MANAGING NITROGEN FERTILIZER FOR MAXIMUM RETURNS OF THE SUGAR BEET CROP AS RELATED TO SOIL TYPE

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Introduction:

In the Amalgamated Sugar Company's growing area, there are approximately 180,000 acres of sugar beets (be*ta vulgaris L*) grown. The sugar beets are grown mostly in Idaho, with some being grown in Oregon and Washington. For the past 30 years, Nitrogen (N) recommendations have been made using a standard 8 lbs. per historical (5 year average) ton of sugar beets. This standard was established by researchers doing N plot work across the company growing areas and in all different soil types for 7 years. The standard for making N recommendations was established to be 8 lbs. N per projected historical ton produced.

Objective:

Studies were conducted to see if the N input needs, for Roundup Ready® (RR) sugar beet varieties, could be further adjusted to improve sugar beet quality. Studies were conducted in crop years 2008, 2009, and 2010 using RR sugar beet varieties to determine if sugar beet N usage requirements had changed since the last studies were completed.

Materials and Methods:

All plot sites were located inside of a Growers/Cooperator commercial field. Attempts were made to choose a plot area inside the field's boundaries that were uniform. The Grower/Cooperators historical 5 year average tons per acre (T/A) was then used as the treatment yield goal. All plots were replicated 6 times using a randomized complete block design. The plots were 6 rows wide (22" rows) 27-40 feet in length with a 3-5 foot alley way between replications. The center 2 rows were used for data collection. Plots were defoliated with a 2 row double drum defoliator and harvested with a 1 row harvester. There were 2 samples taken per plot at harvest to determine quality factor results.

In 2008-09, N treatments of 5, 6, 7, and 8 lbs. per historical T/A were used. In 2010, N treatments were expanded to include 0, 4, 6, 8 and 11 lbs. per historical T/A was used. All plots were soil sampled to a 3 foot depth. It should be noted that the 0 N treatment means 0 N was applied, not that there was no N available. Each plot in the 0 N treatments had its respective soil available N. N was applied in the form of Urea (46-0-0). Each replication was soil sampled as one unit and the soil sample results were used to determine N requirements in each plot treatment within that replication. Soil sample results were reported in Nitrate part per million (ppm). Nitrate ppm from the respective 1, 2 and 3 foot soil depths were then added together and multiplied by 4 to convert ppm to lbs. of N. This is the total soil available N. Total recommended N was calculated for each treatment by taking historical T/A times the N treatment. Total soil available N was then subtracted from the total recommended N requirement

based on the N treatment. The difference was then applied to the respective treatments. The N plots were spread with a Scotts® drop type lawn fertilizer spreader.

Results and Discussion:

Studies on a silt loam type of soil began in 2008 and continued through 2010. Data for the 2010 crop year in the silt loam study was not used because of irrigation and disease problems. The 5, 6, and 7 lbs. N rate had a significant difference (See Figure 1) from 8 lbs. in sugar content, brei nitrate, conductivity, estimated recoverable sugar per ton (ERS/T), and dollars per ton. Though not significant from 7 lbs., the 5-6 lbs. N rates, top all other quality parameters. In a silt loam type of soil, the 5-6 lbs. of N per projected ton of N can be used on sugar beets without harming root yield, while improving the other sugar beet quality factors.

Hansen & Trail Ranches 2008 Silt Loam Combined Figure 1

Treatment	Root Yield (T/A)	Sugar Content (%)	Nitrate Content (ppm)	Conductivity (mmhos)	ERS/T	ERS/A	$/T	$/A
5 Lbs N	36.67	17.78a	58b	0.618b	308.8a	11297	48.99a	1791
6 Lbs N	37.94	17.85a	54b	0.62b	309.8a	11752	49.2a	1866
7 Lbs N	37.38	17.52ab	78ab	0.64ab	303ab	11328	48.09ab	1798
8 Lbs N	37.75	17.09b	95a	0.66a	294.5b	11104	46.63b	1757
LSD (0.05)	NS	0.48	24	0.031	9.5	NS	1.63	NS
LSD (0.1)	NS	0.40	20	0.026	7.9	NS	1.35	NS
CV (%)	4.7	3.2	40.2	5.8	3.7	5.7	4.0	5.8
PR > F	0.3360	0.0157	0.0054	0.0283	0.0112	0.1868	0.0158	0.1735
Grand Mean	37.42	17.55	72	0.635	304.0	11363	48.21	1802

Studies began on sandy loam soils in 2009. Sugar beet yields were significantly (Table 2) better when a higher (7-8 lbs.) rate of N was applied.

