



Manitoba soybeans show little response to phosphorus fertilization

CATEGORY [soils and fertility](#) | November 26, 2024

Phosphorus (P) fertilization did not increase seed yield, regardless of P rate, P placement or Olsen soil test P level, except for one out of 28 site-years. High rates of seed-placed P reduced stand establishment at 5 of 28 site-years.

Limited research had been conducted on soybean response to phosphorus (P) fertilization in Manitoba. This was especially the case for soybeans planted on narrow rows using small grains seeding equipment, a common practice in this province.

A three-year study was conducted between 2013 and 2015 across the agricultural region of Manitoba. The two main objectives were to determine the risk of reduced plant stand and seed yield due to toxicity from seed-placed P fertilizer, and to evaluate the impact of three different P fertilizer rates and three placements on plant stand and seed yield.

Twenty-eight site-years of trails were established with 8 sites in 2013 and 10 sites in each of 2014 and 2015. These sites were located near Arborg, Beausejour, Brandon, Carberry, Carman, Melita, Portage La Prairie, Roblin, Roseisle, and St. Adolphe with a range of soil types. Row spacing ranged from 8 to 12 inches. Growing season precipitation was considered adequate for crop growth except for a deficiency at Roblin 2015.

Wheat was the most common previous crop at 16 site-years followed by canola with 3 site-years and flax at 2 site-years.

Olsen P soil test levels at the 0-6 inch (0-15 cm) depth ranged from 3 ppm at one site to very high levels at 71 ppm at another site. Overall, 3 sites tested very low, 10 were low, 5 were medium, 3 were high, and 7 were very high.

Commercial mono-ammonium phosphate (MAP; 11-52-0) was applied at three rates of 20, 40, and 80 lbs P₂O₅/ac (22.5, 45, and 90 kg P₂O₅/ha), except for the sites at Portage La Prairie, St. Adolphe and Roblin in 2013 which did not include the 80 lbs/ac rate.

Three fertilizer placements were compared. Seed-placed P was applied with the seed through the same seed opener. Side-band P was placed 2 inches to the side and 2 inches below the seed (5 cm below and to the side). Broadcast P was broadcast on the soil surface and incorporated by the seeding implement during planting.

Where potassium (K) and sulphur (S) nutrient requirements were identified by soil tests, they were broadcast and incorporated across the entire site prior to planting soybean. No additional nitrogen (N) was applied.

Little response to P

Measured at 4 weeks and averaged across fertilizer rate and placement, P fertilizer treatments did not increase plant stands at any site. However, plant stands were reduced at 5 of 28 site-years when P fertilizer was seed-placed at planting compared to the control. These reductions most often occurred with the 80 lbs/ac rate of P₂O₅ and with low seedbed utilization due to narrower openers on wider row spacing. For example, Melita 2013 had a 71% plant stand reduction at the 80 lbs. rate with narrow row openers on coarse-textured soils. Across the five site-years, plant stand reductions with 80 lbs/ac seed-placed P ranged from 36 to 71%. Of these 5 site-years, Melita 2013 had a yield loss of 36% and Carberry 2013 lost 29% yield. At the other three sites, soybean plants were able to fully compensate for lower plant stands by producing more branches and pods per plant.

Current Manitoba Agriculture guidelines recommend a maximum of 10 lbs. P₂O₅/ac (11 kg P₂O₅/ha) seed-placed for row spacing of 15 inches (38 cm) or less. While this study found seed-placed rates reduced plant emergence at one site-year at 20 lbs/ac rate, 2 site-years at 40 lbs/ac and 5 site-years at 80 lbs/ac compared to the control, interpreting the safety of seed-placed P from this study should be done cautiously. Most of the sites generally had good early season moisture, which could

have reduced fertilizer toxicity. The risk of germination damage from fertilizer toxicity increases in situations with low seedbed utilization, coarse-textured soils, and low soil moisture.

Soybean yield was generally higher than the provincial average in those years. Yield averaged 46 bu/ac (3102 kg/ha) in 2013, 42 bu/ac (2792 kg/ha) in 2014, and 52 bu/ac (3480 kg/ha) in 2015. Seed yield was higher with P fertilization at only 1 of 28 site-years, Roseisle 2015. This was despite about one-half of the site-years with very low or low concentrations of soil test P – at levels where most field crops in western Canada will respond positively to P fertilization. The lack of response illustrates soybean's ability to scavenge soil P.

There were no significant differences in soybean seed yield between the control and side-banded P at 40 lbs/ac, or P broadcast at 80 lbs/ac. However, side-band P would still be the preferred placement method for rates higher than current recommendations of 10 lbs. P₂O₅/ac seed-placed. Side-banding is safer than seed-placed while still providing early season access to P uptake by the soybean plant. And side-banding reduces the risk of P runoff losses that can occur in broadcast treatments.

While the study found little soybean yield response to P, soybean growers need to consider the large amount of P uptake and removal from a field, and the long term impact on soil P fertility. For example, a 45 bu/ac soybean crop removes 39 pounds P₂O₅/ac. In order to maintain P soil fertility, growers need to somehow replace this removal either by side-banding P during soybean planting, or replacing it when seeding other crops that are more tolerant to seed-placed or side-banded P, such as cereals. The goal should be to maintain Olsen P soil test levels at 10 to 15 ppm for optimum P fertility for crops typically grown in rotation in Manitoba.

Financial support for this research was provided by the Manitoba Pulse and Soybean Growers Association, Western Grains Research Foundation, and the Manitoba-Canada Growing Forward 2 Program.

Mr. Gustavo Bardella, Dr. Kevin H.D. Tiessen, Dr. Donald N. Flaten, Dr. Mario Tenuta, Dr. Yvonne Lawley, Mr. John Heard, and Dr. Francis Zvomuya. Soybean responds infrequently to phosphorus fertilization in Manitoba. *Canadian Journal of Plant Science*. **Just-IN OPEN**

ACCESS <https://doi.org/10.1139/cjps-2024-0030>