NebGuide

University of Nebraska–Lincoln Extension, Institute of Agriculture and Natural Resources

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G1459

Fertilizing Sugarbeet

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Soil testing and calculating recommended rates for nitrogen, phosphorus, potassium and micronutrient fertilizers for sugarbeet.

Management practices which provide an adequate, but not excessive, supply of plant nutrients are essential for top yields of high quality sugarbeet in the High Plains. Yields of 22-28 tons per acre at 16 to 18 percent sugar can be attained most years with good management.

Soil Testing

Soil testing is the foundation of nutrient management in sugarbeets. The goal of soil testing is to characterize the amount of nutrients in the soil prior to planting. Fertilizers can then be applied to ensure optimal nutritional conditions for the crop.

Soil samples from the surface to a depth of 6 feet are necessary for the most accurate prediction of nutrient needs. These should include a plow-layer sample (0-8 inches), a sample from 8 to 24 inches and a sample from each 2-foot increment below 24 inches. Collect composite cores from at least 15 points in the field for the surface sample and from 8 to 10 points for the deeper samples. More than one set of samples may be necessary from some fields if parts of the field differ in slope or soil characteristics such as color, sandiness or previous crop. For more information on soil sampling refer to NebGuide G91-1000, *Guidelines for Soil Sampling*.

The plow layer sample should be analyzed for nitrate and all other nutrients, organic matter concentration, and soil pH. The deeper samples should be analyzed for nitrate only. The reasons for this difference in analysis are:

1) while most nutrients are not very soluble and are mainly in the top 8 inches of soil, nitrate is very soluble, and rainfall or irrigation may leach it from the plow layer; and
2) research and experience has shown that sugarbeets can utilize nitrate-nitrogen from depths of 6 feet or more. Soil samples from the plow layer alone do not accurately predict the amount of nitrogen available to the crop.

Nitrogen Recommendations

Under most circumstances nitrogen is the most limiting nutrient in sugarbeet production. Nitrogen is a building block of amino acids and proteins in plants. Chlorophyll, the most abundant protein in plants, gives them their green color. It is necessary for photosynthesis — the conversion of carbon dioxide gas and water into sugars with the help of light energy. Plants deficient in nitrogen contain less chlorophyll and appear light green. With increasing severity of nitrogen deficiency, leaves will appear yellow and older leaves will age prematurely. Symptoms of nitrogen deficiency appear first on older leaves.

Proper nitrogen nutrition in sugarbeet production is crucial. Lack of nitrogen will result in significant reductions in root yields, while excess nitrogen will promote significant decreases in sucrose content of the root and excessive leaf growth. Because of the significant effects of nitrogen on crop yield and crop quality, the goal of nitrogen management in sugarbeet is to supply enough nitrogen during the beginning and middle of the growing season to ensure optimal crop growth and canopy development and to exhaust nitrogen reserves in the soil toward the end of the growing season to obtain optimal crop quality.

About 9 pounds of nitrogen are necessary for 1 ton of harvestable sugarbeets. This nitrogen can be obtained from residual soil nitrogen within the rooting zone, become available from organic matter during the growing season (mineralization), or may be applied as fertilizer. Applied fertilizer should be considered a supplement to available soil nutrients. When assessing nitrogen needs of the crop, consider expected yield, organic matter concentration of the soil, and residual soil nitrate-nitrogen. The expected yield should be a reasonable estimate of what a grower can produce on a given field. Normally it should not exceed the average of the last five crops by more than 5 percent.

Fertilizer nitrogen recommendations can be calculated using the following equation or by using the information in *Table I*.

Nitrogen need (lb N/A) =
9 x EY - 30 x OM - RSN - other credits

Where EY = expected yield (tons/A),
OM = organic matter percent,
RSN = residual soil nitrogen measured to 6 ft depth (lb N/A).
For other credits see *Table II*.

Consider this example: A grower has a field with soil test values of 95 lb residual nitrate-nitrogen in a 6-foot soil profile and 1.2 percent soil organic matter. For this field, his yield goal is 24 tons of sugarbeets per acre.

The nitrogen fertilizer requirement is calculated as follows:

Nitrogen need (lb N / acre) = 9 x 24 - 30 x 1.2 - 95
Nitrogen need = 85 lb N / acre

Table I. Nitrogen fertilizer recommendations for a yield goal of 25 tons per acre.

Soil test	*Soil organic matter (%)*			
Nitrate-N	*0-1.4*	*1.5-1.7*	*1.8-2.1*	*2.2+*
lb/A 6ft	*Pounds of N per acre to apply*			
0-25	175	165	155	145
26-45	155	145	135	125
46-65	135	125	115	105
66-85	115	105	95	85
86-105	95	85	75	65
106-125	75	65	55	45
126-145	55	45	35	25
146-165	35	25	15	0
More than 166	0	0	0	0

All nitrogen fertilizer sources — ammonium nitrate (33-0-0); urea (45-0-0); urea-ammonium nitrate (28-0-0); and anhydrous ammonia (82-0-0) — are generally very effective. However, liquid and dry nitrogen sources vary in their susceptibility to volatilization or gaseous loss as ammonia to the atmosphere. Ammonium nitrate is the least susceptible, while urea is usually the most susceptible. With incorporation soon after application all nitrogen sources should be equally effective.