Kerry Bowen Sand Rate Study 2009 Figure 2

Treatment	Root Yield (T/A)	Sugar Content (%)	Nitrate Content (ppm)	Conductivity (mmhos)	ERS/T	ERS/A	$/T	$/A
5 Lbs N	20.67c	15.62	49	0.452	276.5	5729c	41.59	861c
6 Lbs N	24.29b	15.62	55	0.432	277.3	6759b	41.59	1014b
7 Lbs N	28.59a	15.78	59	0.44	280	8011ab	42.16	1206ab
8 Lbs N	27.64a	15.57	60	0.448	275.7	7636a	41.42	1148a
LSD (0.05)	2.70	ns	ns	ns	ns	895	ns	138
LSD (0.1)	2.22	ns	ns	ns	ns	736	ns	114
CV (%)	8.7	3.8	41.9	8.8	4.3	10.3	4.9	10.6
PR > F	0.0001	0.9271	0.8397	0.8107	0.9258	0.0003	0.9270	0.0004
Grand Mean	25.30	15.65	56	0.443	277.4	7034	41.69	1057

The 7 and 8 lb. rates of N were the best rates in this study. While sugar content was not affected in a significant way, brei nitrate levels of sugar beets at harvest were extremely low and suggest that a change in N the timing of application and include a higher rate of N would have produced better results. Estimated recoverable sugar per acre (ERS/A) and dollars per acre value produced

significant differences. As a result of these N studies, more N is needed when raising Sugar beets in sandy loam soils. These studies show that 7-8 lbs. or more are needed to achieve maximum sugar per acre yields in sandy soils.

Studies began on a clay type of soil in 2010. Like the silt loam tonnage, yields were not increased with the addition of N (Table 3). The other quality parameters were significantly improved with the exception of ERS/A. In this analysis, an additional parameter of net dollars per acre was added to see if further separation could be made. The cost of the fertilizer (.25lb N) and the cost of trucking to the receiving station ($2.5/T) was subtracted from the gross dollars per acre.

Bowen and Big D Clay Soils N Rate Studies 2010 Figure 3

Treatment	Root Yield (T/A)	Sugar Content (%)	Nitrate Content (ppm)	Conductivity (mmhos)	ERS/T	ERS/A	$/A	$/A	Net $/A
4 Lbs N	35.21	17.56a	75a	0.678a	302a	10588	$48.80a	$1,707	$1619a
6 Lbs N	35.08	17.43a	98ab	0.711a	298.1a	10425	$48.34a	$1,687	$1581a
8 Lbs N	35.77	17.05b	146b	0.774b	288.4b	10279	$47.02b	$1,671	$1545ab
11Lbs N	36.19	16.67c	238c	0.823b	279.8c	10119	$45.73c	$1,650	$1495b
LSD (0.05)	ns	0.36	49	0.055	8.4	ns	1.25	ns	80
LSD (0.1)	ns	0.30	41	0.046	7.0	ns	1.04	ns	66
CV (%)	6.1	2.4	39.5	8.3	3.3	5.9	3.0	5.7	5.8
PR > F	0.4366	0.0001	0.0001	0.0002	0.0001	0.5604	0.0001	0.7359	0.0455
Grand Mean	35.57	17.17	141	0.748	291.8	10347	47.44	1678	1558

Unfortunately, it made no significant difference between the 4 and 6 lbs. rate, but the 4 lbs. N rate netted @$38 more per acre than the 6 lbs. N rate. The study shows that 4-6 lbs. of N should be used to clay type soils.

Brei nitrate levels in sugar beets at harvest need to be monitored. Brei N levels at harvest should be 250 ppm or less. Brei nitrate levels under 100 ppm need to be watched and analyzed closely to assure that overall sugar production is not compromised. When fine tuning N requirements in sugar beets, make small adjustments to N inputs so that sugar beet yields and quality parameters are maximized.