AGRICULTURAL EXPERIMENT STATION

SAN LUIS VALLEY RESEARCH CENTER

RESEARCH PROPOSAL FOR CPAC

2004

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 :
Cultivar specific management aims at tailoring cultural and storage practices for new and existing cultivars. Management profiles consist of cultivar specific information pertinent to production such as nutrient management, plant population, pest susceptibilities, and water requirements, storage considerations, processing and marketing, and are designed to supplement general production recommendations.
Proposed research for 2004 will involve evaluation and integration of plant response to numerous production management variables, such as seed piece handling, nitrogen management , plant population, vine kill and harvest dates, and herbicide tolerance. Studies evaluating breaking of dormancy of long dormant mini tubers before planting will be undertaken . This will involve evaluation of the response of long dormant mini tubers to green sprouting over various time intervals.
An advance russet clone AC92009-4RU has good looking tubers with excellent quality but produces low yields due to fewer stem numbers. Studies will be conducted to determine the effect of seed size and seed warming on stem number of AC92009-4RU.
The effect of 2, 4-D application on color enhancement of red potatoes at harvest and color retention in storage will be evaluated.
There is a need to develop storage performance profiles of existing and new potato introductions. Studies will be conducted to determine the effect of different storage temperatures on storage life (or dormancy) of potato clones.

Objectives:
The specific objectives of this project are:
1. To Develop cultivar specific management profiles for new and existing potato cultivars.
2. To Determine the physiological basis for differences in yield and quality of potato clones grown under different nitrogen application rates.
3. To increase stem numbers of AC92009- 4RU for higher total yield.
4. To use the technique of green sprouting to break dormancy of long dormant mini tubers before they are planted, to produce a uniform stand with early emergence after planting.
5. To enhance and retain the color of red potatoes using 2, 4-D application in the field.
6. To determine the optimal temperature for efficient and prolonged storage of new potato cultivars.
7. To evaluate yield performance of several advance potato clones grown on different soils and under different management practices.

MATERIALS AND METHODS

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

(a) *Nitrogen application x seed piece spacing interaction*:

The experiment will be located at the San Luis Valley Research Center (SLVRC). Two russets (standard Norkotah and AC89536 -5RU), two reds (Sangre and CO89097 -2R), and two specialty (All Blue and CO94165 - 3P/P) clones will be entered in this study. Nitrogen treatment will consist of five application rates (0, 80,140, 200 and 260 1b/ac) and 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 treatment will consist of four rows of potatoes, each 25ft long , with 34 inches between rows and replicated three times. Potatoes will be planted between the last week of April and the first week of May. Vines will be killed at 110 days after planting. The experiment will be a split plot design, with nitrogen application rate as main plot, and seedpiece spacing as sub plot.

(b) *Nitrogen Fertility Rate:*

A field experiment will be conducted to determine the effect of nitrogen application rate on the performance of three russets (standard Norkotah, AC93026 - 9RU, CO93001 - 11RU), and two reds (Sangre and CO93037 - 6R). Treatments will consist of five nitrogen application rates (0, 80, 140, 200 and 260 1b/ac.) Urea Ammonium Nitrate (32 - 0 - 0) will be used as source of nitrogen, and will be applied using a back pack, hand held compressed - air sprayer. Each treatment will consist of four rows of potatoes, each twenty five feet long , with thirty four inches between rows, and replicated three times.

(c) *Seed Piece Spacing:*

A field experiment will be conducted to evaluate the effect of within - row seed spacing on yield and quality of three russets (Standard Norkotah , AC93026 - 9RU, CO93001 - 11RU), and two reds (Sangre and CO93037 - 6R). Treatments will consist of four seed piece spacings (6, 9, 12 and 15 inches). Each treatment will consist of three rows of potatoes, each 25ft long, 34 inches between rows, and replicated three times. The experiment will be a split plot design with seed spacing as main plot, and potato cultivar as sub plot.

(d) *Vine killing Date Study:*

This study will be conducted to evaluate the influence of vine killing date on yield and quality of three russets (Standard Norkotah, AC93026 - 9RU, CO 93001 - 11RU) and two reds (Sangre, CO930037 - 6R). Treatments will include three vine killing dates (100, 110 and 120 days after planting). Each treatment will consist of four rows of potatoes, each 25ft long , with 34 inches spacing between rows, and replicated three times. The experiment will be a split plot design with vine killing date as main plot and potato cultivars as sub plot.

Data collection:

Soil and water samples:

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

Yield and tuber quality evaluation:

Tubers will be harvested fourteen to twenty one days after vine kill from a 10 - feet section of the two middle rows of each plot, and weighed. Tubers from each plot will be graded for external and internal defects (greens, misshapen, knobs, growth cracks, hollow heart and brown center), tuber weight, and diameter. Tubers will be separated into various size distribution groups based on weight (< 4oz, 4 - 8oz, 8 - 10oz, 10 - 12oz, 12 - 16oz) and diameter (<2", 2 to 4", > 4", >2" but <10oz, >2"and >10oz). Ten large (12 - 16oz) tubers per sample will be taken for hollow heart evaluation . Specific gravity will be measured with the weight- in- air/weight-in-water method.

