



Soybean largely unresponsive to K fertilizer in Manitoba

CATEGORY [soils and fertility](#) | June 23, 2022

Soybeans were found to be largely unresponsive to potassium (K) fertilizer even on low K-testing soils in Manitoba. Despite visual K deficiency symptoms mid-season, there were still no yield responses to K fertilizer at varying rates and placements. The current soil test threshold of 100 ppm K (mg ammonium acetate-exchangeable K/kg soil) for recommending K fertilizer is not as reliable for soybean as it is for barley.

Soybean is a high user of K, removing more K in the seed at harvest (1.1 - 1.4 lb K₂O/bu) than most other common crops grown in western Canada. Recently, soybean production in Manitoba has expanded its footprint and is now the third largest crop grown in the province, following canola and wheat. The combination of a high K-removing crop with a prominent place in the crop rotation has led to increases in K deficiency symptoms in soybeans, especially on coarse-textured soils naturally lower in potassium.

Additionally, K recommendations for soybeans in Manitoba are the same for other crops such as canola and wheat that do not remove nearly as much potassium as soybeans do. The Manitoba K

rates and soil test thresholds are lower than those used in neighbouring soybean producing regions (Ontario, North Dakota, Minnesota).

The objectives of this research study were to (1) evaluate the frequency of soybean yield response across a range of soil test K levels using on-farm field-scale trials; and, (2) to determine the effectiveness of different K fertilizer rates and placements for soybeans on low K soils. All sites were established at various locations around Manitoba in 2017 and 2018.

On-farm trials found no relationship between soil test K levels and soybean yield

For the on-farm trials, conducted in collaboration with Manitoba Pulse and Soybean Growers, twenty site-years were established on fields with soil test K levels between 52 and 235 ppm. Each site had replicated strips comparing an untreated check to a K fertilizer treatment, which was either 60 lb K₂O/ac banded away from the seed or 120 lb K₂O/ac broadcast and incorporated.

Only 3 of the 20 sites had a significant yield response to the applied K fertilizer, with 2 sites showing a yield increase and one site a yield decrease. Of the two positive yield sites, just one had soil test K levels below 100 ppm (the current threshold used to recommend applying K fertilizer). The researchers found no definitive reasons for the significant yield differences at these three sites. The researchers had also expected to see many more low K sites show a yield response to K fertilizer application, and concluded that soil test K below 100 ppm is not an indicator that K fertilizer will result in a yield increase for soybeans.

Small-plot trials found no yield response to K fertilizer on low K soils

For the small plot trials, seven site-years were established on low K sites, with soil test K levels ranging from 49 to 117 ppm. Six fertilizer treatments were compared: no K fertilizer, side-banded K at 30 or 60 lb K₂O/ac, and broadcast and incorporated K at 30, 60 or 120 lb K₂O/ac. Potash (0-0-60) was used as the K fertilizer source.

In both years, symptoms of K deficiency began to show in the control plots early in the season (at V2-V3 stages). The plants seemed to grow out of the deficiency until growth stage R5 when K deficiency symptoms developed in the upper canopy. These symptoms appeared to confirm that the sites were indeed low in K. However, no statistically or agronomically significant yield responses were found for any of the K fertilizer treatments in any of the site-years. This result could be partly explained by the low amount of rainfall received during the trial (48 to 69% of normal rainfall in 2017 and 2018, respectively). The low rainfall decreased yield potential and subsequent K demand, so the K deficiency observed mid-season shifted to a K sufficient status by harvest.

Despite the lack of rainfall, the soybeans averaged 31.6 bu/ac over the two years (40 bu/ac in 2017 and 23 bu/ac in 2018). Considering the 5-year (2015 - 2019) provincial average for soybean was 35.2 bu/ac, which was not that much higher than the soybean plot yields, the researchers suggested that soybeans grown in Manitoba simply may not need as much K as in regions with higher rainfall and yield potential.

The researchers also found no correlation between soil test K and yield on soils with K values less than 100 ppm. They concluded that the 100 ppm threshold for recommending K fertilizer is too high for soybean in Manitoba and/or the commonly used ammonium acetate soil testing method for measuring exchangeable K is not suitable for predicting soybean response to K.

Differences in K fertilizer response found between soybean and barley

After the 2017 results showed no yield response to added K fertilizer, a supplemental study was added for 2018. This study aimed to compare the sensitivity of soybean to low soil test K soils and K fertilizer response to that of barley, a crop well known to be sensitive to low K soils in the Prairies. The two fertilizer treatments used for this additional study were no K fertilizer and broadcast and incorporated K at 120 lb K₂O/ac.

Potassium fertilizer had a significant effect on barley yield, accounting for a 21.5% yield increase (barley yield was 55 bu/ac without K fertilizer and 67 bu/ac with added K fertilizer). However, soybean yield showed no significant difference with added K fertilizer.

The surprising lack of yield response to added K fertilizer meant that the researchers could not determine the best application rate and placement of K fertilizer in this study. In addition, the critical threshold of 100 ppm of soil test K was not found to be a suitable guideline for predicting soybean response to K fertilizer as it is for barley. The researchers expressed the need for further studies to explore how K uptake in soybean interacts with soil and fertilizer K in coarse-textured soils in Manitoba.

This study was funded primarily by the Manitoba Pulse and Soybean Growers and Western Grains Research Foundation, with supplemental support from Nutrien, Dekalb, and Western Ag Innovations.

Ms. Megan A. Bourns and Dr. Donald N. Flaten. Soybean is relatively non-responsive to K fertilizer rate or placement in Manitoba soils. *Canadian Journal of Plant Science*. **Just-IN**
<https://doi.org/10.1139/CJPS-2021-0254>

Photo by Megan Bourns: Visual symptoms of soybean K deficiency in control strip (left) vs K fertilizer treatment (right) in one of the on-farm trials. Despite the fertilizer correcting the visual symptoms of K deficiency in mid-season, seed yield responses to K fertilizer were extremely rare.