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Sweet corn response to nitrogen fertilizer in Wisconsin's central sands: Results after two years of data collection

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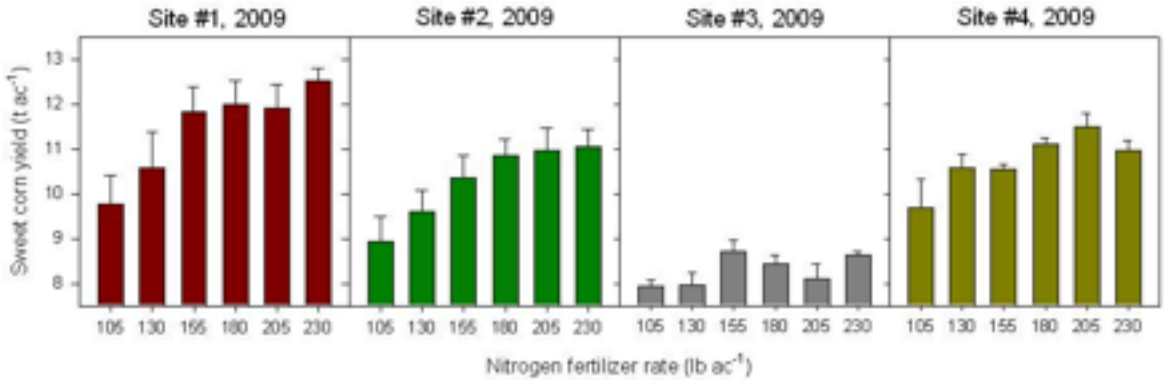
Wisconsin ranks second in the nation for production of sweet corn for processing, growing over 88,000 acres annually, or 24% of the total United States processing sweet corn acreage (USDA 2008). This production requires substantial nitrogen fertilizer inputs. University of Wisconsin publication A2809 Nutrient Application Guidelines for Field, Vegetable, and Fruit Crops in Wisconsin, recommends applying 70 to 150 lbs of nitrogen (N) per acre, depending on soil organic matter content, to grow two to ten ton of sweet corn per acre. University of Minnesota recommends 170 lb/ac of N for sweet corn following non-legumes with organic matter <3.1% and a yield goal of ten ton or more per acre (irrigated sandy soils). Current production practices have growers applying 200 plus lb/ac of N on irrigated sweet corn. Sweet corn is a high-value crop and even with the relatively high cost of N fertilizer, growers are not willing to be short on N. So the question arises, Are University nitrogen fertilization recommendations still adequate? We have very little current information regarding the advantages and disadvantages of over applying N on sweet corn. Things have changed since the research was done to develop the current N recommendations. We have new hybrids with greater genetic yield potential and many growers are managing their fertilizer applications better using split applications to meet and not exceed plant needs at each growth stage. Does all this lead to better nitrogen use efficiency and in turn, a need for less nitrogen to meet our yield goals?

