Soil Fertility, Irrigation Keys to Potato Production

Absolute essentials in producing high yields and quality tubers.

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Summary: *Increasing nutrient efficiency with drip irrigation compared to sprinklers is of substantial interest to potato producers and input suppliers. There has been an increased level of communication and is proposed that the drip experience be expanded into a larger field area. We are looking forward to scaling this project up and beginning to seriously answer questions of value and economics associated with drip irrigation on processing potatoes.*

Potato production is at the heart of the J.R. Simplot Company and our company's success, in this part of our agribusiness endeavors, speaks volumes for who we are as a company and how success, in many aspects, is measured. Potato and soil fertility and irrigation management are the two single most important inputs for producing high yields and high quality tubers that are needed for potato processing contracts for Simplot's own facilities, as well as potato processing plants owned by other companies. Delivering nutrients has been a part of potato management needs since potatoes were first domesticated. Combining irrigation water with proper nutrition allows greater efficiencies that go beyond either one of these inputs by themselves.

Simplot is in a unique position, more so than any other company in the world. This stems from the complete integration of resources from mining to fertilizer manufacturing and importing fertilizers, wholesale and retail fertilizer distribution, farming activities, and eventually process and distribution of the finished potato products to key customers as French-fries, hash browns and other consumer potato products. While Simplot has rich heritage in the world of potato production, we are still interested in doing a better job with efficiencies when it comes to production. This includes fertilizer components as well as irrigation management strategies to be more responsible with limited natural resources. We are also more profitable as we balance environmental components that we rely on so heavily in "Bring Earth's Resources to Life."

Drip irrigation, along with the ability to inject fluid fertilizer products through irrigation lines, is a developing area of potato management strategies. Drip potato evaluations began in 2014 with cooperation of the University of Idaho Parma Research Station and the J.R. Simplot Company as well as in 2015 with Netafim Drip Irrigation Company whose

headquarters is in Israel. Netafim is a world leader in drip irrigation, U of I Parma knows how to carry out detailed research, and Simplot knows how to grow potatoes--a great combination for a successful evaluation of drip on potatoes.

Methods and Materials

Small plot field trials were established in the spring of 2016 at the Parma Research and Extension Center located 1.5 hours west of Boise, Idaho. These trials were done in close association with Dr. Mike Thornton and his capable staff, Ransey Portenier, Oksana Adams and other farm team members. Soil was a Greenleaf Silt Loam with a cation exchange capacity (CEC) of about 18 meq/100/gm of soil. Preplant applications of NPK and micronutrients were made in line with nutrient management recommendations based on soil sampling and yield goals of 800 cwt/A (40 tons/A). All pre-plant nutrients were incorporated and spring beds created in preparation for planting. Drip tape, irrigation water filtering station and all connectors were provided by Netafim through their North American Corporate offices in Fresno, CA. The 2016 field trials included 3 potato varieties: Ranger Russet, Alturas, and Clearwater. Plots were 4 rows wide by 40 feet with 5 foot alleys between each plot length with red potatoes planted within the alleyways. NutriSphere-N (N-N) (Verdesian Life Sciences--Cary, NC), an N enhancement polymer, was applied in combination with urea ammonium nitrate (UAN). Each treatment was replicated 4 times. Besides the variety differences, nutrient treatments included:

1. Grower Standard Practice (GSP)--in-season N provided by UAN through the drip lines
2. GPS plus N-N at the same rate of N
3. GSP plus N-N at 70% of GSP N rate.

Plots were planted April 14th using a 2-row planter that applied fungicide, potatoes spaced at 12 inches, and laid the drip tape 2 inches below the soil surface and 4 inches directly above the seed piece (see Figure 1).

Comparisons were also made with the same treatments and potato varieties using solid set sprinklers within the same field trial area. This allowed comparison of water application method effects on water use efficiency as well as potato quality parameters.

Netafim provided sensors within the field to monitor soil temperature with a probe located at the seed piece and soil moisture sensors located both at the seed piece and 10 cm below the seed piece. Information was recorded in real time and up-loaded to the cloud and back to computers established for monitoring both water application and temperature for both drip and sprinkler comparisons (see Figure 2).

