

Fertilizer Side-Dressing Studies on Sugar Beets in Southern Alberta

K. W. HILL AND S. DUBETZ¹

Introduction

Sugar beets have been grown in southern Alberta for twenty-six years. Since the early 1930's growers have been applying 100 pounds of 11-48-0 fertilizer per acre, at the time of seeding. This has become a common practice and is virtually a requirement of the grower's contract. For this reason it is expected that sugar beet farms are quite well supplied with phosphorus. Some barnyard manure has been applied to beet fields since the inception of the industry, but of recent years growers have become more aware of its benefits to the extent that at the present time about twenty percent of the beet land receives manure during the rotation cycle.

Table 1.—Mean Yields in Tons per Acre of Sugar Beets Grown Under Different Fertilizer Side-Dressing Experiments in Southern Alberta in Three Successive Tests During 1948, 1949, and 1950.

1948					
Amount and kind of fertilizer used for side-dressing	Check	100 lb.	250 lb.	500 lb.	
	No side-dressing	11-48-0	16-20-0	21-0-0	
Mean Yield	13.86	13.59	13.97	14.04	
1949					
Amount and kind of fertilizer used for side-dressing	Check	140 lb.	270 lb.	540 lb.	
	No side-dressing	21-0-0	21-0-0	21-0-0	
Mean Yield	11.96	11.80	12.19	12.70	
M. S. D. = 0.41					
1950					
Amount and kind of fertilizer used for side-dressing	Check	230 lb.	460 lb.	150 lb.	300 lb.
	No side-dressing	21-0-0	21-0-0	23-0-0	23-0-0
Mean Yield	12.32	13.57	14.00	13.66	14.34
M. S. D. = 0.92					

Outline of Experiments

In 1948, 1949 and 1950, in cooperation with the Canadian Sugar Factories Ltd., and the Consolidated Mining and Smelting Co. Ltd., experiments were undertaken by the Dominion Experimental Station, Lethbridge, to study the effect of applying additional fertilizer as a side-dressing to sugar beets. The effect on the percentage of sucrose as well as the yield of beets has been considered. Suitable fields of sugar beets were selected on different farms, widely scattered throughout the beet growing districts of southern Alberta. Tests were conducted on a total of 53 farms during the three years.

The side-dressing machine provided for four rows of beets to be side-dressed at one time with both sides of each row receiving fertilizer at a depth of three inches. The side-dressing was done soon after thinning and before the first irrigation.

¹ Senior Agronomist, Ottawa, formerly Agronomist, Dominion Experimental Station, Lethbridge, and Graduate Assistant, respectively.

The 1948 experiment was designed to compare the response of sugar beets to nitrogen and phosphorus fertilizers, and consisted of four treatments. The side-dressing fertilizer applications were:

1. 100 pounds of 11-48-0 per acre
2. 250 pounds of 16-20-0 per acre
3. 200 pounds of 21-0-0 per acre
4. Check (no fertilizer used for side-dressing, but all check plots received the usual 100 pounds of 11-48-0 at the time of seeding)

As in the two following years the treatments were in duplicate on each farm. A treatment plot consisted of eight, twelve or sixteen rows throughout the full length of the farmer's field. During all seasons the plots were sampled, usually during the first week of October, to provide material for sucrose and purity determinations, and all plots were harvested during the

Table 2.—Variance Table Showing Analysis of Yields of Sugar Beets Grown Under Different Fertilizer Side-Dressing Treatments in Southern Alberta in Three Successive Tests during 1948, 1949, and 1950.

Variance due to	1948		1949		1950	
	D.F.	Mean Square	D.F.	Mean Square	D.F.	Mean Square
Treatments	3	1.64	3	4.10**	4	14.07**
Reps. in General	8	0.95	13	1.38*	12	10.44**
Farms	7	59.59**	12	24.04**	11	111.84**
Treatments x farms	21	0.90	36	0.61	44	1.11
Error	24	0.64	39	0.55	48	2.51
Total	63		103		119	

first two weeks of October. The yields were calculated from the total weight of beets grown on the plots, since the production from each plot was delivered separately to the sugar company's receiving station.

The data for the three years are summarized in Tables 1, 2 and 3. The 1950 results from individual farms are shown in Tables 4 and 5.

