

POTATO VARIETY RESPONSE TO PHOSPHORUS FERTILIZER

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ABSTRACT

The response of four potato varieties (Russet Burbank, Ranger Russet, Shepody, 6LS) to applied fertilizer P was evaluated in a three year study (2005-2007) at Parma, ID. Soils with relatively low soil test P levels (5 to 15 ppm) were fertilized with 11-52-0 (0, 100, 200, 300 lbs P₂O₅/acre) applied as a spring broadcast prior to bedding. Plant development, measured as ground cover, was significantly reduced at low fertilizer P levels. Petiole P concentration increased with increasing fertilizer rate in all cultivars except Shepody. Total and US No.1 yields were generally optimum at the 200 lb rate. Ranger Russet and 6LS tended to exhibit a stronger yield response to P fertilizer than Shepody or Russet Burbank. Total P uptake by tubers, based on tuber nutrient content and dry matter yield, indicated that potatoes removed 21 to 33 lbs P per acre, with a slight increase in this value with increasing fertilizer rate. These results show that new potato varieties may exhibit differences in plant P status and yield response to applied P fertilizer compared to Russet Burbank.

INTRODUCTION

Phosphorus is a critical nutrient in potato plant and tuber development, and plant P status has been shown to be closely related to yield. Recommendations on P fertilizer rates and in-season petiole P concentrations for potatoes were primarily developed for Russet Burbank, the most widely grown variety in Idaho. However, the proportion of acreage planted to Russet Burbank has been declining, while newer varieties such as Shepody and Ranger Russet are increasing. There is relatively little information available on the P fertilizer requirements of potato varieties other than Russet Burbank. Work that has been done with respect to N management shows substantial differences among varieties.

The objective of this research was to compare the response to fertilizer P rate of four potato varieties in terms of plant growth, petiole P concentration, tuber yield and total P uptake.

METHODS

Fields for these studies were chosen each year based on soil test P concentrations. The fields had not been cropped to potatoes for at least 4 years prior to these studies, and were usually in small grains the year prior to the trial. Soil P concentrations ranged from 5 to 15 ppm (Table 1), and were considered likely to result in a significant response to P fertilizer. Four rates of P fertilizer (0, 100, 200, 300 lbs P₂O₅/acre) were broadcast applied as 11-52-0 in the spring prior to potato planting. The P fertilizer, along with enough urea to balance the total amount of nitrogen applied, was incorporated into the bed during the hilling operation. Cut certified seed of four potato varieties (Russet Burbank, Ranger Russet, Shepody, 6LS) was planted with a mechanical planter in early April of 2005, 2006 and 2007. Individual plots were 6 rows wide by 30 feet in length. The experimental design was a randomized split plot with 5 replications.

Ground cover was determined weekly from emergence through full row closure and after the beginning of vine senescence until vine kill as a measure of plant growth. The data are

expressed as the relative area under the ground cover curve (RAUGCC). Tissue P concentration was determined on the 4th petiole at two dates during mid-season each year. Total vine and tuber dry matter and tissue P concentration were determined on 5 plant samples from the border rows of each plot on these same dates. At harvest, tubers from the middle two rows of each plot were collected, graded by size, and weighed. Tuber specific gravity and incidence of hollow heart and brown center were determined on a 20 tuber sample from each plot.

Table 1. Soil analysis results for the experimental fields at the Parma Research and Extension Center during 2005 to 2007.

Year	pH	Free lime (%)	P concentration (ppm)
2005	8.2	1	15
2006	7.7	2	8
2007	8.2	1	5

RESULTS AND DISCUSSION

Plant development was more impacted by fertilizer P rate in Shepody compared to the other varieties (Figure 1). This was due to a slight delay in early season plant growth at low fertilizer rates, followed by more rapid senescence at the end of the season. The variety 6LS was observed to exhibit severe early season plant stunting under low fertilizer P rates. However, the vigorous vine growth habit of this variety resulted in complete row closure in all treatments, and relatively less impact on ground cover over the entire season.

Petiole P concentrations in mid-July to early August ranged from 0.17 to 0.28%. Ranger Russet generally had the highest petiole P levels at any given fertilizer rate while Russet Burbank was the lowest (Figure 2). There was a significant increase in Petiole P levels with increasing P fertilizer rate in all varieties except Shepody. Petiole P concentrations in Russet Burbank and 6LS were often below the critical concentration of 0.22% recommended by the University of Idaho (Stark, Westermann and Hopkins, 2004).

Total and US No.1 tuber yield were generally optimum at the 200 lbs P₂O₅/acre rate (Figure 3A,B). Ranger Russet and 6LS exhibited a greater response to P rate compared to Russet Burbank and Shepody.

Total P uptake in tuber tissue was also optimum at 200 to 300 lbs P₂O₅/acre (Figure 4). P uptake ranged from 21 to 33 lbs/acre, and there was a slight increase in total P removal in tubers as fertilizer P rate increased.