Figure 3 is an example of comparative differences between water applications for drip and sprinklers. This information is critical to monitor water use, temperature, and the ability to provide moisture at critical times and to assure that water applications are kept within the effective root zone of the potato. Over-watering is costly and pushes any soluble N below a point where it would be accessible by

Figure 1. Planting drip potato plots and laying drip tape located 2 inches below the soil surface and 4 inches above the seed piece. Parma ID

Figure 2. Soil moisture and temperature monitoring on drip potatoes with Netafim equipment—Dr. Ami Gipps—Israel.

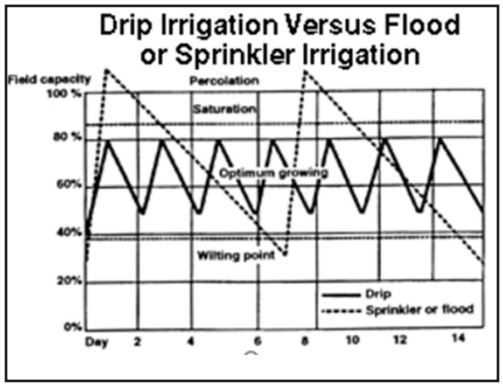

Figure 3. Soil temperature and moisture monitoring between drip irrigation and sprinkler for potatoes 2016.

Figure 4. Water pattern associated with drip irrigation where areas between rows remains dry which improves water use efficiency within a potato crop.

a growing plant and can be lost to the environment. This sensor arrangement allowed observation of the effects of watering intervals between drip and sprinklers. Drip irrigation appears to have the ability to control irrigation intervals with much smaller increments of water.

Visual differences can also be observed by the wetting pattern that occurs with drip irrigation. Instead of irrigating just the plants, a sprinkler system irrigates the areas between plant rows which allows a greater incidence of evaporation, leading to poor water use efficiency (Figure 4).

Harvest and Results

Potato plants were shredded, allowed to dry, drip tape was lifted and removed carefully from the field to assure no pieces of tape would be left in the field. The two center rows from each plot were lifted with a two row harvester and total potato harvestable weights were measured. A composite sample from each treatment was collected and placed in storage at a controlled temperature and at four weeks taken to Food Group for quality evaluation based on the Simplot contract.

Based on those results, graphs were developed to illustrate measured differences within each treatment and compared to the same variety of potato produced under conventional sprinkler application.

Drip irrigated potato yields were all higher compared to traditional sprinkler irrigation (Figures 5 and 6). The greatest response differences were observed for Russet Burbank and Alturas varieties and the smallest response differences in Ranger and Clearwater varieties. It should also be noted that there was no advantage or disadvantage from decreasing the rate of N applied (70% of GSP). However, there were additional positive responses to NutriSphere-N applied through the drip system for both Ranger and Alturas but nothing striking for Russet Burbank or Clearwater varieties in this study.

It is interesting that both ends of the variety spectrum did not respond more favorably--Russet Burbank that is difficult to grow and Clearwater whose inputs are much more reasonable and of higher nutrient use efficiency. Perhaps this is also a reflection of irrigation use efficiency.

Fry color (Figure 7) is a very important part of processing potato quality parameters and dependent on agronomic factors that include nutrient management, irrigation rates and timings as well as varieties. Treasure Valley, Idaho has been notorious for high sugar ends and this has been in the past reflected in percent color changes. However, these quality issues vary from year to year. There were greater changes in 2015 in Russet Burbank where all percentages of fry color were less than the other varieties. In 2016 the percent fry color was minimal for all other varieties (Russet Burbank not included). This was also true for irrigation effects on fry color.

There did not appear to be challenges with fry color percent between sprinkler irrigation and drip. Perhaps this might be

