Drip Irrigated Potatoes

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Simplot

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Introduction

Water in the desert west is always the greatest limiting factor to overall production. Even in years of normal precipitation and adequate snow pack, water and its management control overall production and quality of potatoes. Water delivery systems have improved over the years with movement to more advanced systems of water application. These have come with some resistance from the beginning of flood irrigation to furrow with siphon tubes to sprinkler hand lines, and wheel lines to pivot sprinklers that are the most common way of irrigating potatoes in the world. However, with the advent of climate change and concerns of very limited irrigation combined with increased population centers and limited access to water, drip irrigation is becoming a more acceptable form of irrigation.

Drip irrigation has the ability to improve water use efficiency to its highest level and when used effectively as a nutrient delivery system can also improve fertilizer use efficiency. An additional advantage of drip irrigation to potatoes may also include improvements of potato quality for processing. Tuber quality improvements associated with production and JRS Food Group's interests are based on challenges of meeting demand from the JRS processing facility in Caldwell. The Treasure Valley has always struggled with producing high-quality Russet Burbank potatoes. Much of this is related to irrigation efficiency, but more so due to the high temperatures at tuber initiation. High temperatures at this sensitive time may result in high sugar ends, lower yields, and quality that is often below contract thresholds resulting in lower potential profits for Treasure Valley producers and lower-quality raw product for processing.

There are indications that drip irrigation may resolve to some extent the quality issues that have been a serious concern for Simplot over the years. An additional high concern for Food Group managers has nothing to do with the tuber itself, but rather associated with "foreign material" that would include pieces of broken drip tape, connectors and residue from the drip system. If these types of foreign materials end up in the processing plants serious consequences can result. This may result in the shutting down of an entire processing line. Until assurances for the elimination of foreign material can be satisfied within a processing contract acceptance of drip will be a challenge but not impossible to overcome.

Methods and Materials

A small field demonstration was initiated at the University of Idaho's Parma Research Extension Center located in Western Idaho to evaluate the use of drip irrigation on potatoes. Soils consisted of a Greenleaf silt loam with less than 1.0 % organic matter. Phosphorus and other nutrients were applied to eliminate deficiencies within the production season. A portion of the predicted nitrogen was applied pre-plant with the interests of applying additional N as needed through the drip system. Potato varieties consisted of Russet Burbank, Ranger Russet, and Alturas. Seed was prepared by JRS agronomy staff and delivered to the U of I for planting. Planting was completed by April 20th with each plot consisting of two rows on 36-inch centers and separated from the adjoining plots with a single border row.

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Row 1	Burbank Guard											
Row 2	112	111	113	211	213	212	311	313	312	412	411	413
Row 3												
Row 4	Burbank Guard											
Row 5	121	123	122	223	222	221	322	321	323	423	422	421
Row 6												
Row 7	Burbank Guard											
Row 8	131	132	131	232	231	233	333	332	331	431	431	432
Row 9												
Row 10	Burbank Guard											

AgriBusiness Drip Irrigation Trial

Figure 1. Plot plan for 2014 drip-irrigated potatoes located at the U of I Parma Research Center: Green = Alturas, Blue = Russet Burbank, and Red = Ranger Russet.

Figure 2. Pictures left to right, top row: Drip tape being laid after planting, distance from potato seed piece. Bottom row: Filter system and injection tank for UAN and N-N, abandoned tape preventing future potato crops from ever being produced on this farm.

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Each treatment consisted of two 30-foot rows and a single potato variety separated by a border row. Drip tape was located approximately 5 inches from the seed piece and located at the same depth as the seed piece. Drip tape was also located on the north side of the row as the rows were going east and west. Water was delivered based on measured evapotranspiration in an attempt to keep soil moisture at approximately 65% available soil moisture. Nitrogen use and application in-season and through the drip as urea ammonium nitrate (UAN) was estimated based on yield goal and designated the grower standard practice or treatment 1. Treatment 2 was the same N rate as treatment 1, but included NutriSphere-N (Verdesian Life Sciences—Carey North Carolina) at the prescribed rate of .05 % by volume and injected along with the UAN. Treatment 3 was similar to 2 with the entire amount of N being reduced by 25%. Other than the pre-plant N that was soil incorporated, all in-season N applications were made through the drip system.

