Fine-Tuning Sugar Beet Fertility Management in the Red River Valley

By Dave Hilde

Few crops financially reward precision nitrogen (N) management more than sugar beet. Both yield and quality can be dramatically altered if the optimum N level is missed. Therefore, sugar beet is a natural crop for grid sampling and variable rate fertilization. This early evaluation of variable rate fertilization based on soil nitrate (NO_3-N) samples taken to a 4-foot depth shows a net profit increase from variable rate technology (VRT) of over $140/A.

SUGAR BEET PRODUCTION practices have changed drastically in the Red River Valley of Minnesota and North Dakota since the implementation of the quality payment system in 1980. Changes in the grower payment system mandated change to production of high sugar content, low impurity beets. Maximum beet yields require adequate amounts of N for fast early growth. However, **excess** N is detrimental to beet quality, because sugar content is reduced and impurities causing a sugar loss to molasses are increased. The net effect of excess N is reduced production of recoverable sugar per ton and per acre.

Prior to 1980, the N recommendation for a 20-ton crop was 170 lb/A. The present N management guideline . . . N to apply=120 minus (soil NO_3-N in zero to 2-foot depth + excess N in 2 to 4-foot depth) . . . was developed by American Crystal Sugar, North Dakota State University and the University of Minnesota, Crookston. A significant increase in the production of recoverable sugar per ton of beets and per acre has occurred with improved grower N management practices. For example, the 1993 Red River Valley sugar beet crop averaged 55 lb more recoverable sugar per ton than the 1980 crop. Based on an average 6.8 million ton crop at present sugar values, the 1993 sugar beet crop increased grower revenues by approximately $81.6 million over the 1980 crop.

Room for Improvement

While progress in increased sugar production has been good, there is still room for improvement. Many sugar beet growers have reached a production plateau with conventional soil sampling and fertilizer application methods and are looking at fine-tuning their N management program with grid sampling and VRT for fertilizer applications. One such grower is Dan Jacobsen who farms near Moorhead, MN. With help from Dave Braaten, American Crystal agriculturist, he conducted a side-by-side comparison of VRT with conventional fertilizer management.

The trial field was 83 acres and was soil sampled in the fall of 1992 to determine N, phosphorus (P), and potassium (K) requirements for the 1993 sugar beet crop. The standard sampling method was used, taking 20 cores in a random weave pattern on the entire 83 acres. Available N (after adjustment for excess N at the 2 to 4-foot depth) averaged 50 lb/A and the available P averaged 18 lb/A. Potassium tested very high at 430 lb/A.

Jacobsen then applied the required N and P on 10 acres which became the standard check. The field was then soil sampled in 440 ft. square grids (4.44 acres) and tested for N, P and K. Available N (after adjustment for excess 2 to 4-foot N) ranged from 31 to 149 lb/A. Phosphorus ranged from 10 to 31 lb/A and K ranged from 353 to 766 lb/A. The required N and

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P were applied on each grid by VRT on 73 acres. No additional K was required on either field. The standard and VRT areas were contracted separately so yield and quality data could be accurately determined at harvest using conventional harvesting machinery and standard beet sampling procedures at the receiving station.

Yield and quality results from VRT versus standard fertility management are shown in **Table 1**, the economic analysis in **Table 2**.

Table 1. Comparative effects of VRT and standard fertility management on sugar beet yield and quality.

Field report data	VRT	Standard
Yield, tons/A	18.70	18.00
Sugar, %	17.89	16.59
Sugar loss to molasses, %	1.41	1.56
Recoverable sugar, lb/ton	330	301
Recoverable sugar, lb/A	6,171	5,418
Brei nitrate grade	2.1	3.4

Jacobsen, 1993

Table 2. Economic comparisons of VRT and standard fertility management.

Field data	VRT	Standard	Difference (VRT-Standard)
Cost/A (soil test, fert. appl.)	$15.00	$5.00	+$10.00
Cost/A, N + P	16.89	23.17	-6.28
Beet payment/ton	39.32	33.31	+6.51
Beet payment/A	744.51	599.51	+145.07

VRT Net Profit = $141.35/A

Jacobsen, 1993

Summary and Conclusions

This comparison shows how VRT can boost farm profits. The dramatic increase in beet quality and the subsequent increase in beet payment are attributed to reducing the N variability in the field. With high rainfall the past two years, ponding occurred in low areas of the field, resulting in N losses through denitrification and possibly leaching.

Conventional soil sampling methods did not account for the uneven N patterns in the field. With VRT, the deficient areas received the needed N and the high testing areas received less N, or none at all, so both yield and beet quality increased. Another contributing factor to slightly higher yield per acre in the VRT field may be reduced P variability. Some grids were low in P. With VRT, these areas received adequate P for fast early growth required for top yields. The variations were not detected in the standard sampling method.

Grid soil sampling and VRT by Red River Valley sugar beet growers continue to increase each year. The quality payment system provides the financial incentive for sugar beet growers to fine-tune N management for maximum production of recoverable sugar and maximum income per acre. ■

IDEALLY, N deficiency as shown by the yellowing foliage in this field should occur 6 to 8 weeks prior to harvest for maximum production of recoverable sugar.

EXCESS available soil N at harvest, as indicated by the dark green foliage in parts of this field, results in reduced sugar content, increased impurities and lower sugar production.