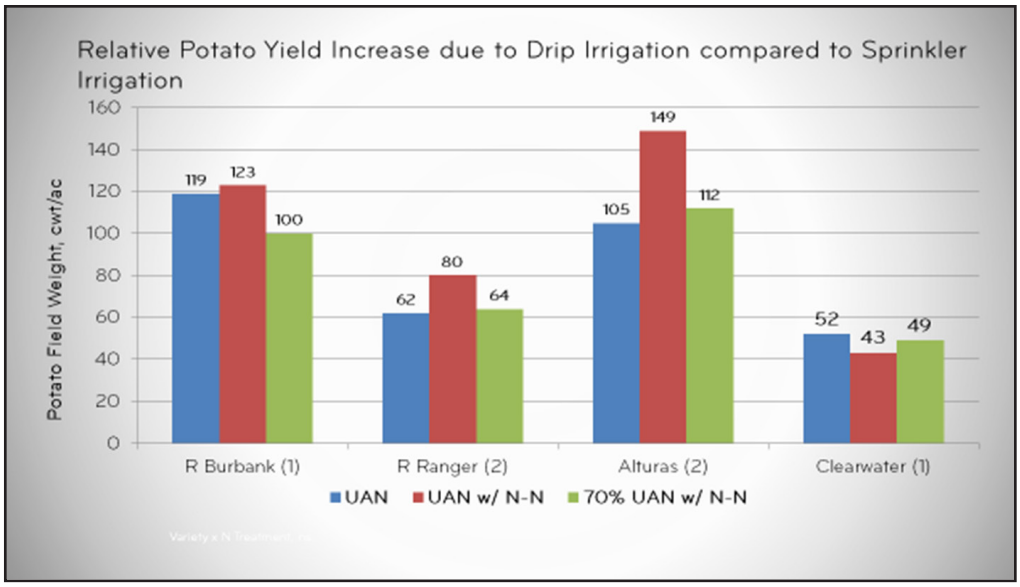

Figure 5. Total field weight for each variety of potato tested and summarized over the three years of drip studies (2 years for RB, 3 for Ranger and Alturas and 1 for Clearwater. This comparison is a relative comparison to sprinkler irrigation and indicates the percentage of yield above sprinkler.

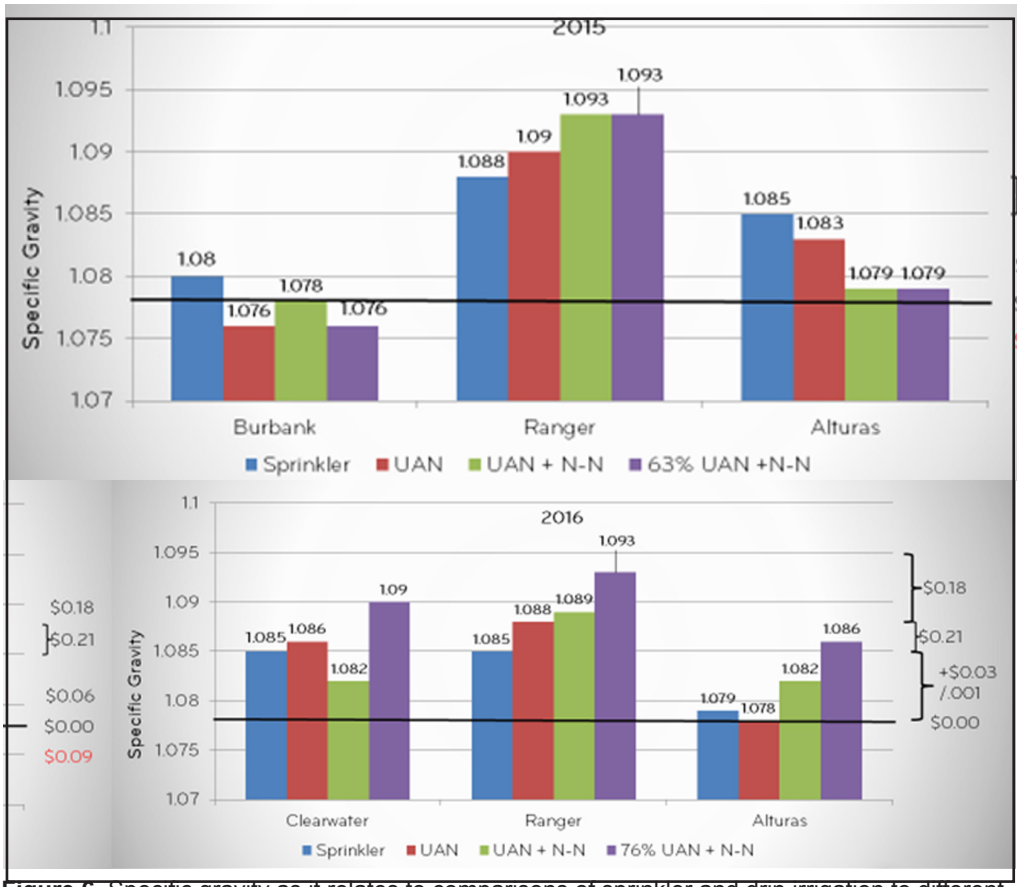

Figure 6. Specific gravity as it relates to comparisons of sprinkler and drip irrigation to different potato varieties—Parma Idaho, 2015-16.

different when compared in a larger field setting, but in these smaller field trials, not much difference.

