

**USING SOIL AMENDMENT TO IMPROVE SOIL HEALTH
AND TO OPTIMIZE PROFITABILITY IN POTATO
PRODUCTION**

**SUMMARY OF RESEARCH PROGRESS REPORT FOR 2012
AND RESEARCH PROPOSAL FOR 2013**

**RESEARCH PROPOSAL FOR COLORADO CERTIFIED
POTATO GROWERS ASSOCIATION (CCPGA) ROYALTY
FUNDS**

2013

SUBMITTED BY

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SUMMARY OF 2012 RESEARCH STUDIES

Executive Summary

The purpose of this project was to evaluate the effect of applying soil amendment on potato root development, plant nutrient uptake, tuber yield, and the economic implications of using soil amendments in potato production.

Two soil amendment products (nutrisorb and bioblend) were used independently in this study. Both products, when applied to the soil increased root dry matter yield, plant nutrient uptake, and potato tuber yield (see attached report). Economic analysis performed indicated that using soil amendment maximized net returns in Rio Grande Russet potato production.

2013 RESEARCH PROPOSAL

Since this is a field study, it has to be repeated at least for a second year to validate the results over years. Funding is therefore being requested to complete a second year of this study.

Project Title

Using Soil Amendments to Improve Soil Health and to Optimize Profitability in Potato Production

Funding Source

Colorado Certified Potato Growers Association (CCPGA) – CSU Cultivar Royalty Funds

Investigators

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Nature and Scope of Proposed Research

The intensive production of potatoes in recent years has rendered productive soils to be less sustainable in terms of soil health and crop productivity. Soil amendments have been known to improve soil health by acting as bio-stimulants to increase the population of beneficial soil microorganisms which in turn improve the physical properties of the soil and the soil water holding capacity. Additionally, beneficial microorganisms tend to stimulate root growth and increase root biomass. With improved root biomass, the plant is able to effectively mine nutrients from the soil for increased plant growth and productivity.

Objectives of Proposed Research

The objectives of this proposed research are;

1. Evaluate the effect of two soil amendments that are being promoted in the San Luis Valley on potato root development, plant nutrient uptake, and potato tuber yield and quality. The soil amendments are Bioblend and Nutrisorb.
2. Analyze the cost-benefit effects of the soil amendments in potato production

MATERIALS AND METHODS

Experimental Site

The field study will be conducted at the San Luis Valley Research Center, Colorado State University, during the 2013 potato growing season.

Experimental Design and Treatments

The study will be laid out as a randomized complete block design for each of the soil amendments used in the study.

Treatments will include application of each soil amendment with the recommended rate of nitrogen fertilizer application. Another set of treatments will include applying each soil amendment with 20% reduction in the recommended rate of nitrogen fertilizer application. There will be control treatments where no soil amendment will be applied, and where only the soil amendment will be applied with no nitrogen fertilizer application. The individual treatments will be:

1. Application of nitrogen fertilizer at recommended rate with no soil amendment (control).
2. Soil amendment application with the recommended nitrogen fertilizer application rate.

3. Soil amendment application with 20% reduction in the recommended rate of nitrogen fertilizer application.

Potato cultivars to be used in this study will include an early maturing cultivar and a medium maturing cultivar.

With two different soil amendments used in this study, the number of treatments for each cultivar will be six. The total number of treatments for both cultivars will be twelve. Each treatment will be replicated four times.

Soil amendments will be applied by drenching.

Plant Sampling and Analysis

During tuber bulking, plant samples will be taken from each plot at periodic intervals for nutrient analysis. Sampled tubers will be analyzed for their nutrient concentration, and the stems and leaves (aboveground biomass) will be composited and analyzed for their nutrient concentration. Sampled plants will be thoroughly washed to get rid of all soil particles, and then oven dried. The oven dried samples will be ground and sent to a nutrient analytical lab for nutrient analysis. The oven dried plant samples will be analyzed for nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), zinc (Zn), and iron (Fe) concentration.

Root Mass

During tuber bulking, plant roots will be sampled at periodic intervals to evaluate the effect of soil amendment on root mass development. All roots from sampled plants will be retrieved from the soil, washed to get rid of any soil particles, and oven dried. The root mass will be documented on dry weight basis.

Tuber Bulking and Harvest Index

During the potato growing season, tubers will be sampled from each plot at periodic intervals to evaluate the effect of soil amendment and nitrogen application rate on tuber bulking. Harvest index (HI), which is a measure of how efficient the plant is able to translocate photosynthate to the tubers will be evaluated in this study.

The effect of the treatments on tuber set (number of tubers/plant) and stem number will be evaluated in this project.

Tuber Yield and Tuber Size Distribution

At harvest, tubers from each plot will be weighed for total yield. The harvested tubers will be separated into various size distribution groups based on weight (<4 oz., >4 oz., >6 oz., 4-10 oz., >10 oz., 4-16 oz., and >16 oz.), and based on tuber diameter (<2 inches (in.), >2 in., >2 in.<10 oz., and >2 in.>10 oz.).

