Possibilities of Improved Nitrogen Fertilization of Sugar Beets Through the Use of Leaf Analysis

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The problem of nitrogen fertilization in many areas is quite complicated (1) (4) *r* Responses to nitrogen may vary so markedly from field to field that it is impossible, even on the basis of field experiments, to arrive at general recommendations which will be satisfactory for a high percentage of fields. Furthermore, this variation in response to nitrogen not only occurs between adjacent fields, but can occur on the same field in different years. Table 1 gives the results of two trials conducted on the same field at closely associated locations and shows the variation in response to nitrogen on succeeding beet crops.

In some locations, such as the Woodland area of California, nitrogen appears to be one of the principal factors limiting yields and influencing sugar concentrations. During the crop years of 1949 and 1950 the Spreckels Sugar Company conducted a survey of sugar beet production problems in this area (2) . This study utilized leaf analysis as a tool in evaluating the nutrient status of a large number of beet fields. The results indicated that in many fields yields were limited because of nitrogen deficiency and in others a high nitrogen level late in the season appeared to be one of the major reasons for lower sucrose concentration. The nitrogen status, as indicated by periodic petiole samples, of Field A in Figure 1 is typical of

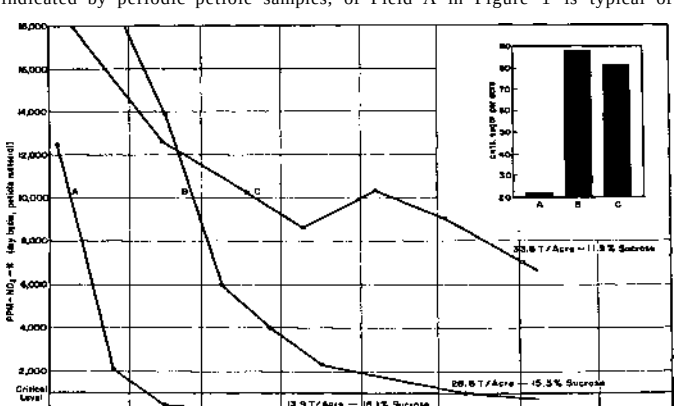

Figure 1.—The nitrogen status of three sugar beet fields as indicated by periodic petiole samplings.

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[2] Numbers in parentheses refer to literature cited.

Table 1.—Effect of Nitrogen on Yield of Sugar Beets Grown on the Same Field in Different Years.

	Tons/Acre		% Sugar		Tons Sugar/Acre	
Lbs. N/Acre	1947	1950	1947	1950	1947	1950
0	25.0	14.6	17.5	15.6	4.38	2.26
80	27.9	20.0	16.9	15.6	4.71	3.13
160	28.0	21.6	16.1	15.0	4.52	3.24
240	27.8	20.9	15.5	13.9	4.47	2-90
LSD 19:1	2.1	1.3	0.5	0.3	NS	0.16

a field becoming deficient early in the season.

Figure 2 illustrates a correlation between the nitrogen status of beet fields and their sucrose concentration at harvest. The fact that such a correlation is obtained among fields differing greatly in management practices is evidence that nitrogen probably plays an important role in determining the sucrose concentrations of fields in such an area. In view of this situation, it would seem that there is much to be gained through more efficient fertilizer programs.

Through greenhouse and field experiments, the relationship of the nitrate content of beet petioles to the growth of sugar beet plants has been determined (3). A critical range has been established of 1,000 to 2,000 parts per million nitrate-nitrogen (dry basis). When the concentration of this nutrient in the petioles falls into this range, the growth of the plants will decrease. This critical level concept has been verified many times by field experiences. Figure 1 indicates how this technique can be used to evaluate how well a given crop was supplied with nitrogen. It is reasonable

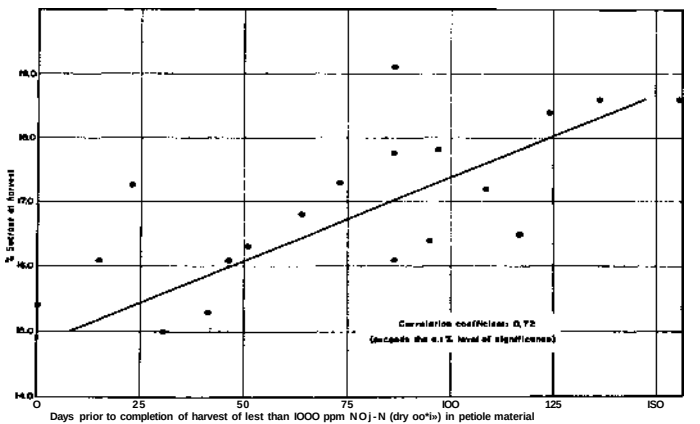

Figure 2.—The relationship of the duration of nitrogen deficiency, as indicated by petiole analysis, to sucrose concentration at harvest.

to conclude from such data, for fields which were observed closely throughout the growing season as these were, that a good deal of the difference in the performance of these crops was due to differences in the amount of nitrogen available. Obviously heavier nitrogen applications should be considered for Field A while it appears that Field C might have had a higher sucrose concentration if less nitrogen had been used. With respect to nitrogen, Field B appears to have been adequately fertilized.

Plant analysis might also be used effectively to indicate the need for supplemental nitrogen applications on growing crops. This would be particularly true with extreme fields. In cases where low fertility is suspected a basic nitogen application could well be supplemented profitably by another application should petiole samples indicate an approaching deficiency relatively early in the season. On fields of known high fertility, such as Field C in Figure 1, it might be well not to apply nitrogen but to watch the field closely through a petiole sampling program and fertilize only if the need arises.

In applying plant analysis to the problem of nitrogen fertilization of the current season's crop certain important considerations should be kept in mind. When the concentration of nitrate in the petioles falls below the critical level the growth rate of the plants will decrease. Plant analysis, however, can not tell how serious the deficiency is, how much fertilizer should be added to correct the deficiency or the magnitude of response to expect when the deficiency is corrected. These questions can only be answered by trial and through experience in a given area.

Experience gained to date indicates that investigations should be continued under a wide range of conditions so as to determine how leaf analysis can best be used to aid sugar beet fertilization.

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