Economics

Positive yield and quality improvements for potatoes being produced under drip were observed and then related to economic improvements that are presented in Figure 8. Variety differences were also observed associated with drip improvements over sprinklers. These small plots had relative economic improvements ranging from $345/A for Clearwater to a high of $375/A for Rangers. Alturas variety was within this range. While positive economic benefits are always a good step in creating a basis for adopting any new technology, yields and quality parameters will have to be considerably higher for drip potatoes to be adopted across larger processing acreages. This would be especially true if there were no limitations of moisture within a production area. Our goal for the future is to dramatically improve both yield (to the range of 200 cwt/A) and quality in sugar ends. We can move forward all we want with small plots, but the real test is being able to scale the drip trial up and place in a production field with commercial equipment for planting and harvest, measure differences in water and nutrient use efficiency and quality parameters going through a production plant.

The Future

Drip irrigation is being continued in 2017 with major changes. Small plot work will be continued with the University of Idaho at Parma. Clearwater, Umatilla, and Ranger will be continued for year to year consistency. We will plan to drop NutriSphere N as a variable but still look to increase nutrient efficiency with drip compared to sprinklers. Our intention is evaluate 6-24-6 low salt fluid fertilizer in combination with other materials. The drip experience will be expanded into a 6-acre field that will be managed with commercial equipment comparing drip and sprinkler irrigation. The field will be evaluated for yield, quality, water use efficiency, and how they relate to profitability within a more sustainable potato system. Netafim will help support this project with drip tape, connectors, moisture sensing equipment, filtration system, and a weather station. We are looking forward to scaling this project up and begin to seriously answer questions of value and economics associated with drip irrigation on processing potatoes.

