Proposal to CPAC
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Project Title:
Development of cultivar specific management profiles for new and existing potato cultivars.

Investigator:
Samuel Y.C. Essah
Department of Horticulture and Landscape Architecture
San Luis Valley Research Center

Nature and Scope of Research:

The development of cultivar specific management profiles for potato lines, 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 2005 will evaluate the response of several potato lines to numerous cultural management practices, such as pre-plant seed piece handling, nutrient management, plant population studies, vine kill timing and harvest dates, and screening of advanced potato clones for metribuzin tolerance.

The technique of green sprouting will be used in a repeated study to evaluate the effect of breaking the dormancy of long dormant minitubers before planting. This will involve the evaluation of the response of long dormant minitubers to green sprouting compared to non sprouted minitubers when planted in the field.

An advanced 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 seed reconditioning (seed warming) on stem and tuber number per plant, canopy volume, yield, and quality of AC92009-4RU.

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

The performance of several advanced potato lines and standard cultivars (checks) grown under different management and soil conditions will also be evaluated in four grower farms.

There is the need to develop post harvest storage management profiles for existing and advance potato lines before they are released for grower adoption. Studies will be conducted to evaluate the effect of different storage temperatures on the storage life of several advanced potato lines, and to determine the optimum storage temperatures when these lines are grown under different cultural management practices.

Objectives:
The specific objectives of this project are, to;

1. Develop cultivar specific management profiles for new and existing potato cultivars.
2. Increase the stem number per plant of AC92009-4RU to increase the yield of marketable size tubers.
3. Use the technique of green sprouting to break the dormancy of long dormant minitubers before they are planted, which could result in early emergence, uniform plant stand, and possible yield increase.
4. Enhance and retain the color of red potatoes using 2,4-D applied in the field.
5. Evaluate the yield performance of several advanced potato lines grown in different soil types, and under different management practices.
6. Determine the optimal temperature for efficient and prolonged storage of new potato cultivars grown under different cultural management practices.

EXPERIMENTAL PROCEDURE (Materials and Methods)

Objective 1. **Develop cultivar specific management profiles for new and existing potato cultivars.**

(a) *NITROGEN RATE AND SEED PIECE SPACING INTERACTION STUDY*

The experiment will be conducted at the San Luis Valley Research Center (SLVRC). This study is being repeated to confirm the 2004 results, so that concrete recommendations can be made for the clones entered. Two reds (Sangre and NDC5281-2R), and three specialty clones (All Blue, CO94165-3P/P and CO94183-1R/R), will be entered in this study. Nitrogen treatment will consist of five application rates (0, 60, 120, 180, and 240 lb/ac). Seed piece spacing treatment will include three spacings (10, 12, and 14 inches) to give a total of 15 treatments for each potato clone entered. Each plot will consist of four rows of potatoes, 25 ft. long, and 34 inches between rows. Each treatment will be replicated three times. Potatoes will be planted during the first week of May. Vines will be killed at 110 days after planting. The experimental design will be a split plot, with nitrogen application rate as main plot, and seed piece spacing as the sub plot.

(b) *TIMING OF NITROGEN APPLICATION*

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 will be conducted to evaluate the effect of 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.

Table 1. Treatment arrangement of nitrogen application timing study.

		Weeks After Planting								
	Pre-plant	5	6	7	8	9	10	11	12	13
Treatment	Nitrogen Applied (lb/ac)									
1	60	30		20		20		20		
2	60		30		20		20		20	
3	60			30		20		20		20

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

(c) *TIMING OF VINE KILL AND SEED PIECE SPACING INTERACTION STUDY*

This study will be conducted to evaluate the response of tuber yield and quality of advance clones to vine kill timing and seed piece spacing. Four russets [Russet Norkotah (sel. 3), Rio Grand Russet (AC89536-5RU), Klamath Russet, CO93001-11RU], and two reds [Durango Red (CO86218-2R), Colorado Rose (CO89097-2R)], will be entered in this study. Vine kill timing treatment will include, 90, 100, 110, and 120 days after planting. Seed piece spacing treatment will be 10, 12, and 14 inches, to give a total of 12 treatments for each potato clone entered. Each plot will consist of four rows of potatoes, 25 ft. long, and 34 inches spacing between rows. Each treatment will be replicated three times. The experimental design will be a split plot. Seed piece spacing will be the main plot factor, and timing of vine kill will be the sub plot factor.

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.