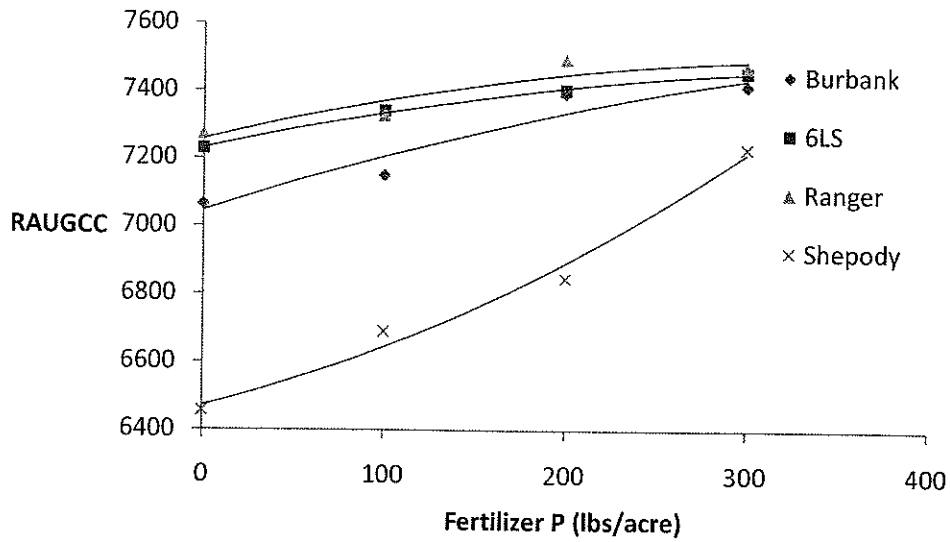


Figure 1. Influence of fertilizer P rate on ground cover development as expressed by the relative area under the ground cover curve (RAUGCC). Data for each variety is the mean of 5 replications and two years (2006-2007) at Parma, ID.

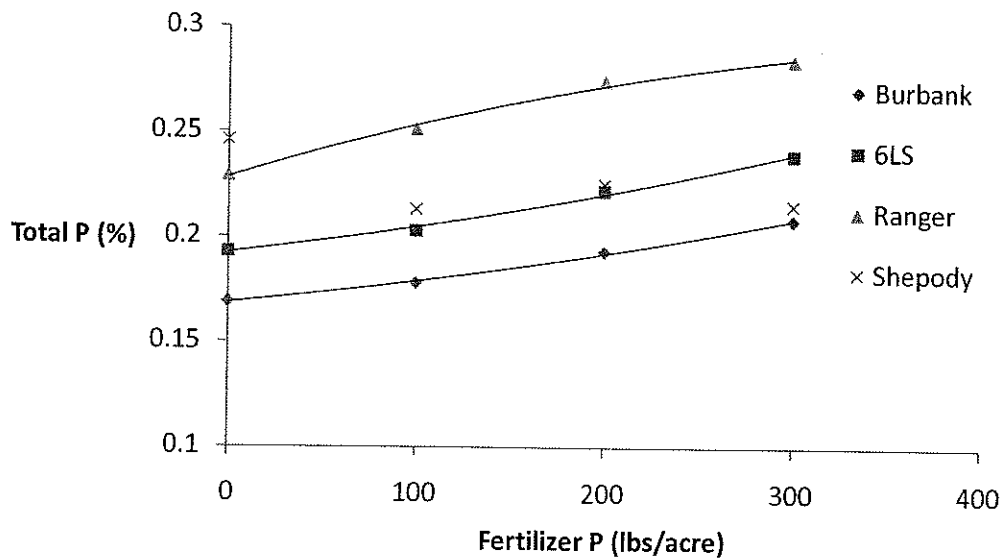


Figure 2. Influence of fertilizer P rate on total P concentration in the 4th petiole for samples taken mid July to early August. Data for each variety is the mean of 5 replications and two years (2005-2006) at Parma, ID.

