AIM Trial: Impact of Reduced Phosphorus on Potato Yield and Quality
Working Group: AIM Science & Technology Working Group
Crop Year: 2024
Author: Ryan Barrett and Bethany Visser
Publication Date: December 6th, 2024

Project Rationale:

Historically, potato production in PEI has involved high levels of phosphorus (P) application. Phosphorus is essential for shoot and root development early in the life of the crop and can be bound by other elements (such as aluminum) in the soil at acidic pH. For this reason, PEI potato producers have historically applied P at three times the removal rate by the crop. However, many potato fields are now maintained at higher pH (> 6.0) than in the past, so the rate of P availability is significantly improved. In addition, P concentrations in many fields have reached levels of greater than 500 ppm (using Mehlich III extraction), many times higher than the needs of the crop.

Therefore, this project was undertaken to explore the effects of reducing phosphorus in fields where doing so made sense based on soil characteristics. Each selected field had pH at or above 6.0, had ppm P greater than 400, and had a P/Al ratio greater than 10:1. The hypothesis is that there will be no reduction in yield or tuber quality by reducing P by at least 33% from the grower standard practice rate.

Project Overview:

Two farms participated in this trial. Farm A contributed two fields of Mountain Gems to the trial which were planted on May 27th, both in East Prince. Farm B provided a Mountain Gem field planted on the 22nd of May in the Elmsdale area of West Prince.

For Farm A, the grower standard practice (GSP) phosphorus rate was 160 lbs/ac P_2O_5 applied in the dry fertilizer blend at planting. Treatment rate (low P) was 100 lbs/ac P_2O_5, with no change in the other applied nutrients. For Farm B, the GSP rate was 150 lbs/ac P_2O_5 and the treatment rate was 100 lbs/ac P_2O_5.

In all three trial fields, GSP and Low P rows were planted in close proximity in parts of the field that were consistent for soil type, slope, and background fertility. Harvest samples from the two Farm A fields were dug on September 24th. Here, four ten-foot strips were dug in each of the GSP and Low P treatments in each field. On October 1st, the Farm B field was sampled with six ten-foot strips dug from each treatment area. Samples were stored at 10 C until grading at Central Grading at Cavendish on November 14. Colour and specific gravity were not assessed as it was assumed that the treatment would have little to no effect on either metric. A factor of 13 was multiplied with pounds per 10 feet of row to calculate yield in cwt per acre. Marketable yield and payout was calculated using Period 6A on the Cavendish Farms winter contract, assuming full bonus for colour and specific gravity.

Potato Yield and Quality

Farm A-1 – Mountain Gem Russets

Treatment	Total Yield	Smalls	>10 oz.	Total Defect	M. Yield	Payout
	cwt/ac	%			cwt/ac	$/acre
Low P	306	9.2	2.8	1.5	274.9	$4817
GSP	292	5	14.5	0	277.3	$4938
Difference	14	4.2	-11.7	1.5	-2.4	-$121
p value	0.42	0.11	<0.001	0.13	0.91	0.74

Farm A-2 – Mountain Gem Russets

Treatment	Total Yield	Smalls	>10 oz.	Total Defect	M. Yield	Payout
	cwt/ac	%			cwt/ac	$/acre
Low P	294	8.3	12.2	1.5	266.0	$4751
GSP	281	9.2	3.3	0.3	254.8	$4478
Difference	13	-0.9	8.9	1.2	11.2	$273
p value	0.18	0.35	0.11	0.12	0.28	0.17

Farm B – Mountain Gem Russets

Treatment	Total Yield	Smalls	>10 oz.	Total Defect	M. Yield	Payout
	cwt/ac	%			cwt/ac	$/acre
Low P	319.2	10.5	11.0	0	287.0	$5144
GSP	308.7	9.4	10.6	0.8	277.8	$4970
Difference	10.5	1.1	0.4	-0.8	9.2	$174
p value	0.69	0.67	0.95	0.30	0.77	0.77

All

Treatment	Total Yield	Smalls	>10 oz.	Total Defect	M. Yield	Payout
	cwt/ac	%			cwt/ac	$/acre
Low P	308.2	9.5	9.0	0.9	277.5	$4938
GSP	295.1	8.0	9.5	0.4	270.6	$4809
Difference	13.1	1.5	-0.5	0.5	6.9	$129
p value	0.27	0.27	0.89	0.35	0.61	0.62

Key Findings:

- There is a slight trend toward higher total yield and marketable yield in favour of the Low P treatment; however, this difference is not significantly different in any individual field or across fields. Nonetheless, we can say with some certainty that there was no negative impact on yield where phosphorus was reduced.
- There was no significant impact on the percentages of smalls, greater than 10 ounce or total defects from the Low P treatment. Total Payout differences are likewise non-signficant.

Discussion:

- A reduction of 50 lbs/ac of P in the fertilizer blend at planting is estimated to reduce the per acre fertilizer bill by $37.30, assuming that DAP is the source of phosphorus and the nitrogen contributed by DAP is replaced by urea. While this value will change depending on fertilizer blends and blend pricing, it is not an insignificant opportunity for savings. On a 500 acre potato farm, this represents savings of $18,650 with no loss in yield or quality.
- These results are consistent with other on-farm trials that farmers have shared in recent years.
- A 350 cwt/acre potato crop will take up 80 lbs/acre of P_2O_5 during the growing season and will export 52.5 lbs/acre of P_2O_5. (Source: AgPhD fertilizer removal calculator).
- For fields with higher pH and P/Al ratios greater than 10:1, there is ample rationale to reduce P rates. How much reduction is warranted will depend on how much available P_2O_5 you have in your field from soil test results.
- Liquid phosphorus products applied in-furrow at planting may accomplish the goal of having high P availability at emergence/early root development without requiring high application rates of P_2O_5.

Thank you to the two participating farms for agreeing to host these trials this year. Thank you also to AAFC Charlottetown for providing storage for potato samples and to Cavendish Farms for making Central Grading available for grading.