

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

2007

SUBMITTED BY

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Project Title

Development of cultivar specific management profiles for new and existing potato cultivars.

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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 for individual potato cultivars. Management profiles consist of cultivar specific information pertinent to production such as nutrient management, irrigation/water management, plant population management, pesticide susceptibilities, vine kill and harvest date management, post harvest storage considerations, processing and marketing; and are designed to supplement general production recommendations.

The proposed research for 2007 will evaluate the response of several potato cultivars and selections to numerous cultural management practices, involving nutrient management, irrigation/water management, drip irrigation, seed piece treatment before planting, plant population (seed piece spacing) management, vine kill and harvest date management, enhancement of skin color of red potatoes, and screening of potato clones for metribuzin tolerance.

Canela Russet has good looking tubers with excellent quality, but produces low yield, probably due to fewer stem numbers (average of 2) per plant. Several agronomic studies will be evaluated aimed at increasing the stem number per plant and/or increasing tuber yield for this cultivar.

The planting of whole seed (single drop) versus cut seed will be evaluated for several cultivars to define the best type of seed to plant for optimum tuber yield and quality.

The effect of 2,4-D application on color enhancement and retention in red potato cultivars will be evaluated.

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

Project Objective

The objective of this project is 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, while minimizing economic inputs and environmental impact.

The specific objectives of this project are;

1. Define optimum irrigation/water requirements for newly released potato cultivars.
2. Evaluate the performance of potato yield and quality, and water use efficiency under drip irrigation.
3. Increase the stem number per plant of Canela Russet to improve total and marketable size tuber yield and quality.
4. Define optimum nitrogen requirement and proper nitrogen application timing for potato cultivars grown in the San Luis Valley, including Canela Russet.
5. Define optimum in-row seed piece spacing and optimum vine kill management for Potato cultivars grown in the San Luis Valley, including Canela Russet.
6. Determine whether cut seed or whole seed (single drop) can influence stem number per plant, tuber yield and quality of different potato cultivars, including Canela Russet.
7. Enhance and retain the skin color of red potatoes by spraying the crop with an ester of 2,4-D in the field.
8. Determine which potato cultivars are tolerant, or susceptible to pre- and post-emergence application of metribuzin (sencor).
9. Evaluate the yield and quality performance of several advance potato selections grown under different management practices and in different soil types.

EXPERIMENTAL PROCEDURE (Materials and Methods)

Objective 1. Define optimum irrigation/water requirement for newly released potato cultivars.

Currently, in the San Luis Valley, irrigation of most potato cultivars is based on the ET requirements for Russet Norkotah (early maturity), Centennial Russet (medium maturity), and Russet Nugget (late maturity). It is hypothesized that the newly released potato cultivars have different water requirements. It is also hypothesized that the water

requirements of potato cultivars will vary depending on the in-row seed piece spacing. This study aims at evaluating the interactive effect of reduced water application rate and in-row seed piece spacing on the yield and quality performance of new potato cultivars grown in the San Luis Valley. Irrigation treatment will include (i) applying the full amount of water required by the plant as dictated by ET reading, and (ii) applying 75% of the water requirement as dictated by ET reading. In-row seed spacing treatment will be 10, 12, and 14 inches. The experimental design will be a split plot in RCBD, with irrigation treatment as the main plot factor, and seed piece spacing as sub plot treatment. All possible combinations of the irrigation and seed piece spacing treatments will be entered. Each treatment will be replicated three times.

Objective 2. Evaluate the yield and quality performance of potato, and water use efficiency 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 required 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 less. The aim of this study is to evaluate the feasibility of drip irrigation in potato crop production in the San Luis Valley, and to determine whether drip irrigation could reduce water use for equal or higher potato 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. Increase the stem number per plant of Canela Russet to improve total and marketable size tuber yield and quality.

(a) Seed treatment with StorOx:

Seed tubers of Canela Russet will be treated with StorOx (an oxidizing agent) in storage to induce multiple peeping of sprouts before planting. It is hypothesized that inducing sprouting in storage can accelerate sprout emergence in the field, and increase stem number per plant. This can result in increased tuber yield and quality of Canela Russet. StorOx treated seeds will be planted in the field together with seeds that have not been treated (control). Plants will be evaluated for sprout emergence, plant stand, stem number per plant, and tuber yield and quality.

(b) Seed size and age:

This experiment is being repeated to evaluate the effect of seed size and age on stem number per plant, tuber yield, and tuber size distribution of Canela Russet. Seed size treatment will include 2.0 to 2.5 oz and 3.0 to 3.5 oz seed tubers. The seed aging treatment will include seed planted directly from storage, or seed warmed at 60 °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 warmed at 60 °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 warm seed.

The experimental design will be a randomized complete block. Each plot will consist of three rows of potatoes, 25 ft. long, and 34 inches spacing between rows. Each treatment will be replicated four times.

Objective 4. Define optimum nitrogen requirement and proper nitrogen application timing for potato cultivars grown in the San Luis Valley, including Canela Russet.

(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 three times in a randomized complete block design.

(b) Pre-Plant Nitrogen Application Rate

Depending on the growth rate and maturity period of the cultivar, the required pre-plant N rate can differ among cultivars. Pre-plant 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 (CRBD), with three replications.

