



## Sugarbeet Soil Fertility

Soil fertility is the foundation in building a successful sugarbeet crop in Michigan. Nitrogen (N) is the most yield-limiting nutrient and critical in order to maximize sugarbeet yield and quality. However phosphorus (P) and potassium (K) fertilizer additions may also result in crop responses if not already present in adequate amounts but P and K application rates should be based on a soil test.

Soil sampling may be the most important part of soil testing. Grid sampling or separating the field by differences in soil texture, organic matter, slope, or past management (i.e., cropping or tillage system) tends to provide the most accurate recommendations. Within each sampling zone, collect about 20 cores to a depth of 8 inches and mix thoroughly.

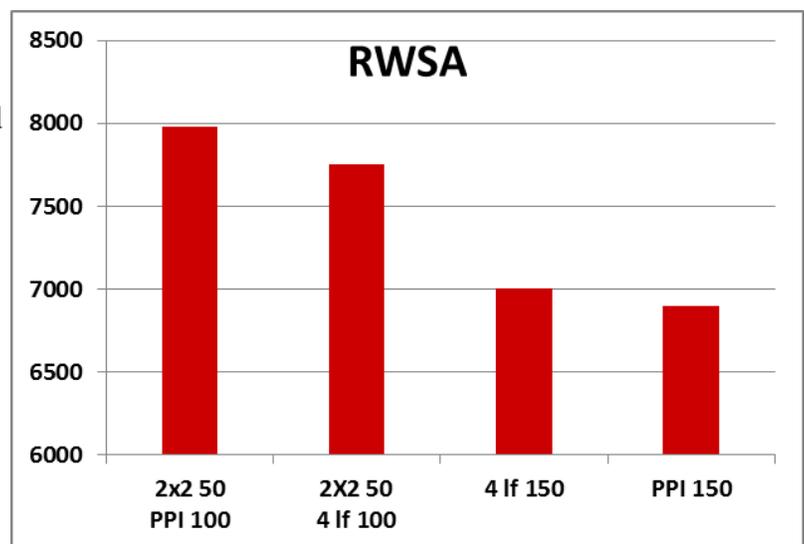
**Nitrogen (N) and Placement:** Michigan Sugar Co. and Michigan State University researchers recommend applying 40 to 50 pounds of N in a 2x2 (2 inches below the seed level and 2 inches away from the row) for 30 inch and 22 inch rows respectively at planting. **Table 1** illustrates the advantage of applying a portion of the N in a 2x2 at planting. This is most significant when planting into high residue crops such as corn and wheat stubble.

Sugarbeets require N early to attain canopy closure with smaller amounts of N required later for canopy maintenance. In the autumn canopy color should be declining and leaves yellowing otherwise significant sugar losses may occur if green and vigorous at harvest time.

Excess N late in the season will not increase yield but will reduce quality and sugar per ton. The total amount of N required depends on the amount of residue from the previous crop. Sugarbeet following high residue crops (corn and wheat) typically require 130-160 pounds of N while low residue crops (soybean and dry bean) typically require 90-130 pounds of N. Three factors that may reduce N application rates include: 1) high soil organic matter (> 3%), 2) manure application, and 3) clover or alfalfa plowed down. A plow down of a legume (e.g. clover) after wheat may supply anywhere from 40-80 pounds N per acre depending on the stand density, growth, and timing of the plowdown. Sugarbeet Advancement research indicated that 10,000 gallons of dairy manure applied in the fall may supply most of the sugarbeet N needs in addition to 40 pounds of N applied as a 2x2 at planting.

**Phosphorus (P):** P is generally immobile in the soil and is required for plant growth. Availability is reduced during the cool and moist early spring soil conditions often encountered during sugarbeet planting. Sugarbeets generally do not respond to fertilizer P on high P testing soils (>30 ppm) but growers may still wish to consider a 2x2 starter application of P at planting. Phosphorus application has been documented to increase root yields

Table 1: Nitrogen Application Timing (3 years, 3 locations)



in soils that are low in P (< 25 ppm) while not affecting sugarbeet quality. Soil testing above 50 ppm soil test P do not require P applications.

**Potassium (K):** K is essential to sugarbeet production and is more mobile in the soil than P but less mobile than N. Much of Michigan’s sugarbeet acres are grown in soils natively high in K. Potassium recommendations depend upon a soil’s cation exchange capacity (CEC) so growers need to closely examine changes in soil texture as this may have the greatest impact upon K recommendations.

Michigan’s P and K recommendations follow the build-up, maintenance, and drawdown philosophy which allow for a build-up of P and K when soil test levels are below critical. Sugarbeets growing on soils that test below critical in P or K

have a greater opportunity to respond to applied fertilizer and often result in an economic benefit to the grower. Build-up, maintenance, and drawdown levels for soil P and K (ppm) are shown in **Table 2**.

**Table 2: Sugarbeet Soil Analysis Levels for P and K.**

Nutrient	Soil Critical Level (ppm)	Soil Maintenance Level (ppm)	Soil Drawdown Zone (ppm)
P	25	25-40 (Apply 1.3 lbs P2O5/T)	40-50 (Apply 0.65 lbs P2O5/T)
K	75 + (2.5 x CEC)	Extends 30 ppm beyond critical level	Extends 20 ppm beyond maintenance level

**Micro-nutrients:** Of

the micronutrients, Boron (B) and Manganese (Mn) are the two that may often be considered for sugarbeets. Typically the most effective application method is in a 2x2 band at planting.

