

**RESEARCH PROPOSAL FOR COLORADO POTATO  
ADMINISTRATIVE COMMITTEE, AREA II**

**2008**

***SUBMITTED BY***

***SAMUEL ESSAH***

**Project Title**

Development of management profiles for new and existing potato cultivars.

**Funding Source**

Colorado Potato Administrative Committee (CPAC Area II)

**Investigator**

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**Nature and Scope of Research**

The development of cultivar specific management profiles for potato cultivars aim at tailoring cultural management guidelines to individual potato cultivars. Management profiles consist of cultivar specific management information pertinent to production such as fertility management, irrigation/water management, planting date and seed spacing, reducing the risk of pesticide use without compromising tuber yield and quality, and vine kill and harvest date management for improved tuber skin set.

The proposed research for 2008 will evaluate the response of potato cultivars to numerous cultural management practices, including seed tuber preparation before planting, fertility management, irrigation/water management, drip irrigation, plant population (seed piece spacing) management, planting, vine kill, and harvest date management to improve skin set. The application of Compost Tea to reduce the use of fungicides in potato production without sacrificing tuber yield and quality will be evaluated in 2008.

Canela Russet has good looking tubers with excellent quality but has long dormancy with delayed field emergence. It can produce low yield, probably due to fewer stem numbers (average of 2) per plant. Studies conducted in 2005 and 2007 have shown that seed reconditioning and seed size could accelerate field emergence and increase the stem number from 2 to 3. The reconditioning temperature used in these studies were high (70 to 75 °F) and resulted in early senescence of the plants. I propose to reduce the reconditioning temperature to 50 to 55 °F to see the effect on tuber yield and quality.

The performance of several advance potato selections grown under different management practices and in different soil types will be evaluated in several grower fields.

## **Project Objective**

The general objectives of this proposal are to develop cultural management guidelines for the successful, sustainable, and economic production of potato cultivars grown in the San Luis Valley, which optimize their genetic potential. The management strategies should be agronomically sound, economically advantageous, and environmentally responsible.

The specific objectives of this project are;

1. Accelerate field emergence, increase stem number, tuber yield and quality of Canela Russet by manipulating seed size and seed reconditioning before planting.
2. Evaluate the water use efficiency, tuber yield, tuber size distribution, and quality of potato grown under drip irrigation.
3. Define optimum nitrogen requirement and proper nitrogen application timing for potato cultivars grown in the San Luis Valley.
4. Define optimum in-row seed piece spacing, planting date, and vine kill management to improve skin set of potato cultivars grown in the San Luis Valley.
5. Evaluate the effect of Compost Tea application with reduced or no fungicide use on potato tuber yield, tuber size distribution, and quality.
6. Evaluate the yield and quality performance of several advance potato selections from the Colorado Potato Breeding Program, grown under different management practices and in different soil types.

## **MATERIALS AND METHODS**

### ***Objective 1. . Accelerate field emergence, increase stem number, tuber yield and quality of Canela Russet by manipulating seed size and seed reconditioning before planting.***

This study is being repeated but modified to evaluate the effect of seed size and seed reconditioning on field emergence, stem number per plant, tuber yield, tuber size distribution and quality of Canela Russet. Seed size treatment will include 2.0 to 2.5 oz and 3.0 to 3.5 oz seed tubers. Seed reconditioning treatment will include seed planted directly from storage, and seed reconditioned at 55 °F for 7 and 14 days before planting. There will be a total of six treatments; 2.0 to 2.5 oz seed planted from cold storage (cold seed), 2.0 to 2.5 oz seed reconditioned at 55 °F for 7 and 14 days before planting (warm seed), 3.0 to 3.5 oz cold seed, and 3.0 to 3.5 oz reconditioned seed. The experimental design will be a randomized complete block with four replications.

