FIELD FACTS

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Soybean Nutrient Management for the Northern High Plains

Higher soybean prices have placed an increased emphasis on maximizing soybean production. This *Field Facts* will provide a review of one aspect of soybean production that can lead to improved yields and profits – soil fertility management.

Nitrogen and Nodulation

There are several environmental factors that will limit or delay nodulation in soybean production – even on well-inoculated soybean seed. Soil temps outside the range of 60-80 °F, soil compaction, early season dry soils, as well as water-logged spring soils can all impact nodulation effectiveness and thus early season nitrogen efficiency by the plant. Because of these effects, the following is an early season nitrogen recommendation (based on Table 1 below): if soil test N levels to two feet deep are less than 50-75 lb/acre, then apply the difference up to the 75 lb/acre plus level to compensate for potential low early N-fixing activity. (A 40 bushel soybean crop requires nearly 200 lb/acre of N to reach maturity. Soybean production without nodule formation requires about 3.5 lbs of N per bushel of yield goal.) If a field has history of soybeans, 3 to 4 crop producing seasons with good nodulation, supplemental N may not provide consistent yield gain. Late season nitrogen use on soybeans in the Northern Plains on early maturing varieties to improve yields has not had extensive research.

Figure 1. *Soybean seedlings showing healthy nodule formation on roots.*

Table 1: Influence of N fertilizer on soybean yield, South Dakota, 1993. Initial soil NO_3-N level at site 1 was 59 lb N/acre, at site 2, 35 lb N/acre.

N rate (lb/acre)	Site 1	Site 2
	- - - Soybean Yield (bu/acre) - - -	
0	40.5	31.4
40	41.4	32.3
80	43.8	35.9
120	43.5	45.8
LSD 5%	NS	11.3

Phosphorus

Data suggests that soybeans may react to broadcast applications of P better than banded applications with or near the seed. Soybeans appear to prefer their entire rooting zone bathed in nutrients, rather than having nutrients concentrated in a small area of the root zone. Soybeans have a different, more tap-rooted habit than grassy plants like wheat and corn, which often respond more efficiently to banded fertilizer. Several recent studies confirm that broadcast application of P is better than banded P (Table 2).

Table 2: Effect of P placement on soybean yield, Neb., 1981 (P soil test very low).

P Rate (lb P_2O_5/acre)	Starter	Broadcast
	- - Soybean Yield (bu/acre) - -	
0	34	34
23	35	42
46	36	42
69	37	43

Potassium

Potassium soil levels are typically fairly high in most Northern Plains soils. However, fields with sandier soil types and low organic matter (around 2% or less) will be candidates to monitor potassium levels. Potassium fertilization should produce a yield response in soybeans if soil test results are less than 150-160 ppm.

Figure 2: *Potassium deficiency in soybeans. Note the yellowing pattern beginning at the leaf margins. Photo courtesy of Robert Mullen, Ohio State University.*

Fertilizer Application

Starter fertilizer applied in-furrow with the seed is not recommended with soybean production due to the crops natural high sensitivity to salt. Soybean production in wider rows (> 15"), under sandy soil conditions, and/or with dry spring conditions will increase the risk of soybean seedling injury if in-furrow fertilizer is applied. Research has not shown consistent yield gains from banded fertilizers over broadcast fertilizer applications.

Micronutrients

SULFUR (S) – Sulfur is an element that is mobile in the soil (leaching is common), but fairly immobile in the plant. High soil test variability along with significant use rates (15 to 25 lbs/acre) by most crops in the Northern Plains places producers in a position to manage sulfur – especially in sandier soils and fields comprised of several different soil types. Deficiency symptoms in soybeans are pale green to yellow leaf color without prominent veins or necrosis in the youngest trifoliate leaves.

MANGANESE (Mn) – Soil testing for manganese is a fairly reliable tool - optimum levels should be in the 15 to 25 ppm range and higher with soil pH's significantly above 7.0. In alkaline soils (pH above 7.0), manganese begins to form insoluble compounds, making it unavailable to the plant. Foliar applications are the preferred method of supplying manganese to a growing soybean crop. Usually, 0.2 to 0.5 pounds of manganese per acre is sufficient per application. If a grower is tank-mixing manganese with glyphosate, the chelated forms of manganese are recommended.

Figure 3: *Manganese deficient soybean plants. Uppermost (youngest) leaves show interveinal chlorosis while the veins remain green. Manganese is fairly immobile in the plant rendering symptoms on the newest leaves. (Photo courtesy of Ron Gehl, NC State University).*

IRON (Fe) – Symptoms of iron chlorosis and manganese deficiency can easily be confused. Iron deficiency symptoms will tend to show up in irregularly shaped spots randomly distributed across a field and with a year over year history. The minor plant symptom differences are that leaves with iron chlorosis will have veins a bit more prominently dark green and the plants are usually stunted. Under severe iron deficiency, plant leaf edges become necrotic (turn brown), and the necrosis may progress until entire leaves or even plants are dead.

OTHERS – Soybean micronutrient deficiencies have also been documented with various other elements. Zinc, magnesium, and copper are the most prevalent in soybean production after sulfur, manganese and iron for the Northern Plains. Tissue tests along with soil tests conducted during the growing season should be utilized to confirm or deny nutrient deficiency suspicions. Environmental stresses such as drought, heat, insect and disease pressure can all influence tissue test results. Some micronutrients can cause phytotoxicity if prevalent in large quantities.

Figure 4*: Interveinal chlorosis due to iron deficiency (left). Note the similar appearance to Mn deficiency (Fig 3) and stunted growth (right).*

Miscellaneous

It is also well documented that high soil fertility levels can manifest white mold infestation potential and increase the severity of the disease. For fields that have a frequent history of white mold infestation in soybean or susceptible crops in rotation (primarily dry edible beans) careful consideration and attention should be given to soybean variety selection as well as consideration to producing soybeans in wider rows (15–30 inch) to assist in minimizing white mold field infestation.

References

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