Survey of Sugar Beet Production Practices in Ohio and Their Effect on Sugar Beet Quality and Yield[1]

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Introduction

The purpose of a study conducted in Ohio during 1968 and 1969 was to determine the effect of commercial sugar beet production practices on yield and quality of sugar beets.

Methods

Growers were chosen for the sugar beet survey at random, with all growers, regardless of acreage, eligible for selection. One grower for each 90 acres of beets was chosen by Northern Ohio Sugar Company and one for each 50 acres of beets by Buckeye Sugar Company, Ottawa. The 1968 survey consisted of 298 Northern Ohio Sugar Company Growers and 160 Buckeye Growers, and the 1969 survey consisted of 180 Buckeye Sugar Company Growers, making a total of 647 growers surveyed during the two-year period.

Company agriculturalists and fieldmen reported the production practices, collected soil and plant samples and quality information, and calculated yields.

All data were sorted by yield quartile based on recoverable sugar per acre. Mean yields were determined for some practices separately. Correlation coefficients were determined between those practices having quantitative values, and yield of recoverable sugar per acre.

Results and Discussion

The 647 growers produced a mean yield of 17.9 tons per acre, containing 4751 lb. of recoverable sugar. The data in Table 1 shows there is no trend in percent sugar and purity between yield quartiles. Sodium and potassium content of the juice was highest in the low yield

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Table 1.—Yield and quality factors of sugar beet growers in northwest Ohio during 1968 and 1969.

Measurement	Mean for 647 growers	Means by yield quartile			
		1	2	3	4
Recoverable sugar per acre	4751	6017	5214	4244	3528
Tons/acre*	17.9	23.3	19.9	17.5	13.9
% Sugar	15.4	15.4	15.6	15.3	15.1
Gross sugar	5747	7217	6201	5339	4228
Recoverable sugar/ton	258	258	262	257	254
% Purity	92.6	92.5	92.7	92.6	92.6
Na in Juice gms./100 gms.†	.117	.116	.113	.116	.125
K in juice gms./100 gms.†	1.208	1.208	1.195	1.210	1.218
NH_2 in juice gms./100 gms.†	.267	.287	.262	.264	.257
Invert‡	1.23	1.21	1.31	1.26	1.15
Rhizoctonia ratings §	1.40	1.36	1.35	1.41	1.48

* "r" Value .951
† 1969 data only
‡ 1968 Buckeye data only
§ Rhizoctonia rating
1 - None
2 - Some
3 - Severe

quartile; however, these differences were not statistically significant. The incidence of rhizoctonia rot appeared higher in the low yield quartile.

Cultural practice variables investigated are given in Table 2. The mean date of planting was April 14, with the highest yields associated

Table 2.—Cultural practices used by sugar beet growers in northwest Ohio during 1968 and 1969.

Practice	Mean for 647 growers	Means by yield quartile			
		1	2	3	4
Planting date†	4-14**	4-12	4-13	4-14	4-16
Thinning date	5-31	5-28	5-30	6-01	6-02
Days planting to thinning	47	46	47	48	47
% Precision planters	64	72	66	65	52
Final ridge inches*, ‡	4.3**	5.0	4.3	4.2	3.7
Number cultivations §	4.4**	4.8	4.5	4.3	4.1
Row width inches ¶	31**	31	31	31	32
Seed depth	.90	.86	.91	.89	.94
% Using herbicide	81	89	83	80	73
% Spraying for leaf spot	29	48	31	21	14
Population ††	17715**	17961	17659	17023	16315
Date harvest ‡‡	10-22**	10-26	10-23	10-23	10-17

* 1968 and 1969 Buckeye only
† "r" value -.212
‡ "r" value .205
§ "r" value .285
¶ "r" value -.172
** Significant at .01 level
†† "r" value .312
‡‡ "r" value .286

with early planting. Growers in the study averaged a 31 inch row width and cultivated more than 4 times per year. The planting date and row width data support the findings of Baldwin *et. al.* (1).[3] More growers in the high yield quartile used herbicides and sprayed for cercospora leaf spot than those in the low yield quartile.

