

# Effect of Nitrogen on the Yield and Sucrose Content of Sugar Beets

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## Introduction

Basic principles of maintaining soil fertility involve a sound crop rotation program in which crop residues are utilized and livestock are fed to keep fertility on the farm, and commercial fertilizers are used to replace the plant food elements which are sold and leached from the farm.

The use of commercial fertilizer to help supply nitrogen and phosphate needs has become an important part of sugar beet production.

There no longer can be any question concerning the necessity of supplying and maintaining adequate levels of nitrogen and phosphorus. However, there is a growing concern in the sugar beet industry relative to the use of excess amounts of nitrogen. It is important that commercial fertilizers be used in amounts which will produce maximum amounts of sugar per acre. The studies reported in this paper were conducted to determine the level of nitrogen application which would be most advantageous to both the farmer and the processing company.

## Experimental Trials

During the 1956 season field trials were conducted in Utah, Idaho, South Dakota, and Washington to test the effect of a wide range of nitrogen levels on both yield and sucrose percentage. Approximately one hundred pounds of  $P_2O_5$  were applied on all tests so that nitrogen was the variable studied.

There were 35 field trials in all. The range of nitrogen levels tested in each area is shown in Tables 1, 2, and 3. Each test consisted of 8-row strips of each nitrogen level and each set of treatments was in triplicate on each farm. Farms selected for test were located in widely separated parts of each district so that the final results would indicate an average result for each of the areas involved. The effects of these rates on yield, sucrose percentage and indicated gross sugar per acre are shown in Tables 1, 2, and 3.

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Table 1.—Effect of Nitrogen Rate on Yield of Beets per Acre in Various Districts During 1956.

District	No. of Tests	Pounds of Nitrogen Applied per Acre					
		40 Lbs. N	80 Lbs. N	120 Lbs. N	160 Lbs. N	200 Lbs. N	240 Lbs. N
		Tons	Tons	Tons	Tons	Tons	Tons
South Utah	5	27.10	27.99	28.83	29.13	—	—
Garland, Utah	4	21.33	23.58	24.68	24.50	—	—
Idaho	10	18.03	19.61	20.87	20.81	—	—
South Dakota and Nebraska	8	19.26	19.78	20.60	21.04	—	—
Washington <sup>1</sup>							
New Land	4	—	26.85	28.27	29.34	30.48	31.22
Old Land	4	—	28.94	29.43	29.70	28.99	28.07

<sup>1</sup> Nitrogen requirements appear to be much higher on land which has been farmed a short period as compared to requirements on land in older farming areas.

Table 2.—Effect of Nitrogen Rate on the Sucrose Content of Sugar Beets in Various Districts During 1956.

District	No. of Tests	Pounds of Nitrogen Applied per Acre					
		40 Lbs. N	80 Lbs. N	120 Lbs. N	160 Lbs. N	200 Lbs. N	240 Lbs. N
South Utah	5	15.90	15.46	15.20	14.59	—	—
Garland, Utah	4	15.30	15.02	14.77	14.45	—	—
Idaho	10	15.80	15.79	15.72	15.39	—	—
South Dakota and Nebraska	8	15.07	14.48	14.47	13.77	—	—
Washington							
New Land	4	—	17.52	17.45	17.27	17.13	16.58
Old Land	4	—	15.12	15.53	15.20	14.77	15.01

It is evident from the data in Table 1 that nitrogen applications increased the yield in all areas. Judging from tests conducted in previous years, the first increment of 40 pounds of N undoubtedly gave the greatest response. In some areas there continued to be yield increases over the entire range of nitrogen applied, but in the balance of the areas maximum yields were obtained at rates lower than the maximum applied.

In all areas there was a marked and continued decrease in sucrose percentage over the entire range of nitrogen applications (Table 2). However, this decrease became proportionately greater as nitrogen rates increased and as yield increase became proportionately smaller.

Table 3.—Effect of Nitrogen Rate on Yield of Indicated Gross Sugar per Acre. Tests Conducted in 1956.

District	No. of Tests	Pounds of Nitrogen per Acre					
		40 Lbs. N	80 Lbs. N	120 Lbs. N	160 Lbs. N	200 Lbs. N	240 Lbs. N
South Utah	5	8614	8680	8812	8590	-----	-----
Garland, Utah	4	6526	7084	7290	7080	-----	-----
Idaho	10	5653	6173	6533	6375	-----	-----
South Dakota and Nebraska	8	5767	5854	5952	5779	-----	-----
Washington							
New Land	4	-----	9356	9857	10121	10421	10286
Old Land	4	-----	8712	9135	9015	8543	8397

It can be agreed that the optimum rate of nitrogen per acre is at some level slightly below the rate giving the highest yield of gross sugar per acre. Looking at the data on indicated gross sugar per acre it is noted that in every case the maximum amount of gross sugar per acre was produced at a rate of nitrogen application which was below the maximum applied (Table 3).

In Utah, Idaho, and South Dakota the maximum amount of gross sugar was produced by 120 pounds applications of N and it is judged that the optimum rate of nitrogen application is about 100 pounds of N per acre.

In Washington there was a marked difference between tests located on farms in the older established farming areas and those on farms which had only been under irrigation for a four- or five-year period. In the older area the optimum rate of application seemed to be not more than 120 pounds of nitrogen per acre. In the new farming area the optimum rate seemed to be somewhere between 175 and 200 pounds of N per acre.

These yield results were also confirmed by petiole tests using Diphenylamine. In Utah, Idaho, and South Dakota, 40-pound applications of N started showing deficiency symptoms, or lack of available nitrates, in beet petioles by about August 20; the 80-pound applications showed shortage of nitrates about September 25th; the 120-pound applications showed surplus nitrate in the petioles as late as October 15.

In Washington, petiole tests indicated that on the older farm land 160 pounds of N were in excess of requirements, while on new farm lands the petiole tests indicated that the application of N needed to be 200 pounds or more per acre before an excess amount of nitrate was available in the petioles at harvest time.

### Summary

These data show the importance of properly evaluating nitrogen needs in various areas and on individual farms within any area.

Knowledge of the crop history, past fertilizer practice, and the yield level on individual farms is an important guide in estimating nitrogen needs. However, general conclusions can be drawn which serve as a guide in avoiding excess nitrogen use. It would appear that in most short season areas 80 to 100 pounds of N per acre will supply the needs of the sugar beet crop. In long season areas and on new land the requirements will be higher and may run as high as 200 pounds of N per acre.

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