PRINCE EDWARD ISLAND

Phosphorus Sources for Potato Production

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Potato growers feel increasing pressure about the impact of their cropping practices on the environment. A Prince Edward Island (PEI) Roundtable in 1997, and the Canadian government's 2001 report entitled *Nutrients and Their Impact on the Canadian Environment*, raise questions regarding nutrient losses from potato fields and the sustainability of applying P at rates in excess of crop removal. Currently, 63% of PEI soils test high or above in P. We initiated a project in 1998 to examine the validity of currently used rates of P fertilization and to explore methods to improve P uptake.

Potatoes grown in high phosphorus (P) soil often still need P fertilizer. A three-year study found that liming and P source had little impact on P uptake, yield, and quality, but that cultivars differed in their ability to use soil P.

Field experiments compared monoammonium (MAP) and diammonium (DAP) phosphate applied with and without lime. Growers have traditionally used DAP, but liming in the spring prior to planting is not common. The latter is practiced by some growers trying to increase the calcium (Ca) levels in the tubers.

Placed in a band, DAP initially increases pH, in contrast to MAP which lowers it. These pH changes are temporary and localized to the band. The duration of this initial pH change depends on temperature, however, and within a few weeks soil pH is lower with DAP than MAP. The pH dynamics may impact the mineral nutrition of the young plant. Our aim was to determine if a specific combination of lime, P source and rate would aid P utilization in potato.

Two potato cultivars were planted with typical management practices. Soils in each of the three years had a pH of 5.7 to 5.8 and tested high to very high in P. Rates of applied P were zero, intermediate and typical for each of the two cultivars. Ammonium nitrate provided the nitrogen (N) source to augment the N in the P fertilizer, for a total of 160 lb N/A for Russet Burbank and 135 lb N/A for Shepody. Potassium (K) fertilizer was applied at rates of 145 to 215 lb K_2O/A. Fertilizers were applied according to the typical method of double-banding beside and below the seed piece. Where lime was applied, it was

TABLE 1. Processing pay weight potato yield in response to MAP or DAP applied with and without lime (mean of three years, 1998-2000). Soil test P (Mehlich 3) was over 200 parts per million (ppm.)

P_2O_5 applied, lb/A	Processing pay weight, cwt/A			
	Lime		No lime	
	DAP	MAP	DAP	MAP
Russet Burbank				
0	141	141	152	152
135	146	174	181	171
215	164	165	188	157
Shepody				
0	244	244	252	252
67	248	265	256	260
179	233	244	281	253

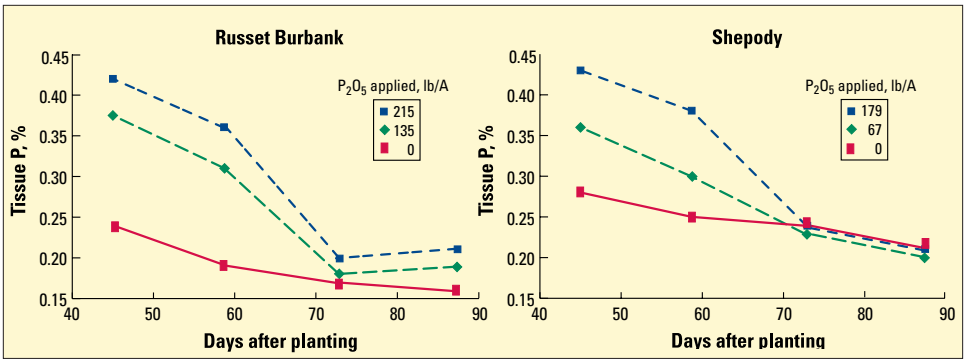

Figure 1. The Russet Burbank cultivar required higher rates of applied P than Shepody to maintain petiole tissue P levels above 0.2% .

calcitic and the rate was 900 lb/A, broadcast and incorporated in the spring.

The percentage of tubers with internal and external defects, and the percentage of tubers < 2 in., according to current French fry processing contracts, were deducted from total yield to calculate processing pay weight.

Previous work showed that Shepody responds less to applied P than Russet Burbank, and the current work supports that observation. The yield of Russet Burbank increased substantially with applied P regardless of source, but Shepody responded less (**Table 1**).

For both cultivars, increased yield was more than sufficient to pay for the intermediate rate of P fertilizer. Returns were calculated as pay weight value (at \$7/cwt) less the cost of the fertilizer (\$0.30/lb for P_2O_5), compared to a control with no fertilizer. When averaged across sources and lime treatments and relative to the control, the intermediate rate of P applied to Russet Burbank returned \$110 per acre. With Shepody, the intermediate rate returned \$43 per acre. While the full rates produced slightly higher pay weight yields, they were not economically justified on these high P soils.

Lime did not increase yields. Neither did it affect the overall response to P. However, there was a tendency for yields to be higher with MAP when lime was applied, and with DAP when it was not (**Table 1**). It is possible that when lime is applied, the pH rise in the fertilizer band induces levels of ammonia that harm the young seedling. For this reason, MAP may be a preferred source of P for banding in recently limed fields.

Lime increased tuber Ca from 280 to 360 ppm in Russet Burbank, and from 160 to 210 ppm in Shepody. Higher Ca in tubers may improve storability.

Lime did not affect the P content of tubers or petioles. It increased specific gravity slightly, by about 0.001. In comparison, specific gravity varied by 0.007 among the three years.

Shepody maintained higher P levels

Russet Burbank potatoes grown without (foreground) and with (background) applied P on the iron-rich soils of Prince Edward Island in 1999.

TOOLBOX

PKalc Software Checks Nutrient Balance

"Toolbox" is a new feature on the PPI/PPIC website which holds downloadable software tools for improved nutrient management.

The newest tool is called PKalc (v.1.12), a simple nutrient balance calculator which helps users determine if phosphorus (P) and potassium (K) nutrient additions are keeping up with removal by crops. It is an Excel spreadsheet which enables development of a multi-year, multi-crop nutrient budget. PKalc was originated as part of a project supported by a grant from USDA-Cooperative State Research, Education, and Extension Service (CSREES), through the Initiative for Future Agriculture and Food Systems (IFAFS).

Users of PKalc input crops grown and yields, plus a list of nutrients added (fertilizer and manure). The program then estimates total crop nutrient removal and calculates total nutrient additions and the resulting net balance of P and K. Default crop removal coefficients can be changed if the user prefers. The estimated net P and K balances are intended to get farmers and their consultants thinking about whether or not fertilization programs are meeting goals.

Detailed user instructions are included as pop-up comments within the spreadsheet. A Quick Start Guide and Power Point slide set also provide background information and selected state-level data.

PKalc and other useful programs can be accessed at:

www.ppi-ppic.org/toolbox. BC

in petioles than Russet Burbank at any given stage of growth (**Figure 1**). It is possible that its root system is more capable of extracting P from the soil. Petiole P increased with each increment of applied P, particularly in the early season. The two P sources did not differ in their effect on petiole P. The application of P did not affect most processing characteristics, including fry color. It reduced specific gravity slightly, by about 0.001.

In summary, we found that liming can increase tuber Ca and specific gravity, but does not increase P uptake at this soil pH. However, results could differ in soils of lower pH.

Applied P, even under high soil P conditions, can boost yield profitably, without influencing processing quality. The two potato cultivars differed considerably in their response to applied P. The greatest opportunity for improving P utilization lies in genetic improvement and cultivar choice. BC

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