**Objective 2. Evaluate the water use efficiency, tuber yield, tuber size distribution, and quality of potato grown under drip irrigation.**

Drip irrigation supplies water close to the plant roots where it is needed. This system eliminates the potential of water loss through drift and evaporation when overhead irrigation is used. It is hypothesized that under drip irrigation less water will be used to produce high yield and quality potato tubers when compared to the use of overhead irrigation. The incidence of foliar disease is also projected to be low. The aim of this study is to evaluate the feasibility of drip irrigation in potato production in the San Luis Valley, and to determine whether drip irrigation could reduce water use for equal or higher potato tuber yield and quality when compared to conventional overhead irrigation. Irrigation treatment will consist of (i) overhead irrigation (ii) surface drip irrigation (tape buried at 2 -3 inches), and (iii) subsurface drip irrigation (tape buried at 10 and 14 inches). The experimental design will be a split plot in RCBD, with irrigation treatment as the main plot, and depth of tape as sub plot treatment. Each treatment will be replicated five times.

**Objective 3. Define optimum nitrogen requirement and proper nitrogen application timing for potato cultivars grown in the San Luis Valley.**

(a) *Nitrogen Application Rate*

Nitrogen (N) fertilizer requirement for optimum tuber yield and quality differ among potato cultivars. There is the need to establish available N requirements for individual cultivars. Nitrogen treatment will include five application rates, 60, 120, 180, and 240 lb N/ac, and a control where no N will be applied. Each treatment will be replicated four times in a randomized complete block design.

(b) *Pre-Plant/At Planting Nitrogen Application Rate*

Depending on the growth rate and maturity period of the cultivar, the required pre-plant/at planting N rate can differ among cultivars. Pre-plant/At planting nitrogen treatment will include four application rates, 60, 80, and 100 lb N/ac, and a control, where no N will be applied pre-plant. The experimental design will be a randomized complete block (RCBD), with four replications.

(c) *Develop Optimum In-Season Nitrogen Application Timing Schedule*

While the total nitrogen applied can influence the performance of potato cultivars, timing the application of N during the growing season can also influence tuber yield, tuber size distribution, and quality. A study will be conducted to evaluate the effect of weekly application of N fertilizer (spoon feeding) during the growing season, compared to applying N at two weeks interval. In-season nitrogen application will be initiated after tuber initiation. After the initial in-season N application, subsequent N application will be done every 7 days (spoon feeding) or every 14 days, until the total N requirement for the specific cultivar is applied.

**Objective 4. Define optimum in-row seed piece spacing, planting date, and vine kill management to improve skin set of potato cultivars grown in the San Luis Valley.**

This study will be conducted to evaluate the response of tuber yield, tuber size distribution, tuber quality, and tuber skin set to in-row seed piece spacing, planting date and vine kill timing. In-row seed spacing treatment will be 10, 12, and 14 inches. Vine kill timing treatment will include killing the vines at 14, 21 and 28 days before crop harvest. Each experimental design will be an RCBD, with four replications.

**Objective 5. Evaluate the effect of Compost Tea Application with reduced fungicide application on potato tuber yield, tuber size distribution, and quality.**

The objective of this study is to reduce the use of fungicides but apply Compost Tea in potato production. The study will evaluate the effect of Compost Tea application with reduced rates of fungicide and nitrogen application on potato tuber yield, tuber size distribution, tuber quality, and foliar disease incidence. The main treatments will include application of Compost Tea, two rates of N (80 and 120 lb N/ac), and fungicide application. This study will be a factorial design in RCBD, and all treatment combinations will be evaluated.

**Objective 6. Evaluate the yield and quality performance of several advance potato selections from the Colorado Potato Breeding Program when grown under different management practices and in different soil types.**

The objective of this study is to evaluate the yield stability, and the yield and quality performance of advance selections from the Colorado Potato Breeding Program when grown under different management practices and in different soil types. Several advance selections of Russets, Reds, Chippers, and Specialty type potatoes will be planted in strips on six grower farms. The six farms that will be selected will differ in crop management practices and in soil type. Clones entered in this study will also be screened for metribuzin tolerance. At harvest, each clone will be evaluated for yield and tuber quality.

## **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. Soil samples will also be taken at the end of the crop harvest and analyzed for the nutrients that were not used by the crop. This will help evaluate nutrient use efficiency.

### *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 treatment effects on stem number, tuber number, mean tuber weight, and tuber bulking rate.

