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Economics of managing nitrogen for sweet corn

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Nitrogen (N) management for processing sweet corn in Wisconsin has proven to be a complex issue. Sweet corn has a relatively large N demand and, to ensure complete kernel development, requires maintaining plant available N in the soil profile throughout the growing season, which can be a challenge on sandy soils. Current N guidelines for sweet corn in the University of Wisconsin Extension Publication A2809 (Nutrient Application Guidelines for Field, Vegetable and Fruit Crops in Wisconsin) suggest 150 lb/ac of N for soils with less than 2% soil organic matter and 130 lb/ac of N for soils with 2 to 10% soil organic matter, based on a yield range of 2 to 10 ton/ac. The guidelines also suggest split-applications or sidedress applications of N on coarse-textured (sandy) soils. Most, if not all, sweet corn production in the Central Sands is on coarse-textured soil with less than 2% soil organic matter and grown with split-applications of N. To evaluate the current A2809 guidelines for N application, on-farm N rate trials were conducted in 2009, 2010, and 2011, on four fields per year, for a total of twelve site-years. All fields were located in Adams County, WI. All plots had 60 lb/ac of N applied before V4 and 45 lb/ac of N applied as fertigation at tassel (VT stage). Six different N rates were then added as sidedress at V6-V8: 0, 25, 50, 75, 100, and 125 lb/ac of N, resulting in total N applications of 105, 130, 155, 180, 205, and 230 lb/ac of N.

When analyzed by each site-year, application of N over 155 lb/ac resulted in statistically significant yield increases only 17% of the time – in only 2 of 12 site-years. However, plot-to-plot variation was quite large, resulting in the lack of ability to determine yield differences of 1 ton/ac. Based on these results, the N application guideline for sweet corn of 150 lb/ac is adequate from the standpoint that yield losses may occur at rates less than this amount (Fig. 1).

With this data set, we can analyze all the data together to evaluate the economic benefit of N applications to sweet corn. Since the minimum amount of N that would be applied is 155 lb/ac, we focus our analysis on determining if there is an economic advantage to applying N above this rate. Relative to the yield at 155 lb/ac of N, the average yield gain for an extra 25 lb/ac of N was 0.13 ton/ac, 0.27 ton/ac for an extra 50 lb/ac of N, and 0.42 ton/ac for an extra 75 lb/ac of N. The variability of this extra yield also increased with the additional N (Fig. 2). In short, it appears that on average, small yield gains can be achieved with additional N above 155 lb/ac. However, the question remains as to whether there is an economic benefit to applying this additional N. In other words, is the value of the potential yield gain worth the risk of applying extra N (the cost of applying more N fertilizer)?

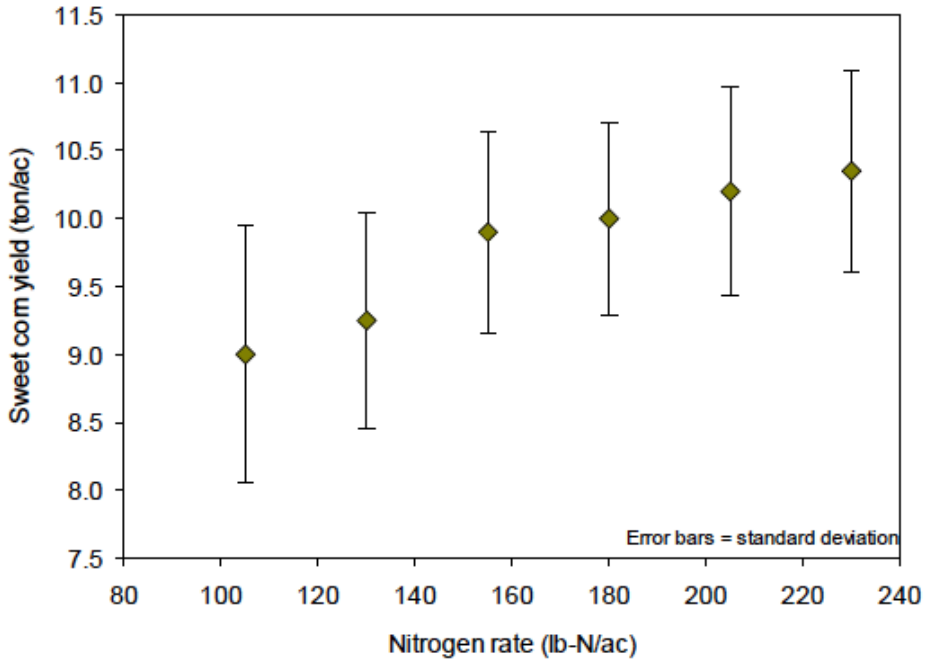

Figure 1. Average sweet corn yield across six nitrogen rates (yields averaged across sites and years).