Drip tape, injection pump, filters, and control mechanisms were supplied by Toro and under the help and support of Jim Klausen from Clearwater Supply; we are grateful for his support.

As the season progressed and plants grew and developed, it was observed that the overall above-ground bio-mass was much less robust than plants produced under sprinkler irrigation. Also, the drip tape provided adequate moisture to the north half of the plant, but the roots and tubers produced on the south side of the plant away from the drip tape were noticeably dryer.

Tissue samples were collected on a weekly basis and analyzed for petiole nitrate as a predictor of N availability to the plant. Changes were observed in petiole nitrates when compared to GSP vs. N-N as well as reduced N applications for each variety (Fig. 3).

Petiole concentrations compared to GSP were elevated with the applications of both N-N in direct comparison with similar N treatments and also where the total amount of N was reduced by 25%. The most striking differences were observed with Ranger Russets, where all observations including the end of the season had higher comparative N tissue concentrations. It is important for long-season production, yield, and quality parameters to be expressed when adequate levels of tissue N are maintained. These higher tissue nitrate levels are often directly related to economic returns observed within a Simplot processing contract.

Potato Quality

Many quality parameters were measured for tubers produced under this drip demonstration; these included: specific gravity, % sugar ends, % U.S. # 1's, greater than 6 oz tubers, % bruise free, and % fry color.

Specific gravity (SG) from each variety was measured and compared back to GSP (Fig. 4). Russet Burbank had the lowest SG and Rangers had the highest. Numerically the N-N and reduced levels of N had the highest SG, but the largest differences in SG was directly related to variety and not as much to differences in N-N treatments.

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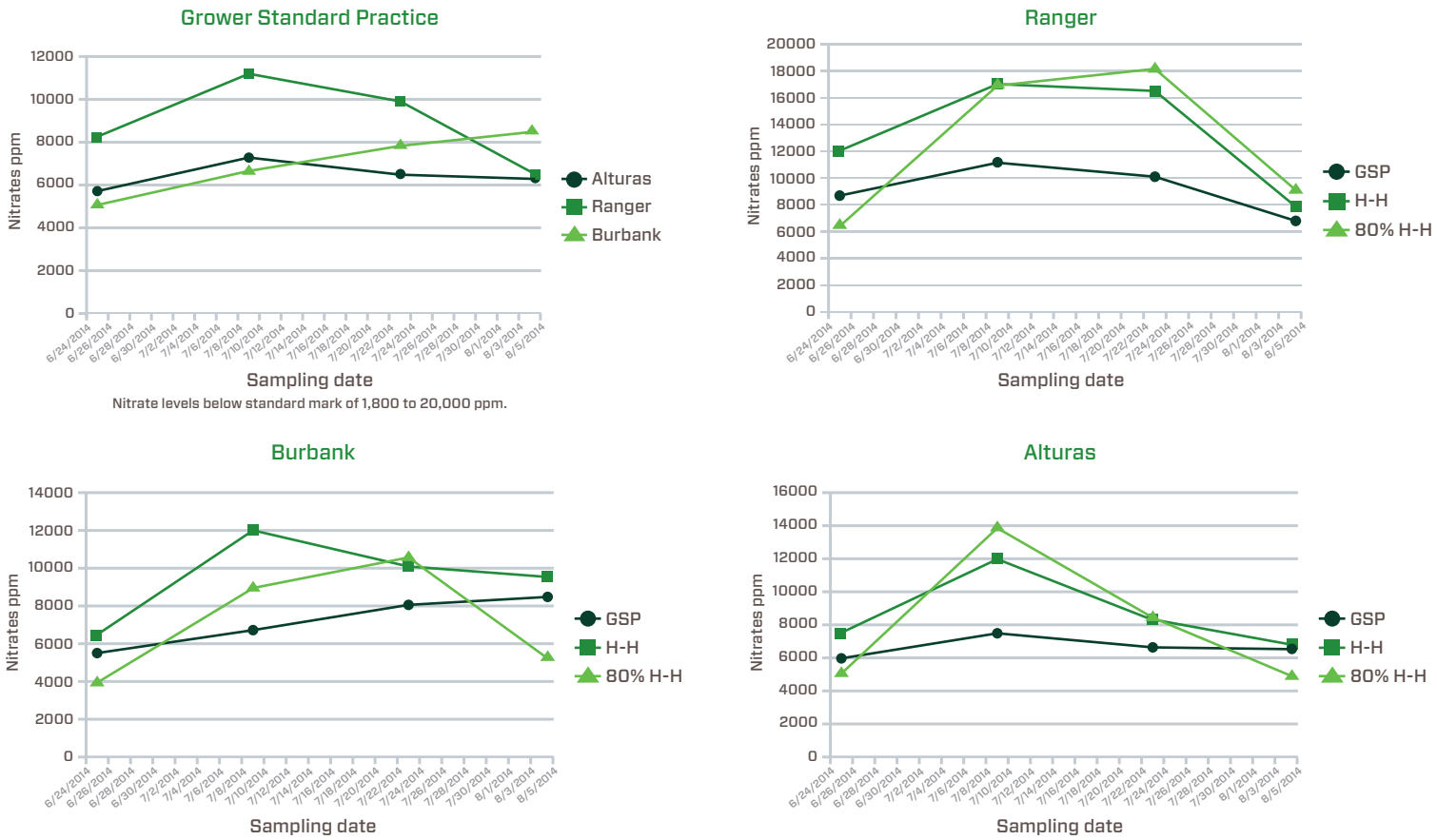