(c) In-Season Nitrogen Application Timing

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 and quality. This study will evaluate the effect of in-season nitrogen application timing on the performance of new potato cultivars, including Canela Russet. Three different in-season nitrogen application timing treatments will be evaluated. Table 1. shows the treatment arrangements.

The treatments will be arranged in a randomized complete block design and replicated three times.

Table 1. Treatment arrangement for the in-season nitrogen application timing study.

Start of in-season N application	Weeks After Planting									
	Pre-plant	5	6	7	8	9	10	11	12	13
	Nitrogen to be Applied (lb/ac)									
Before tuberization	40	20	20		10		10			
During tuberization	40		20		20		10		10	
After tuberization	40			20		20		10		10

Objective 5. Define optimum in-row seed piece spacing and vine kill management for potato cultivars grown in the San Luis Valley, including Canela Russet.

This study will be conducted to evaluate the response of tuber yield, tuber size distribution and quality of potato cultivars and advance selections to in-row seed piece spacing 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 90, 100, 110, and 120 days after planting. Each experimental design will be an RCBD, with three replications.

Objective 6. Determine whether cut seed or whole seed (single drop) can influence stem number per plant, tuber yield, and quality of different potato cultivars, including Canela Russet.

The aim of this study is to determine whether a particular cultivar or selection performs better when planted as whole seed (single drop) or as cut seed. The experimental design will be an RCBD, and each treatment will be replicated three times.

Objective 7. Enhance and retain the skin color of red potatoes by spraying the crop with an ester of 2,4-D in the field.

It has been established that red-skin potatoes respond differently to the application of 2,4-D for tuber yield and skin color improvement. This study is aimed at screening for red varieties that respond positively to the application of 2,4-D for optimum tuber yield and improved skin color. There will be two chemical treatments, (a) Application of Weedone® LV4 EC (an ester of 2, 4- D) and (b) a control with no application of the chemical. Weedone® LV4 EC will be applied twice during the growing season. Application rate will be 0.07 lb a.i./ac during each application. First application will be pre-bud (or when plants are 7 to 10 inches high). Second application will be at 10 - 14 days after the first application, and would be at least 45 days before harvest. The experiment will be a split plot design with 2,4-D treatment as main plot, and potato cultivar as subplot. Each subplot will consist of three rows of potatoes, each 25ft long, with 34 inches space between rows, and replicated four times.

Objective 8. Determine which potato cultivars are tolerant or susceptible to application of metribuzin (sencor).

Metribuzin is a popular herbicide used for the control of weeds in potato production. However, not all potato cultivars are tolerant to the herbicide when applied post-emergence. This study will evaluate the response of several potato cultivars to pre- and post-emergence application of metribuzin. Plants will be rated for severity of damage as well as for tuber yield and quality. The experimental design will be an RCBD with three replications.

Objective 9. Evaluate the yield and quality performance of several advance potato selections 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 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.

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 in the nutrient studies 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.

In collaboration with USDA-ARS, petiole samples will be pulled from the nutrient studies and sent to the USDA lab in Fort Collins for nutrient analysis. This will help establish in-season petiole nitrate curves for individual cultivars.

In the 2,4-D application study, skin color of potatoes from each plot will be measured at harvest and during storage using the HunterLab colorimeter, and by visual assessment using a color assessment panel.

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 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 provide information related to nutrient management, seed preparation and handling, plant population management, pesticide susceptibilities, vine kill management, optimum water requirements of new varieties that are developed, and other pertinent management information needed for a successful potato crop.

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 conservation research. Other sources of funding could be from chemical companies to screen for metribuzin tolerance, and 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 2007 to provide management guidelines to growers of those cultivars. At the end of the 2007 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 several new potato cultivars will be documented at the end of the 2007 growing season. Cultural management guidelines will be developed for these cultivars at the end of the 2008 growing season. Varieties that will be released between 2007 and 2010 will be accompanied by management guidelines for the successful production of those cultivars.

ANNUAL BUDGET

Personnel

Summer and Fall help	(3)	\$19,000.00
Winter and Spring help	(1)	\$ 7,000.00
Total Personnel		<u>\$26,000.00</u>

Materials and Supplies

Soil, water and plant sample analysis		\$2,000.00
Potato sacks and sample paper bags		\$1,000.00
Total Materials and Supplies		<u>\$3,000.00</u>

Travel		\$1,000.00
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Total amount of this request		<u><u>\$30,000.00</u></u>
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Budget justification

1. Salaries and Wages:

Because of the extensive field and green house research work, including potato planting, in-season data collection, potato harvest and grading, and sample analysis involved in this project, considerable financial resources are committed to personnel. Salary support for three summer and fall help and one help during winter and spring are requested in the budget.

2. Materials and Supplies:

Considering the volume of materials and supplies needed for the field and green house research work, \$3,000.00 is requested for materials and supplies. Field supplies include items such as field stakes, flags, paper sacks, sample bags and potato sacks for harvesting. Laboratory supplies include soil, water, and plant sample analysis.

3. Travel

One thousand (\$1,000.00) is being requested for part payment of travel expenses to potato evaluation and development meetings, as well as potato cultivar management meetings.