

TURKEY LITTER EFFECTS ON SUGAR BEET PRODUCTION

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Livestock operations, mainly poultry and swine, are increasing in size and impact in the Southern Minnesota sugar beet growing area. Many sugar beet producers own or have interest in these operations; thus have manure available to use on their fields. Manure research data concludes that manure has a positive effect on crop production from its effects on soil nutrient availability and soil physical properties. A concern has been raised about the effect of late season nitrogen mineralized from the manure on sugar beet quality. Grower observations indicate better growth in fields that have had manure applied. With the large amount of manure available, the question has changed from whether to use manure but when in the sugar beet crop rotation should manure be applied to minimize quality concerns and realize benefits? Turkey manure has a considerable amount of litter in it, thus slowing initial release of poultry manure-N. The implication of the manure-N release is critical, especially to sugar beet growers. Therefore, recommendations need to be evaluated with sugar beets. This research project has been designed to: 1) determine when in a three-year rotation, should turkey litter be applied and 2) determine nitrogen fertilizer equivalent of turkey litter applied two and three years in advance of sugar beet production.

Materials and Methods

To meet the objectives of this experiment the first of three sites was established near Raymond, Minnesota in the fall of 2006 while a second site was established in the fall of 2007 near Olivia, Minnesota. The Raymond site was cropped to soybean in 2007. Turkey manure was applied fall 2006 and soybean grain yields were harvested by a plot combine in the fall of 2007. The treatments for the second year were applied to the first site near Raymond in the fall of 2007 with corn grown in 2008. A second site was established near Olivia, Minnesota in the fall of 2007 with soybean grown in 2008. Below is a complete description of this project.

Each site of this study will have five replications of the treatments list in Table 1. Turkey litter treatments of 3 and 6 tons per acres are applied 2 and 3 years ahead in the three year rotation of soybean/corn/sugar beet. This rotation is the most common rotation in this growing area. Treatment 5 is the check treatment for the whole experiment while treatments 8 and 15 are checks for different parts of the rotation. Treatments 6 through 14 are the N fertilizer rates plus the two turkey litter rate applied the fall before the sugar beet production year. During the corn production year, 120 lb N per acre will be applied for treatments 6 through 14. This is the current U of MN N guideline for corn following soybean. In the soybean production year, grain yield will be measured. Soil samples to and depth of 4 feet will be analyzed for nitrate-N while soil samples to a 6 inch depth will be analyzed for phosphorus, potassium, organic matter, and pH. The soil test phosphorus, potassium, and pH will be additional information to assess the effect of turkey litter on other soil chemical properties besides nitrogen. The year 2 manure and fertilizer treatments will be applied in the late fall. During the corn production year, biomass will be measured using a hand held sensor to assess early growth. Basal stalk samples will be taken at a week after grain black layer and analyzed for nitrate. This is a good tool to determine the effect of the nitrogen management treatments. Grain will be harvested and similar to year 1 soil samples will be taken. The year 3 treatments will be applied late fall of year 2. Sugar beet late season leaf growth will be assessed with a sensor. Root yield and quality will be determined in the fall. Final soil samples for nitrate-N, phosphorus, potassium, and pH will be taken after harvest. In each of the production years, optimum production practices for pests control and nutrient management besides nitrogen will be used.

Table 1. Treatment List

Treatment Number	Year 1 (soybean)	Year 2 (corn)	Year 3 (sugar beet)
1	3 ton litter	0 N	0 N
2	6 ton litter	0 N	0 N
3	0 N	3 ton litter	0 N
4	0 N	6 ton litter	0 N
5	0 N	0N	0 N
6	0 N	120 N	3 ton litter
7	0 N	120 N	6 ton litter
8	0 N	120 N	0 N
9	0 N	120 N	30 N
10	0 N	120 N	60 N
11	0 N	120 N	90 N
12	0 N	120 N	120 N
13	0 N	120 N	150 N
14	0 N	120 N	180 N
15	0 N	0 N	90 N

Table 2. Timeline for crops at each of three locations.

2007-08	2008-09	2009-10	2010-2011	2011-2012
Location 1 - soybean	Location 1 - corn	Location 1 – sugar beet		
	Location 2 - soybean	Location 2 - corn	Location 2 – sugar beet	
		Location 3 - soybean	Location 3 - corn	Location 3 - sugarbeet

Results

Soybean grain yields were significantly increased by the application of manure in 2007 at the Raymond site, Table 3. This increase was small. There were no differences in grain yield between 3 and 6 tons of turkey litter application. Soil samples were taken after the soybean production year in the fall of 2007. The application of 3 and 6 tons of turkey litter, fall 2006, increased the soil residual nitrate-N, soil test P, and soil test K at the fall 2007 soil sampling, Table 4.

Table 3. Soybean grain yields as affected by the application of 3 and 6 tons of turkey litter in fall 2006 at Raymond, Minnesota in 2007.

Treatment	Soybean grain yield (bushels per acre)
Zero (check)	50.0
3 tons turkey litter	51.8
6 tons turkey litter	53.5
Statistics	P>F
Zero vs turkey litter application	0.005
Manure (3 vs 6 tons turkey litter)	NS
C.V. (%)	5.3

Table 4. Soil test results fall 2007 after soybean production as affected by the application of 3 and 6 tons of turkey litter in fall 2006 at Raymond, Minnesota.

Treatment	pH	Organic matter (%)	Nitrate-N 0-4 ft. (lb/A)	Olsen-P (ppm)	Potassium (ppm)
Zero (check)	7.6	4.3	45	30	157
3 tons turkey litter	7.3	4.4	98	38	178
6 tons turkey litter	7.4	4.4	172	45	187

Corn grain yields in 2008 were measured at the Raymond site, Table 5. The only significant difference in corn grain yield was between the check, with no N fertilizer or turkey litter applied and the corn grain yield from the 120 pounds N per acre and the turkey litter treatments. Sugar beets will be planted in 2009 with N rate treatments and 3 and 6 turkey litter applications made fall 2008.

Table 5. Corn grain yields as affected by the application of 120 pounds N per acre, 3 and 6 tons of turkey litter in fall 2006, and 3 and 6 tons of turkey litter in fall 2007 at Raymond, Minnesota in 2008.

Treatment	Corn grain yield (bushels per acre)
Zero N (check)	102
120 pounds N per acre applied fall 2007	150
3 tons turkey litter applied fall 2006	130
6 tons turkey litter applied fall 2006	146
3 tons turkey litter applied fall 2007	150
6 tons turkey litter applied fall 2007	144
Statistics	P > F
Check vs rest	0.0001
120 lb N per acre vs turkey litter	NS
2006 vs 2007 turkey litter	NS
2006 3 ton vs 6 ton turkey litter	NS
2007 3 ton vs 6 ton turkey litter	NS

A second site was established south of Olivia fall of 2007. Soybean was planted and harvested in 2008. The soybean grain yields were not affected by the 3 and 6 tons turkey litter application in the fall of 2007, Table 6. Corn will be grown in 2009 with treatments added of 120 pounds N per acre and 3 and 6 tons turkey litter applied fall 2008.

Table 6. Soybean grain yields as affected by the application of 3 and 6 tons of turkey litter in fall 2007 at Olivia, Minnesota in 2008.

Treatment	Soybean grain yield (bushels per acre)
Zero (check)	49.8
3 tons turkey litter	50.1
6 tons turkey litter	50.7
Statistics	P>F
Zero vs turkey litter application	NS
Manure (3 vs 6 tons turkey litter)	NS
C.V. (%)	6.0