

NITROGEN REQUIREMENT FOR SUGAR BEETS: A SUMMARY OF PAST AND PRESENT RESEARCH FINDINGS

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INTRODUCTION

Nitrogen management is an important management factor in row crop production. In sugar beet production it is especially important due to decreased profits associated with under and over supply of N relative to crop requirements. Under supplying N greatly affects root yield, and over supplying N results in increased root impurities (decreases sucrose extraction efficiency) and decreased sucrose content. Much research has been conducted over time to determine optimum N supplies for sugar beet in various climates, soils, and management practices. One measure of N requirement or efficiency for sugar beet production is the lbs of N needed to produce a ton of beets (Nr). This paper seeks to highlight changes in N use within the U.S. sugar beet production and the Nr values determined from studies conducted in the U.S. sugar beet production areas over time.

RESULTS AND DISCUSSION

Yield Improvements

Improvements in genetics and overall management have resulted in increased sugar beet yields in the U.S. over time (Figure 1). Improvement of N management has likely been a contributing factor to this steady increase over time. Fitting a linear regression model to this data set (1909-2010) results in a slope (average tons root yield increase/year) of 0.16. This corresponds to a 1 ton/acre increase every 6.25 years.

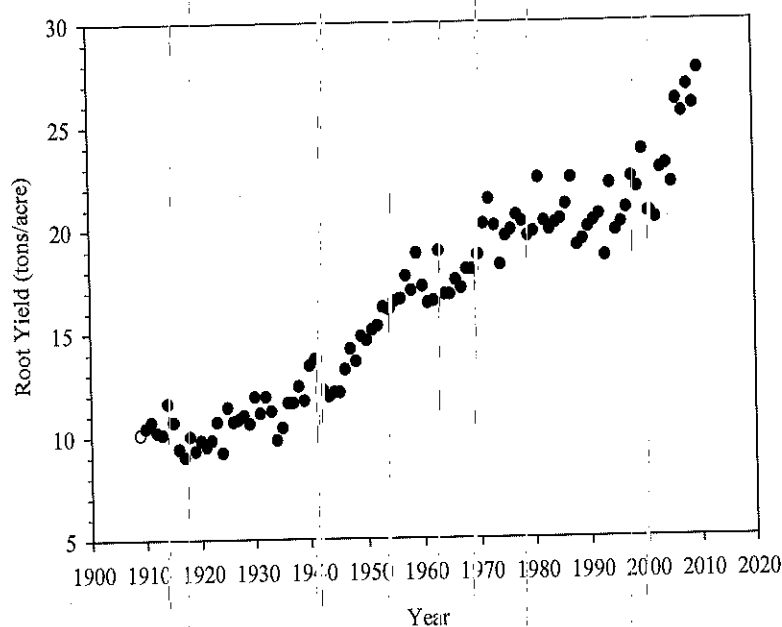


Figure 1. Average U.S. sugar beet root yield over time (USDA-NASS, 2011).

Yield and Available N

In the sugar beet growing area of North Central U.S. (American Crystal Sugar Company growing area), root and sucrose yields increased at an average rate of 0.28 tons roots/acre/yr and 119 lbs sucrose/acre/yr from 1980 to 2010 with total available N (pre-season soil $\text{NO}_3\text{-N}$ to 4 ft. + applied N fertilizer) remaining constant over time (Figure 2).

