/ac of actual N). Each plot was 20’ long and 4 rows (10’) wide. The nitrogen was applied as urea top-dressed on each plot on July 17. Prior to planting, liquid manure was applied to the field in the winter at roughly 8,000 gallons per acre. In addition, two-hundred pounds of 20-10-26 4S treated with Agrotain was applied pre-plant.

To determine total biomass yield all plants within a 5’ 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

Page 2 includes a photo of each sampled field and the results of the pre-sidedress nitrate test. Results varied from a low of 7.2ppm to a high of 48.3ppm. The high field (Field 4) had urea top-dressed roughly one week prior to sampling as was obvious in burning of the leaves and the exceptionally high nitrate test. Field 5 had obvious chlorotic strips in the field due to a problem with the fertilizer buggy. Not surprisingly, the chlorotic strips tested low for nitrates. The sampling showed that nitrate levels among the fields varied, but the chlorotic symptoms did not always correlate with low nitrate results.

	Silage Yield	
Treatment	**DM**	**65%**
No added nitrogen	8.1	23.2
87 lbs urea per acre	7.5	21.5
175 lbs urea per acre	8.1	23.0
LSD (0.05)	**1.2**	**3.4**

Table 2. Corn silage yields in response to three rates of top-dressed urea.

Table 2 shows the corn silage yields in response to three different rates of urea applied the day after receiving the results of the pre-sidedress nitrate test. There was no statistically significant difference in silage yields among the three treatments, even when adding an additional 80 lbs of actual N.

The lack of response to top-dressed nitrogen is consistent with previous studies in the area (Fischbach 2012, 2011) suggesting that the background nitrogen in the soil system may overcome any losses or short term lack of availability caused by moisture or cool temperatures. In other words, organic nitrogen in the form of ammonium (or protected urea) is relatively safe from leaching and de-nitrification. As soils warm in the summer, this ammonium becomes more available to plants as nitrate. It is possible due to the relatively short seasons of the area with cool springs and cool falls, little nitrogen loss is occurring and the organic nitrogen pool builds over time resulting in high nitrogen availability during the peak of the growing season, making supplemental nitrogen applications unnecessary.

Testing for nitrates after the corn is chlorotic and after a wetting period has passed may not measure the nitrate levels that caused the chlorotic corn. By the time the sample is pulled, the nitrate levels may have risen, possibly explaining why some yellow fields had relatively high nitrate levels at sampling. Additional research on more fields is necessary to better validate the use of the PSNT.

Conclusions

The ongoing corn nitrogen trials suggest that less supplemental nitrogen may be needed on the soils in the region to support corn production. Certainly, fully crediting nitrogen from manure and legumes should be done to avoid applying nitrogen when not needed.

Acknowledgements

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