Growth Analysis Data Collection

During the growing season plant samples from individual plots in the nitrogen studies will be taken at bi-weekly intervals for the determination of leaf area production, number of stems and tubers produced, and the accumulation and partitioning of dry matter into the leaves, stems, tubers and roots.

Canopy Light Interception

The effect of nitrogen rate and seed spacing interaction, and the effect of nitrogen application timing on the efficiency of light interception by the crop canopy will be determined during the growing season at bi-weekly intervals, using the light meter.

Leaf Chlorophyll Measurement

The spad meter will be used to measure the chlorophyll content of potato leaves in both the nitrogen and seed spacing study, and in the timing of nitrogen application study. Spad meter readings will be taken at three growth stages, pre-tuberization, tuber formation, and at tuber bulking. The data obtained will be evaluated to determine whether spad readings could correlate with crop performance.

Yield and Tuber Quality Evaluation

Potato tubers will be harvested twenty one days after vine kill from a 10 ft. section of the two middle rows 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, 4-8 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 0z) 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.

Objective 2. **Increase the stem number per plant of AC92009-4RU to increase the yield of marketable size tubers.**

An experiment will be conducted to evaluate the effect of seed size and seed warming interaction on stem number per plant, and the effect on tuber size profile of AC92009-4RU. Seed size treatments will include 2.0 to 2.5 oz and 3.0 to 3.5 oz seed tubers. The seed warming treatments 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 four rows of potatoes, 25 ft. long, and 34 inches spacing between rows. Each treatment will be replicated four times.

Data Collection

The effect of the treatments on sprout emergence, on crop stand, and on canopy volume, will be evaluated. Also, during tuber bulking, ten plants will be selected at random from the two middle rows of each plot to evaluate stem number, number of tubers, and mean tuber weight per plant.

The effect of the treatments on dry matter accumulation and partitioning in the crop will be monitored during the growing season.
Tuber yield and quality evaluation will follow the procedure described in objective 1.

Objective 3. **Use the technique of green sprouting to break the dormancy of long dormant minitubers before they are planted, which could result in early emergence, uniform plant stand, and possible yield increase.**

Two long dormant clones (AC92009 - 4RU, AC93026 - 9RU) and one short dormant clone (Silverton Russet) will be used in this study. Mini tubers of the three clones will be harvested within the same week. Each clone will be divided into two lots. One lot will be kept in storage in darkness at a temperature of 39 °F and the other lot will be green sprouted by putting the mini tubers in a nylon mesh bag and hanged in a green house equipped with cool white fluorescent lamps, for ten weeks before planting . Room temperature will be controlled at 60 °F with relative humidity of approximately 85%. There will be a total of six treatments. The experiment will be a split plot design, with cultivars as the main plot factor, and green sprouting as sub plots. Each subplot will consist of three rows of potatoes, each row measuring 25ft long with a spacing of 34 inches between rows, and replicated two times.

Data collection:

The effect of the treatments on sprout emergence, on crop stand, and on canopy volume will be evaluated. Also, during tuber bulking, ten plants will be selected at random from the middle row of each plot to evaluate stem number, number of tubers, and mean tuber weight per plant.
Plant samples will be taken at pre-tuberization, at tuber formation, and at tuber bulking to evaluate leaf area index, and dry matter accumulation and partitioning into the various plant parts.
Tuber yield and quality will be evaluated as described in objective 1.

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

Two red potatoes [Sangre and Colorado Rose (CO89097 - 2R)] will be used in this study. There will be two chemical treatments;
(a) Application of Weedone®) LV4 EC (an esther 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 four rows of potatoes, each 25ft long, with 34 inches space between rows, and replicated four times.

Data collection

Skin color of potatoes from each plot will be measured at harvest and at monthly intervals during storage using the colorimeter. Tuber yield and quality will be evaluated as described in objective 1.

Objective 5. **Evaluate the yield performance of several advanced potato lines grown in different soil types, and under different management practices.**

The objective of this study is to identify, early in the selection process, potential high yielding clones with good quality tubers that have yield stability when grown in different soil types and under different management practices. This study hopes to reduce the amount of time, labor, and resources which otherwise would be spent on less desirable clones that would be eliminated at advance stages of the selection process. Eight russets [Russet Norkotah (sel. 3), CO95086-8RU, CO95172-3RU, AC96010-3RU, AC96052-1RU, CO96045-1RU, CO96047-7RU, CO96109-7RU], three whites (CO95051-7W, CO96141-4W, Chipeta) and six specialty lines (All Blue, Yukon Gold, VC1009-1W/Y, VC1015-7R/Y, CO94157-2W/Y, VC1123-2W/Y) will be planted in strips on four grower farms. The four farms that will be selected will differ in soil characteristics and crop management practices. Clones entered in this study will also be screened for metribuzin tolerance. At harvest each clone will be evaluated for yield and quality as described in objective 1.