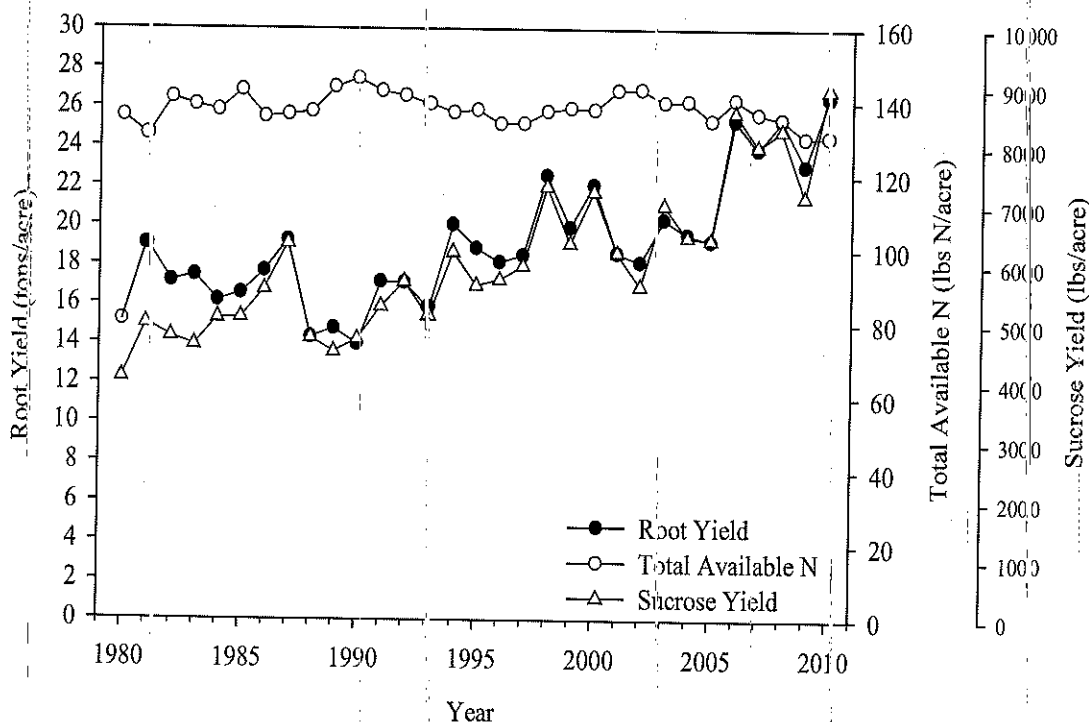


Figure 2. Average sugar beet root yield, sucrose yield, and total available N (pre-season soil $\text{NO}_3\text{-N}$ to 4 ft. + applied N fertilizer) over time in the American Crystal Sugar Company growing area (MN and ND). (Data supplied by American Crystal Sugar Company).

This data and the calculation of Nr values from this data set gives added evidence that N use efficiency (NUE) has increased over time (Figure 3). This increase in NUE has positive economic and environmental implications; decreased potential N losses to the environment and increased economic returns for producers. It is likely that other sugar beet growing areas are seeing the same trends. Past and current research has likely had a great influence on these positive trends.