Figure 3. Petiole nitrate concentrations indicating changes to N uptake associated with N-N injection through the drip lines as well as reductions in recommended N.

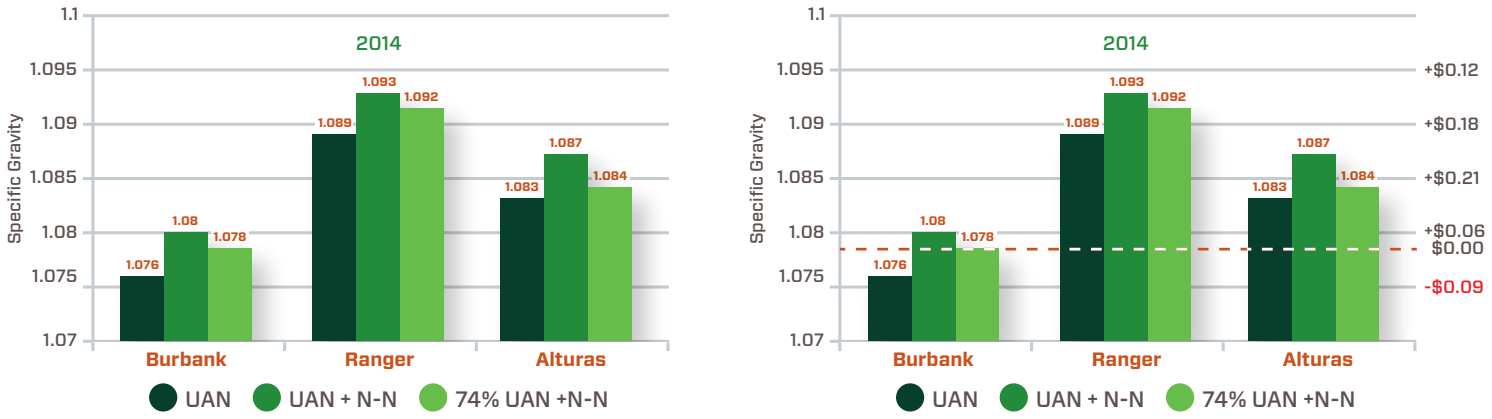

Figure 4. Specific gravity for potato varieties being produced under drip irrigation and increases in economic value back to the grower related to N-N and reduction in total N.

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Sugar ends were high for most of the treatments associated with the Russet Burbank potatoes (Fig. 5). There were very little changes associated with N treatments as they remained high for all observations. Ranger GSP was also high and indicated a reduction of profit to the grower by as much as $.50 from the JRS contract. However, the N-N significantly reduced the percentage of sugar ends to a range that there would have been no economic deduction within the JRS contract. This is of particular interest as N-N becomes a more and more commonly utilized additive within a potato cropping system. Alturas had no concerns with sugar ends regardless of treatment. Improvements in sugar ends as indicated by reductions was a goal for this project. Our treatments with Russet Burbank potatoes failed to reduce these quality parameters. To overcome this in 2015 it is being proposed that the drip tape be more central to the plant and applied above the seed piece and to the side with a minimum seed-to-drip separation of at least 2 inches. This would allow greater moisture distribution during the entire growing season and greater cooling because of evaporation associated with the critical time of tuber initiation.

