

\$ 10,000

**RESEARCH PROPOSAL REQUESTING FOR FUNDS  
FROM THE POTATO ROYALTY REVENUE**

**2007**

***SUBMITTED BY***

***SAMUEL ESSAH***

**Project Title:**

Drip irrigation in potato production for reduced water and nutrient use.

**Investigator:**

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**Nature and Scope of Research:**

This project addresses critical issues in the San Luis Valley of Colorado including, optimal use of limited irrigation resources in the watershed, optimal use of nitrogen fertilizer to reduce production cost and the potential of ground water contamination, and improved potato yield and quality.

Making the groundwater aquifer sustainable has become the key to survival for communities in the San Luis Valley. According to the 2002 Division 3 Irrigated Lands Assessment and Groundwater Use Evaluation Study, the aquifers in the San Luis Valley have been depleted from 10 feet in some areas to 40 feet near Del Norte. A ten year reduction target of 22% groundwater use has been established.

Drip irrigation supplies the needed amount of water close to the plant root, thereby avoiding the potential of water loss through drift and evaporation as observed in overhead irrigation through the center pivot. The technique of drip irrigation is more efficient in water use, and can lead to reduced water use for improved potato yield and quality. In the same manner, plant nutrients that are injected through the drip system are supplied close to the crop root zone. This system improves the nutrient use efficiency of the crop, and can lead to a reduction in nutrient input when compared to the conventional overhead irrigation system.

**Project Objective:**

The primary objective of this project is to improve water and nutrient use efficiency in potato production.

The specific objectives of this project are,

1. Reduce the amount of water needed for optimum production of potatoes by at least 25%.
2. Significantly reduce the amount of nitrogen (N) fertilizer needed for optimum potato production.
3. Increase yield and quality of potatoes produced in the San Luis Valley.
4. Reduce potato foliar diseases to the minimum.

## MATERIALS AND METHODS

### *Experimental Site and Years of Study:*

The study will be conducted at the San Luis Valley Research Center, CO, during the 2007 and 2008 potato growing seasons.

### *Potato Varieties to Use:*

Two potato varieties, one russet and one red variety that are commonly grown in the San Luis Valley will be used as test crops in this study.

### *Treatments:*

There will be two major treatments, irrigation method, and nitrogen application rate. The irrigation treatments will include two drip irrigation systems, (i) surface drip, where the drip tapes are buried 2-3 inches below the soil surface, (ii) subsurface drip, where the drip tapes are buried 10 inches below the soil surface. The subsurface drip tapes can stay permanent for several years, but the surface drip tapes need to be rolled every year before harvesting. The third irrigation treatment will be overhead irrigation which will serve as the control.

Nitrogen fertilizer treatment will include liquid N fertilizer applied at 60 and 120 lb N/ac, and a control where no N will be applied.

### *Experimental Design:*

The study will be laid out in the field as a split plot in a randomized complete block design. Irrigation treatment will be the main plot factor, and N application rate will constitute the sub plot factor. All treatments will be replicated five times.

## **Data Collection**

### *Soil and Water Samples*

Soil samples from experimental plots and water samples from the irrigation well will be taken in mid April and analyzed for their nutrient content. This will indicate the amount of residual nitrogen and other nutrients in the soil before planting, and how much nitrate nitrogen is supplied to the crop from the irrigation water at each time of irrigation.

### *In-Season Plant Sampling and measurements*

The effect of treatments on sprout emergence, crop stand, and canopy volume will be evaluated. During tuber bulking, plants will be sampled to evaluate stem number, tuber number, and mean tuber weight per plant.

Plant samples from individual plots will be taken at bi-weekly intervals for determination of rate of leaf area production, number of stems and tubers produced, and the rate of dry matter accumulation and partitioning in the leaves, stems, tubers, and roots.

Petiole samples will be pulled and sent to the USDA lab in Fort Collins for nutrient analysis. This will help establish in-season petiole nitrate curves for individual cultivars.

### *Yield and Tuber Quality Evaluation*

Potato tubers will be harvested twenty one days after vine kill from a 10 ft. section of the middle row in each plot. Tubers from each plot will be weighed and

graded for external (misshapes, knobs, growth cracks) and internal (hollow heart and brown center) defects. The harvested tubers will be separated into the various size distribution groups based on weight (<4 oz, 4-6 oz, 6-8 oz, 8-10 oz, 10-12 oz, 12-16 oz, and >16 oz), and diameter [<2 inches (in.), 2-4 in., >4 in., >2 in. but <10 oz, >2 in. and >10 oz], to evaluate the tuber size profile for each cultivar. Ten large (10-16 Oz) tubers from each plot will be taken for hollow heart and brown center evaluation. Specific gravity will be measured using the weight-in-air/weight-in-water method.

