2017 DELTA FERTILIZER TRIALS
POTATOES – REDUCED PHOSPHORUS
PROJECT OVERVIEW

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Background

Soil nutrient studies have identified concerns about the accumulation of high soil phosphorus (P) in Delta, BC (Kowalenko *et al.* 2007, Temple *et al.* 2011). When available soil P is high, crop yield responses to additional P inputs may not be profitable. There is a need to develop management solutions for this nutrient and help growers optimize their fertilizer inputs. Trials in Delta have indicated that P fertilizer rates can be reduced when soil P is high without impacting potato yield (Lewis and Meberg 2012, Yates *et al.* 2017). Fertilizer trials done in 2016 in five different potato fields in Delta (Yates *et al.* 2017) used urea (46-0-0) to reduce applied fertilizer P and K by 50-100% in reduced fertilizer plots. Reduced fertilizer plots that received some P and K in the fertilizer mix indicated no negative impacts to yield, while plots that received zero P and zero K generally had lower yield and higher yield variability. Overall, the 2016 trial findings were limited by: extreme reductions in fertilizer P and K, with zero P and K applied in some fields; a lack of additional macro- and micro-nutrients (e.g. Ca, Mg, S, B, Zn) in the reduced fertilizer treatments; and complete broadcast of the reduced fertilizer treatments in most of the fields, which is not a standard fertilizer application practice. These Delta potato fertilizer trials were continued in 2017 to build on the work done in 2016 and to promote grower uptake of reduced P fertilization practices.

Objective

To assess the effects of reducing phosphorus fertilizer inputs on potato yield.

Experimental Design

Each trial involved two fertilizer treatments: (1) Reduced rate and (2) Farm rate. Seven trials were conducted in five fields in Delta, BC (Gleysolic mineral soils), labelled Fields A through E. Fields A and B received a complete random design with three replicated plots per treatment and four subsamples per plot. Trials in Fields C and D were unreplicated, with four subsamples per plot. Field E contained three separate unreplicated trials in different sections of the field. Application rates for each fertilizer treatment varied between fields (Table 1), but all Reduced rate treatments consisted of 25% to 50% less P than their Farm rate treatment counterparts. Custom fertilizer mixes were used in the Reduced rate treatments to apply similar amounts of nitrogen (N) and potassium (K) as the Farm rate treatments. Plot size was a minimum of 12 ft (four rows) by 200 ft and a maximum of 48 ft (16 rows) by 400 ft. Prior to the study, all fields had high or very high levels of soil P (Table 1) according to ratings developed for potatoes in the Lower Mainland according to the Kelowna method (Gough 1996). Crop planting and maintenance were completed by the growers.

Assessments

The assessment parameters that the trial focused on were foliar nutrient content, soil nutrient content, and yield. Foliar nutrient content was sampled once during tuber initiation. Soil nutrient content (0-15 cm depth) was sampled in the spring prior to trial set-up, and in the fall post-harvest. Post-harvest nitrate was also sampled in the fall (0-30 cm depth). Yield assessments were done within subsample areas that were 7 ft 3 in by 3 ft (one row). Four yield subsamples were assessed per trial plot. Data from Fields A and B were analyzed using a one-way ANOVA (JMP®, Version 13.2.1). Data from Fields C, D, and E were not statistically analyzed due to lack of replication.

Table 1. Pre-trial soil P (Kelowna method) and fertilizer application rates per field.

Field	Pre-trial soil P (ppm)	Fertilizer Treatment	Total applied N (lb/acre)	Total applied P_2O_5 (lb/acre)	Total applied (K_2O lb/acre)
A	174 Very High	Farm rate	74	115	184
		Reduced rate	74	62	180
B	163 Very High	Farm rate	80	180	220
		Reduced rate	80	90	220
C	318 Very High	Farm rate	88	198	242
		Reduced rate	88	99	242
D	67 High	Farm rate	195	144	216
		Reduced rate	158	90	256
E	179 Very High	Farm rate	88	198	242
Trial 1		Reduced rate-1	101	105	271
Trial 2		Reduced rate-2	101	105	271
Trial 3		Reduced rate-3	88	149	242

Results Summary

Replicated fields. Reduced P fertilizers did not result in lower mean total weight of potatoes in either Field A or Field B (Fig. 1). In Field A, mean total yield was unexpectedly significantly higher under the Reduced rate. In this field, both fertilizer treatments were applied in the same way (53% broadcast, 47% in-furrow by fertilizer weight). There were also no differences in soil (pre-trial or post-harvest) or foliar nitrate, P, K between treatments in Field A. Other field conditions or field variability not measured in this study were likely the cause of this yield difference. In Field B, while the mean total weight was not different between treatments the range of total yield variation was wider under reduced P. This may have been a result of fertilizer placement – the Reduced treatment was all broadcasted, whereas the Farm treatment was all in-furrow. Broadcasting nutrients, especially P, may have increased variability of nutrient distribution in the soil, in turn impacting plant access to fertilizer nutrients. There were no differences between treatments in foliar P or soil nitrate, P, or K. Foliar nitrate and K were statistically lower under Reduced rate plots in Field B, but still within sufficiency ranges for potatoes.