A Mn application of 4 - 18 pounds of Mn would be recommended in actual Mn-deficient situations. If applying as a preventative application, 1-2 pounds of Mn in a starter 2x2 band at planting would be recommended. If you opt not to apply Mn as a starter fertilizer, then a foliar rescue application of 1 to 2.5 pounds Mn per acre in 15 gallons of water is recommended as Mn sulfate or Mn chelate. This application rate may need to be spread over multiple spray intervals. Soil application of foliar chelates is not recommended as other cations (e.g., Ca or Fe) often replace Mn in the chelate and may convert to unavailable forms. Use a spray grade Mn and apply the higher rate on larger plants.

Mn deficiency in sugarbeets often appears as yellowing between leaf veins while veins remain dark green. Since Mn is not a mobile nutrient, chlorosis usually begins on the younger leaves. Do not confuse Mn deficiency with N deficient plants. N deficient plants tend to not have green veins whereas Mn deficient plants have uniform leaf yellowing with green veins.

Research in Michigan has not indicated need for a preventative application of B on sugarbeets grown on finer-textured soils. Sugarbeets growing on sandy or sandy loam soils may benefit from a B application. When applied early in the growing season (typically prior to mid-June) foliar and granular B applications seem to be equally effective. Application of 1 to 3 pounds of granular B in a 2x2 at planting would be recommended (1 pound for heavier soils and 3 pounds for sandier soils). Sodium borate would be the preference to use at this time. Foliar applications may require 1-2 sprays of 0.15 - 0.25 pounds in 15 gallons of water.

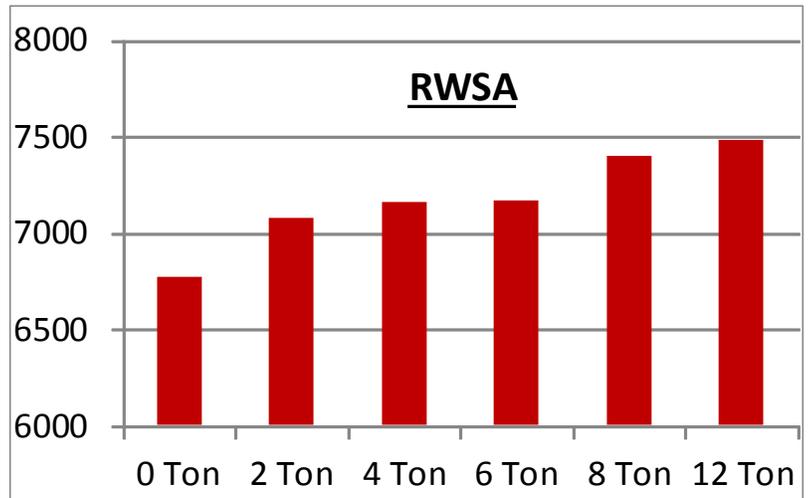
Like Mn, B is not mobile and symptoms of B deficiency in sugarbeets start with younger leaves, thus causing cessation of the terminal bud and white, netted chapping of the upper leaves and wilting of tops. Plants later exhibit crosswise cracking of petioles, death of the growing point, and heart rot of the root.

**Lime:** Sugarbeets do not grow well in acidic soils below pH 6.5. Soil test results will provide the current pH level of soils and whether liming should be considered. Sugarbeet growers often may utilize sugarbeet factory lime for adjusting soil pH. In addition to soil pH adjustments, other benefits for lime application may in-

clude 1) improving soil structure, 2) reducing the pressure of seedling *Aphanomyces*, and 3) accessing quantities of unavailable P, K and other micro-nutrients due to pH adjustments.

Soil pH will decrease over time and sandier soils will become acidic faster and have lower pH than fine textured soils. Recent trials have demonstrated some benefits to applying lime when it is not needed to raise soil pH as beet factory lime contains significant levels of plant nutrients (**Table 3**). In these trials, following lime application to high pH soil there has been some decrease in Mn tissue test levels but no Mn fertilizer was applied to these trials. Further research is being conducted to confirm if applying 2-3 tons of factory lime in the rotation before sugarbeets would be beneficial in Michigan Sugar Company's fertility recommendations.

**Table 3: Sugar per ton after factory lime application, 6 locations, 2 years**



#### Conclusions:

1. Return plant residue to the soil whenever possible.
2. Plant radish after wheat or pickles.
3. When using radish as a sugarbeet cyst nematode trap crop use Defender, Image or Colonel varieties.
4. Use a clover cover crop when growing wheat or plant a cover following wheat harvest.
5. Apply 40-50 pounds of N in 2x2 at planting for sugarbeets for 30 and 22 inch rows respectively.
6. Apply 90-130 pounds N after soybeans or dry beans and 130-160 pounds after corn or wheat not interseeded with a cover crop.
7. Reduce N rates with high OM soil, following manure application, and after clover or alfalfa.
8. Application of Mn and B may need to be considered for sugarbeets.
9. Lime should be used to keep the pH at 6.5 or above and applying 2-3 ton per acre of factory lime to soil with a good pH may increase production.

Contributing Author: Dr. Kurt Steinke, Soil Fertility & Nutrient Management  
Dept. of Plant, Soil, & Microbial Sciences  
Michigan State University, 517-355-0271

#### REACH Research Contacts



Jim Stewart, MSC Director of Research, 989-225-6720  
Greg Clark, MSC Agronomist, 989-891-6785  
Steve Poindexter, MSU Extension Educator, 989-798-5848  
Lee Hubbell, MSC Research Agronomist, 989-225-6708