Petiole samples will be taken every fourteen days from the fertility study plots for nutrient analysis. This will help establish in-season petiole nitrate, phosphorous, and potassium curves for individual cultivars.

### *Yield and Tuber Quality Evaluation*

Potato tubers will be harvested and evaluated at the end of the growing season for yield and tuber size distribution. 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 the proposed Research to overall problem for potato growers**

This project augments and completes information needed for potato cultivar development and improvement at the San Luis Valley. In the cultivar evaluation and development process, shortcomings of selections and cultivars may be recognized and appropriate cultural management strategies are explored and identified to solve such cultivar specific problems. Cultivar specific management profiles developed from this project will result in a more successful experience for producers when trying a new cultivar that is released. The cultivar specific management profiles developed will help in the profitable production of potato in the San Luis Valley.

### **Potential for Leveraging Research Results to Obtain Outside Funding**

Results obtained from this project could help obtain outside funding. Funding could be obtained from USDA - CSREES as part of the potato development and improvement project, and from USDA-NRCS for water and nutrient conservation research. Funding from the Environmental Protection Agency (EPA) could help in research involving

reduction in pesticide use. Other sources of funding could be from fertilizer companies for nutrient management studies.

### **Timeline of Proposed Research and Expected Outcomes**

Cultural management studies on advance selections and new cultivars will be conducted in 2008 to provide management guidelines to growers of those cultivars. At the end of the 2008 growing season, cultural management guidelines will be updated for Canela Russet, Rio Colorado, Rio Grande Russet, Colorado Rose, Purple Majesty, and Mountain Rose. Preliminary information on management guidelines for other new potato cultivars will be documented at the end of the 2008 growing season. Cultural management guidelines will be completed for some of these cultivars at the end of the 2009 growing season. Varieties that will be released between 2008 and 2011 will be accompanied by management guidelines for the successful production of those cultivars. The feasibility of drip irrigation and compost tea in potato production will be concluded at the end of the 2009 growing season.

## ANNUAL BUDGET

### Personnel

1. Two (2) non-student hourly help for 6 months (24 weeks).  
Wages per helper:  $\$8.50/\text{hr} \times 40 \text{ hr}/\text{wk} = \$340.00/\text{wk} \times 24 \text{ wks} = \$8,160.00$  for the season.

Fringe benefits:  $14.5\% \times \$8,160.00 = \$1,183.00$ .

Total cost per helper for the season =  $\$9,343.00$

Total cost for tow (2) helpers = \$18,686.00

2. A third helper who stays year round

Wages: \$18,686.00

**Total Personnel** \$37,372.00

### Materials and Supplies

Potato sacks, gloves, masks, and sample paper bags \$2,000.00

Fertilizer purchase \$2,000.00

**Total Materials and Supplies** \$4,000.00

### Services

Soil, water, and plant sample analysis \$3,000.00

**Travel** \$2,000.00

**Total amount of this request** \$46,372.00

## Budget justification

### 1. Salaries and Wages:

Because of the extensive field and green house research work, including soil sampling, seed cutting, potato planting, in-season data collection (plant sampling, petiole sampling), extensive fertilizer and compost tea spraying, potato harvest and grading, and data analysis and compilation involved in this project, considerable financial resources are committed to personnel. Wages for three helpers are requested in the budget.



## **2. Materials and Supplies:**

Field supplies include items such as field stakes, flags, sample paper bags, gloves, masks, and potato sacks for harvesting. Fertilizer will be purchased. Four thousand dollars (\$4,000.00) is requested for materials and supplies in this budget.

## **3. Services:**

Soil samples will be taken for each experimental plot before planting, and for each fertility management plot after harvest. Petiole and plant samples will be taken during the crop growing season. Water samples will also be taken from the irrigation well. All samples collected will be taken to the Colorado State University analytical lab for analysis. Three thousand dollars (3,000.00) is being requested for all sample analysis.

## **3. Travel**

Two thousand dollars (\$2,000.00) is being requested for part payment of travel expenses to potato evaluation and development meetings, as well as potato cultivar management meetings.