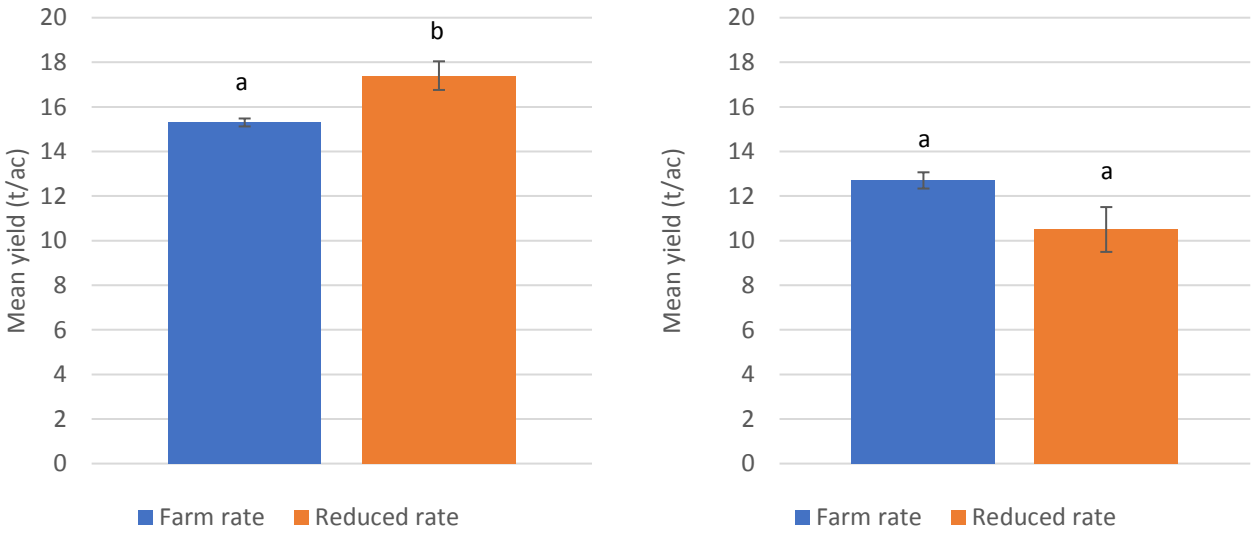

Figure 1. Mean potato yield (t/ac) under Farm rate and Reduced rate fertilization treatments for Field A (left) and Field B (right). Error bars represent standard error of the mean (n = 3). Bars with the same letter are not significantly different ($P < 0.05$).

Results

cont'd

Unreplicated fields. In all three fields, the Reduced rate plots had similar total yield to the Farm rate plots (overlap of subsample yields between treatment). The range in total yield per plot was also relatively similar between fertilizer treatments in each field. Field D received different fertilizer application methods per treatment (broadcasted Reduced rate vs. in-furrow Farm rate), similar to Field B, but this did not appear to impact variability in yield in Field D. In all unreplicated fields, there were no foliar P deficiencies detected. Please see accompanying *Field Specific Results* report for this project for more results per field.

Conclusions

- When soil P is high, P fertilizer rates can be reduced by as much as 50% without negatively impacting yield.
- Overall, plots that received reduced P fertilizers had similar total yield, yield variability, and foliar P values at tuber initiation relative to their counterpart plots that received higher P fertilizers.
- Fertilizer placement is an important part of nutrient management, especially for P which is relatively immobile in soil solution and important in early crop growth – solely broadcasting fertilizers in some of the Reduced P treatments could have created higher variation in yield.
- Future investigations into reducing soil P would benefit from:
    1. Evaluation of reduced P fertilizer applications using different application methods (e.g. partial broadcast and in-furrow applications).
    2. Evaluation of different fertilizer P sources (e.g. manure used in combination with chemical fertilizers).

References

Gough, N. 1996. Soil and plant tissue testing methods and interpretations of their results for British Columbia agricultural soils. BC Ministry of Agriculture, Fisheries and Food.

JMP®, Version 13.2.1. 2016. SAS Institute Inc., Cary, NC, 1989-2007.

Kowalenko, C.G., Schmidt, S., and Hughes-Games, G. 2007. Fraser Valley Soil Nutrient Study 2005. British Columbia Agriculture Council, Abbotsford, BC.

Lewis, D. and Meberg, H. 2012. 2011 Integrated Nutrient Management Pilot Project – Final Report. The Sustainable Agriculture Management Branch, BC Ministry of Agriculture.

Temple, W., Lewis, D., and Bomke, A.A. 2011. Eco-Friendly Crop Rotations – Final Report. Delta Farmers' Institute, Delta, BC.

Yates, D., Jack, K., Dessureault, M., and Meberg, H. 2017. 2016 Fertilizer Trials, Potatoes – Reduced Phosphorus and Potassium – Project Overview. Ministry of Agriculture, Abbotsford, BC.

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