EVALUATE NITROGEN RATES, APPLICATION TIMINGS AND APPLICATION METHODS FOR SUGARBEETS IN MICHIGAN

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Introduction:

Nitrogen is generally the most yield limiting nutrient in sugarbeet production in Michigan. Adequate nitrogen supplies are needed early in the season to promote early growth and canopy development. Smaller amounts of nitrogen are needed during the middle of the season to maintain the canopy and promote root growth and sugar storage. Excess nitrogen late in the season will decrease sugar levels and increase impurities. Michigan State University recommends applying four pounds of actual nitrogen per acre for each expected ton of sugarbeet yield. This recommendation is modified by other factors including the previous crop. Sugarbeets following corn need an additional 30 pounds of nitrogen to reach maximum sugar per acre yields. When growing sugarbeets after alfalfa or clover less added nitrogen is needed. The MSU recommendations are very similar to the Michigan Sugar Company nitrogen recommendations. Michigan Sugar recommends 90 to 120 pounds of nitrogen following soybeans or dry beans and up to 150 pounds following wheat or corn. Sugarbeets following corn with heavy residue require more nitrogen than sugarbeets following wheat. Considerations are also made for alfalfa or clover as the previous crop, for recent manure applications and for soils with high levels of organic matter. The timing and method of nitrogen applications is as important as the nitrogen rate. Nitrogen fertilizer should be applied close the the planting date. Applying nitrogen after the six leaf stage will depress sugarbeet quality. Five nitrogen fertility trials were conducted from 2008 to 2010 comparing nitrogen rates, application timings and application methods. Information from three of the trials is not considered to be reliable due to field problems including sugarbeet cyst nematode infestations and soil crusting. Results from the two good quality trials are discussed in this paper.

Research Objectives:

The objectives of this research program are: 1) Evaluate nitrogen rates (50, 100 and 150 lbs nitrogen ai/A); 2) Evaluate application timings and methods including: a) Pre-plant incorporated (PPI); b) Starter (2x2) applied at planting (nitrogen applied two inches to the side of the row and two inches below the seed depth); and c) Side-dress nitrogen (SD) (applied at the 4 leaf stage with a fluted coulted applicator with stream jet nozzles following the coulters).

Materials and Methods:

These were small plot replicated trials. A Monosem six row planter modified for research was used to plant the trials. Sugarbeets were planted one inch deep. In 2008 the plots were planted thick and thinned to 180 beets per 100 foot of row at the four leaf stage. In 2010, beets were planted to stand at a four inch spacing and an average stand of 205 beets per 100 ft of row was achieved. The 2010 trial had a lot of corn residue left from the previous year. We were able to plant with row cleaners, however, ridges were formed between the rows at planting and the sugarbeet seeds were planted in a depression. The nitrogen treatments were applied as

follows: Pre-plant incorporated treatments were hand spread evenly over the plot area and incorporated to a two inch depth with a triple K cultivator. Starter 2x2 fertilizer treatments were applied by spreading fertilizer evenly on a section of belt which turned slowly during planting and dumped the fertilizer into the 2x2 applicator. The side-dress treatments were applied by spraying a stream of UAN 28% directly between the sugarbeet rows with a fluted coulter applicator (one coulter and one nozzle per row). The fluted coulters cut narrow openings in the soil and the nozzles sprayed directly into the soil. The plot size was 6 rows X 50 ft in 2008 and 6 rows X 50 feet in 2010. There were 6 replications each year. The 2008 trial was planted in 30 inch rows and the 2010 trial was planted in 22 inch rows. Sugarbeet emergence, vigor, canopy development, yield and quality were measured. The trial locations were soil tested and fertility levels were high for most nutrients at both locations. Micronutrient levels were in a favorable range except for boron which was somewhat low at both locations. Boron deficiency symptoms were not visible either year. Tables 1 and 2 show general trial information and soil test results.

