

Project Title

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

Investigator

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Nature and Scope of Research

The development of cultivar specific management profiles for potato clones, aim at tailoring cultural and storage management practices for individual potato cultivars. Management profiles consist of cultivar specific information pertinent to production such as nutrient management, plant population, pesticide susceptibilities, timing of vine kill and crop harvest, water requirements, post harvest storage considerations, processing and marketing; and are designed to supplement general production recommendations.

The proposed research for 2006 will evaluate the response of several potato selections and cultivars to numerous cultural management practices, such as pre-plant seed piece handling, nutrient management, plant population studies, vine kill timing and harvest dates, irrigation application rate and water use efficiency, enhancement of skin color of red potatoes, and screening of advance potato clones for metribuzin tolerance.

The planting of 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.

An advance russet line, AC92009-4RU has good looking tubers with excellent quality, but produces low yield, probably due to fewer stem numbers (average of 2) per plant. A study will be repeated to determine the effect of seed size and age, on stem and tuber number per plant, canopy volume, tuber yield and quality of this clone.

The effect of 2,4-D application on color enhancement and retention in advance red potato clones 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 six grower farms.

Project Objective

The objective of this project is to define cultural management practices for the successful, sustainable, and economic production of advance clonal selections and newly released cultivars, which optimize their genetic potential, while minimizing economic inputs and environmental impact.

The specific objectives of this project are;

1. Define optimum nutrient application rate and application timing for advance selections and new cultivars.
2. Define optimum irrigation management for newly released cultivars.
3. Evaluate water and nutrient use efficiency of surface and subsurface drip irrigation in potato production.
4. Define optimum in-row seed piece spacing and vine kill management for

- newly released potato cultivars and advance selections.
5. Define the seed type to plant for optimum tuber yield and quality
 6. Increase the stem number per plant of AC92009-4RU to improve total and marketable size tuber yield.
 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. 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 nutrient application rate and application timing for advance selections and new cultivars.

(a) Pre-Plant/At Planting Nitrogen Application Rate

The study will be conducted at the San Luis Valley Research Center. Rio Grande Russet, AC92009-4RU, and Russet Norkotah will be entered in this study. Pre-plant/At planting nitrogen treatment will consist of four application rates (0, 60, 90, and 120 lb N/ac). Each treatment will be replicated three times. The experimental design will be a randomized complete block (CRBD).

(b) Nitrogen Application Rate

Potato clones to be entered in this study are, Rio Grande Russet, AC92009-4RU, and Colorado Rose. Nitrogen treatment will consist of five application rates (0, 60, 120, 180, and 240 lb N/ac). Each treatment will be replicated three times in a randomized complete block design.

(c) In-Season Nitrogen Application Timing

While the rate of nitrogen applied can influence the performance of potato clones, timing of the nitrogen applied could also influence the yield and quality of a specific clone. This study is being repeated to evaluate the effect of in-season nitrogen application timing on the performance of Rio Grand Russet (AC89536-5RU) and Colorado Rose (CO89097-2R). Previous studies have shown that the total amount of nitrogen applied for these clones should not exceed 150 lb/ac. Three 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. Each plot will consist of three rows of potatoes, 25 ft. long, and 34 inches between rows.

Table 1. Treatment arrangement of nitrogen application timing study.

Treatment	Pre-plant	Weeks After Planting								
		5	6	7	8	9	10	11	12	13
		Nitrogen to be Applied (lb/ac)								
1	60	20		20		20		20		20
2	60		20		20		20		20	
3	60			20		20		20		20

(d) *Phosphorus and Potassium Application Rate*

This study will be conducted on farm in a grower field in corporation with Agro Engineering, Inc., an agricultural consulting firm at the San Luis Valley. An area of a half circle of the grower farm will be used for this study. The experimental field will be planted to Rio Grande Russet. Phosphorus treatment will consist of four application rates, at 60, 120, 180, and 240 lb P₂O₅/ac. Potassium treatment will consist of six application rates, at 0, 40, 80, 120, 160, and 200 lb K₂O/ac, to give a total of 24 treatments. The experimental design will be a factorial arrangement in RCBD. Each treatment will be replicated five times.

(e) *Nitrogen Application Rate and Seed Spacing Interaction*

Previous studies have shown that the optimum N rate for a potato clone could be influenced by in-row seed spacing. This study aims at evaluating the interactive effect of nitrogen application rate and in-row seed spacing for two advance selections, CO95172-3RU and AC96052-1RU. Nitrogen treatment will consist of three application rates at 60, 120, and 180 lb N/ac. The in-row seed piece spacing treatment will be 10, 12, and 14 inches. The experimental design will be a split plot in RCBD, with nitrogen application rate as the main plot, and seed piece spacing as sub plot. Each treatment will be replicated three times.

(f) *Nitrogen Application Rate and Vine Kill Management Interaction*

Previous research have shown that the optimum time of vine kill for a potato clone could be influenced by the nitrogen rate applied. This study aims at evaluating the interactive effect of nitrogen application rate and vine kill management for the two newly released cultivars, Purple Majesty and Mountain Rose. Nitrogen treatment will consist of three application rates at 60, 120, and 180 lb N/ac. Vine kill treatment will involve killing the vines at 90, 100, 110, and 120 days after planting. The experimental design will be a split plot in RCBD, with nitrogen application rate as the main plot and vine kill management as sub plot. Each treatment will be replicated three times.

