

SIMS, ALBERT L.^{1*}, JOHN A. LAMB², MARK W. BREDEHOEFT³, KIM R. HOFF¹ and CHRIS DUNSMORE³, ¹Northwest Research and Outreach Center, University of Minnesota, 2900 University Avenue, Crookston, MN 56716, ²Department of Soil, Water, and Climate, University of Minnesota, 1991 Upper Buford Circle, St. Paul, MN 55108 and ³Southern Minnesota Beet Sugar Coop., 83550 County Rd. 21, Renville, MN 56284. **Nitrogen mineralized during the Minnesota sugar beet growing season as affected by previous crops.**

ABSTRACT

Nitrogen (N) is one of the primary inputs for sugar beet production and has significant consequences if under or over supplied. Under application results in reduced root yield and over application results in reduced root quality. The fertilizer N recommendation for sugar beet production in North Dakota and Minnesota was revised in 2001, but many producers, fertilizer dealers, consultants, and cooperative agronomist have questioned if the new recommendations account for variability in soil organic matter or previous crop. The amount of N mineralized from soil organic matter during the growing season varies with the nature of the organic matter, quantity of organic matter, temperature, and moisture. Soil organic matter content is not included in fertilizer recommendations in Minnesota and North Dakota because of the difficulty in quantifying mineralized soil N. Nitrogen mineralization has been estimated using insitu soil cores enclosed within a barrier and using ion exchange resin to capture nitrate-N that might leach from the soil core. This methodology can be used to estimate total N mineralized, but is probably more appropriately used to compare N mineralization between treatments. The objective of this research is to determine if previous crop affects N mineralization during the following sugar beet growing season.

Experiments were established in 2006 and 2007 in the central Red River Valley at the University of Minnesota's Northwest Research and Outreach Center (NWROC) near Crookston, Minnesota and in 2006, 2007, and 2008 in south central Minnesota (So. Minn.) in the Southern Minnesota Beet Sugar Cooperative growing area. In both locations, previous crops were established and grown the year prior to when the sugar beet crop was grown. At NWROC previous crops were corn, soybean, and hard red spring wheat. In So. Minn, previous crops were field corn and sweet corn. Soon after the previous crops were harvested, plots were chisel plowed and split for different N fertilizer rates that would be applied to the following year's sugar beet crop. The following spring, plots were tilled and planted to sugar beet. Individual sugar beet plots were 6 rows wide. Nitrogen mineralization was estimated using rows 2 and 5 and in late September, sugar beet from rows 3 and 4 of each plot were harvested to determine total root yield and a subsample of the roots analyzed for sucrose content and impurity content. Sugar beet root yield is measured as (Mg per ha) and root quality measured as (kg sucrose per Mg beet root).

Insitu soil cores to estimate N mineralization were installed in rows 2 and 5 of sugar beet plots that had received 0 N fertilizer or 101 kg N ha⁻¹ fertilizer (84 kg N ha⁻¹ at NWROC in 2007) soon after sugar beet were planted. At NWROC, all three previous crops were represented at the 0 N fertilizer rate, but only wheat and soybean were tested when fertilizer N was applied. Both sweet corn and field corn were represented at both N rates in So. Minn. An acetate tube (6 cm inside diameter) was inserted into a stainless steel soil coring tube and the tube was pushed into the soil to a depth of 17 to 20 cm then extracted. The soil core was contained inside the acetate tube. The acetate tube and enclosed soil core were removed from the coring tube, a

nylon bag containing anion/cation exchange resin placed at the bottom of the soil core, inside the acetate tube, and placed back in the hole from where the soil core was extracted. Sufficient cores were so placed to allow three core samplings throughout the sugar beet growing season. Initial inorganic N levels were determined by extracting extra soil cores taken during the core installation process. At all sampling times, six soil cores were harvested along with the ion exchange resin bags and sent to the analytical lab for analysis. After initial installation, subsequent core and resin bag samplings occurred throughout the growing season at intervals of approximately in 42 days. The last sampling occurred just prior to harvesting the sugar beet plots in late September.

All soil cores from individual plots and sampling times were analyzed for bulk density estimates by measuring length and weight of wet soil from individual cores before mixing and a subsample removed for moisture determination. The remaining soil was dried at 25 to 30° C and ground. A subsample was analyzed for nitrate-N and ammonium-N content. Resin bags were extracted with KCl solutions and analyzed for nitrate- and ammonium-N content and combined back to the associated soil cores. Total nitrate- and ammonium-N estimates of inorganic N and the accumulation of inorganic N through the growing season is assumed to represent apparent N mineralization.

At NWROC, there was no difference in apparent N mineralization between previous crops of soybean or corn when fertilizer N was applied. In addition, though there was more total inorganic N measured in soil cores and resin bags from plots receiving N fertilizer compared to no N fertilizer, there was no difference between the N rates in the apparent N mineralization that occurred throughout the sugar beet growing season. Where no N fertilizer was applied, more N was mineralized following soybean than following corn in both the 2006 and 2007 sugar beet growing seasons. Nitrogen mineralization following wheat was similar to that following soybean early in both growing seasons. Hot, dry soil conditions appeared to slow N mineralization following wheat through the middle part of the 2006 growing season. This did not occur in 2007 where N mineralization following wheat was similar to that following soybean throughout the year. Apparent N mineralized was 40, 60, and 40 kg N ha⁻¹ following corn, soybean, and wheat, respectively (0 fertilizer N) in 2006 and 50, 60, and 60 kg N ha⁻¹ following the same respective crops in 2007.

In Southern Minnesota, there was a difference in mineralized N between the sweet corn and field corn only in 2007 when 120 and 62 kg N ha⁻¹ was mineralized following sweet corn and field corn, respectively. In the 2006 and 2008, there was little difference in N mineralized between the two previous crops. Apparent N mineralized was 129 and 123 kg N ha⁻¹ following sweet corn and field corn, respectively. Nitrogen fertilizer rates did not effect N mineralization.

At neither location did N mineralization following various previous crops affect sugar beet root yield or quality. We conclude that previous crops can affect N mineralization during the following sugar beet crop, but mineralization differences were not sufficiently large enough to cause an effect on sugar beet root yield or root quality.