Phosphorus Nutrition of Potatoes

D. T. Westermann

Preplant P Fertilization

Sufficient soil P must be available preplant for early vegetative plant growth and for continued P uptake during tuber growth if tuber yields are to be maximized. Phosphorus uptake increases rapidly during tuber initiation and then parallels tuber growth until the start of plant maturation. Preplant soil test P concentrations (STPC) should be 15 ppm or above for maximum potato tuber yields. Eroded or scraped field areas (white, high lime soil conditions) present special P availability problems for potatoes and the STPC should be maintained between 20 and 30 ppm P on these areas. In many fields, this problem may be corrected by fertilizing the problem areas at twice the recommended P fertilization rate. Growers should consider increasing their preplant STPC if their petiole P concentrations usually drop below the critical concentration before normal plant maturation begins.

Preplant P fertilizer materials should be plowed down or disked into the seedbed 4 to 6 inches for maximum benefits. Phosphorus materials banded above or to the side of the seed at planting, or sidedressed at hilling, have not been as effective as broadcasting under southern Idaho conditions (Table 1). Starter materials containing P should be placed above the seed piece at planting for maximum benefits.

Table 1. Effect of P fertilizer placement on petiole P concentrations.

<table>
<thead>
<tr>
<th>Placement</th>
<th>6/27</th>
<th>7/17</th>
<th>8/1</th>
<th>8/22</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>1530</td>
<td>2184</td>
<td>1748</td>
<td>896</td>
</tr>
<tr>
<td>Banded</td>
<td>1510</td>
<td>2074</td>
<td>1476</td>
<td>514</td>
</tr>
<tr>
<td>Above Seed</td>
<td>1578</td>
<td>2030</td>
<td>1660</td>
<td>542</td>
</tr>
<tr>
<td>Broadcast</td>
<td>1826</td>
<td>2828</td>
<td>2116</td>
<td>664</td>
</tr>
</tbody>
</table>

*40 lbs P/A, STPC = 27, 239-85

Plant P Concentrations

The P concentration of the petiole is a good indicator of the P status of the Potato plant. The soluble P concentration in the fourth petiole should be greater than 1000 ppm until the start of normal plant maturation or 20 days before vine kill. Phosphorus concentrations may drop below 1000 ppm during tuber growth even when the STPC is adequate because of root diseases, different plant and tuber growth rates, and other environmental constraints. Since consulting laboratories are reporting total P concentrations rather than soluble, the total P concentration (%) is related to the soluble P concentration (ppm) in the petiole by the following equation:

\[ \text{Soluble P} = 5600 \times (\% \text{ total P})^2 + 3620 \times (\% \text{ total P}) - 10 \]

Future petiole P concentrations during the growing season may be estimated by (1) petiole sampling after the peak P concentration, usually after the tubers are one inch diameter or greater, (2) obtaining at least two samples, 10 to 14 days apart, (3) plotting the P concentrations on a logarithmic scale (y-axis) against time on a linear scale (x-axis), (4) drawing a straight line through the two points, and (5) extrapolating this line to estimate future petiole P concentrations. Figure 1 illustrates this technique. Additional petiole samples can be used to adjust the slope of the extrapolated line and will increase the accuracy of the prediction. Growers should take corrective measures if the extrapolated line falls below the critical concentration (1000 ppm P) before normal plant maturation or 20 days before scheduled vine kill.

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Figure 1. Two examples of estimating future petiole PO₄-P concentrations on semi-logarithmic paper. S₁ and S₂ are the first and second samples. The dashed line is extrapolated by drawing a straight line through S₁ and S₂. Additional P would be needed on field B but not on field A. Open symbols (○,△) are petiole samples taken after making the estimate. An additional petiole sample from field B would improve the accuracy of its prediction.

Seasonal P Fertilizer Applications

Low plant P concentrations may be corrected by (1) an application of a foliar spray directly to the plants, and (2) applying a P fertilizer solution with an irrigation or broadcasting a dry material followed by an irrigation. Repeated applications of foliar sprays may be necessary to prevent late season P deficiencies. Including 1 to 2 gallons of 10-34-0 in blight sprays can also be used for applying P needed for plant growth.

Research data indicates that a single application of 20 to 40 lbs P/A in late July can increase total P uptake 4 to 5 lbs P/A and maintain an adequate petiole P concentration until normal plant maturation. Sprinkler applications are generally more effective than broadcasting dry materials followed by an irrigation. Growers considering sprinkler application of P solutions need to consider the following:

1) Check the compatibility of P solutions with irrigation water. Avoid solutions that form precipitates upon addition to irrigation water. Check water pH after adding acidic P solutions to avoid corrosion problems due to low pH's (<5).

2) Do not apply any of the P solutions directly to plants in their concentrated forms.

3) If possible, delay applications until after row closure. Soil temperatures will be reduced and plant root activities near the soil surface will be much greater after shading.

4) Sprinkler applications are most effective when applied to a healthy growing crop. Diseased or maturing plants will not benefit from foliar or sprinkler applied plant nutrients.

Summary

Growers are encouraged to use a good preplant soil testing and fertilization program and then monitor the nutritional status of their potato fields during the growing season. These techniques will identify seasonal and environmental effects and allow the grower to make the necessary corrections. This practice should help maximize tuber yields and quality if there are no other production constraints.