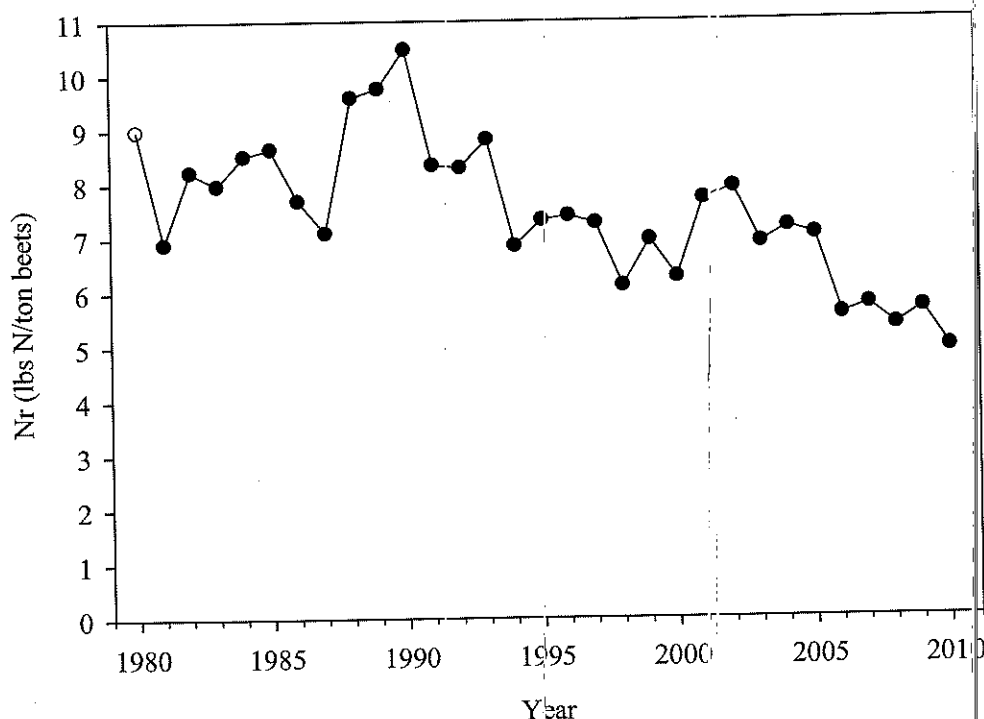


Figure 3. Average N requirement (Nr) of sugar beet over time in the American Crystal Sugar Company growing area (MN and ND). The N requirement supply was calculated based on actual root yields, measured soil $\text{NO}_3\text{-N}$ to 4 ft., and applied N fertilizer rates. (Data supplied by American Crystal Sugar Company).

A research literature search was conducted to obtain data sets where Nr to achieve maximum root or sucrose yield could be extracted. The ranges (minimum to maximum) of the Nr values are presented in Figure 4. There is no clear pattern of reduced Nr over time and there are large variations in Nr within a study and across studies. The reasons for these observations are likely a result of variability in climate, soil properties, and growth conditions. N requirements need to be evaluated on a site-specific basis. Producers can use information from research under similar conditions as found in their fields to estimate initial Nrs, then adjust as needed based on historical N rate, root yield, sugar yield, and sugar beet root sugar and quality. To fine-tune Nr, producers need to keep good records of sugar beet production in fields over time.

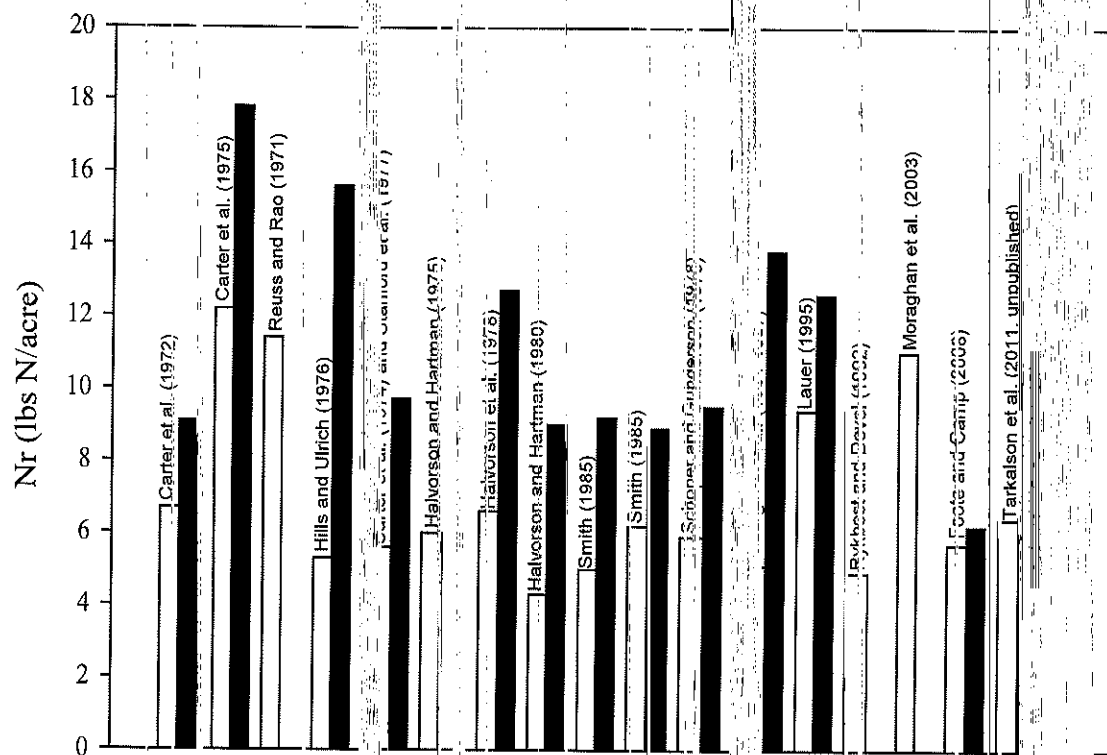


Figure 4. Nr values reported or calculated from research studies in North America. For each study the white bar is the minimum and the black bar is the maximum Nr value in the study.

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