### **Statistical Analysis**

All data will be subjected to analysis of variance to test for main effects and interactions among cultivars and treatments. When significant interaction effects are detected, the proc mixed procedure in SAS will be used to analyze the data to estimate differences between treatment means.

### **Relationship of Proposed Research to Overall Problem for Potato Growers:**

The San Luis Valley has suffered from many years of drought. This was especially noted after the Rio Grande ran only 15% of normal in 2002. Almost no water was available for recharge that year, but the normal amount of water needed for potato production was pumped. Ground water has now been depleted to the extreme. Water conservation (water use efficiency) is demanded. Most irrigation well production has declined; many wells produce much less than before; less than what is needed for a center pivot. Some irrigation wells now do not even reach the water table and do not pump water. The Rio Grande Water Conservancy District estimates that ground water pumping must be reduced by 25% to make the aquifer sustainable for a long time. Center pivot systems cannot be made that much more efficient. A new, innovative system such as drip irrigation must be investigated. A more efficient irrigation system is needed to make the San Luis Valley groundwater more sustainable.

The cost of potato production keep on increasing due to energy and other input costs. With drip irrigation, liquid fertilizer will be injected into the drip system. The fertilizer nutrients are metered close to the crop root zone. This will increase nutrient use efficiency, and therefore reduce the total amount of fertilizer nutrients applied. With less fertilizer nutrient applied, cost of production will reduce, and the negative impact of groundwater contamination due to nitrate nitrogen leaching will be mitigated.

### **Potential for Leveraging Results to Obtain Additional Outside Funding:**

Results obtained from this study could be used as leverage for obtaining outside funding. Funding could be obtained from the USDA-NRCS for water conservation research. Other sources of funding could be from drip irrigation companies who are pushing for the drip irrigation technology in potato production. Fertilizer companies can also fund fertilizer nutrient management projects.

### **Timeline and Expected Short term and Longer term Outcomes:**

This project is organized into three phases. The first phase will document the feasibility of drip irrigation in potato production, with preliminary results showing water savings from drip irrigation as compared to overhead irrigation. Also, preliminary results on N use efficiency in drip irrigation as well as potato tuber yield and quality will be documented at the end of 2007. Potato growers will have the opportunity to see how the drip system works during the 2007 field day. The second phase will involve monitoring how the permanent drip irrigation system (subsurface drip) works in the second year, and then document a second year result for the whole study. The final phase will evaluate and analyze the acquired data which will be presented to potato growers through a professionally prepared power point presentation. A detailed report of the two years study, together with recommendations will be made available to potato growers during the power point presentations. The final Phase is scheduled for December 2008. The entire project duration will be 24 months.

### **BUDGET FOR THE TWO YEARS STUDY**

#### **Personnel**

Spring, summer, and fall help (1) \$8,000.00 for each year = \$16,000.00

#### **Materials and Supplies**

|  |            |
|--|------------|
| Soil moisture sensors                    | \$ 500.00  |
| Drip lines, tapes, and nutrient injector | \$2,500.00 |
| Other drip accessories                   | \$ 500.00  |
| Soil, water, and plant analysis          | \$ 500.00  |

**Total Requested for this Proposal** \$20,000.00

### **BUDGET JUSTIFICATION**

#### **Salaries and Wages:**

One person is needed to help in the management of this project. The person will help in laying out drip lines and tapes before potato planting. The person will help in potato planting, harvesting, and grading. Before harvesting, the individual will help roll the surface drip irrigation tapes. Soil and plant samples will be collected from the field with the help of this person. This individual will also help in the general maintenance of the

plots. Sixteen thousand dollars (\$16,000.00) is request to hire one person for the two years study.

**Materials and Supplies:**

Moisture sensors will be needed to measure soil moisture throughout the growing season for the individual treatments. Drip lines and tapes need to be purchased and laid down for each plot. An injector will be needed to inject nutrients into the drip system. Plant and soil samples will be ground and sent to the soil analysis lab for nutrient analysis. During the two years of the study, it is anticipated that some repairs and accessories will be needed for the drip system. A total of \$4,000.00 is being requested in this proposal for materials and supplies for the two years study.