In 1949, phosphorus fertilizer was not used for side-dressing and the primary objective of the experiment was to determine the most practical amount of nitrogen fertilizer to be used as a side-dressing. The treatments were as follows:

1. 140 pounds of 21-0-0 per acre
2. 270 pounds of 21-0-0 per acre
3. 540 pounds of 21-0-0 per acre
4. Check (no fertilizer used for side-dressing)

An additional purpose of the 1950 experiment was to compare the effectiveness of the two common nitrogenous fertilizers, ammonium sulphate (21-0-0) and ammonium nitrate (33-0-0). The following treatments were used:

1. 230 pounds of 21-0-0 per acre
2. 460 pounds of 21-0-0 per acre
3. 150 pounds of 33-0-0 per acre
4. 300 pounds of 33-0-0 per acre
5. Check (no fertilizer used for side-dressing)

Discussion

Tons of Beets per Acre

The yield results of the 1948 experiment did not show wide differences and statistical analysis did not reveal significant differences between the treatments. However, a careful study during the growing season and of the resulting data indicated that, on some farms where response was most pronounced, the yield increases and improvement in growth due to nitrogen application were too large and too consistent to be ignored. Several farms showed no response, and there was no suggestion of an increase in yield due to phosphorus application on any farm, but two-thirds of the farms

Table 3.—Mean Percentages of Sucrose of Sugar Beets Grown Under Different Fertilizer Side-Dressing Treatments in Southern Alberta in Three Successive Tests During 1948, 1949, and 1950.

		1948		
Amount and kind of fertilizer used for side-dressing	Check	100 lb.	250 lb.	200 lb.
	No side-dressing	11-48-0	16-20-0	21-0-0
Mean sucrose percentage	17.5 ^a	17.1	17.2	17.1
		1949		
Amount and kind of fertilizer used for side-dressing	Check	140 lb.	270 lb.	540 lb.
	No side-dressing	21-0-0	21-0-0	21-0-0
Mean sucrose percentage	15.8	15.7	15.7	15.7
		1950		
Amount and kind of fertilizer used for side-dressing	Check	250 lb.	450 lb.	150 lb.
	No side-dressing	21-0-0	21-0-0	33-0-0
Mean sucrose percentage	17.6	17.3	17.0	17.2
				17.5

^a There were no significant differences between the percentages of sucrose resulting from the various treatments in any of the three years.

showed decided increases from the nitrogen fertilizer. For these reasons it was decided the following year that different rates of nitrogen fertilizer alone be used for side-dressing.

The 1949 results established that nitrogen fertilizer can be side-dressed to sugar beets profitably. However, the 540-pound application was the only rate which produced significantly higher yields. Because eight of the thirteen fields were either in fallow or grew a legume the preceding year, it was felt that the lower applications of nitrogen did not have a chance to express themselves. Therefore, the sugar company fieldmen were requested to select fields for the 1950 experiment, which, on the basis of the results of 1948 and 1949, would be expected to respond to additional nitrogen. The selected fields were of relatively lower fertility than in the two former years, the previous crop being sugar beets or cereal grains in all cases. Two different nitrogen fertilizers were used to compare their relative effectiveness.

The results from this experiment showed highly significant yield increases of all treatments over the check plots. The source of nitrogen had no effect on yields; plots treated with ammonium sulphate (21-0-0) or ammonium nitrate (33-0-0) gave essentially the same yields at comparable levels of nitrogen application.

Table 4.—Individual Farm Yields in Tons per Acre of Sugar Beets Grown Under Different Fertilizer Side-Dressing Treatments in Southern Alberta in 1950.

Grower	Reps	Amount and kind of fertilizer used for side-dressing				
		460 lb. 21 0-0	Check No Side-dressing	3001b. 33-0 0	1501b. 33-0-0	2301b. 21-0-0
Schmidt	1	17.23	17.10	17.55	17.37	17.43
	2	17.40	16.51	17.55	17.66	16.88
Barton	1	16.40	12.59	21.33	22.10	18.30
	2	19.07	13.90	17.93	13.40	16.59
Zink	1	19.50	15.77	18.47	17.22	17.28
	2	17.67	13.58	17.12	15.09	15.63
Dueck	1	16.14	9.99	14.98	14.52	13.82
	2	11.62	10.15	12.99	12.55	11.69
Boras	1	14.81	12.14	12.38	12.33	13.98
	2	16.43	16.11	16.11	13.28	16.45
Johnson	1	12.12	10.04	11.53	12.10	14.33
	2	12.04	10.92	15.07	12.86	10.68
Jensen	1	14.19	13.42	15.62	15.20	14.14
	2	17.15	15.81	17.39	16.57	16.34
Thomas	1	18.97	16.53	17.80	20.95	18.00
	2	15.24	12.78	15.58	12.23	12.36
Knoch	1	9.50	9.82	11.94	11.27	10.82
	2	10.36	10.41	11.02	6.70	7.86
Bartz	1	14.37	11.31	13.94	13.39	13.94
	2	14.02	13.71	14.70	15.04	15.45
Dahl	1	10.85	10.88	10.51	10.38	9.65
	2	9.38	9.87	9.46	11.54	9.84
Toth	1	5.45	5.44	6.38	6.74	6.99
	2	6.21	7.02	6.85	7.43	7.29
Mean yield		14.00	12.32	14.34	13.66	13.57