Table 1. General Trial Information

Year	Variety	Plant Date	Harvest Date	Previous Crop	Beets/100 ft at Harvest	Field Preparation Tillage Methods
2008	HM 28RR	May 22	Oct 17	Wheat	175	Chisel Plow Fall, Light Spring Cultivation
2010	HM 131RR	Apr 14	Sep 21	Corn*	205	Chisel Plow Fall, Light Spring Cultivation

*Excessive corn residue was present at planting

Table 2. Soil Test Information from the Trial Locations in 2008 and 2010

Year	Soil Type	pH	% OM	CEC	P ppm	K ppm	Mn ppm	B ppm
2008	Sandy Loam	8.0	1.5	9.3	47 High	114 Optimum	35 High	0.6 Low
2010	Sandy Clay Loam	6.7	4.8	10.6	126 High	164 High	17 High	0.9 Low

Other micronutrient levels were adequate

Nitrogen Treatments:

Nitrogen was applied to the plots a rates of 50, 100 and 150 lbs of actual nitrogen per acre. An untreated check was included. The treatments were applied pre-plant incorporated, 2x2 at planting and side-dress at the four leaf stage. Starter 2x2 applications were also applied in sequence with PPI and side-dress treatments. Urea 46% was the nitrogen source for pre-plant incorporated treatments, ammonium sulfate 21% was used for the 2x2 at planting treatments and UAN 28% was the nitrogen source for the side dress treatments. The nitrogen treatments are shown in (table 3).

Table 3. Nitrogen rates, application methods and application timings, Auburn and Albee, MI – 2008 and 2010

Total Nitrogen Rate	Application Method	Appliction Timing
50	PPI	Pre Plant
50	2x2	Planting
50	SD	4 leaf stage
100	PPI	Pre Plant
100	SD	4 leaf
100	PPI and 2x2	Pre Plant and at Planting
100	2x2 and SD	At Planting and 4 leaf stage
150	PPI	Pre Plant
150	SD	4 leaf stage
150	PPI and 2x2	Pre Plant and at Planting
150	2x2 and SD	At Planting and 4 leaf stage

Results and Discussion:

Nitrogen applied 2x2 at planting at a rate of 50 lbs actual nitrogen per acre in sequence with either 50 or 100 lbs of nitrogen applied pre-plant incorporated or side dress provided higher yields than the same total nitrogen rate applied either pre-plant incorporated or side dressed (Tables 4 and 5). Sugarbeet quality and grower income was also improved when nitrogen 2x2 at planting applications were a part of the total nitrogen treatment. Sugarbeet growth early in the season was significantly improved when 50 pounds of nitrogen was applied 2x2 at planting and the sugarbeet canopy closed earlier and to a greater extent in treatments that included 2x2 nitrogen applications. It appears that applying nitrogen near the row (2x2 at planting) increased nitrogen use efficiency. When comparing application methods with low nitrogen rates (50 lbs nitrogen per acre) the 2x2 treatment yielded 7105 lbs of recoverable sugar per acre compared to

6986 and 6253 for side-dress and pre-plant incorporated treatments, respectively. The quality was also better in the 2x2 treatments, 262 lbs recoverable sugar per ton compared to 237 and 249 lbs for side-dress and pre-plant incorporated, respectively. Amino nitrogen and canopy color ratings also indicated that the 2x2 nitrogen treatments had higher quality compared to pre-plant incorporated and side-dress applications. (Table 4). Wheat was the previous crop in 2008 and corn was the previous crop in 2010 and there was a lot of corn residue at planting. Data from

Table 4. Influence of Nitrogen Rate, Application Method and Timing on Sugarbeet Yield, Quality, Grower Income and Other Factors – Albee, MI - 2010

