PRECISION FARMING PRACTICES IMPACT ON SUGARBEET PRODUCTION IN MN & ND

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Introduction

Site specific management practices and utilization of new technology have been extensively promoted in the past decade. The American Crystal Sugar Company Agriculture Department and its shareholders have been adopting selected precision farming practices since the early 1990's, beginning with grid soil sampling and associated variable rate fertilization. Present technology, utilizing satellite images, is beginning to show positive results in increasing crop yield and quality.

Previous Work

Beet top imagery analysis and interpretation for fertility management has gained acceptance by industry research specialists, primarily through the work of Dr. John Moraghan, NDSU. Dr. Moraghan's work has allowed nitrogen credits to be assigned to specific areas within a field based upon near infared reflectance, a measure of the crop bio-mass. By assigning management zones within a field with respect to the sugarbeet canopy reflectance, agriculturists can now zone a field for fertilization by assigning the correct nitrogen credit based upon the satellite image of that field.

Objectives:

1. Improvement in yield and quality of crops following sugarbeets in rotation.
2. Improvement in sugarbeet quality following rotations on fields, which have been cycled utilizing precision farming methods.
3. Reduction in grower production costs.
4. Enhance protection of our soil and water resources.

Methods/Materials/Discussion

The American Crystal Sugar Company (ACSC) Agriculture Department and its shareholders have been adopting selected precision farming practices since the early 1990's. Grid soil sampling of fields and associated variable rate fertilization was the first practice adopted. Presently, ACSC has been focused on the use of satellite images to assign beet top N credits to subsequent crops in rotation. The goal is to reduce N fertilizer costs and achieve improved N management throughout the crop rotation. Agriculturists and growers have used three satellite images per year since 1998 to refine crop production practices. The following table shows the amount of N returned to the soil from beet tops after defoliation, based on NDSU research.

Table 1
Beet Top Dry Matter and N Content

Canopy	*Dry Matter (Lb/Acre)*	*Total N (%)*	*Total N (Lb/Acre)*	*Petiole NO3–N (PPM)*
Green	*7940*	*3.5*	*276*	*8,600*
Yellow-green	*6160*	*2*	*125*	*26*
Yellow	*4190*	*1.3*	*55*	*20*

J. Moraghan, NDSU

Nitrogen credits are given to specific parts of the field based on the amounts of biomass within zones of that field. American Crystal Sugar Agriculturists assign these credits based on analysis of the satellite image with the grower and then create management zones of fertilization for crops following sugarbeets. Sugarbeet quality is directly proportional to the amounts of available nitrogen at harvest. By utilizing precision farming practices throughout the entire crop rotation, better sugarbeet quality should be the end result.

Table 2
N Effects on Sugarbeet Quality

N Rate (Lb/A)	Yield (T/A)	*Net Sucrose (%)	Recoverable Sucrose (Lb/A)	(Lb/T)	Gross Return ($/T)	($/A)
0	21.1	16.03	6752	320.5	35.68	753
40	24.3	17.08	8308	341.5	40.35	981
80	25.4	17.07	8653	341.5	40.36	1025
120	27.9	16.30	9102	326.0	36.90	1030
160	29.9	16.00	9551	320.0	35.56	1063
200	29.0	14.98	8682	299.5	30.99	899
LSD .05	1.59	0.61	597	11.9		

* % Sucrose - % LTM = Net Sucrose

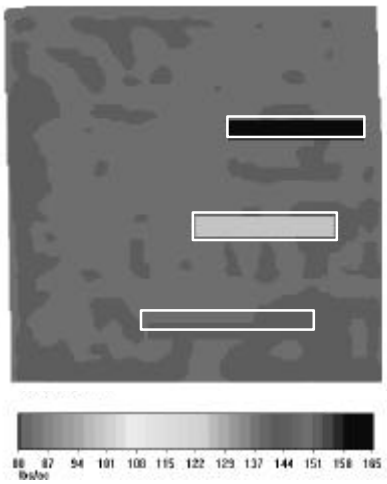
Site Information: Planting Date: April 29 Variety: Maribo 9369 N Recommendation – 95 Lb/A

NO_3 - N (0-2') - 25 Lb/A (2-4') – 19 Lb/A O.M. 3.3% Available N – 25 Lb/A

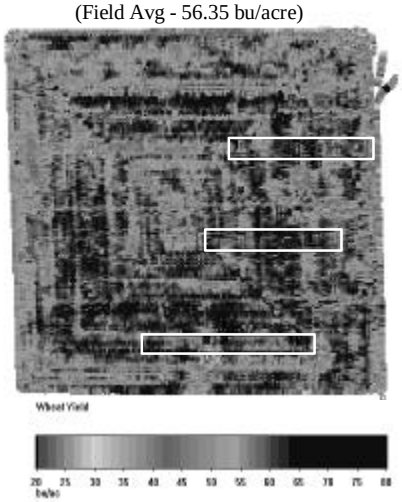
L.Smith, UofMN

The impact of N management on crops following sugarbeet in rotation can be dramatic in terms of yield and quality when utilizing the principles of zone applications in conjunction with satellite images. In cereal grains, there is less lodging without impacts on yield. One area that is still somewhat questionable is the protein content of a grain crop if it is under fertilized. By working with the grower who might be concerned about protein, agriculturists can increase the amount of nitrogen zone spread according to yield goal to reduce chance of any impact on grain protein content. Another positive impact that is being brought more to the forefront is reducing disease severity in edible beans and lower moisture content of corn. The following slides show examples of wheat yield and corn moisture when properly applied fertilizer is used. Check strips are depicted below.

