LAMB, JOHN A.[1*], MARK W. BREDEHOEFT[2] and CHRIS DUNSMORE[2], [1]Department of Soil, Water and Climate, University of Minnesota, 1991 Upper Buford Circle, St. Paul, MN 55108 and [2]Southern Minnesota Beet Sugar Coop., 83550 County Rd 21, Renville, MN 56284. **Sugar beet production following corn, BtRR corn, sweet corn, spring wheat, and soybean in Southern Minnesota.**

ABSTRACT

Nitrogen guidelines for increased sugar beet root quality were revised in 2000. The current recommendation is 130 pounds N per acre as soil nitrate-N in the surface 4 feet of soil plus fertilizer N. The research used for development of the guidelines for the SMBSC area came from locations where the previous crop in the rotation was corn. Since then many growers have adopted corn varieties that have been genetically modified for insect and herbicide protection. Growers have commented that these modified corn varieties do not break down as fast as the non-genetically alter varieties. The concern is whether growers change the N applied to make up for slower N mineralized from the plant material.

Information about the effect of other previous crops grown in the SMBSC is also limited. In the past is has proposed to use spring wheat as a previous crop to improve sugar beet yield and quality. No information exists from the Southern Minnesota growing area about how spring wheat as a previous crop affects N rate. Sweet corn is a crop grown in the eastern growing area before sugar beet. It is general knowledge that sweet corn is over fertilized and prediction of N contribution for the sugar beet is difficult because of early harvest date of an immature plant. Finally soybean is the previous crop in about 15 % of the acres that sugar beet is grown in the SMBSC area. When the sugar beet crop is not greatly affected by diseases, sugar beet root yield and quality tend to be decreased when soybean is a previous crop. Little information exists on the effect of soybean as a previous crop on the N mineralization during the following sugar beet growing season. A study was established to determine the effect of previous crops on N required for optimum sugar beet yield and quality.

Three sites were established to achieve the objective of the study. These sites are located and established near Hector in 2005, Buffalo Lake in 2006, and Clara City in 2007. Each site was established a year before they were cropped to sugar beet. In the initial set up year, four large replicated blocks (10.7 X 20.1 m) of corn, genetically modified corn (round up ready and Bt or BtRR corn), sweet corn, soybean, and spring wheat were grown. Each crop was fertilized according to U of MN guidelines. Deep soil samples for nitrate-N were taken late fall of the initial year to characterize the sites before being cropped to sugar beet. The large crop blocks were subdivided into 3.4 X 10.7 m subplots to accommodate six N rates (0, 34, 67, 101, 134, and 168 kg N ha^{-1}) that were applied late fall before the sugar beet crop was grown. In the second year, sugar beet was grown with root yield and quality measured.

Soil test results prior to sugar beet production: The previous crops of spring wheat, sweet corn, conventional corn, BtRR corn, and soybean were fertilized according to University of Minnesota fertilizer recommendations. Soil nitrate-N to a depth of 120 cm feet was measured the fall before sugar beet production in each of the previous crops. The residual soil nitrate-N at the Hector site, fall 2005, was on the average low at 35 kg ha^{-1}. The residual soil nitrate-N was elevated for the soil when the previous crop was

sweet corn or soybean. At the Buffalo Lake site, fall 2006, the residual soil nitrate-N was the least following spring wheat while the rest were very similar. The average residual soil nitrate-N for the Buffalo Lake site was 25 kg ha^{-1}. The average residual nitrate-N at the Clara City site, fall 2007, was elevated to 106 kg ha^{-1}. Where the previous crop was spring wheat, the residual soil nitrate-N was considerably less than the average, 66 kg ha^{-1}, while the residual soil nitrate-N when the soybean was the previous crop, was greater than the average at 136 kg ha^{-1}.

Sugar beet yield and quality: In 2006, there was no previous crop by nitrogen rate interaction for any reported parameter. The lack of an interaction means that nitrogen rate guidelines are not affected by the previous crop at this location. Root yield and extractable sucrose per acre were significantly affected by previous crop and nitrogen application rate. Sugar beet grown after BtRR corn had the lowest root yield and extractable sucrose per acre, followed by corn. Sugar beet grown after soybean and sweet corn had similar root yield and extractable sucrose per acre while sugar beet grown after spring wheat had to largest. At this site the optimum root yield and extractable sucrose per acre were obtained at the 101 kg ha^{-1} nitrogen application.

Purity was not affected by previous crop or nitrogen application. Extractable sucrose per Mg was reduced by a previous crop of genetically modified corn for Bt and RR. The other previous crops had similar extractable sucrose per Mg.

In 2006, there was no evidence to adjust nitrogen application rates for sugar beet because of previous crop.

In 2007, there was only one parameter with a N rate by previous crop interaction, extractable sucrose per ha. Root yield was significantly affected by the previous crop and N rate. Root yields were affected with the least yield from the greatest root yield as follows: BtRR corn similar to corn < soybean < sweet corn < spring wheat. Increasing N rate increased root yield up to 137 kg N ha^{-1}. The residual nitrate-N in 2007 was between 22 and 39 kg nitrate-N ha^{-1} in the surface 120 cm.

Purity was decreased on the average by the application of nitrogen fertilizer. Previous crop did not affect purity in 2007. Extractable sucrose per Mg of sugar beet refined integrates the sucrose concentration and the impurities in the sugar beet. Extractable sucrose per Mg was not significantly affected by previous crop or N rate application.

Extractable sucrose per ha was affected by previous crop and N rate in 2007. There was also an interaction between previous crop and N rate. The main reason for the interaction is because of the response of extractable sucrose per ha to N rate application when soybean is the previous crop. In general, the extractable sucrose per ha increased with increasing N application in 2007. Extractable sucrose per ha was the least for sugar beet grown after BtRR corn and corn. Soybean was greater than the corn except at the 167 kg N ha^{-1} application. Sweet corn and spring wheat were the best.

In 2007, there was no evidence that N applications needed to be adjusted by previous crop.

In 2008, there were no differences in root yield, purity, and extractable sucrose cause by the previous crop or nitrogen rate. These results were caused by the relatively high residual soil nitrate-N values, 106 kg N ha^{-1} 0-120 cm, in the fall of 2007 at this site.

Root yield and extractable sucrose per ha were affected by the previous crop and nitrogen application in 2006 and 2007. Corn and genetically modified corn had least root yield and extractable sucrose. Spring wheat had the greatest root yield and extractable sucrose per ha in each year. In 2008, previous crop and nitrogen application did not affect any parameter measured. This was because of the high soil residual nitrate, 106 kg N ha^{-1}. The previous crop did not affect the optimum nitrogen application rate in any year of this study.