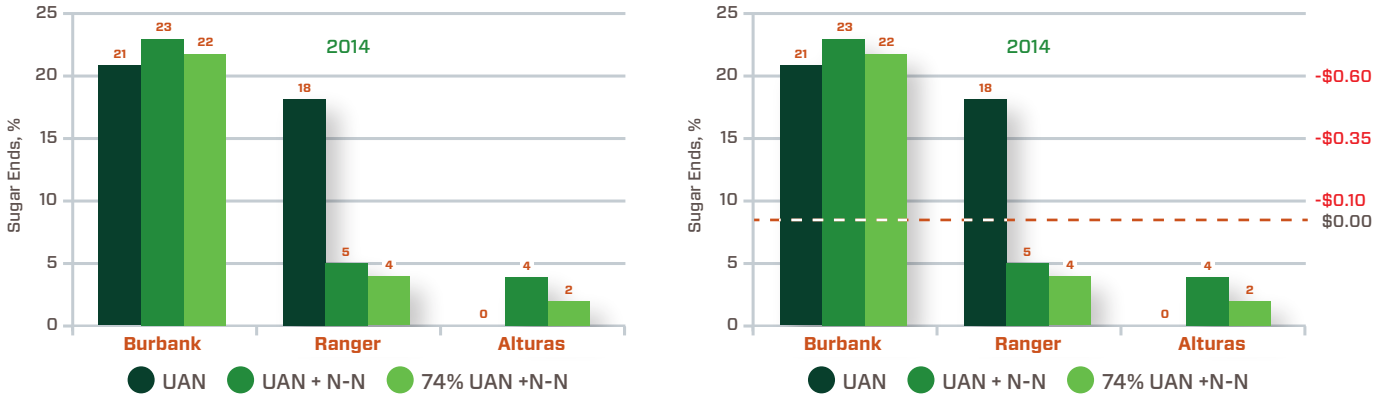

Figure 5. Percentage of sugar ends associated with drip-irrigated potatoes and the incorporation of N-N or the reduction of total N being applied through the drip system—2014.

U.S. # 1 potatoes were not significantly impacted by N treatments within the Simplot contract (data not shown). However, there were differences in the percentage of tubers greater than 6 oz treatments associated with N treatments (Fig. 6). Nitrogen treatments increased this quality parameter from 68% to 72% with the N-N treatments for RB, 74% to 78% for Rangers, and 69% to 76% for Alturas, adding an additional $.03/cwt.

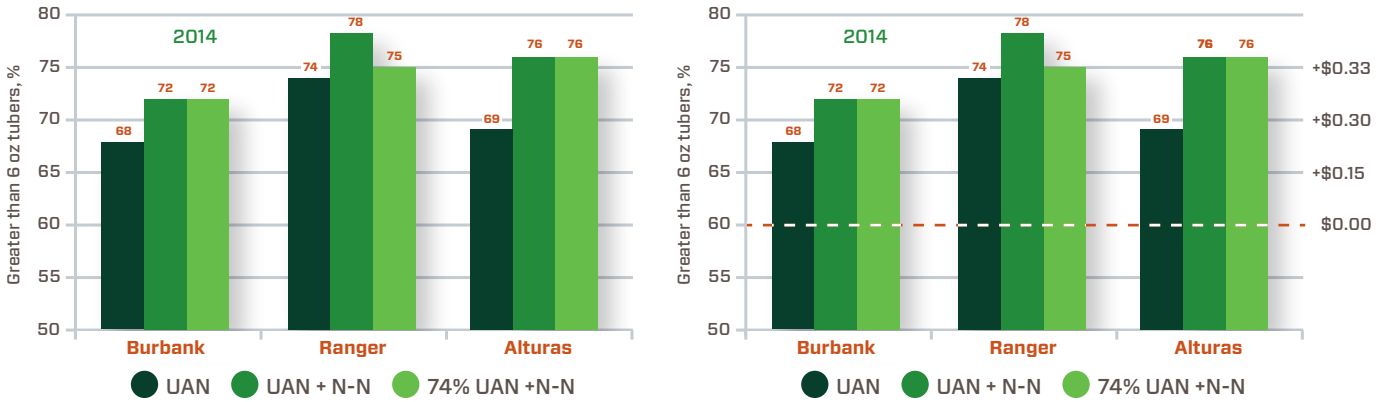

Figure 6. Percentage of tubers greater than 6 oz associated with drip irrigation and N treatments.—2014