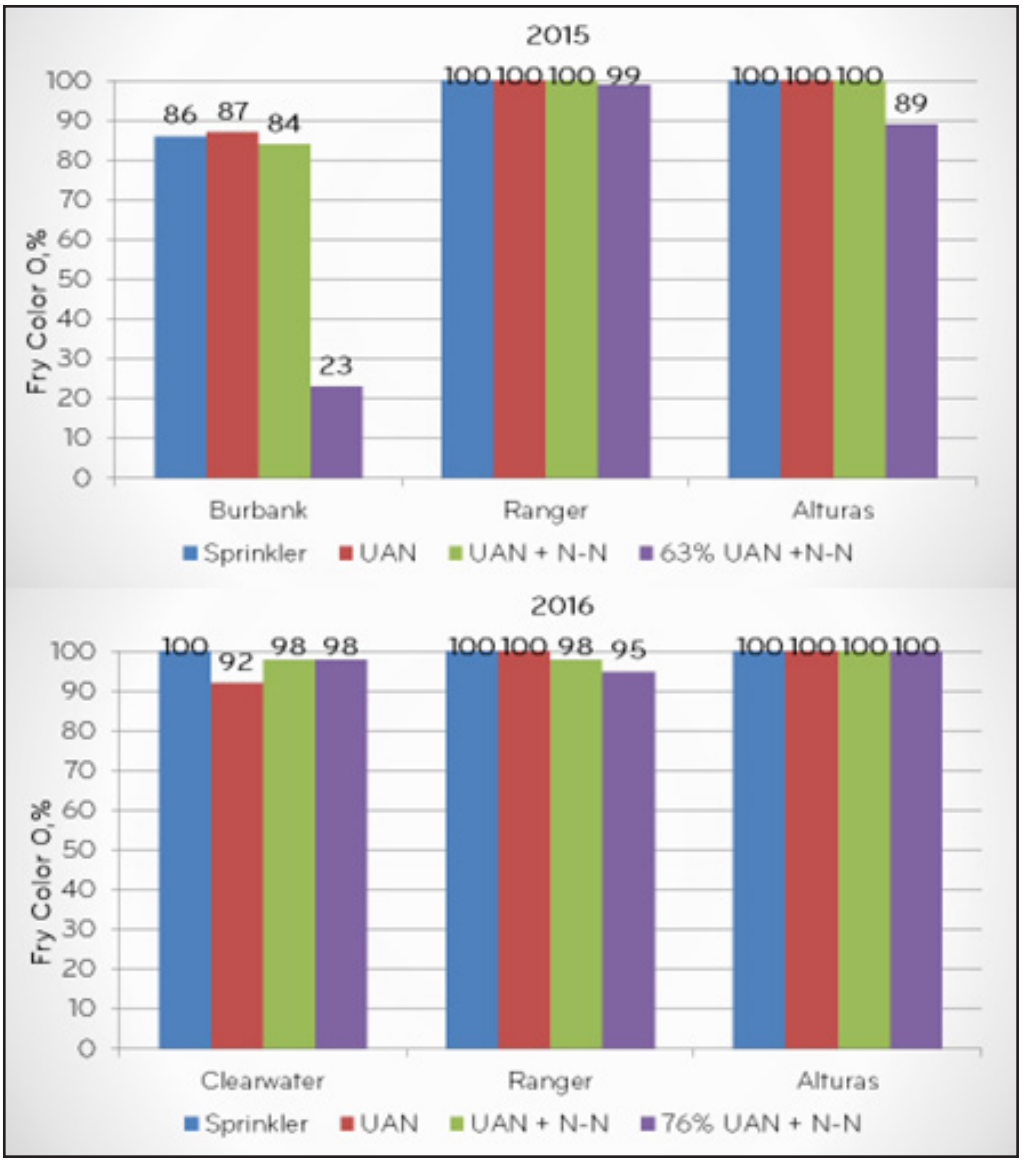

Figure 7. Fry color % comparing 2015-16 potato drip compared to sprinkler irrigation.

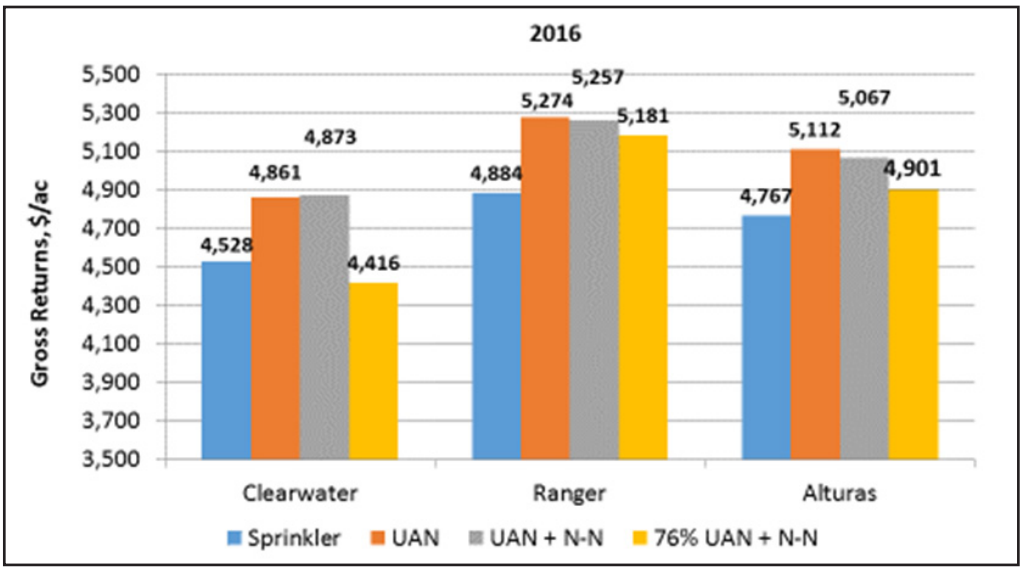

Figure 8. Economic predictions for Clearwater, Ranger and Alturas potato varieties being produced under sprinkler compared to drip irrigation at Parma Idaho, 2016.

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