Tuber External and Internal Defects

Tubers harvested from each plot will be evaluated for external (growth cracks, knobs, and misshapes), and internal (Hollow Heart and Brown Center) defects.

Tuber Specific Gravity

Ten large tubers will be randomly selected from each plot for tuber specific gravity evaluation. Tuber specific gravity will be measured by using the weight-in-air/weight-in-water method.

Root Hair Analysis

At specific times during the growth period, crop root analyses will be performed in the field. These analyses will document the presence of root hairs and the viability of the roots. If the treatments are successful, we expect to see an increased number of root hairs and a higher number of younger roots as compared to the control. Roots will be collected from the field without destroying the plants and then the ratios of root hairs will be determined in the laboratory with a microscope. We also envision determining root hair analysis in situ by using a mini rhizotron. Additionally, the mRNA will be collected from those roots and gene expression analysis will be conducted. We will select a set of marker genes involved in root growth such as genes related to auxin transport and biosynthesis.

ECONOMIC ANALYSIS

An economic analysis will be performed on the Cost-Benefit effect of soil amendment application in potato production.

Competitiveness of Project for Potato Growers

The use of soil amendments will improve the sustainability of potato production in the San Luis Valley. Soils that have been degraded due to intensive cultivation, and due to the continual use of inorganic fertilizers, will improve in their health and productivity. The use of soil amendments will increase potato tuber yields and improve tuber quality. In the short and long term, potato growers will increase their profit margins significantly.

Extension-Outreach Plan for Reporting Project Information to Growers

A field day will be organized in late July or early August for growers to see the effect of the soil amendment treatments on root and tuber growth, and on the development of the potato crop.

Data from this project will be presented at the Southern Rocky Mountain Agricultural conference and Trade Fair.

An extension fact sheet will be developed to highlight the positive effects of soil amendments on potato tuber yield and quality. Results from this project will be posted on the CPAC website, as well as on the San Luis Valley Research Center website. Summary of data from the project will be printed and hard copies distributed to potato growers in the San Luis Valley.

Potential for Results to Leverage Additional Outside Funding

This project will provide preliminary data for the submission of proposals to agencies such as the Environmental Protection Agency (EPA), USDA-Natural Resource Conservation Service, Western SARE for nutrient use efficiency research, and the International Plant Nutrition Institute.

Timeline of Proposed Research and Expected Short Term and long Term Outcomes

Potato will be planted during the first week of May, 2013. The in-furrow treatments will be applied at time of planting, and subsequent applications will be done during the growing season. A field day (tour) for potato growers will take place in late July or early August. Potato vines will be killed in August, and tubers harvested in late September. Tuber sizing and grading will be done in October and November. Statistical analysis and report writing will be done in December and January. Results will be posted on the website in February, and printed data distributed to growers at the same time. At the end of 2013, growers will see how soil amendments can increase tuber yield and quality. In the longer term, the soil health and soil productivity of potato farms will be improved, and potato production will be sustainable in the San Luis Valley, with increased profit to potato growers.

ANNUAL BUDGET

Personnel

One non-student help will be needed to get the field and laboratory studies completed successfully, and one person devoted to root analyses.

One person working for 20 weeks (800 hours) @ \$8.5/hr = \$6,800.00

One person devoted to root analyses for 10 weeks
(400 hr.) @ \$8.5/hr \$3,400.00

Total Wages and Fringe Benefits for Personnel \$10,200.00

Materials and Supplies

Potato sacks, gloves, masks, sample paper bags,
field stakes, flags, scissors, and fertilizer purchase \$ 200.00

Molecular supplies \$7,000.00

Total Materials and Supplies \$7,200.00

Services

Soil and water analysis \$ 100.00

Petiole sample analysis: 40 Samples per sample date x 4
sample dates x \$14.00/sample \$2,000.00

Total Services \$2,100.00

Total amount of this request \$19,500.00

Budget justification

Salaries and Wages for Personnel:

Because of the extensive field and lab work involved in this study, such as soil sampling, seed cutting, potato planting, in-season data collection (whole plant sampling, petiole sampling), fertilizer application before and during the growing season, root analysis, potato harvest, sizing and grading, data compilation and analysis, considerable financial resources are committed to personnel. Ten thousand two hundred dollars (\$10,200.00) is being requested for wages and fringe benefits in this budget.

Materials and Supplies:

Field supplies include items such as field stakes, flags, sample paper bags, gloves, masks, scissors, and potato sacks for harvesting. Fertilizer will be purchased. In addition, molecular markers will be purchased for Jorge's molecular studies on root hairs. Seven thousand two hundred dollars (\$7,200.00) is being requested for materials and supplies in this budget.

Services:

Soil samples will be taken from each experimental plot before planting. Petiole 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. Two thousand one hundred dollars (\$2,100.00) is being requested for shipment and payment of sample analysis.