SIMS, ALBERT L., Northwest Research and Outreach Center, University of Minnesota, 2900 University Avenue, Crookston, MN 56716. **Sugar beet production following wheat, corn, and soybean in the Red River Valley.**

ABSTRACT

Traditionally, sugar beet has followed a small grains crop in the crop rotation of the Red River Valley (RRV) of Minnesota and North Dakota. In the last 15 years, small grain acreage has substantially decreased due to disease and economic considerations. In the central and northern parts of the RRV, barley acreage nearly disappeared and hard red spring wheat acreage is greatly diminished. Replacing the small grain acreage is soybean, and to a lesser extent, corn. Growing sugar beet after soybean is not recommended in Minnesota and North Dakota because research from the 1980s indicated sugar beet root yield and quality were significantly reduced compared to where sugar beet followed small grains. Nevertheless, the substantial increase in soybean acreage in the northern RRV increases the probability that sugar beet will, at times, follow soybean in the rotation. Sugar beet following corn in the rotation has been common practice in the southern RRV and south central Minnesota sugar beet growing areas for many years. But, research in the early part of this decade in the central RRV clearly and consistently indicated that sugar beet root yield was decreased when grown after corn compared to after spring wheat. Furthermore, additional nitrogen fertilizer failed to equalize the sugar beet root yield between the two previous crops.

The objectives of this research was to determine the effects on sugar beet root yield and quality of growing sugar beets after previous crops of spring wheat, corn, and soybean. Additionally, I wanted to determine if nitrogen (N) fertilizer rates or primary tillage system of the previous crop would impact the previous crop effects on sugar beet root yield and quality.

Field experiments were established at the University of Minnesota's Northwest Research and Outreach Center near Crookston, Minnesota. The experimental design was a split-split-plot randomized complete block with four blocks (replications). Whole plot treatments were previous crops of corn, soybean, and hard red spring wheat (wheat). Split-plot treatments were initial primary tillage of the previous crop, which was either moldboard plow or twisted shank chisel plow. Split-split-plot treatments consisted of six spring applied nitrogen (N) rates. In 2005, and again in 2006, strips of corn, soybean, and wheat were planted in replicated side-by-side strips. Immediately after the previous crop was harvested, each strip was split and either moldboard plowed or chisel plowed. Initial tillage of wheat strips occurred in August of both years. Initial tillage of corn and soybean strip occurred in early October. Prior to initial tillage of the corn strips, the corn stalks were shredded. In late October, the entire experimental area was tilled a second time with the chisel plow in preparation for winter. In late April the following spring, individual plots were flagged and six rates of N fertilizer as urea were hand broadcast to each previous crop-tillage combination. Two passes of a field cultivator with packers incorporated the fertilizer and prepared the seedbed for planting. Within two or three days, plots were planted to sugar beet with a 12 row planter. Sugar beet rows were spaced 56 cm apart and oriented perpendicular to the length of the previous crop strips. Each split-split-plot was 6-rows wide and 9.1 m long. Nitrogen fertilizer rates were 0 to 168 kg N ha^{-1} in 33.5 kg N ha^{-1} increments in 2006. In 2007, N fertilizer rates were 0 to 140 kg N ha^{-1} in 28 kg N ha^{-1} increments. Difference in N rate between the two years was due to difference in residual soil nitrate-N within the previous crop strips the previous fall. Soil residual nitrate-N was determined

from soil samples collected in October from a soil depth of 1.2 m. Sugar beet was over seeded then hand thinned to 88,000 plants per hectare. Sugar beet plots were sprayed with herbicide and fungicide as needed. Further weed control occurred with cultivation and hand weeding. In the last week of September, the entire middle two rows of each plot were harvested with a 2-row plot lifter. All harvested beet roots were weighed. Ten randomly selected beet roots from each plot were sent to the American Crystal Sugar Company Quality Laboratory in East Grand Forks, Minnesota to be analyzed for tare, sugar concentration, and impurities. Sugar beet root yield is calculated as Mg ha^{-1}, root quality is measured as kg recoverable sucrose per Mg beets and includes adjustments for impurities, and total recoverable sucrose is the product of the two variables.

Primary tillage of the previous crops had no differential effects on sugar beet production or its response to the previous crops or N fertilizer rates. In both 2006 and 2007, sugar beet root yield was greater following wheat than following corn at all N rates applied. This was consistent with earlier research. When beets were grown after soybean, root yields were more similar to those following wheat in 2006 and more similar to those following corn in 2007. Overall, however, sugar beet root yield when grown after soybean was less than when grown after wheat and greater than when grown after corn. Sugar beet root quality responded to the applied N fertilizer rate, but the response varied depending on the previous crop. Following corn, some N application was necessary to maximize sugar beet root quality with only minimal declines in quality at N rates above the critical level. This was somewhat similar to when sugar beets were grown after soybean except the critical N level was less than following corn and the decline in root quality at higher N rates was much greater than when following any other crop. Following wheat, sugar beet root quality was constant at lower N rates before starting to decline at higher N rates. However, this decline was not as dramatic as when sugar beet follows soybean. Total recoverable sucrose followed similar trends as did the root yield, especially at lower N rates. At higher N rates, total recoverable sucrose was more affected by the declining root quality differences among the previous crops.

Sugar beet production, in terms of root yield and quality and total recoverable sucrose was greatest when grown after hard red spring wheat and least when grown after corn. This response difference to previous crop was not affected by the previous crops primary tillage or increased N rate application. Sugar beet production following soybean was somewhere between the production following wheat and corn. The data suggests that growing sugar beet after soybean is not has productive as when growing after wheat. But, it is still better than growing after corn. However, if sugar beet is grown after soybean, the level of N availability is more critical because of the effects on root quality and because other research has indicating an increased risk of Rhizoctonia root rot that was not an issue in these trials.