Fertilizer usage (Table 3) averaged 104 lb. of nitrogen (N), 131 lb. phosphorus (P_2O_5), and 120 lb. of potassium (K_2O) per acre. This is higher than the 80-80-120 recommended by the Ohio Cooperative Extension Service (2). Ninety-six percent of all growers used row fertilizer. Most of the nitrogen was side-dressed between June 1 and June 20. Growers in the high yield quartile applied a larger percentage of their nitrogen ahead of planting. Baldwin (1) reported that late side-dressing of nitrogen lowered sugar yield.

Table 3.—Fertilizer usage by sugar beet growers in northwest Ohio during 1968 and 1969.

Nutrient			Mean for 647 growers*	Means by yield quartile			
				1	2	3	4
Preplant	N†	Lbs./acre	$43^{(505)}$**	$51^{(135)}$	$44^{(126)}$	$41^{(117)}$	$40^{(127)}$
	P_2O_5	"	$92^{(580)}$	$95^{(148)}$	$91^{(149)}$	$92^{(138)}$	$89^{(145)}$
	K_2O	"	$99^{(575)}$	$120^{(151)}$	$93^{(147)}$	$94^{(134)}$	$88^{(143)}$
Row	N	"	$13^{(618)}$	$14^{(159)}$	$13^{(155)}$	$13^{(153)}$	$13^{(151)}$
	P_2O_5	"	$50^{(619)}$	$51^{(159)}$	$50^{(156)}$	$50^{(153)}$	$49^{(151)}$
	K_2O	"	$30^{(615)}$	$33^{(157)}$	$31^{(155)}$	$28^{(153)}$	$30^{(150)}$
	Mn	"	$3.8^{(89)}$	$3.3^{(31)}$	$3.4^{(17)}$	$4.0^{(23)}$	$4.4^{(18)}$
Sidedress	N	"	$77^{(480)}$	$80^{(102)}$	$76^{(123)}$	$79^{(129)}$	$75^{(126)}$
Date of sidedress ‡			6-10**	6-6	6-8	6-11	6-15
Total	N	Lbs./acre	104	106	101	106	102
	P_2O_5	"	131	138	133	127	126
	K_2O	"	120	143	121	107	108

* Mean figures are for those using fertilizer; therefore, mean of preplant, row, and sidedress do not add up to total. Total number of growers using this method of fertilization is given in brackets ().

† "r" value .203

‡ "r" value -.192

**Significant at .01 level

Soil test data from the 647 farms are reported in Table 4. Soil pH of 6.7, phosphorus of 92 lb. per acre available P (using Bray P_1 test), and potassium of 345 lb. K per acre indicate that the fertility level was adequate for sugar beets. Soil phosphorus and potassium levels did not appear to be associated with yield differences.

Very few plant nutrient deficiencies were detected. Phosphorus was below the .26% level in 25% of the samples; however, phosphorus

[3]Numbers in parentheses refer to literature cited.

Table 4.—Soil test results for sugar beet growers in northwest Ohio during 1968 and 1969.

Test	Mean for 647 growers	Means by yield quartile 1	2	3	4
Topsoil					
pH*	6.7**	6.8	6.7	6.7	6.6
P	92	97	92	88	89
K	345	334	334	358	354
Ca	5966	5604	5861	6177	6221
Mg	876	835	890	884	897
CEC	21.2	19.8	20.9	22.0	22.3
% Ca	69.9	70.5	69.9	69.8	69.4
% Mg	17.4	18.0	18.4	17.2	16.0
% K	2.2	2.3	2.2	2.2	2.2
Ca/Mg	4.5	4.6	4.3	4.6	4.5
Subsoil					
pH	6.8	6.8	6.8	6.8	6.8
P	44	55	48	39	36
K	317	310	310	322	326

* "r" value .193
** Significant at .01 level

content was not correlated with yield or phosphorus applications. In 1969, 82% of the samples were low in P. Although some leaf samples were low in nitrogen the average nitrogen composition was above 3% in August, a level considered to be too high for optimum production. Table 5 shows that nutrient composition was similar in each quartile, while Table 6 indicates that relatively few plant nutrient deficiency problems existed.