Recent research has shown that applying dry nitrogen fertilizer in spring prior to planting has a profound effect on stand establishment. Spring application of 100 lb nitrogen per acre of dry fertilizer reduced stands on average by more than 6000 plants per acre, regardless of fertilizer source and method of incorporation. Under gravity irrigation, it is advisable to apply nitrogen fertilizers in the fall or between the two- to six-true leaf growth stages. Nitrogen application with the irrigation water is very efficient. The practice of weed-and-feed (applying granular fertilizers impregnated with herbicide before planting) is discouraged because the high amount of fertilizer required to ensure good ground coverage of herbicide for weed control can have a negative effect on sugarbeet stand.

Manure application is not recommended for sugarbeet production. Much of the nitrogen from manure is released in the latter part of the season and tends to retard sugar accumulation in the root. When alfalfa precedes the sugarbeet crop, and/or if manure is applied, it must be noted on the soil sample information sheet so that adjustments to nitrogen application rates can be made. The following table can be used as a guide for an average situation *(Table II)*.

Table II. Guide for adjusting nitrogen recommendations

Previous crop or treatment	*Lb N/A to subtract from recommendations*
Alfalfa	50
Manure, with bedding, per ton	5
Manure, feedlot run, per ton	7

If manure is applied to sugarbeet, actual testing of the manure for nutrients may be necessary. Nutrient recommendations should be adjusted by the actual amount of nutrients added with the manure.

Phosphorus Recommendations

Under most circumstances phosphorus is the second most limiting nutrient in sugarbeet production. Phosphorus is involved in energy transfer within the plant and aids in maintaining the structural integrity of the plant cell membranes. Leaves of plants deficient in phosphorus will appear darker green than usual. With increasing severity of the deficiency plant, growth will be stunted.

Phosphorus deficiencies will most likely be associated with soils that are high in pH and low in organic matter (eroded knolls under sprinkler irrigation systems and areas of intensive land leveling under gravity irrigation systems). Phosphorus contents of many soils in the sugarbeet producing areas have increased over time because the nutrient has been added for several years and now soil test levels tend to be high. This means that phosphate fertilization is not necessary in many instances. On the other hand, adequate phosphorus fertilization is essential for optimum yields on low phosphorus soils. Soils which still need phosphorus fertilization can be identified and properly fertilized by following the recommendation in *Table III*.

Table III. Phosphorus fertilizer recommendations.

Phosphorus soil test level		*Phosphate application rate (lb P_2O_5/A)*
Bray P1 soil test (ppm)	*Olsen-P soil test (ppm)*	
0-5	0-3	100
6-15	3.5-10	80
16-25	10.5-16.5	0
26+	17+	0

Because phosphate is rather insoluble and is not readily transported with water, phosphorus fertilizers must be incorporated into the soil. Phosphate fertilizers are not toxic to sugarbeet and can be safely applied before planting. Phosphate fertilizers also can be applied in a band at planting. Band application can increase seedling vigor, especially on soils testing low in phosphorus. Because the most common phosphate fertilizers also contain nitrogen, a producer has to take care that the application equipment is well adjusted and that the fertilizer is placed 2 inches away from the seed. Placing fertilizer too close to the seed will result in seedling damage and poor stand establishment.

Potassium Recommendations

Most soils of the High Plains are capable of supplying adequate potassium for maximum sugarbeet production. Potassium is important for the function of the stomata, pore-like openings of the plant leaves, through which transpiration of water and uptake of gaseous carbon dioxide occurs. Adequate potassium nutrition of the plant is necessary to ensure the integrity of the water economy within the plant. Early symptoms of potassium deficiency include a tanning and leathering of edges of recently matured leaves. More severe deficiency symptoms are a severe interveinal leaf scorch and crinkling that proceeds to the midrib.

Less than 5 percent of the soils in the region would be expected to need potassium. Soil tests measure exchangeable and soluble potassium, which is readily available to the plant. Soils which need potassium fertilization can be identified and properly fertilized by following the recommendations in *Table IV*.

Table IV. Potassium fertilizer recommendations.

Potassium soil test level (Exchangeable potassium, ppm)	*Potash application rate (lb K_2O/A)*
0-39	120
40-74	80
75-124	40
125+	0

Micronutrient Recommendations

Micronutrients applied to sugarbeets rarely increased yields or sugar content in experiments conducted over several years. Visual diagnosis of micronutrient deficiencies in sugarbeet is rather difficult because the symptoms are quite diffuse. Plant tissue or petiole analysis is required in most instances to positively identify the nutrient that is deficient.

Zinc has increased yields in a few experiments where tests indicated low soil zinc content. Soils deficient in zinc can be identified and properly fertilized by following the recommendations in *Table V*.

Table V. Zinc fertilizer recommendations.

Zinc soil test level	*Zinc application rate (lb Zn/A, as inorganic Zn such as zinc sulfate)*
Very low & low	10-15
Medium	0
High	0

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