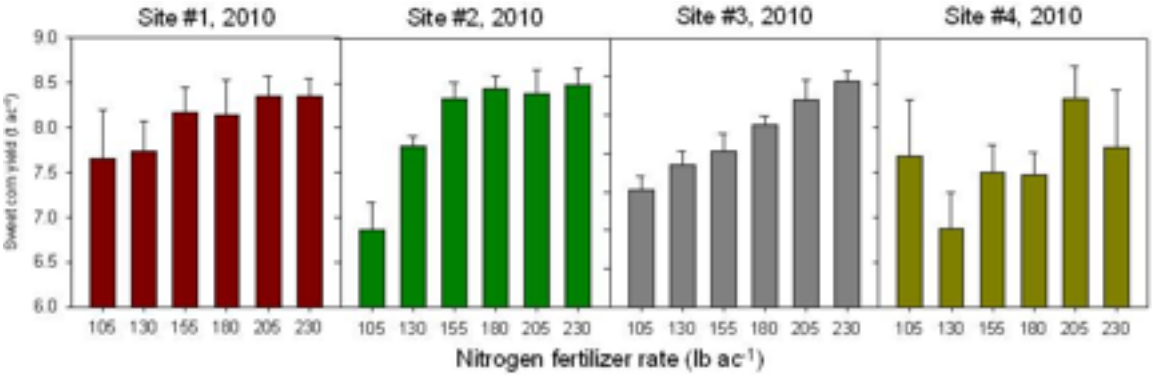
What we did: To address these questions, Ken Schroeder, Portage County UW-Extension Agriculture Agent worked with Dr. Matt Ruark, UW-Madison soil scientist, Don Genrich, Adams County UW-Extension Agriculture Agent, and a central Wisconsin sweet corn processor to do on-farm field trials looking at sweet corn response to nitrogen fertilizer application. In 2009 we had three locations in Waushara County and one in Adams County, four planting dates (April through June), six nitrogen (N) levels from 105 to 230 lb/ac of N, and four replications per field. This same experimental design was used in 2010 in different fields. Three were again located in Waushara County and one in Adams County. Yield data was collected for analysis.

What we learned: 2009 was an unusually cool growing season with an extended dry period mid-summer leading to low plant stress and higher than average yields. The two early planted sites (April 28th, Site 1 and May 9th, Site 2) showed a classic response curve with yields plateauing at 155 lb/ac of N. Yields from N application rates higher than 155 lb/ac were not significantly different than yields at

155 lb/ac. At Site 4, planted on June 15th, N rates greater than 155 lb/ac did not statistically increase yield, although the yield from 205 lb/ac of N was about 1.0 ton/ac greater. This highlights a major issue of growing irrigated sweet corn on sandy soil: even though there is a relatively low chance of a yield gain above 155 lb/ac of N, many growers are willing to take the economic risk of using greater amounts of N to gain 0.5 to 1.0 ton/ac in yield. In most cases greater yields with greater N rates reflects the fact that there were larger N leaching losses from these systems, not necessarily greater N use efficiencies. Lastly, Site 3, planted June 1st, is difficult to explain with low yields across the board and no statistical differences between N application rates. Error bars in figures below represent standard error.



In 2010, growing conditions were warm and unusually wet with many rain events in excess of one inch and up to five inches leading to flooding and probable N leaching in some areas. The 2010 trials produced similar results to 2009 for the early planting dates (Site 1 and Site 2), with yields optimized at 155 lb/ac of N. The later planting dates (Site 3 and Site 4) again responded differently when compared to early planted sweet corn, which raises the question, "Does planting date affect optimal nitrogen fertilizer rate?"



Conclusions after two years:

- Under favorable weather conditions, yields greater than 10 ton/ac can be achieved with only 155 lb/ac of N.

- There was no statistical advantage to applying more than 155 lb/ac of N at 83% of the sites, thus there is a low probability of a yield gain by increasing N application rates above 155 lb/ac.
- Early planted sweet corn responded differently to N applications than late planted sweet corn.
  - Future research will focus on the relationship between planting date and response of sweet corn to N fertilization.
- The potential yield gains with greater amounts of N at sites planted later in the season (Site #4, 2009; Site #3, 2010; Site #4, 2010) reflect inefficiencies in fertilizer application. Sweet corn yields from later planting dates were not greater than sweet corn yields from earlier planting dates, but required greater amounts of N to maximize yield.
- More data is needed before nitrogen application guidelines can be updated.
  - This study will be continued in 2011.

Thoughts to ponder:

1. Having more N available than a crop can utilize at any given growth stage increases the risk of nitrogen loss, which is costly to the grower due to no return on that investment and can potentially have negative effects on our groundwater.

2. We grow about 88,000 acres of sweet corn annually. At current nitrogen fertilizer costs, if growers use 25 lbs less nitrogen per acre, they could save nearly ¾ million dollars and use over 2 million tons less nitrogen. At 50 lbs less, savings would total $1.5 million.