Table 5.—Chemical composition of leaf blades collected in August from sugar beet fields in northwest Ohio during 1968 and 1969.

Element	Mean for 647 growers	Means by yield quartile* 1	2	3	4
N %	3.24	3.23	3.23	3.25	3.25
P %	.30	.30	.30	.28	.29
K %	6.47	6.54	6.54	6.61	6.21
Ca %	1.21	1.18	1.22	1.19	1.26
Mg%	1.02	.99	1.05	1.03	1.00
Mn PPM	93	92	94	90	95
B PPM	48	46	46	48	51
Cu PPM	54	57	57	52	50
Zn PPM	45	42	46	47	46

* Differences between yield quartiles are not statistically significant.

Table 6.—Percent of sugar beet growers in northwest Ohio producing beets with low or deficient plant nutrient levels during 1968 and 1969.

Element	% Low or deficient	Minimum levels used
N	13	2.00%
P	25	.26%
K	2	2.01%
Ca	0	.36%
Mg	0	.36%
Mn	2	21 PPM
B	0	26 PPM
Cu	0	11 PPM
Zn	0	19 PPM

Sugar beet yields were higher on medium to coarse textured soils than on the clay soils (Table 7). The lower yield from the clay is attributed to poor internal and surface drainage.

Table 7.—Yield of sugar beets as affected by soil texture for growers in northwest Ohio during 1968 and 1969.

Soil texture	Number	Tons/acre
Sand	66	18.8
Silt loams and loams	223	19.4
Clays	358	17.4

Yields were highest when the beets were preceded by a crop of corn, soybeans, or tomatoes, and were reduced when beets followed alfalfa (Table 8). Most beets in Ohio are preceded by corn or soybeans.

Table 8.—Sugar beet yield by previous crop for growers in northwest Ohio during 1968 and 1969.

Previous crop	Number	Tons/acre
Corn	255	18.9
Soybeans	199	18.2
Tomatoes	92	18.6
Alfalfa	24	17.6
Others	77	19.4

The correlations show that the highest yields were associated with early planting, frequent cultivation, ridge height, narrow rows, and late harvest date. Yields also increased with increasing soil pH, plant

population, nitrogen applied before planting, and the earliness of side-dressed nitrogen. These are the practices which some of the growers should improve. Variation in the remaining practices were not correlated with yield. The use of herbicides and spraying for cercospora leaf spot appeared to be correlated with yield. Since these were qualitative inputs, answered on the survey with either a "yes" or a "no," no attempt was made to correlate them with yield.

Other correlations indicated that as nitrogen rates increased, percent sugar and recoverable sugar per ton decreased. Phosphorus and potassium composition in the leaf increased as soil test level of these elements increased. Nitrogen composition of the leaf blade increased as nitrogen rates increased. It was interesting to note that as phosphorus level in the leaf increased, other nutrients in the leaf increased.

Summary

Since one of the objectives of the survey was to identify grower practices, trends were deemed as important as significant "r" values. Low "r" values are not uncommon when large numbers of observations covering multiple years are used. This survey covered an area 75 miles by 100 miles and included a 2 year period.

Most Ohio sugar beet growers were using recommended practices; in only a few cases did practices vary between yield groups. Nitrogen appears to be a major problem of many growers, as it decreases quality and yield of beets when large amounts are applied late. The survey also indicates that growers should plant early, secure higher populations (higher populations probably are more uniform), and harvest late. Cultivation appears to be an important grower practice and should not be overlooked from a weed control standpoint. Using chemicals for both weed and disease control seems to increase the probability of getting into the high yield group.

Acknowledgement

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Literature Cited

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