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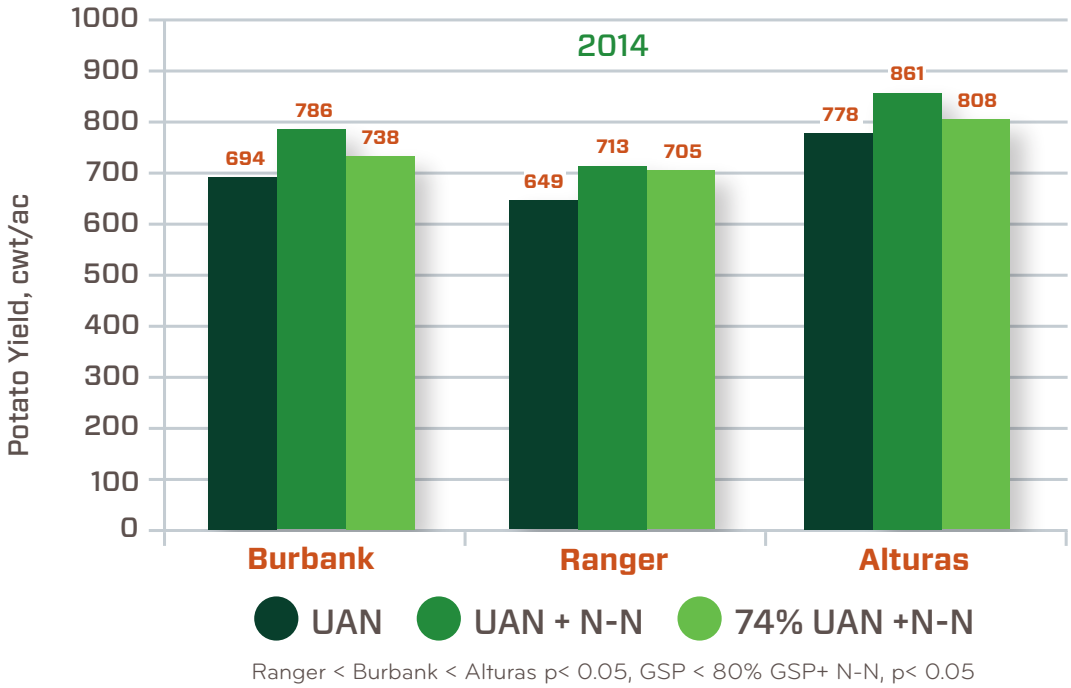
Potato Yield

Yield changes were observed for all varieties being produced under drip irrigation and associated with nutrient management schemes. It should be noted that a traditional Russet Burbank sprinkler irrigation field was located on the Parma station that we are using as a comparison for yield. The field was treated the same in regards to N rates being applied as well as crop rotation. That field had a total yield of 650 cwt/ac (32.5 tons/ac). Yields within the drip study ranged from 694 for GSP to 786 with N-N and 738 for reduced N with N-N. Ranger yields ranged from 649 GSP to 713 with N-N and Alturas ranged from 778 with GSP to 861 cwt (43 tons/ac) with N-N and 808 with the reduced N, but retaining the N-N (Fig. 7).



Ranger < Burbank < Alturas p< 0.05, GSP < 80% GSP+ N-N, p< 0.05

Figure 7. Potato yields associated with drip study for Russet Burbank, Ranger, and Alturas compared to (1) GSP, (2) GSP with N-N, and (3) 25% reduction in N with N-N. Traditional sprinkler field yield comparison for potatoes being produced at the Parma R and E Center was 650 cwt—2014.

