AGRONOMY

Phosphorus Fertilization Beneficial Management Practices for Soybean in Manitoba

Seed yield increase to phosphorus (P) fertilization was rarely observed, regardless of P fertilizer rate, placement or soil test level.

Dr. Don Flaten and graduate student Gustavo Bardella presenting results at 2015 MPSG SMART field day, Carman, MB.

SOIL SAMPLES TESTING below the critical P concentration have increased concurrently with the increase in soybean acreage in Manitoba. Soybeans remove relatively large amounts of P in harvested seed (~0.83 lbs P_2O_5/bu); however, P fertilizer application for soybean is not common, as farmers often do not observe a yield response. Although P fertilizer is placed in the seed row for many crops, some crops do not tolerate high rates and crop removal rates often exceed fertilizer application rates, depleting soil P reserves. As soybeans gain prominence in rotations, basic fertility recommendations for soybean and strategies for maintaining soil fertility need to be established. Two studies investigated the maximum safe rate of seed-placed P fertilizer for soybean and soybean yield response to P fertilizer placement and rate, and soil test P level.

Field trials at 10 locations in Manitoba (2013–2015) measured soybean yield response and seedling toxicity of P fertilizer rates (0, 20, 40 and 80 lb P_2O_5/ac) applied in side band, seed row or broadcast. Locations varied in soil texture and seeding equipment, which are important factors affecting fertilizer toxicity risk. Half of the trial sites had soil P test levels in the 0–10 ppm Olsen P range, a level at which many crops would have high probability of response to P fertilizer.

Plant stand reduction caused by seed-placed fertilizer toxicity was rare, but was most common in soils with medium to coarse textures or when low-disturbance or low seed-bed utilization seeding equipment was used. Seed-placed P reduced plant stand at six of 28 site-years, but usually only at the 80 lb P_2O_5/ac rate; rates of 20 and 40 lb P_2O_5/ac reduced emergence at one and two site-years, respectively. Soybean yield was reduced by P fertilizer in two site-years where, in both cases, seed-placed fertilizer was applied at 80 lb P_2O_5/ac and the plant stand was reduced below 100,000 plants/ac. Phosphorus fertilizer increased yield at only one of 28 site-years, where 40 and 80 lb P_2O_5/ac both increased yield by ~15%, compared to the control, regardless of placement.

Considering these results, the recommended maximum safe rate of seed-placed P_2O_5 (10 lbs/ac) probably underestimates soybeans' tolerance to seed-placed fertilizer in most situations. However, it is difficult to define a new value since there are many factors that can increase the risk of fertilizer toxicity: dry soil, sandy soil texture, narrow seeder opener type and wide row spacing.

To evaluate the response of soybean to background levels of soil P fertility, i.e. with no additional fertilizer added during the soybean production year, a second field study was conducted over seven site-years at three locations in Manitoba during 2013–2015. The sites for this study had been used for a previous long-term study, in which different rates of monoammonium phosphate (11-52-0) had been annually applied over nine years creating a range of soil P levels (7 to 93 ppm Olsen P). Studies conducted elsewhere have shown that soybean grown on high P fertility soils can produce greater yields. However, despite the differences in soil P in this study, there were no yield responses to soil test P at any site-year.

Although there is little chance of reward for P fertilization for soybeans, depletion of soil P caused by P removal without replacement may be detrimental to yields of other crops in the rotation. Soybeans present farmers with an opportunity for P fertilizer application flexibility, because there is no urgent need to apply P fertilizer at any particular rate or placement for this particular crop. However, to maintain P fertility, rotational fertilization could mean applying P in the soybean year of the rotation, where the best placement is side banding since it minimizes fertilizer toxicity risk, facilitates higher rates and places fertilizer below the soil surface, preventing erosion and run-off losses. Another strategy would be to apply higher than usual rates of P, in the form of commercial fertilizer or livestock manure, to other crops in the rotation.

PRINCIPAL INVESTIGATOR Don Flaten, Department of Soil Science, University of Manitoba

MPSG INVESTMENT $64,653

CO-FUNDER $129,306 – Western Grains Research Foundation, Growing Forward 2 Growing Innovation: Agri-Food Research and Development Initiative

DURATION 3 years