Objective 6. **Determine the optimal temperature for efficient and prolonged storage of new potato cultivars.**

Four advanced clones [Rio Grand Russet (AC89536 -5RU), Colorado Rose (CO89097 - 2R), CO94183-1R/R, and CO94165 -3P/P) that have been grown under different cultural management practices will be used in this study. Three hundred pounds potato samples from each plot will be taken at harvest. Each 300 lb sample will be divided into three lots of 100 lb each. The three 100 lb lots will be stored at three different temperatures (35, 40, and 45 °F). The experiment will be a split plot design with cultural management as main plot, and storage temperature as sub plot.

Data collection

At monthly intervals, samples of each cultivar within each cultural management practice, and from each storage temperature will be pulled to determine weight loss, sprout number, sprout length, and number of damaged tubers. Tuber greening will also be evaluated.

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, water requirements, timing of vine kill, and storage management 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. An Economic Development Grant from USDA could be requested for storage research. Other sources of funding could be from chemical companies to screen for metribuzin tolerance, and from fertilizer companies for nutrient management studies.

Time Table

A minimum of two years cultural and storage management research will be conducted on advanced potato clones that are to be released for grower trial. A schedule for conducting major activities of the project, including field trials, green house studies and post harvest storage research is shown in Table 2.

Milestones and Major Expected Accomplishments

At the end of the 2005 growing season cultural management profiles will be developed for AC92009-4RU, NDC5281-2R, CO94183-1R/R, and CO94165 - 3P/P. Preliminary information on management practices for Rio Grand Russet (AC89536 -5RU), Klamath Russet, and Colorado Rose (CO89097 - 2R) will be documented at the end of the 2005 growing season. Management profiles will be developed for Rio Grand Russet, Colorado Rose, and Klamath Russet at the end of 2006. Preliminary information on storage protocols for Rio Grand Russet, Colorado Rose, CO94183-1R/R and CO94165 - 3P/P will be documented in June 2006. Storage management profiles for these cultivars will be developed at the end of 2007.

Table 2. Schedule for conducting major activities of the project.

ACTIVITIES	2005				2006				2007			
	1*	2	3	4	1	2	3	4	1	2	3	4
Objective 1. **Develop cultivar specific management profiles for new and existing potato cultivars.**												
(a) *NITROGEN RATE AND SEED PIECE SPACING INTERACTION STUDY*		✔	✔			✔	✔			✔	✔	
(b) *TIMING OF NITROGEN APPLICATION*		✔	✔			✔	✔			✔	✔	
(c) *TIMING OF VINE KILL AND SEED PIECE SPACING INTERACTION STUDY*		✔	✔			✔	✔			✔	✔	
SOIL AND WATER SAMPLING		✔				✔				✔		
GROWTH ANALYSIS DATA COLLECTION			✔				✔				✔	
CANOPY LIGHT INTERCEPTION AND LEAF CHLOROPHYLL MEASUREMENTS			✔				✔				✔	
Objective 2. Seed size and seed warming interaction study		✔	✔			✔	✔			✔	✔	
Objective 3. Green sprouting minitubers before planting		✔	✔			✔	✔			✔	✔	
Objective 4. Enhancement and retention of color in red potatoes		✔	✔			✔	✔			✔	✔	
Objective 5. Research on grower farms		✔	✔			✔	✔			✔	✔	
Objective 6. Storage management research			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Post harvest data collection and all data analysis				✔	✔			✔	✔			✔

*** 1 = Winter, 2 = Spring, 3 = Summer, 4 = Fall**

ANNUAL BUDGET

Personnel		
Summer help	(3)	$21,000.00
Winter and Spring help	(1)	$ 7,000.00
Total Personnel		$28,000.00
Materials and Supplies		
Soil, water and plant sample analysis		$1,000.00
Potato sacks and sample paper bags		$1,000.00
Total Materials and Supplies		$2,000.00
Total amount of this request		**$30,000.00**

Budget justification

1. Salaries and Wages:

Because of the extensive field , green house, and storage 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.