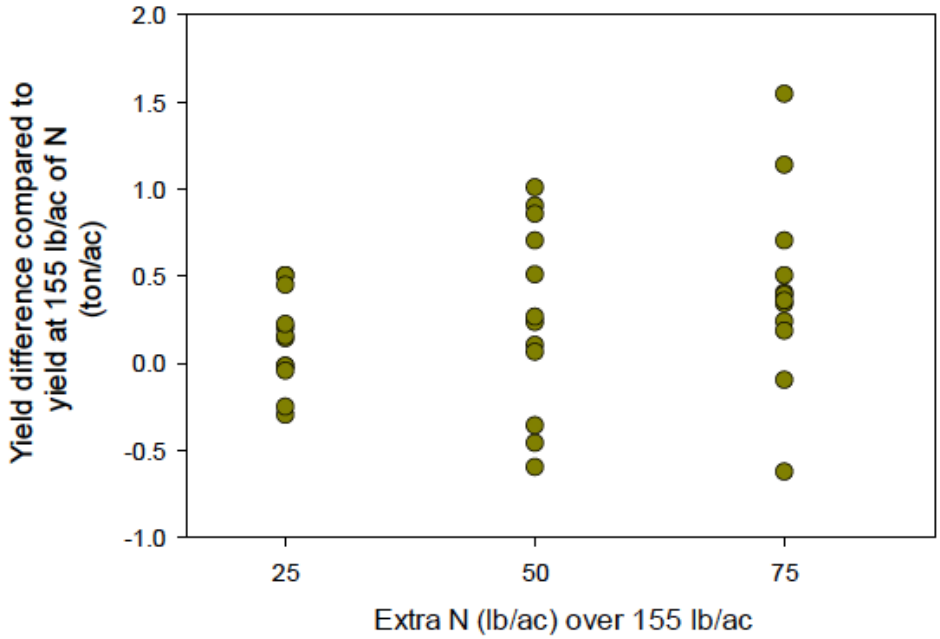

Figure 2. Yield gain or loss with 25, 50, or 75 lb/ac of extra N compared to yield at 155 lb/ac of N (average yields at each of 12 site years, 2009-2011).

For this analysis, we used a current estimate of N fertilizer cost of $0.50/lb-N and the state average price of Wisconsin sweet corn in 2010 ($74/ton) and 2011 ($110/ton) as reported by the USDA National Agricultural Statistics Service. Based on this N fertilizer price and the yield data reported in Fig. 2, we calculated the aver-

age economic return at both sweet corn prices. These calculations were made separately for each site-year, and then averaged across site-years. At a sweet corn price of $110/ton, the average economic gain was $1/ac for 25 lb/ac of extra N, $4/ac for 50 lb/ac of extra N, and $9/ac for 75 lb/ac of extra N. However, with a sweet corn price of $74/ton, the average economic loss was $3/ac for 25 lb/ac of extra N, $5/ac for 50 lb/ac of extra N, and $6/ac for 75 lb/ac of extra N. However, Fig. 3 shows the tremendous amount of variability that exists around these average gains and losses. For example, with a sweet corn price of $110/ton, though the average gain for an extra 75 lb/ac of N was $9/ac, the observed range was from a gain of about $140/ac to a loss of over $100/ac.

Considering all site-years' worth of data, large economic gains or losses can occur with applying extra N to sweet corn, but on average there is likely little economic gain. This is especially true when the cost of N is high and the price of sweet corn is lower than average. It is important to consider these economic issues and use price calculations to confirm an economic need for applying more than 155 lb/ac of N.

Finally, several caveats apply to this analysis. For the yield data collected here, the N was split applied, with plots receiving N early (pre-V4) and late (VT). It is possible that the split application method led to optimum N use efficiency and played a role in seeing little benefit above 155 lb/ac of N. Large rainfall events can leach large quantities of N from the root zone on sandy soils. The split applications used here reduced the risk of large amounts of N in the soil at any given time to potentially be leached. If N were applied with fewer applications, the yield benefit from extra N may be greater, but only because the extra N would compensate for the amount of N that is leached. It is also important to note that based on current data we have collected, it is not clear if we can predict which fields would be the most responsive to extra amounts of N fertilizer.

