2016 FERTILIZER TRIALS
POTATOES – REDUCED PHOSPHORUS AND POTASSIUM
PROJECT OVERVIEW

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Background

Soil nutrient studies in 2005 (Kowalenko *et al.* 2007) and 2009 (Temple *et al.* 2011) identified concerns about the accumulation of high soil phosphorus (P) and potassium (K) in Delta, BC. A fertilizer trial in 2011 (Lewis *et al*. 2012) using reduced P and K in four different potato fields in the Fraser Valley found comparable yield to the higher P and K (regular) fertilizer rates, while cutting fertilizer input costs. In 2016, potato fertilizer trials were performed in Delta to continue investigating the yield effects of reduced fertilization and promote grower uptake of reduced P and K fertilization practices.

When available soil P and K are high, crop yield responses to additional inputs will not be profitable. Fertilizer trials will help develop management solutions to this nutrient management challenge and help growers get the most out of their fertilizer inputs.

Objective To assess effects of reducing phosphorus and potassium nutrient inputs on potato yield.

Experimental Design

To assess the effect of reduced phosphorus and potassium inputs, the trial looked at two treatments: 1) Reduced rate and 2) Farm rate. Five trials were conducted in different fields in Delta, BC (Gleysolic mineral soils), labelled Fields A, B, C, D, and E. Fields A and B received a complete random design with three replicated plots per treatment and four subsamples per plot. Fields C, D, and E were unreplicated with four subsamples. Application rates for each fertilizer treatment varied between fields (Table 1), but all Reduced rate treatments consisted of 50-100% less P and K than their Farm rate treatment counterparts. Urea fertilizer (46-0-0) was used in the Reduced rate treatments to apply similar amounts of nitrogen as the Farm rate treatments. Plot size was a minimum of 24 ft (8 rows) by 200 ft and a maximum of 24 ft (8 rows) by 300 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 (Table 2). Crop planting and maintenance were completed by the growers.

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	150 Very High	Farm rate	85	140	215
		Reduced rate	90	25	115
B	144 Very High	Farm rate	84	189	231
		Reduced rate	87	0	0
C	133 Very High	Farm rate	100	180	220
		Reduced rate	86	0	0
D	63 High	Farm rate	110	149	259
		Reduced rate	87	0	0
E	202 Very High	Farm rate	88	198	242
		Reduced rate	85	99	121

Assessments

The assessment parameters that the trial focused on were foliar nutrient content, soil nutrient content, and yield. Foliar nutrient content was sampled for twice – once during tuber initiation, and once during tuber bulking. Soil nutrient content was sampled for in the spring, prior to trial set-up (0-15 cm depth), and in the fall, post-harvest (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. Data from Fields C, D, and E were not statistically analyzed due to lack of replication.

Table 2. Soil Test Phosphorus (P) and Soil Test Potassium (K) ratings for potatoes in the B.C. Lower Mainland.

"Kelowna" method rating	Soil Test P (ppm) 0-15 cm	Soil Test K (ppm) 0-15 cm
Low	< 20	< 80
Medium	20 – 49	81 – 174
High	50 – 100	175 – 250
Very High	> 100	> 250

ppm, parts per million

Values are based on Kelowna extraction method (Gough 1996)

To convert soil test results to "Kelowna" values go to:

Soil Test P and K Converter – BC Government

Results Summary

Replicated fields. Reduced P and K did not affect total weight of potatoes in Field A, whereas the reduced fertilization did reduce the total weight of potatoes in Field B (Fig. 1). Reduced rate plots in Field A did receive some P and K in the fertilizer mix. Reduced rate plots in Field B, on the other hand, received no P or K in the fertilizer mix. Perhaps residual soil P and K alone were not sufficient for optimal yield, leading to reduced yield in Field B. In addition, Reduced rate plots in Field A received some additional macronutrients and micronutrients in the fertilizer mix, while Field B did not; these additional nutrients in the Farm rate fertilizer mix could have played a role in the different yield results between Field A and Field B.

