Physiology of Growth, Sugar Accumulation and Mineral Intake of Sugar Beets[1]

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Preliminary Report

Physiology of growth, accumulation of sugar and mineral content of tops and roots of sugar beets were studied during 1918 and 1949 in six continuous beet plots at Huntley Branch station, Huntley, Montana. These six plots were fertilized since 1942 with the following amendments: Plot 2e was fertilized with phosphorus, nitrogen and manure, plot 2d with phosphorus and manure, plot 2c with nitrogen, plot 2b with manure and plot 2a with phosphorus. Plot 2 was not fertilized and was used as a check. On an acre basis, manure was applied at the rate of 12 tons, nitrogen at 125 lb. as ammonium sulphate and phosphorus as treble superphosphate at 125 lb.

Data pertaining to the physiology of growth, sugar determinations and quantitative measurement of nitrate nitrogen and acid soluble phosphate phosphorus in the petioles were made nine times during the growing season. Quantitative chemical analyses of sugar beet roots and tops for N, P, K, Ca and Na were made three times during the growing season. The soil of each plot was analyzed for available phosphorus four times during the growing season.

Readings of diseases in all these plots were made several times during the growing season.

The effect of soil fertilization was correlated with the growth of beets, sugar and mineral composition and the disease situation in these plots.

The results obtained during this investigation indicate that the growth of beets and their physiology were quite different in relatively poor (2, 2a, 2c) and good (2b, 2d, 2e) plots.

The ratio in weight of sugar beet roots between the poorer and better plots as determined in the first part of August was equal to 1:2.6 in 1948 and 1:2.4 in 1949. These same ratios remained approximately constant until harvest time.

The results indicate that, when beets emerge about May 15, their roots should weigh at least 0.5 pound each by the first part of August to produce a good yield.

The greatest development of beet tops in the better plots occurred from thinning to the middle of August. In the poorer plots the tops of the sugar beets made a gradual growth throughout the season and always remained relatively small.

The ratio in weight of tops of beets in the poorer and better plots was equal to 1:3, as determined in the middle of July and August in both years.

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Toward the end of the growing season the tops of the beets showed a decrease in weight in all plots.

The results show that good size of tops early in the season is a very important predisposing factor for good ultimate performance of the crop. According to the results, it appears that, when beets emerge approximately May 15, their tops should weigh on an average at least a half pound each by the middle of July and a pound by the middle of August in order to produce good yields.

Beets grown in all plots showed the highest number of leaves during August. The number of leaves did not change a great deal after reaching a maximum and in most cases decreased slightly toward fall. The ratio between averages of the number of leaves developed by beets in poorer and better plots was equal to 1:1.8 in 1948 and 1:1.5 in 1949 as determined in the first part of August. The same ratio for the maximum of leaves produced by beets at any time during the growing season was equal to 1:1.3 for poorer and better plots for both years.

These figures show that the number of leaves which beets develop is also a significant factor for judging the ultimate performance of a crop.

Beets grown in all plots in both years showed the maximum development of leaf area by the middle of August. Then the area of leaves decreased gradually toward fall. The ratio between the averages of leaf areas developed by beets grown in poorer and better plots was equal to 1:1.6 in 1948 and 1:1.4 in 1949 as determined in the first part of August. The same ratio for the maximum of leaf area developed by beets at any time during the growing season was equal to 1:1.3 in 1948 and 1:1.5 in 1949.

Variations in size of leaves of beets grown in poorer and better plots are quite similar to those in number of leaves.

In judging top to root ratios of beets, it is considered that 35 to 40 per cent for tops and 60 to 65 per cent for roots is a good proportion for beets at harvest time. On this basis beets grown in plots 2, 2a, 2d and 2e (Check, P, PM, and NPM respectively) had more favorable top to root ratios than beets grown in plots 2b (M) and 2c (N). The tops of beets grown in the last two plots were proportionately too heavy in comparison to the roots. Apparently continuous fertilization with manure and nitrogen created in the soil some excess of nitrogen or deficiency of available phosphorus or both.

The percentage of sugar in beets increased rather rapidly until the end of July; then the sugars increased at a rather slow rate and especially during September. The greatest differentiation in percentage of sugar in all these plots during both years usually occurred during the early part of growth. During the first part of August beets grown *in* better plots showed at least two per cent less sugar than those grown in poorer plots. At the end of the growing season the percentage of sugar was about the same in all plots.

The occurrence, during the first half of the growing season, of a higher percentage of sugar in beets grown in poorer plots as compared to those grown in better plots can be used as a factor of negative correlation with the final production of beets.

Chemical analyses of tops and roots of sugar beets for nitrogen, phosphorus and potassium showed that the percentages of these elements in tops and roots of beets follow closely the productivity of soil and the ultimate yields of beets. It is difficult to establish a similar type of correlation for sodium and calcium.

Colorimetric tests of sugar beet petioles for phosphorus showed that generally beets grown in better plots had a higher percentage of phosphorus than those grown in poorer plots. Analyses of beet petioles for nitrogen have not been completed.

Soil analyses for available phosphorus showed that the soils of plots 2 (check) and 2c (N) had the lowest amount of phosphorus in both years. The soils of the remaining plots (2a (P) , 2b (M) , 2d (PM) and 2e (NPM)) with some exceptions showed a fairly good supply of available phosphorus.

More seedling diseases and fusarium yellows of beets occurred in beets grown in poorer plots than in those grown in better plots.