Crop Response to Foliar Applied Phosphorus Fertilizer

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Researchers initiated a two-year study in 2016 to evaluate the response of canola, pea and wheat to foliar applied phosphorus (P) fertilization growing in different soil zones in Saskatchewan. Overall, the study showed that mid-season foliar P applications would be most suitable for a top up of P nutrition applied in small amounts under conditions of soil P deficiency rather than a substitution for seed row applied P fertilizer. The most suitable applications may be for canola where P demands are high and seed row applications may be limited by seed-row safety concerns. These results underline the importance of the right rate, source, time and placement regarding P fertilization of canola, wheat and pea in contrasting Saskatchewan soils.

Seed-placed phosphorus (P) fertilizer is commonly applied to field crops to enable early P uptake and encourage root growth and establishment. Due to low mobility of P in the soil, fertilizer P is most effective applied in or near the seed row, however seed placed rates are limited. Few studies have evaluated the potential of foliar applied P fertilizers under western Canadian field conditions.

Researchers at the University of Saskatchewan initiated a two-year study in 2016 to evaluate the response to foliar mono-potassium phosphate (KH_2PO_4) fertilization of canola, pea and wheat growing in different soil zones in Saskatchewan, including Central Butte, Rosetown and Pilger areas. The objectives were to determine the crop and soil response of foliar applied P fertilizer applied alone and in combination with soil applied mono-ammonium phosphate (MAP), and to determine the efficiency of the applied P fertilizer in recovery and loss.

Field trials were conducted at four sites in 2016 and 2017 with contrasting soil and environmental conditions, and of varying degrees of P deficiency. Total combined P fertilizer rates were maintained at 20 kg P_2O_5/ha for each of the treatments, except for the unfertilized control. The five treatments included:

- Control - 0 kg/ha (unfertilized)
- F(0) - 20 kg/ha MAP granular at seeding + 0 kg/ha foliar-applied P
- F(25) - 15 kg/ha MAP granular at seeding + 5 kg/ha foliar-applied P
- F(50) - 10 kg/ha MAP granular at seeding + 10 kg/ha foliar-applied P
- F(100) - 0 kg/ha MAP granular at seeding + 20 kg/ha foliar-applied P

Foliar treatments were made prior to anthesis (Pea 6-9 node stage; canola 5-8 leaf stage and wheat near flag leaf emergence) in growth chamber controlled environment studies and field studies. Application of foliar P fertilizer was made in-season for each crop at a time corresponding to when another crop protection operation (fungicide or insecticide) that would be practical for the growers. In 2017, an additional field scale study was added with replicated strips of a commercial foliar P product.

Along with field studies, growth chamber studies were conducted on two soil types from the Central Butte and Pilger field trials to evaluate the response under controlled conditions. For all field and controlled environment studies, measurements of grain and straw P content and recovery in plant and soil following application treatments were made.

Grain sample measurements of Iron (Fe), Zinc (Zn) and phytate were included to determine the influence of treatments on human nutritional value. A simulated snowmelt run-off study was completed from the different treatments in the controlled environment studies, along with field plot soil samples, to evaluate how soil-applied and foliar P applied treatments influenced the export of P off-site in snowmelt run-off.

The study results showed that canola was the most responsive to foliar P fertilization in terms of yield and P uptake, followed by wheat and pea. Although evidence of P uptake was observed through leaf material, foliar P application did not effectively balance off the yield lost by reduced rates of seed-placed MAP fertilizer. Observed similar or higher concentrations of Zn in grain and a lower proportion of phytate with increased proportion of P in foliar form suggests that foliar P application may reduce phytate:Zn molar ratio and therefore slightly increase human bioavailability of Zn in grain. The results of the snow-melt runoff from post-harvest soils in both the controlled environment and field studies did not show any large discernible impacts of the proportion of foliar applied P versus soil applied P in any measurements.

Overall, the study showed that mid-season foliar P applications would be most suitable for a top up of P nutrition applied in small amounts under conditions of soil P deficiency rather than a substitution for seed row applied P fertilizer. The most suitable applications may be for canola where P demands are high and seed row applications may be limited by seed-row safety concerns. More research is needed to evaluate application timing and potential of different foliar P fertilizer compounds along with different adjuvants among different crops before blanket recommendations can be made. These results underline the importance of the right rate, source, time and placement regarding P fertilization of canola, wheat and pea in contrasting Saskatchewan soils.