INTRODUCTION
Phosphorous and potassium are important to grow a high yielding and quality potatoes. Much of the northwest has had traditionally high soil test K levels. These soils have historically had greater that 200 ppm K, with many higher than 400, now have less than 100 ppm K. Some of the sandier soils that have been in production for over 20 years have been testing less than 30 ppm K. Potatoes have a high requirement for K and during the growing season petioles can drop to less than 4% K on low testing soils. Work done in the Columbia Basin has shown that seasonal K uptake can be as high as 800 pounds per acre with daily uptake rates of 20 pounds per acre per day in 2000. There has been a wide variety of methods used to supply K to potatoes on some of these low K soils: including large amounts of K applied pre-plant, applications at planting and in-season additions all with limited success in raising petioles to levels considered adequate.

Phosphorous has always been a battle in potato production. Work done in Idaho suggests 0.1% PO₄ is adequate. The Oregon State University Potato guide recommends minimal P is needed when soil P is greater than 20 ppm. The benefit of in-season phosphorous applications is difficult in potato production. University guidelines tend to be exact, e.g. when soils are greater than 20 ppm P no P is needed or when petioles are will drop below 0.1% apply P. Life is rarely so easy.

METHODS
Uptake and Biomass
Potato nutrient uptake and biomass production has been measured over a period of years starting in 1999 through 2004. Uptake is based on an average of three different harvested areas that represent a field or treatment uniformity. Where uptake is measured in conjunction with an experiment one sample is taken from each replication. Samples are harvested, cut up, dried, ground and analyzed for N, P, K, S, Ca, Mg, Zn, Mn, Cu, Fe and Al.

Potassium
A trial was established in 2002 on both a Shepody and Russet Burbank potato grower fields. Three K rates were used 0, 1X and 2X. The one and two X rates for the Russet Burbank crop was 350 lb/a K and 700 lb/a K or 440 and 880 lb K₂O/a, respectively applied all as KCl in front of dam and diking. The K application would have occurred shortly after emergence. This application time was based on information from the 1999 and 2000 uptake studies. The Shepody K rates were 300 and 600 lb K/a or 375 and 750 lb K₂O/a applied similarly. Biomass samples were harvested during the growing season, dried ground and analyzed for N, P, K, Ca, Mg, S, B, Zn Mn, Cu, Fe, Al and Cl. Chloride and potassium are confounded in this experiment; however previous work indicates that the responses are mainly due to K. The experiment had three replications. Potatoes were yielded and graded.
**Phosphorous**

A grower’s field was used to do a pre-plant banded P study using Atlantic potatoes. Soil test was moderately high at 30 ppm which would have generated a P recommendation of 80 lb P2O5/a if early planted and no P for a later planted potato crop. This study had three P rates 0, 139 and 278 lb/a P2O5 applied.

**Results**

Uptake of nutrients were higher than previous studies have measured. Uptake rates for N exceeded 7 lb N /a-d as shown in Figure 1. All nutrients measured had peak uptake at the same time except phosphorous which uptake peaked later in the season. Phosphorous also had a much broader peak for uptake which coincides with dry matter accumulation.

![Figure 1. Daily uptake rate of N, K, Ca, P and Drymatter for a 1999 Russet Burbank crop.](image)

Potassium applications increased yield in Russet Burbank and Shepody potato crops. The yield increase in shepody was linear where as only the first K application increased yield over the check in Russet Burbank as shown in figure two. Specific gravity was decreased in the shepody crop due to KCl application. Gravities were not impacted in the Russett Burbanks however the trend was the same as what was observed in the Shepody field. The interesting part to this work is the nutrient interaction, chloride uptake and chloride concentration. Petioles in the Russet Burbank crop where adequate for both K treatments as shown in figure 3.

Potassium application increased both K and Cl concentration in the tops and tubers at harvest (figures 5, 6, 7). Chloride uptake at harvest went from 23 lb/A for the check to 130 lb/a for the 2K treatment in Shepody. Chloride uptake in the Russet Burbanks occurred according to Figure 4. Tuber concentration of other nutrients tended to be unaffected by K application rate. The exception was nitrogen which tended to decrease with increasing K rate. Concentration in the tops was much more impacted by K addition than was concentration in the tubers. Nitrogen which decreased with increasing K rate in the tubers was unaffected in the rest of the plant. Nutrients such as Ca, Mg and S all decreased in the tops with increasing K.
Phosphorous response was for the most part not statistically different on an early potato crop. However, yield on average was increased three tons per acre where P was added, the difference was not significant. P concentration in the tubers was not impacted by P-rate. P in the tops increased slightly and P uptake increased with increased P application, a combination of increased yield and increased P in the tops combined to make P uptake significantly different.

Figure 2. Yield for Russet Burbank and Shepody from K applications.

Figure 3. Russet Burbank weekly petiole K for three KCl treatments.
Figure 4. Russet Burbank chloride uptake curves for three KCl treatments.

Figure 5. Chloride concentration on Tops and Tubers for Russet Burbank and Shepody for three K treatments.
Figure 6. Impact of three K treatments on nutrient concentration of Russet Burbank tops (no tubers) at harvest.

Figure 7. Impact of three K treatments on nutrient concentration in Russet Burbank tubers at harvest.
Figure 8. Yield of Atlantics from P application.

Figure 9. P Uptake for Atlantics for tops, tubers and combined tops plus tubers.

Figure 10. P concentration in tops and tubers for Atlantics for three P-rates.