Economics

Improvements in overall yield and quality appear to have been highly impacted by changes in N management strategies associated with drip irrigation. These changes had a direct result in economic parameters associated with the JRS contract for potato processing (Fig. 8). For example, field run $/cwt associated with Russet Burbank potatoes ranged from $6.79 to $7.18 for the N-N with a reduction in total amount of N being applied compared to the GSP. This also resulted in an overall economic improvement on a $/ac that ranged from $4,712.00 to a high of $5,547.00. Ranger Russet potatoes had similar economic benefits from the drip with a GSP of $4,628.00 to a high of $5,457.00 with the N-N treatment and reduced N rate. Alturas ranged from $5,703.00 to $6,587.00. It would appear that for each variety the reduction of N in combination with N-N applied with the UAN through the drip system increased yield of all varieties above their perspective yields where no N-N treatment was applied.

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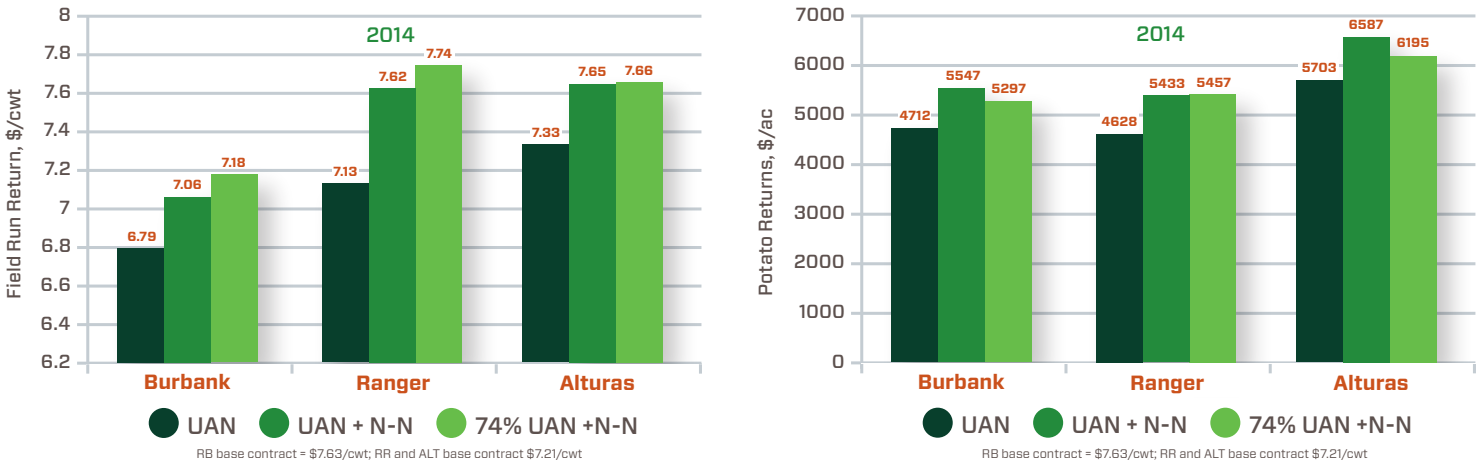

Figure 8. Economic returns associated with drip-irrigated potatoes associated with GSP predicted N requirements and the use of N-N or reduced total N and using N-N.

Summary

Drip irrigation can be used in Western Idaho to produce three varieties of potatoes, including Russet Burbank, Russet Ranger, and Alturas. When compared to the GSP, improvements were also observed by using N-N in combination with UAN or a reduction in total N when N-N was applied through the drip system. N-N increased specific gravity and reduced sugar ends in Ranger, but produced no observable difference in Russet Burbank potatoes. NutriSphere-N increased tuber size for all varieties, which subsequently increased field returns of Russet Burbank potatoes. The percentage of bruise-free potatoes was positively decreased in all varieties of potatoes with N-N and the reduction of N with N-N. Field returns and overall benefits were improved when N-N was applied in combination with UAN as well as when reducing the total amount of N being applied. This reduction provided the greatest economic return based on JRS contract. This study indicates the strong possibility that high-quality, high-production potatoes can be produced in the Treasure Valley under drip, but it is now necessary to explore improvements over our initial efforts.

Changes in 2015 will include the movement of drip tape so that it is closer to the seed piece and located above and to the side. We will also include for the Russet Burbank potato variety an irrigated field close to the drip study area where all quality parameters can be measured in direct comparison with the drip study.

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