

**RESEARCH PROPOSAL TO COLORADO POTATO**

**ADMINISTRATIVE COMMITTEE, AREA II**

**2010**

***SUBMITTED BY***

***SAMUEL ESSAH***

**Project Title**

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

**Funding Source**

Colorado Potato Administrative Committee, Area II

**Investigator**

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**Nature and Scope of Proposed Research**

The development of cultivar specific management profiles for new and existing 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, in-row 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 2010 will evaluate the response of potato cultivars to several cultural management practices, including fertility management, with emphasis on nitrogen (N) use efficiency, phosphorus management, and plant population (in-row seed spacing) management.

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

**Project Objectives**

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 and minimize environmental impact. The management strategies should be agronomically sound, economically advantageous, and environmentally responsible.

The specific objectives of this project proposal are;

1. Define optimum nitrogen application rates for the efficient use of nitrogen, that will lead to maximum tuber yield, tuber size, and quality of potato cultivars that are grown in

the San Luis Valley, and those that have the potential of being named and grown in the San Luis Valley.

2. Define optimum nitrogen application timings for the efficient use of nitrogen, that will lead to maximum tuber yield, tuber size, and quality of potato cultivars that are grown in the San Luis Valley, and those that have the potential of being named and grown in the San Luis Valley.
3. Define optimum in-row seed spacing for the production of maximum tuber yield, tuber size, and quality of potato cultivars grown in the San Luis Valley.
4. Evaluate the yield and quality performance of several advanced potato selections from the Colorado Potato Breeding Program that are grown under different management practices and in different soil types.

## **MATERIALS AND METHODS**

***Objective 1 Define optimum nitrogen application rates for the efficient use of nitrogen, which will lead to maximum tuber yield, tuber size, and quality of potato cultivars that are grown in the San Luis Valley, and those that have the potential of being named and grown in the San Luis Valley.***

Nitrogen (N) fertilizer requirement for maximum tuber yield, tuber size, and quality, differ among potato cultivars. There is the need to establish available N (applied, plus soil, plus irrigation water N) required for the efficient use of N, for new cultivars that are grown, and for those that have the potential of being grown in the San Luis Valley. Nitrogen treatment will include five application rates of 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.

***Objective 2 Develop optimum nitrogen application timings for the efficient use of nitrogen, that will lead to maximum tuber production, tuber size, and quality of potato cultivars that are grown in the San Luis Valley, and those that have the potential of being named and grown in the San Luis Valley.***

While the total nitrogen applied can influence tuber yield, size, and quality of potato cultivars, timing of the nitrogen applied can significantly influence the efficient use of the applied N, which can lead to maximum tuber yield, tuber size, and quality. A study will be conducted to evaluate the effect of early, mid, and late application of N on the performance of potato cultivars grown in the San Luis Valley. Treatments will include (i) the application of most of the required nitrogen pre-plant (100 lb N/ac), and less in-season (during the growing season) (ii) application of half of the required nitrogen (80 lb

N/ac) pre-plant and the remaining half during the growing season (iii) application of less nitrogen (60 lb N/ac) pre-plant, and a major part of the required nitrogen applied during the growing season, and (iv) a control where no nitrogen will be applied pre-plant, but all the required nitrogen will be applied during the growing season. The effect of these N application timing treatments on nitrogen use efficiency of different potato cultivars will be evaluated. In-season nitrogen application will be started after tuber initiation.

***Objective 3 Define optimum in-row seed spacing for the production of maximum tuber yield, tuber size, and quality of potato cultivars grown in the San Luis Valley***

This study will be conducted to evaluate the response of tuber yield, tuber size, and quality to in-row seed spacing. In-row seed spacing treatment will include, 10, 12, and 14 inches spacing. The experimental design will be a randomized complete block design (RCBD), with four replications.

***Objective 4 Evaluate the yield and quality performance of several advanced 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 tuber yield, tuber yield stability, and quality performance of advanced selections from the Colorado Potato Breeding Program when grown under different management practices and in different soil types. Several advanced selections of Russets, Reds, Specialty type potatoes, and fingerlings, will be planted in strips on grower farms. The 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. This study will help in the early and easy identification of advanced selections that have the potential of being adopted by growers.

**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 at four different dates during the growing season from each fertility study plot 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 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 treatment effects on 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 where appropriate. 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. Some treatment means will be separated using contrast.

#### **Relationship of Proposed Research to Overall Problem for Potato Growers**

Each potato cultivar has its own unique set of cultural management requirements. More often than not, growers of a new cultivar are not able to obtain the yield and quality potential of the cultivar because they do not have information on the specific management requirements of that cultivar. Growers of a new cultivar are more successful when release is accompanied by management guidelines. The best cultural management guidelines are obtained from field experiments conducted in the specific production area. Also, in the cultivar evaluation and development process, shortcomings of advanced selections and cultivars may be identified and appropriate cultural management strategies are explored to solve such cultivar specific problems. Cultivar specific management profiles developed from this research 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 Outside Funding**

Results obtained from this project could be used as leverage in obtaining outside funding. Funding could be obtained from USDA - NIFA as part of the potato development and improvement project, and from USDA-NRCS and Western SARE for nutrient use

efficiency research. Funding from the Environmental Protection Agency (EPA) could help in research involving reduction in fertilizer use, and alternative methods in disease suppression. Other sources of funding could be from fertilizer companies, and compost dealers for nutrient management studies.

**Timeline of Proposed Research and Expected Short Term (1 yr) and longer Term (3-5 yrs) Outcomes**

Cultural management studies on advanced selections and new cultivars will be conducted in 2010 to provide management guidelines for the cultivars. At the end of the 2010 growing season, cultural management guidelines will be updated for some of the currently cultivated russet varieties. Preliminary information on management guidelines for some new and advanced russet potatoes will be documented at the end of the 2010 growing season. Cultural management guidelines will be completed for some cultivars at the end of the 2011 growing season. Varieties that will be released between 2010 and 2014 will be accompanied by management guidelines for the successful production of the cultivars.

## ANNUAL BUDGET

### Personnel

1. Three (3) non-student help will be needed to get the field and laboratory studies completed successfully.

Total wages and fringe benefits for personnel = **\$35,000.00**

### Materials and Supplies

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

Fertilizer purchase \$2,000.00

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

### Services

Soil, water, and petiole sample analysis **\$8,000.00**

**Travel** **\$2,000.00**

**Total amount of this request** **\$49,000.00**

## Budget justification

### 1. Salaries and Wages for Personnel:

Because of the extensive field and lab work involved in the studies proposed, including soil sampling, seed cutting, potato planting, in-season data collection (whole plant sampling, petiole sampling), extensive fertilizer application before and during the growing season, potato harvest, sizing and grading, data compilation and analysis, considerable financial resources are committed to personnel. Thirty five thousand dollars (\$35,000.00) is requested for wages and fringe benefits in this 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 whole plant samples will be taken at four different dates during the crop growing season. Water samples will also be taken from the irrigation well. All samples collected will be sent to a soil, water, and plant nutrient analytical lab for analysis. Eight thousand dollars (\$8,000.00) is being requested for payment of sample analysis.

## **4. 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.