Anticipating Soybean Response to Potassium Fertilization in Manitoba.

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Introduction and Study Objectives

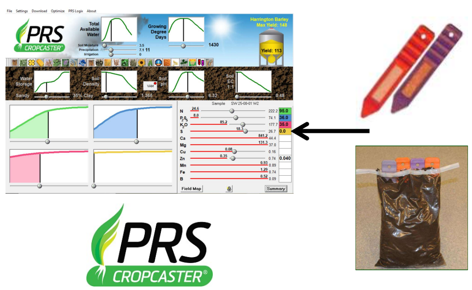
Soybean production in Manitoba has expanded rapidly over the past two decades, with 20% of Manitoba's cropland seeded to soybean in 2017. Potassium (K) removal rates in harvested seed are almost four-fold that of wheat, raising concerns over long-term soil K fertility.

Highlighted Research Objectives

1. Determine soybean yield response to K fertilizer at field scale under range of soil conditions expected to be deficient in K based on extractable soil test levels.
2. Evaluate the effectiveness of PRS® probe measurements and PRS CropCaster® crop modeling to forecast K fertilizer response.

Materials and Methods

- 19 field-scale trials over two seasons (2017 & 2018).
- Trials were facilitated by the **Manitoba Pulse and Soybean Growers** with farmer cooperators across southern Manitoba.
- Fields were expected to be deficient in K (<150 ppm extractable K).
- Replicated treatments included K either broadcast at 120 lb/ac or banded at 60 lb/ac (as potash) and untreated strips.
- Supplemental site characterization using PRS probe analysis and PRS CropCaster crop modeling[1] was completed on 14 sites. Year 1 had one composite sample per site on 10 sites. Year 2 saw composite samples by replicate on 4 sites.
- PRS probes use ion exchange membranes to determine bio-available plant nutrients. The PRS CropCaster utilizes the probe data in a constrained resource model to forecast crop yields under varying growing season scenarios.



Results and Discussion

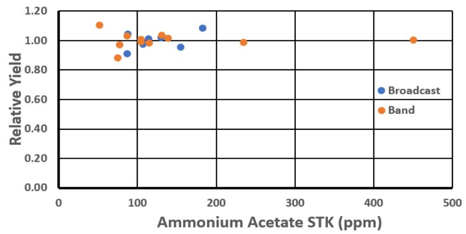


Figure 1. On farm trial relative yield and NH_4OAc STK levels.

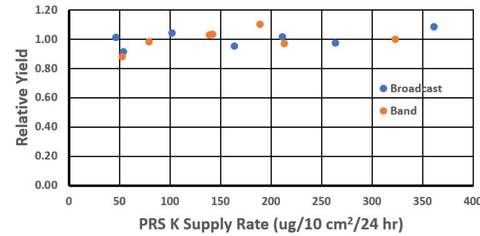


Figure 2. On farm trial relative yield and forecasted bio-available K supply rate.

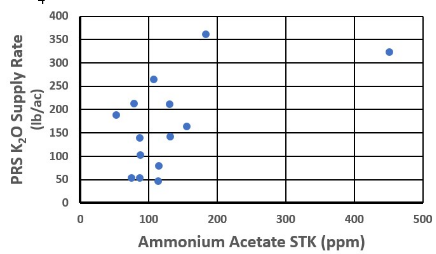


Figure 3. Forecasted bio-available K supply rate vs NH_4OAc STK levels.

- Site selection criteria, based on extractable K <= 150 ppm was generally met (15 of 19 sites, range 52 – 451).
- Soybean yields only increased due to K fertilization at two of the 19 site-years (by 10 and 13%).
- Extractable K level was found to have no correlation to soybean response to K application. Extractable K level did not correlate with forecasted K supply rate.
- PRS probes and CropCaster modeling only anticipated appreciable K fertilizer responses at 3 of 14 sites, which included the two sites where soybean yields were significantly increased by K fertilization.
- Bio-available soil supply K <= 50 lb/ac appears to be the threshold for K response.

Two consecutive dry growing seasons (2017 40-80%, 2018 60-80% of 30 year average precipitation) would have had an impact on treatment efficacy particularly on broadcasted treatments.

Site Characterization by Replicate provides Insight

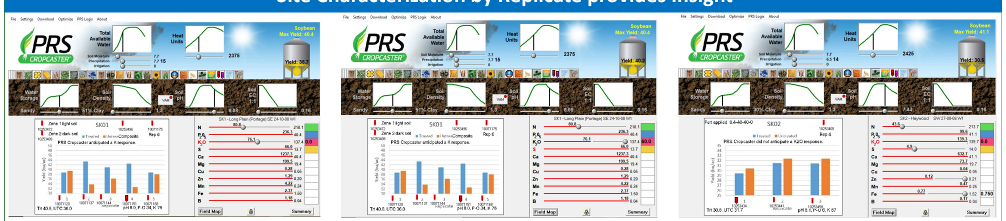


Figure 6, 7 and 8 respectively. PRS CropCaster comparing forecasted K response at 2018 – SK1 Rep 4 (control), 2018 – SK1 Rep 4 (treated) and 2018 – SK2 (control).

Conclusions

The conventional, ammonium acetate extraction, soil test K was not able to predict fertilizer K responsiveness in soybeans and would not be suitable for trial site selection.

PRS technology could improve empirical research efforts by providing more sensitive site characterization tools in trial site reconnaissance. Though models require testing, refinement and validation, synergies gained by combining mechanistic models with empirical methods would enhance the efficacy of research dollars. Enhancing the research effort will speed achieving agriculture industry goals of financial, environmental and product stewardship.

Modeling Soybean Yield

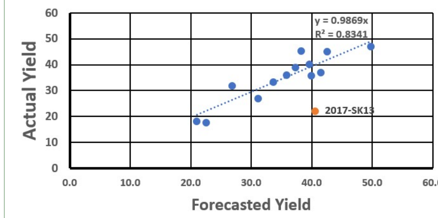


Figure 4. Correlation between actual vs forecasted check yields.

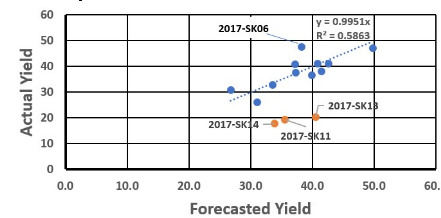


Figure 5. Correlation between actual vs forecasted K-fertilized yields.

Forecasted soybean yields through the PRS CropCaster correlated well (R^2 0.8341 Check, 0.5863 Treated). Further investigation into site 2017-SK6 indicated a bio-available K supply gradient across the replicates that was possibly masked by the composite sample. This discovery lead to sampling by replicate in year two resulting in improved insight into K response potential (Figures 6, 7 and 8).

References

[1]Greer et.al. 2003, Western Nutrient Management Conference. 2003. Vol. 5:170-175. Salt Lake City, UT.

Acknowledgements

Manitoba Pulse and Soybean Growers, Nutrien/Agrium, Dr. Don Flaten

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