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Sugarbeet rooting depth has long been known to reach at least six feet. A photograph taken in 1930 provides evidence that sugarbeet roots are deep-rooted (Figure 1.)

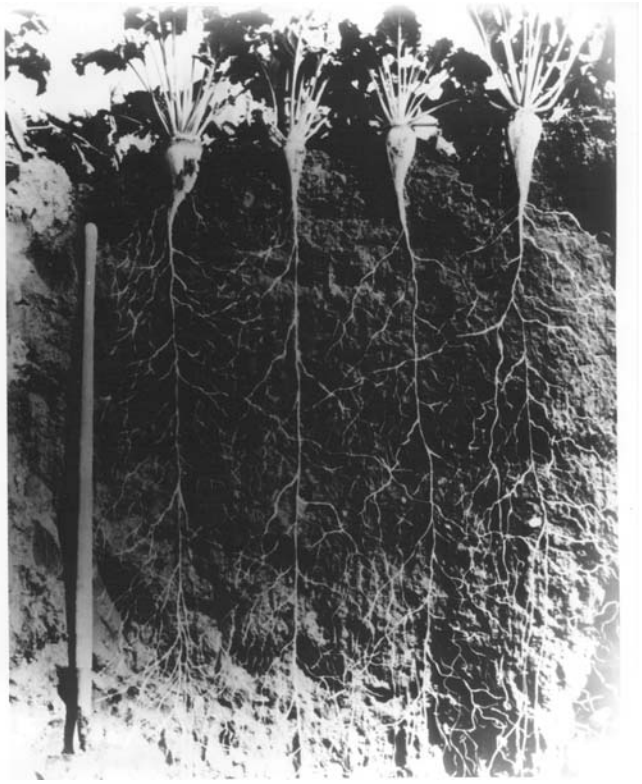

Figure 1. A photograph taken in 1930 by Lyman Andrews of Great Western Sugar Company in Scottsbluff, NE. An irrigation ditch had broken loose and exposed sugarbeet roots. Approximate depth of these roots is between 4-5 feet. Image courtesy of Dave Hilde, Allan Cattanach and American Crystal Sugar.

Additional evidence of sugarbeet rooting depth are experiments which show that sugarbeet extracts residual soil N from depths of at least 6 feet (Moraghan, 1985; Franzen et al., 2000).

Sugarbeet seed companies generally group their variety selections into two groups; high sugar varieties, or tonnage varieties. Tonnage varieties have higher tonnage, but lower sugar, while sugar varieties generally have a little lower tonnage, but higher sugar. Lately, there have been reports that fields where residual soil nitrate is very low due to the use of site-specific farming techniques, such as using sugarbeet leaf N to reduce fertilizer N requirements within a sugarbeet rotation, variable-rate N applications,

and use of N credits from other N providing crops, high sugar variety yields are usually low and tonnage varieties are much more profitable.

There may be several reasons for this problem to develop. There may be physiological differences in sugar storage mechanisms between the two types of varieties, or there may be differences in rooting habits. If sugar varieties were more shallow rooted, in fields with higher residual nitrate at depth, these varieties would not be as affected as varieties that root down into these depths and extract late-season N. The purpose of this study was to observe the rooting depths of several sugar and tonnage varieties within the same test plot environment to see if there were differences between them.

Methods

A sugarbeet variety trial was located near St. Thomas, ND, just west of the Pete Carson home farm. The soils in the trial were Glyndon silt loams. The trial included both sugar and tonnage varieties. There were no interfering weeds within the trial. Two methods for locating and measuring rooting depth were implemented. A Giddings soil core machine with a 3 inch diameter soil corer was backed into each variety, and three cores were obtained to a depth where no further roots were detected. This method assumed that roots would generally follow a straight-down path.
The soil core was split apart and examined thoroughly for any sign of roots from the deepest depth of core towards the surface. The deepest rooting depth within each core was recorded. Three sugar varieties and three tonnage varieties were examined.

