Factsheet: Canola Seed Safety and Yield Response to Novel Phosphorus Sources in Saskatchewan Soils

Objective:

The objectives of the project are to demonstrate canola response to increasing rates of struvite (i.e., Crystal Green), alone or in a blend, relative to other common phosphorus (P) fertilizer formulations with a focus on stand establishment and seed yield.

Methodology:

Field trials with canola were conducted near Swift Current, Scott, Indian Head, and Yorkton in 2020 and repeated at these same four locations in 2021 with additional trials at Melfort, Outlook, and Redvers. These locations vary in both their major soil characteristics (i.e., texture, organic matter, pH) and long-term climatic conditions. With that, they also vary in terms of the relative risk of seedling injury that might be expected with in-furrow placement of P fertilizer. The project aimed to evaluate responses to a range of seed-placed phosphorus (P) fertilizer rates and formulations with a focus on crop establishment and yield. In addition to a control where no P was applied, the rates were 25, 45, and 65 kg P_2O_5/ha. Only granular options could be evaluated due to equipment limitations. The forms included monoammonium phosphate (MAP), MicroEssentials® S15, CrystalGreen®, and a 50:50 blend (by mass of product) of MAP and CrystalGreen®. This blend resulted in actual P_2O_5 proportions of 35:65 from CrystalGreen® and MAP which is comparable to the current industry recommended 25:75 blend. The total amount of nitrogen (N) applied was balanced across treatments within each location; however, the S15 treatments at Yorkton 2020 were discarded because a calculation error resulted in the supplemental urea rate coupled with this P formulation being too low. For simplicity, we did not necessarily attempt to balance total S rates across treatments but did require that S be not limiting; therefore, supplemental ammonium sulfate was applied in all cases. Phosphorus fertilizer products were always seed-placed while urea and ammonium sulfate were side-banded

Table 1. Treatment descriptions for ADOPT Novel Phosphorus demonstrations completed at Swift Current, Scott, Indian Head, and Yorkton in 2020.

#	Phosphorus Form [z]	Nutrient Analyses	Phosphorus Rate
1	Control	Not applicable	0 kg P_2O_5/ha
2	Monoammonium phosphate	11-52-0	25 kg P_2O_5/ha
3	Monoammonium phosphate	11-52-0	45 kg P_2O_5/ha
4	Monoammonium phosphate	11-52-0	65 kg P_2O_5/ha
5	MicroEssentials® S15	13-33-0-15	25 kg P_2O_5/ha
6	MicroEssentials® S15	13-33-0-15	45 kg P_2O_5/ha
7	MicroEssentials® S15	13-33-0-15	65 kg P_2O_5/ha
8	CrystalGreen®	5-28-0 + 10% Mg	25 kg P_2O_5/ha
9	CrystalGreen®	5-28-0 + 10% Mg	45 kg P_2O_5/ha
10	CrystalGreen®	5-28-0 + 10% Mg	65 kg P_2O_5/ha
11	50:50 MAP:CrystalGreen®[z]	8-40-0 + 5% Mg	25 kg P_2O_5/ha
12	50:50 MAP:CrystalGreen®	8-40-0 + 5% Mg	45 kg P_2O_5/ha
13	50:50 MAP:CrystalGreen®	8-40-0 + 5% Mg	65 kg P_2O_5/ha

[z] Expressed as actual P_2O_5 the ratio is 65:35 MAP:CrystalGreen®

The full report is available at www.warc.ca. This project was supported by the Agricultural Demonstration of Practices and Technologies (ADOPT) initiative under the Canadian Agricultural Partnership bi-lateral agreement between the federal government and the Saskatchewan Ministry of Agriculture. Additional funding was provided by Fertilizer Canada
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Key Findings:

- We expected the risks of seedling injury to be highest with S15, followed by MAP, the MAP:CG blend, and finally CG. This is generally what was observed; however, there was essentially no effect on emergence, regardless of form or rate, for approximately 50% of the sites.
- In some cases (i.e. Indian Head and Melfort), we attributed the lack of injury to the relatively high organic matter and fine-textured soils combined with good initial soil moisture or timely precipitation after seeding. There were, however, instances where the lack of response was less expected and more difficult to explain (i.e. Swift Current-2020), based on soil properties and moisture conditions alone.
- While the observed stand reductions were never catastrophic, they were certainly frequent and unpredictable enough to justify caution when seed-placing higher than recommended rates of P fertilizer, especially but not exclusively if other products (i.e. ammonium sulfate, potash) are also included in the seed-placed blend.
- In cases where seed-placing higher than recommended rates cannot be avoided, choosing a product such as struvite (CG), alone or in a blend, can substantially reduce the risk of injury. That said, this product is relatively expensive and, if applied on its own in low P soils, may not be released quickly enough to meet the needs of the crop in the year of application.
- This project also showed that S15 is as, or more, likely to result in seedling injury than MAP on its own. Generally, yield responses to MAP were similar to or better than those achieved with the forms to which it was compared; however, other formulations can be advantageous with respect to overall ease of handling (i.e. S15) or suitability for in-furrow placement at high rates (i.e. struvite) so may still be a good fit for individual operations.
- Dual banding P fertilizer with high rates of urea can reduce its availability early in the season; however, late-season availability can be enhanced with dual banding and documented yield advantages to seedrow versus side-band placement are rare.
- With respect to rates, our results show that the amounts of fertilizer that are generally required to, at minimum, replace the P removed by the crop are also profitable when averaged across a range of environments.
- While yield responses to P can be variable on a field-to-field basis, it must be appreciated that P fertilization is also a long-term investment that is necessary for maintaining or building the overall productivity of our land, regardless of the chosen formulation or responses in the year of application.

Table 2. Main effect means for seed-placed phosphorus (P) fertilizer formulation and rate effects on canola emergence, final plant densities, and seed yield when averaged across 10[Z] location-years in Saskatchewan. The F-test results are for Form and Rate effects and the 0 P control treatment was excluded from the factorial analyses.

Main Effect	Spring Plant Density	Final Plant Density	Seed Yield
	---------- plants/m^2 ----------	---------- stems/m^2 ----------	---------- kg/ha ----------
Control (0 P)	75.8	72.5	2138
P Form [Y]			
MAP	65.1 C	63.4 C	2313 A
S15	61.0 D	57.4 D	2336 A
CG	76.8 A	73.6 A	2242 B
MAP:CG	71.5 B	67.5 B	2305 A
S.E.M.	1.28	1.27	25.2
kg P_2O_5/ha			
25	71.1 A	68.6 A	2230 C
45	69.7 A	65.5 B	2303 B
65	65.1 B	62.3 C	2364 A
S.E.M.	1.14	1.14	23.4

[Z] Yorkton-2020 was excluded from the combined analyses due to missing treatments

[Y] MAP - monoammonium phosphate (11-52-0); S15 - MicroEssentials® S15 (13-33-0-15); CG - Crystal Green® - 5-28-0 + 10% Mg; MAP:CG - 8-40-0 + 5% Mg (50:50 by mass of product)

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