SIMS, ALBERT L., and KIM R. HOFF. University of Minnesota, Northwest Research and Outreach Center, 2900 University Ave, Crookston, MN 56716. **Sugar beet production response to N fertilizer rates following corn in the Red River Valley of Minnesota.**

ABSTRACT

In 2001, university nitrogen (N) recommendations were updated based on field plot research and payment schedules in each of the three sugar beet cooperatives in Minnesota and North Dakota. Currently the recommendation is for a total of 146 kg N ha^{-1} including residual soil nitrate-N in the top 1.2 m of the soil profile plus fertilizer N. Immediately, questions arose as to whether this was sufficient N for sugar beet production when it followed a previous crop of corn. In the Red River Valley north of Fargo North Dakota, sugar beet has traditionally followed a small grain crop. However, corn is being considered by many growers in this region as a possible crop to include in their rotation. Some of the research that contributed to the modification of the N recommendation was done in the Southern Minnesota Beet Sugar Cooperative region of Minnesota where sugar beet typically follows corn in the rotation. Since all the research from north of Fargo that contributed to the new N recommendation were on sugar beet following spring wheat, perhaps corn as a previous crop would provide a different conclusion in the northern Red River Valley growing conditions. Our objectives were to: 1) determine the effect of corn residue on sugar beet root yields and sucrose production; and 2) determine the effects of the corn residue on optimum N fertilizer rates.

Corn was grown in the 2001, 2002, and 2003 growing seasons. After corn harvest, four replications each with two large plots were established. In one plot, corn residue lying on the soil surface was removed using a Carter Forage Harvester and hand raking. The only residue left was corn stubble 5-8 cm high. In the other plot, the corn residue was shredded and left in place. Initial tillage was two passes of a tandom disk first in the same direction as the corn rows then perpendicular to the corn rows. A chisel plow with twisted spikes was used in the final fall tillage operation. The plots were left in this condition for the winter. Care was taken not to drag residue from plot to plot. The following spring (2002, 2003, and 2004), each plot was divided into six subplots and randomly assigned urea-N rates of 0, 34, 68, 102, 136, and 170 kg N ha^{-1}. The urea was broadcast on the soil surface along with 68 kg P_2O_5 ha^{-1} prior to spring tillage, which was two passes with a field cultivator. In 2004, the field cultivator left the soil in a condition that needed packing prior to sugar beet planting. A grain drill with 7.5 cm wide press wheels spaced 15 cm apart (center to center) was used to pack the soil by making a single pass perpendicular to the direction the sugar beet rows were to go. Sugar beet was planted on May 15, May 1, and April 30 in 2002, 2003 and 2004 respectively. Sugar beet was over seeded and later hand thinned to 150 beets 30 m^{-1} of row. In September of each year, the middle two rows of each plot were harvested by machine. The harvested beets were weighed and ten randomly selected beets were placed in rubber tare bags and sent the American Crystal Red River Valley Sugar Quality Laboratory in East Grand Forks Minnesota. The ten beets were analyzed for tare, sucrose concentration, and impurities. Statistics were done using a split plot randomized complete block design where the residue treatment (removal or left) was the whole plot treatment and N rates were the split plot treatments.

Sugar beet root yield was significantly affected by the corn residue treatment and N fertilizer rates in all years. There was no significant interaction between corn residue treatment and N fertilizer rates in 2002 or 2003, but there was in 2004. In 2002 and 2003, sugar beet root

yields responded similarly to increasing N fertilizer rates regardless of whether the corn residue had been removed or not. However, sugar beet root yields were about 7.8 Mg ha^{-1} less where corn residue was left compared to where corn residue was removed when averaged over all N fertilizer rates. Recommended N fertilizer for sugar beet production, based on soil nitrate-N test, was 129 and 136 kg N ha^{-1} in 2002 and 2003, respectively. The data indicated that the N rate where maximum root yield occurred was similar to the N rate recommended and that there was little or no difference whether corn residue was removed or left on the field. In 2004, sugar beet root yields showed a greater response to increasing N fertilizer rates where corn residue was left compared to where corn residue was removed.. Root yields, however, were substantially less where corn residue remained. The recommended N fertilizer rate in 2004 was 102 kg N ha^{-1}. Where corn residue was removed, 102 kg N ha^{-1} maximized sugar beet root yields. Where corn residue remained, root yields increased throughout the entire range of applied N fertilizer, but never attained the same level as where corn residue was removed.

The corn residue treatment had no affect on sugar beet root quality (recoverable sucrose per Mg of beet) in any year. There was a significant affect of N fertilizer rate on sugar beet root quality in all years, but there was no interaction between corn residue treatment and N fertilizer rate in any year. In all years, some N fertilizer was required to maximize root quality, but if N fertilizer rates exceeded recommended rates by over 34 kg N ha^{-1} root quality started to decline.

The response of recoverable sucrose per hectare of land area to residue treatments and N fertilizer rates followed similar trends as was observed for sugar beet root yields. This indicates that corn residue treatments mainly affected root yield and not sugar concentration. Only at very high N fertilizer rates was sugar concentration affected.

There was some variability among the years in the effects of corn residue and N rates on sugar beet production. In 2002 and 2003, optimum N fertilizer rate was similar to that based on updated university recommendations. Though corn residue reduced overall sugar beet production, it did not have an impact on optimum N fertilizer rate. Only in 2004 where corn residue remained was the optimum N fertilizer rate higher than that recommended. However, the data suggest that twice the recommended N fertilizer rate might have been necessary to approach the optimum N rate. Where corn residue was removed the optimum N rate was similar to that recommended. The 2004 growing season was unusually cool and may have contributed to the deviation in results compared to 2002 and 2003. This experiment provides evidence that corn residue can result in lower sugar beet yield compared to where that residue is removed and that this effect is not entirely related to N availability. Furthermore, currently university N recommendations for sugar beet production appear to be adequate when sugar beet follows corn in the rotation.