Nitrogen Treatment	Total N/acre	Grower Income $/acre[1]	RWSA[2] lb/acre	RWST[3] lb/ton	% Canopy Close	Amino N	Leaf Color 1-10[4]	Beet/ 100 ft
PPI 100 + 2x2 50	150	1697	8023	244.3	94.9	8.2	8.0	209
2x2 50 + SD 100	150	1636	7798	239.6	97.5	7.7	7.9	211
2x2 50 + SD 50	100	1632	7651	246.2	97.5	6.9	7.3	199
PPI 50 + 2x2 50	100	1622	7497	258.7	93.4	4.9	6.8	219
PPI 100	100	1589	7375	247.1	91.2	6.4	7.2	207
2x2 50	50	1541	7105	261.9	84.3	4.8	6.7	200
2x2 25 + SD 75	100	1535	7199	246.8	93.2	6.6	7.2	210
PPI 75 + 2x2 25	100	1529	7133	252.4	92.2	6.5	6.8	202
SD 100	100	1522	7123	248.3	92.2	6.6	7.8	203
PPI 50 + 2x2 25	75	1482	6946	249.5	88.6	6.3	6.9	185
SD 150	150	1461	6986	236.8	93.9	7.9	8.0	191
PPI 150	150	1482	6946	249.5	90.4	7.9	8.0	200
SD 50	50	1461	6986	236.8	89.1	6.0	7.3	208
PPI 50	50	1364	6253	249.2	79.6	5.8	7.2	214
Untreated	0	1196	5390	254.4	62.4	4.0	5.7	199
LSD 5%		134.5	606.3	9.5	8.4	1.2	1.1	27.8
CV		7.7	7.4	3.3	8.1	6.4	7.3	11.8
Mean		1510.8	7053.8	247.9	89.4	6.4	7.3	203.9

[1]Income: net income after fertilizer costs are subtracted
[2]RWSA: recoverable white sugar per acre
[3]RWST: recoverable white sugar per ton
[4]Leaf Color: 1. = yellow and 10 = dark green

these trials and from similar research conducted in Michigan (Sugarbeet Advancement) suggests that sugarbeets need nitrogen applied 2x2 at planting, especially following corn, to promote early season growth. None of the nitrogen treatments effected sugarbeet emergence or caused any type of crop injury. Sugarbeet stands at harvest were lower (not statistically significant) in the untreated check plots than for most of the nitrogen treatments. Table 5 illustrates grower income, recoverable sugar per acre and recoverable sugar per ton values averaged over both years. There appeared to be a trend that the 2x2 treatments provide higher yields and grower income although some comparisons were not statistically significant.

Summary and Conclusions:

Nitrogen applied 2x2 at planting promoted early season vigor, a quicker canopy closure, improved quality, increased yields and higher grower income compared to nitrogen applied either pre-plant incorporated or side-dressed at the four leaf stage. None of the nitrogen

Table 5. Influence of Nitrogen Rate and Application Method on Sugarbeet Yield, Quality and Grower Income.
Average of 2 Trials (2008 and 2010)

Application Method and lb Actual Nitrogen per Acre	Income[1] $ per acre	RWSA[2] lb/acre	RWST[3] lb/ton
PPI 100 lb 2x2 50 lb	1539	7518	260
2x2 50lb SD 100 lb	1478	7293	256
PPI 50 lb 2x2 50 lb	1474	7111	271
PPI 150 lb	1434	6947	260
2x2 50 lb SD 50 lb	1427	6927	264
PPI 100 lb	1393	6726	265
2x2 50 lb	1383	6600	278
SD 150 lb	1356	6669	256
SD 100 lb	1337	6485	264
SD 50 lb	1242	6091	261
PPI 50 lb	1186	5683	262
Untreated	1058	5027	268
LSD 5% CV Mean	178 5.7 1359	869 5.7 6590	13.7 2.3 264

[1]Income: net income after subtracting fertilizer cost
[2]RWSA: recoverable white sugar per acre
[3]RWST: recoverable white sugar per ton

treatments reduced sugarbeet emergence or caused crop injury. It appeared that the 2x2 starter treatments improved nitrogen use efficiency by the crop. With respect to the nitrogen rate, 150 pounds provided better overall results than 100 lbs. The 50 pound rate was obviously too low. The previous crops were wheat and corn and a high level of corn residue was present at planting in 2010. Sugarbeets typically need higher nitrogen rates following crops which leave large amounts of residue.