Canadian Agronomist

DIGGING INTO RESEARCH

Performance of phosphorus source and placement varied little

CATEGORY **soils and fertility** | *April 19, 2023*

In this controlled environment chamber study, struvite and MAP had similar crop biomass yield and phosphorus (P) uptake in canola. There was no difference in canola germination between MAP and struvite, or opener spread of 1 inch or 3 inches, or fertilizer rate up to 53 lbs P_2O_5/ac. The one inch opener had better canola biomass yield response to added P and in recovery of P fertilizer compared to the 3 inch spacing.

Some crops are sensitive to seedrow placed granular monoammonium phosphate (MAP) (11-52- 0), resulting in applications rates that are often lower than crop removal in, for example, a crop like canola. The maximum safe rate of seed row P fertilizer for canola is approximately 20 lbs P_2O_5/ac (22 kg/ha) with low seedbed utilization such as with a disc opener. The rate can be safely increased to 25 lbs/ac (28 kg/ha) under good moisture conditions or wider row spacing.

Another source of P that has recently come on the market is struvite, Crystal Green (5-28-0, with 10% Mg), that is extracted from urban waste water systems. It is less soluble, and crops may be more tolerant to high rates of application.

The objectives of this research was to assess how P fertilizer form, opener spread, and P rate affected yield, P uptake and recovery by canola grown on a P deficient Brown Chernozem soil.

A growth chamber trial was set up using soils from Brown Chernozem soil with a loam texture and pH of 7.7. The modified Kelowna soil test P level was 11 ppm, which is considered deficient for crop production.

Two different fertilizer sources of P, MAP and struvite were compared, and were seed placed with canola at 1" (2.5 cm) and 3" (7.5 cm) opener width. Phosphate application rates were at 0, 18, 36, 53 lbs P_2O_5/ac (0, 20, 40, and 60kg P_2O_5/ha).

Nitrogen (N) and sulphur (S) were side-banded in the canola crop at 1 inch (2.5 cm) from the seed row and at 1 inch (2.5 cm) depth. The N rate was 178 lbs N/ac (200 kg N/ha) and 18 lbs S/ac (20 kg S/ha).

Crop response to P was measured in canola, and also the subsequent wheat and pea crops grown in rotation. Phosphate fertilizer was not added to the wheat and pea crops in order to assess any benefit from residual P fertilizer. Responses measured were crop emergence, 30 days above ground biomass yield, uptake of P, and apparent recovery of fertilizer P. Labile soil residual P concentrations at the end of the rotation were also measured.

Struvite has potential

There was no difference in canola germination between MAP and struvite, opener spread or fertilizer rate. All treatments had statistically similar emergence ranging from approximately 80 to 95%. The consistent optimal moisture under the controlled environment conditions could have helped reduce the P fertilizer toxicity.

In the first year canola crop, P uptake and above ground biomass yield were similar for MAP and struvite. In the subsequent wheat crop, struvite produced a higher biomass yield but had similar P uptake. There was no difference between sources in biomass in the third year pea crop, but MAP fertilizer resulted in a slightly greater P uptake in pea.

The 1 inch opener produced greater biomass yield and P uptake for canola and the following wheat crop, but the pea crop had slightly greater P uptake with the 3 inch spread, which the researchers felt might be due to the shallower and more spreading nature of the pea root system.

Application of 18 lbs P_2O_5 significantly increased canola biomass yield compared to the control, but the higher rates were not significantly different from the 18 lbs rate. Increasing P rates resulted in increased P uptake, with the highest rate of 53 lbs P_2O_5 being significantly higher than the lower rates in canola and wheat. Phosphorus uptake in pea was similar across all rates. The lack of

response to P application in pea may have been because soil P levels were depleted as a result of two years of no P fertilizer application, and also because peas are good scavengers of soil P.

An interaction between opener spread and application rate was observed in canola and wheat. The 1" opener spread with 53 lbs P_2O_5 (60 kg P_2O_5/ha) rate had a significantly higher biomass yield and greater P uptake response.

Total P recovery from all three crops grown was slightly but significantly higher for MAP than struvite. The researchers though that this may be because of greater solubility of MAP fertilizer compared to struvite.

Higher application rates left more residual P in the soil as plant available P after the cropping years. There was is significantly less residual available P present in the soil with struvite than with MAP at rates above 18 lbs P_2O_5.

Overall, the research suggests that struvite may be a suitable P fertilizer form that could fit typical Prairie cropping systems. The lack of impact on germination from high rates of P fertilizer in narrow rows should be viewed cautiously, as germination and emergence may be impacted under more difficult field conditions.

The financial support of the Canola Agronomic Research Program (CARP), funded by Alberta Canola, Sask Canola and Manitoba Canola Growers, is gratefully acknowledged.

Mingxuan Shao, Mooleki Patrick, Cory Fatteicher & Jeff Schoenau (2023) Effect of phosphorus fertilizer form, opener spread and rate of application on biomass yield, P uptake and recovery in a canola-wheat-pea rotation under controlled environment conditions, Journal of Plant Nutrition, 46:5, 685-696

https://doi.org/10.1080/01904167.2022.2068437