A small back-hoe was used to dig a soil pit approximately 8 feet deep, three feet wide and 6 feet long. The soil pit was "faced" using a spade, trowel and knife to expose sugarbeet roots. Within two sugar variety pits and two tonnage variety pits, soil samples were extracted from depth increments and sent to a lab for nitrate analysis.

Results

There were no significant differences in rooting depths between the sugar varieties and the tonnage varieties in this experiment. The soil core method, which was the only method where statistical analysis was possible, did not generally find roots at the same depth at which it was possible to reveal them using the back-hoe method. Using the soil core method, the range of rooting depths found was between 44 inches and 81 inches. Careful examination of rooting structure, following the track of sugarbeet roots from the storage root downward, usually showed that the main taproot started branching and became more diffuse at about 36 inches in depth. Below that point, the track of roots tended not to directly follow a straight downward path. Deepest depth measurements in the four soil pits examined ranged between 64 inches and 74 inches.

There were no significant differences between varieties and nitrate analysis at any depth, although one might imagine such a difference from the graph (Figure 2). However, it does show that residual nitrate levels at the surface and between 4 and 6 feet in depth were higher than those in the middle depths.

Despite the lack of rooting depth differences between varieties found using the soil core technique, root yield differences between varieties was large (Table 1). The

highest sugar variety in the trial yielded only 14.2 ton/acre, while the highest tonnage variety yielded 23.1 ton/acre.

Table 1. Yield, recoverable sucrose per acre and gross return per acre from four varieties. Variety 1 is a high tonnage variety, varieties 2 and 3 are intermediate varieties and variety 4 is a high sugar variety.

Variety	Root Yield Tons/a	Recoverable Sucrose lb per acre	Gross Return per acre ($)
1	23.4	6476	664
2	15.4	4510	484
3	17.2	5080	552
4	14.2	4190	455
LSD 5%	0.4	120	15

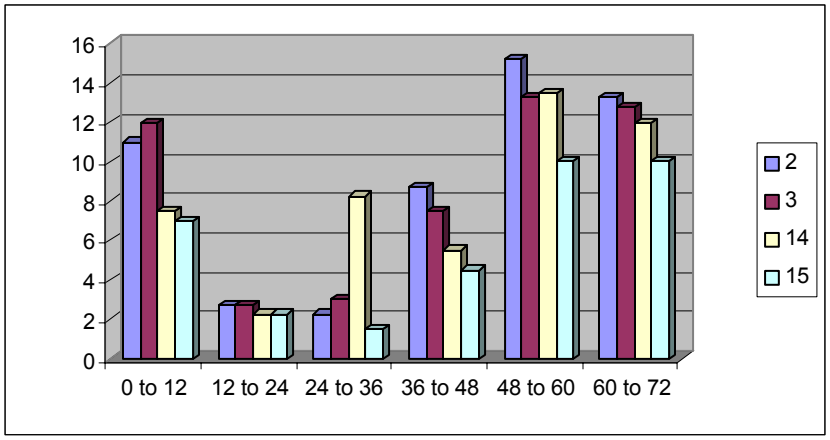

Figure 2. Nitrate analysis at rooting depths adjacent to roots within 4 varieties. Each bar represents a different observation. X-axis is depth increment, Y-axis is ppm nitrate. There were no differences in nitrate between varieties at any depth.

Summary

This was a preliminary study to compare different rooting depth measurement techniques and to determine if differences in rooting depths could be seen between tonnage and sugar variety types. The soil core method did not prove to be a reliable method for root depth determination. If screenings were conducted in the future, the use of replicated soil pits to depths of about 8 feet would be needed to gather the data needed to make a satisfactory determination. The soil nitrate data taken adjacent to sugarbeet roots at depth increments is interesting in that a range of residual nitrate is found between observations, with highest residual N found at the surface and the 4-6 foot depths. If

differences in efficiencies of nitrate uptake were found in future studies, it might explain why sugar varieties do better where residual N is higher, and tonnage varieties in these low N conditions are so much more profitable.

References

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