Objective 2. Define optimum irrigation management for newly released cultivars.

This study aims at evaluating the interactive effect of reduced water application and in-row seed piece spacing. Rio Grande Russet and Purple Majesty will be entered in this study. Irrigation treatment will consist of (i) applying the full amount of water required by the plant as dictated by ET reading, and (ii) applying 2/3 of the water requirement. 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, and seed piece spacing as sub plot. Each treatment will be replicated three times.

Objective 3. Evaluate water and nutrient use efficiency of surface and subsurface drip irrigation in potato production.

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 and nutrient use for equal or improved potato yield and quality as compared to conventional sprinkler irrigation. Irrigation treatment will consist of (i) sprinkler irrigation (ii) surface drip irrigation and (iii) subsurface drip irrigation. Nitrogen treatment will include applying nitrogen at 60, 120, and 180 lb N/ac. Rio Grande Russet and Purple Majesty will be entered in this study. The experimental design will be a split plot in RCBD, with irrigation treatment as the main plot, and nitrogen application rate as sub plot. Each treatment will be replicated five times.

Objective 4. Define optimum in-row seed piece spacing and vine kill management for newly released potato cultivars and advance selections.

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. Three russets [Russet Norkotah (sel. 8), Rio Grande Russet, and CO94035-15R], one red (Colorado Rose), three specialty types (VC1002-3W/Y, VC1009-1W/Y, and VC1123-2W/Y), and three chippers (Chipeta, CO95051-7W and Co96141-4W) will be entered in this study. 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 5. Define the seed type to plant for optimum tuber yield and quality.

The aim of this study is to determine whether a particular cultivar or selection performs better when planted as a single drop or as a cut seed. Two russets (Rio Grande Russet and AC92009-4RU), two reds (Colorado Rose and NDC5281-2R), and two specialty types (Purple Majesty and Mountain Rose) will be entered in this study. The experimental design will be an RCBD, with each treatment replicated three times.

Objective 6. Increase the stem number per plant of AC92009-4RU to improve total and marketable size tuber yield.

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 AC92009-4RU. 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 14

days before planting. There will be a total of four treatments; (a) 2.0 to 2.5 oz seed planted from cold storage (cold seed), (b) 2.0 to 2.5 oz seed warmed at 60 °F for 14 days before planting (warm seed), (c) 3.0 to 3.5 oz cold seed, and (d) 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 7. Enhance and retain the skin color of red potatoes by spraying the crop with an ester of 2,4-D in the field.

This study is being conducted in collaboration with Oregon State University, and is being repeated to establish the effect of 2,4-D application on the skin color of Sangre and Colorado Rose. 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 0.071b a.i./ac during each application. First application will be pre-bud (or when plants are 7 to 10 inches high). Second application would be 10 - 14 days later, 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. 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 of advance selections when grown under different management practices and in different soil types. Six russets [Russet Norkotah (sel. 8), CO97087-2RU, CO97090-4RU, CO97138-3RU, CO97138-7RU, AC96052-1RU], one long white (CO97137-1W), nine specialty types (Purple Majesty, Yukon Gold, VC1009-1W/Y, AC97521-1R/Y, CO97226-2R/R, CO97232-1R/Y, VC1123-2W/Y, CO97233-3R/Y, CO97232-2R/Y), and five chippers (Chipeta, CO96141-4W, AC97097-14W, CO97043-14W, CO97065-7W) 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 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

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.

In the 2,4-D application study, skin color of potatoes from each plot will be measured at harvest and at monthly intervals 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 and internal defects (greens, misshapes, knobs, growth cracks, hollow heart and brown center). 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 clone. 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

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 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 and industry when trying a new cultivar that is released. The cultivar specific management profiles will provide information related to nutrient management, seed preparation and handling, plant population, pest susceptibilities, vine kill management, and water requirements of new varieties that are developed.

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 2006 to provide management guidelines to growers of those cultivars. At the end of the 2006 growing season, cultural management profiles will be developed for Rio Grande Russet, Colorado Rose, Purple Majesty, Mountain Rose, and NDC5281-2R. Preliminary information on management practices for AC92009-4RU, CO94035-15RU, VC1123-2W/Y, CO95172-3RU, AC96052-1RU, and VC1009-1W/Y will be documented at the end of the 2006 growing season. Management profiles will be developed for these advance clones at the end of the 2007 growing season. Varieties that would be released between 2006 and 2008 will be accompanied by management guidelines for the successful production of those cultivars.

ANNUAL BUDGET

Personnel

Summer 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		\$1,000.00
Potato sacks and sample paper bags		\$1,000.00
Part circle nozzles		\$ 1,000.00
Total Materials and Supplies		<u>\$3,000.00</u>

Travel \$1,000.00

Total amount of this request \$30,000.00

Budget justification

1. Salaries and Wages:

Because of the extensive field and green house research work, coupled with data collection and analysis involved in this project, considerable financial resources are

committed to personnel. Salary support for three summer helps and one help during winter and spring are requested in the budget.

2. Materials and Supplies:

Considering the volume of field and green house research work, \$2,000.00 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 and water analysis. An amount of \$1,000.00 is being requested for the purchase of part circle nozzles for one of the irrigation experiments.

3. Travel

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