Percent of Sucrose

The mean percentages of sucrose for the different treatments within each experiment were very similar in amount as is indicated in Table 3. A study of the data for the individual farms revealed no tendency for the superiority of any one treatment. The mean percentages of sucrose for the check plots which received no additional fertilizer as a side-dressing were slightly higher for each of the three years. However, this increase seemed to be due to chance variability since it is accounted for almost wholly by two rather high-testing plots for each year, which gave readings up to 19.8 percent sucrose. The duplicates of these plots showed much lower percentages. The contention that this slight superiority in percentage sucrose is not real was borne out also by the statistical analysis. In spite of the large number of replications of these treatments over a wide variety of farms, the statistical reduction of the data showed no tendency for the fertilizers applied shortly after thinning to significantly influence the percentage of sucrose.

Conclusions

The results from these tests indicate that fields which have been intensively cropped without any organic manurial additions may be expected to be low in nitrogen and probably will react favorably to side-dressed applications of chemical nitrogen fertilizer, in addition to 100 pounds of 11-48-0 at seeding time. Such side-dressed applications are not so likely to produce increased yields on fields which have been summer-fallowed or

Table 5.—Individual Farm Percentages of Sucrose of Sugar Beets Grown Under Different Fertilizer Side-Dressing Treatments in Southern Alberta in 1950.

Grower	Reps	Amount and kind of fertilizer used for side-dressing				
		460 lb. 21-0-0	Check No Side-dressing	300lb. 33 0-0	150lb. 33-0-0	230lb. 21-0-0
Schmidt	1	18.4	17.8	17.6	17.8	18.0
	2	16.8	18.0	18.0	15.4	17.8
Barton	1	17.7	17.4	18.0	17.6	17.3
	2	17.8	18.0	17.6	18.4	17.5
Zink	1	16.8	17.4	16.2	16.2	16.6
	2	17.2	17.0	16.6	17.4	16.4
Dueck	1	18.2	18.6	17.6	18.0	17.8
	2	15.0	17.4	17.2	17.2	18.0
Johnson	1	17.0	16.8	17.4	17.0	17.2
	2	17.0	16.2	17.0	17.2	17.6
Jensen	1	16.0	18.0	18.6	17.8	18.4
	2	18.2	18.8	18.2	20.2	18.0
Thomas	1	16.0	18.0	16.6	17.4	16.6
	2	17.4	18.8	17.8	17.8	18.0
Knoch	1	16.2	17.2	16.2	17.2	16.8
	2	16.4	17.2	16.6	14.8	16.4
Bartz	1	17.0	18.4	18.0	18.2	17.8
	2	18.0	17.8	17.2	18.2	17.4
Dahl	1	16.4	17.4	15.2	16.0	14.8
	2	14.4	16.2	15.0	14.6	15.4
Toth	1	17.4	18.2	19.4	18.8	18.4
	2	18.8	16.4	19.4	16.0	18.4
Mean percentage of sucrose		17.0	17.6	17.3	17.2	17.3

manured recently. The most efficient and profitable rate of application seems to be between 200 and 300 pounds of ammonium sulphate or ammonium nitrate at a comparable rate of nitrogen. As was shown in the choice of fields for the 1950 experiment, the sugar company fieldmen appear to be able to select fields, on the basis of crop history, which will respond favorably to side-dressing with nitrogen fertilizer.

There was no evidence to indicate that the amounts of fertilizer, as they were applied early in the season under the conditions of these experiments, affected the sucrose content of the beets.