Unreplicated fields. In all three fields, comparing the distribution of yield data showed that the Reduced rate plots had a wider range of yield compared to the Farm rate plots. Fields C and E had similar total yield between Farm rate vs. Reduced rate plots. Field D had lower total yield under Reduced rate fertilization. There was foliar evidence of micronutrient problems (iron toxicity and manganese deficiency) throughout Field D, and post-harvest soil evidence of potential sodium excess, specifically in the Reduced rate plot. These field conditions likely interacted with the N-P-K fertilizer effects in Field D and could have led to reduced yield.

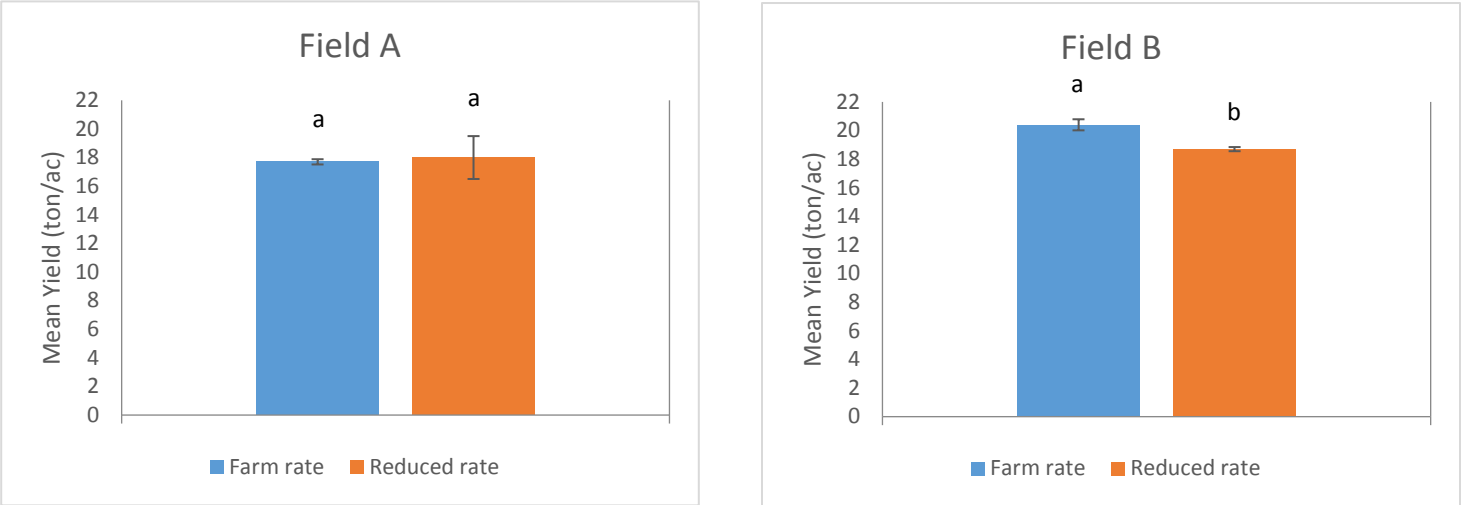

Figure 1. Mean potato yield (ton/ac) under Farm rate and Reduced rate fertilization treatments for Field A (left) and Field B (right). Error bars represent standard error of the mean (n = 3). Bars with the same letter are not significantly different ($P < 0.05$).

Conclusions

- P and K rates can be reduced when soil P and K are high without impacting yield
- Overall, plots that received zero P and zero K had lower yield and higher yield variability
- Treatments with some additional macronutrients (i.e. Ca, Mg, S) and micronutrients (i.e. B, Zn) likely benefited potato yield.
- Broadcasting application method of urea is likely a factor in creating higher variation in yield under Reduced rate treatments, and not a realistic management option for growers to reduce their P and K applications.
- Future investigations into reducing soil P and K would benefit from:
    1. Further evaluation of the effect of reduced P and K applications (rather than no P and K),
    2. Inclusion of some micronutrients in the fertilizer mix (rather than none), and
    3. In-furrow application of fertilizer rather than broadcast.

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.

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