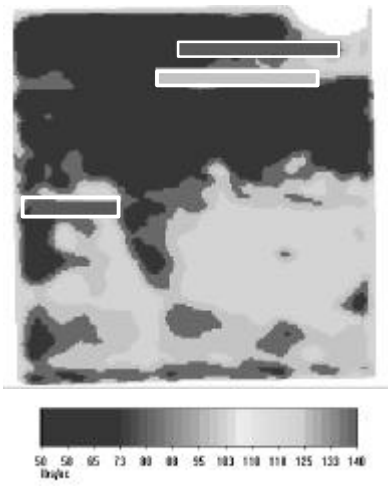
Management zones created for 1999
Wheat using 1998 Sugarbeet images



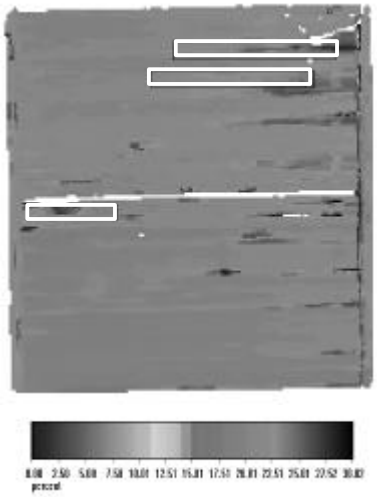
1999 Wheat Yield Map
(Field Avg - 56.35 bu/acre)



Zones created from
Sugarbeet Imagery for Corn

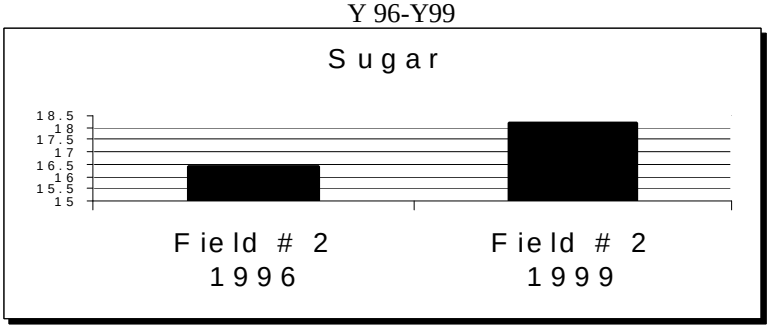


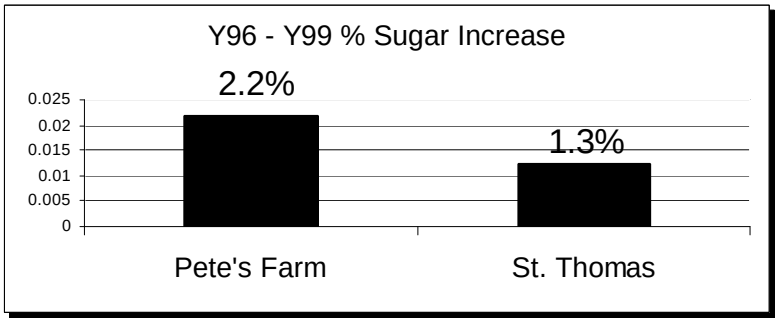
Corn Moisture Map

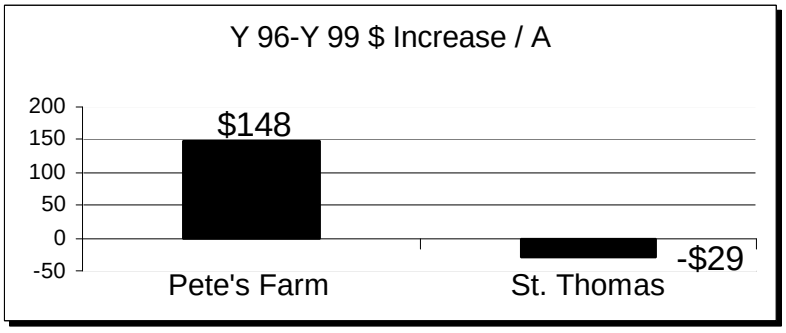


After a complete rotational cycle has been finished using precision farming techniques, very dramatic results are being noted in the quality of sugarbeet crops. The following information shows what one shareholder is seeing when comparing his sugarbeet crop with the receiving station averages he delivers beets to.

Y 96-Y99







Conclusion

From work completed thus far, it has been concluded that an increase in sugarbeet crop quality can be achieved by utilizing precision farming techniques, as well as, savings in fertilizer costs and a positive impact on the environment. Grain yield and quality can be maintained, edible bean diseases potentially reduced and corn moisture content at harvest lowered.

Future Work

Crop prediction based on data management when used with satellite imagery
Pre-harvest delivery of fields based on ground truthing and satellite images
Varietal differences based on reflectance of the top ten varieties
Aphanomyces predictive model

References

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