Objective 2: **To determine the physiological basis for differences in yield and quality of potato clones grown under different nitrogen application rates.**

Petiole Sampling:
Twenty five petiole samples will be collected from plants in each plot within the nitrogen rate study at three growth stages (pre-tuberization, tuber formation, and tuber bulking) to determine the effect of nitrogen application rate on petiole nitrate concentration . Petioles collected will be oven dried, fine ground, and analyzed for nitrate concentration.
Growth analysis Data collection:
Beginning five weeks after planting, plant samples from individual plots in the nitrogen rate study will be taken at bi-weekly intervals for determination of leaf area production, number of tubers produced, and accumulation of dry matter into leaves, stems, tubers and roots.
Canopy light interception:
The effect of nitrogen application rate on the efficiency of light interception by the potato canopy will be determined at bi-weekly intervals beginning at five weeks after planting, using the light meter.
Leaf chlorophyll content:
The spad meter will be used to measure the chlorophyll content of potato leaves in the nitrogen rate experiment at three growth stages (pre-tuberization , tuber formation, and tuber bulking). An infrared reflectometer will be used to measure the N content of potato leaves in this study. A correlation of spad meter and infrared reflectometer readings, and petiole nitrate concentration will be determined.

Objective 3: **To increase stem numbers of AC92009 - 4RU to improve total yield.**

AC92009 - 4RU is a russet line with good looking and excellent tuber quality, but yields are low due to fewer stem numbers per hill. An experiment will be conducted to evaluate the effect of seed size x seed warming interaction on stem number and yield of AC92009 - 4RU. Treatments will include two seed sizes (2 to 2.5oz and 3 to 3.5oz) and an interaction between the two seed sizes and seed planted directly from storage , or seed warmed at 60 °F for 14 days before planting. There will be a total of six treatments: (a) 2 to 2.5oz (b)3 - 3.5oz (c) 2 to 2.5oz x seed from cold storage (d) 2 to 2.5oz x seed warmed at 60 °F for 14 days before planting (warm seed) (e) 3 to 3.5oz x seed from cold storage (f) 3 to 3.5oz x warm seed. The experiment will be a randomized complete block design. Each treatment will consist of four rows of potatoes, each 25ft long, with 34 inches space between rows, and replicated four times.

Data collection:
Ten hills will be selected at random from the two middle rows of each plot during tuber bulking, and stem number per hill will be counted.
Yield and tuber quality evaluation:
This will follow the procedure described for objective 1.

Objective 4: **To use the technique of green sprouting to break dormancy of long dormant mini tubers before planting, which will produce a uniform stand with early emergence.**

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 hang in a green house equipped with cool white fluorescent lamps for six 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:
Plant stands will be counted approximately every two days for four to five weeks, beginning immediately the first sprout emerges. Ten hills will be randomly selected from the middle row of each subplot during tuber bulking and stems per hill counted. Plant samples will be taken at pre-tuberization, tuber formation and at tuber bulking to measure 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 5: **To enhance and retain the color of red potatoes with 2, 4 -D application in the field.**

Two red potatoes (Sangre and 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 growth of the potato plants. 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 one .

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

Three advanced clones (AC89536 -5RU, CO89097 - 2R and CO94165 -3P/P) that have been grown under five nitrogen application rates (0, 80, 140, 200 and 260 1b/ac) will be used in this study. Three hundred pounds potato samples from each plot in the nitrogen rate study 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 temperatures (35, 40, and 45 °F). This experiment will consist of a total of 15 treatments for each potato cultivar. The experiment will be a split plot design with nitrogen rate as main plot, and storage temperature as sub plot.
Data collection:
At monthly intervals, samples of each cultivar within each nitrogen rate, 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 measured .

Objective 7: **Evaluate yield performance of several advance potato clones grown on different soils and under different management practices.**

The objective of this project is to identify potential high yielding clones early in the selection process.
This project 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.
Three russets, three reds, three whites and three specialty lines will be planted in strips on four grower fields. The four fields that will be selected will differ in soil characteristics and crop management practices. Clones entered in this study will be screened for tolerance to pre- and post-emergence application of metribuzin. At harvest each clone will be evaluated for yield and quality as described in objective 1.

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 provide information related to nutrient management, seed preparation and handling, plant population, pest susceptibilities, water requirements and storage protocol.

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 storage research is shown in the table below.

Milestones and Major Expected Accomplishments

At the end of the 2004 growing season cultural management profiles will be developed for AC93026 - 9RU, CO93001 - 11RU and CO94165 - 3P/P. Preliminary information on management practices for AC89536 -5RU, AC92009 - 4RUand CO89097 - 2R will be documented at the end of 2004. At the end of 2005 management profiles will be developed for these clones. Preliminary information on storage protocols for Sangre, CO89097 - 2R, AC89536 - 5RU and CO94165 - 3P/P will be documented in June 2005. Storage management profiles for these cultivars will be developed at the end of 2006.

Schedule for conducting major activities of the project

ACTIVITIES	2004				2005			
	1 *	2	3	4	1	2	3	4
Objectives 1 and 2:								

◘ Nitrogen fertility x seed piece spacing interaction.		✔	✔					
◘ Nitrogen application rate studies.		✔	✔					
◘ Seed piece spacing study.		✔	✔					
◘ Soil and water sampling.		✔						
◘ Petiole sampling.			✔					
◘ Growth analysis data collection.			✔					
◘ Canopy light interception and leaf chlorophyll measurements.			✔					
Objective 3: Seed size x seed warming interaction study.		✔	✔					
Objective 4: Green sprouting mini tubers before planting.		✔	✔					
Objective 5: Enhancement and retention of color of red potatoes.		✔	✔		✔	✔		
Objective 6: Storage research.				✔	✔	✔		
Objective 7: Cultural management screening trials.		✔	✔					
Post harvest data collection and all data analysis.				✔	✔	✔		

*** 1=Winter, 2 = Spring, 3 = Summer, and 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 paper sample 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, and sample bags. Laboratory supplies include soil, water, and petiole nitrate analysis.