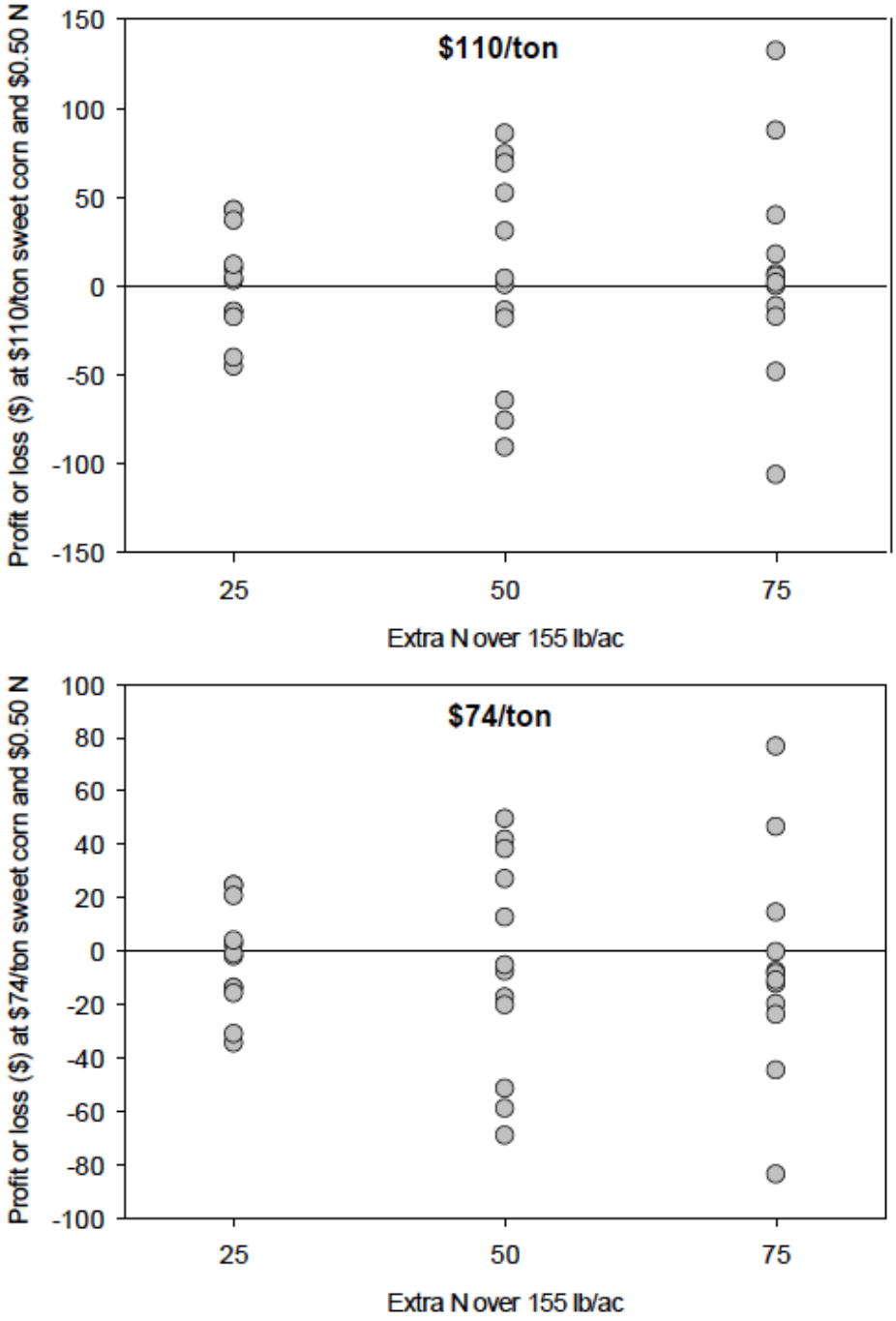

Figure 3. Average economic gain or loss with extra N, with a N price of $0.50/lb of N and sweet corn prices of $110/ton or $74/ton. Each data point within each N rate is one site-year. Reference linces are at $0, indicating no net gain or loss.