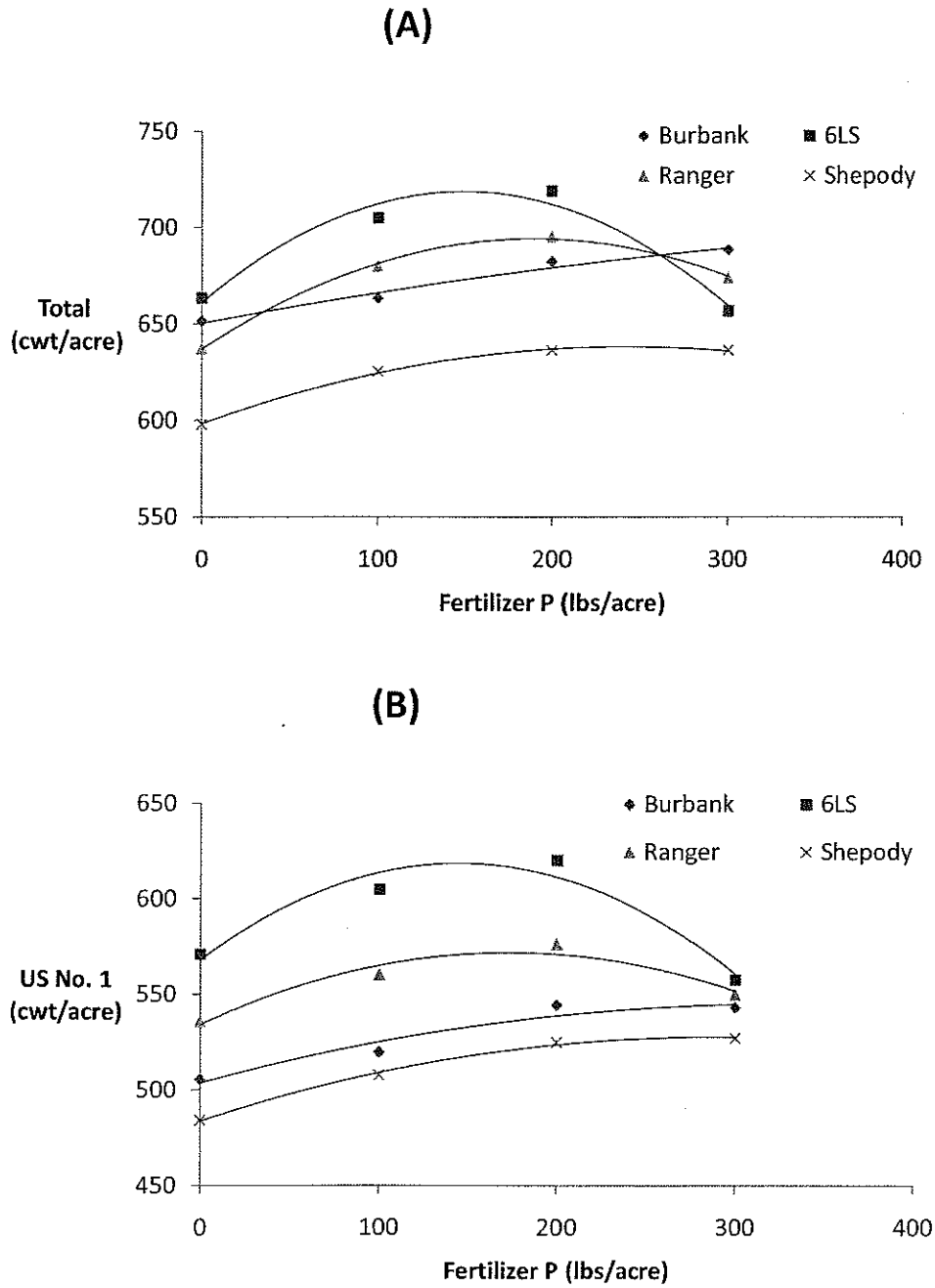


Figure 3. Influence of fertilizer P rate on A) total yield and B) US No 1 yield of 4 potato varieties. Data for each variety is the mean of 5 replications and three years (2005-2007) at Parma, ID.

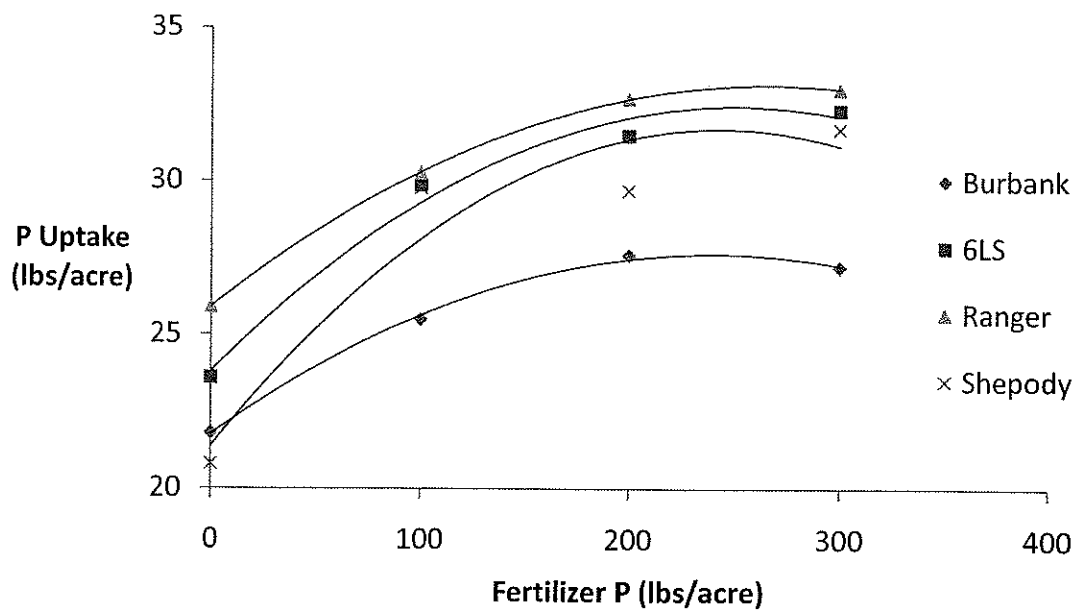


Figure 4. Influence of fertilizer P rate on total P uptake by tubers of 4 potato varieties. Data for each variety is the mean of 5 replications and two years (2005-2006) at Parma, ID.