

Title: Potato Disease Management – 2015 Proposal

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Funding requested from: CPAC (Area II)

Issues Guiding the Potato Disease Management at the SLV Research Center:

The potato industry in the San Luis Valley is constantly faced with serious disease management challenges. These challenges have been made more difficult recently because of the water situation and the potential for new strains of some of the more serious disease issues. In 2014, a higher percentage of potato lots in the SLV were identified as having PVY^{NTN} than have been seen previously. An increased number of samples with tuber necrotic damage have also been observed, which is due to this virus strain. PVY is now epidemic in many cultivars, not just Russet Norkotah. It is of note that some of the new cultivar releases from the Colorado cultivar development program are being screened for their reaction, symptomology, and susceptibility to PVY.

The use of alternative rotational crops shows promise in managing specific crop diseases (Ref. 1), but limited information on this topic is available for potato production systems. Also, there are several diseases that are minimally managed by fungicides (e.g., powdery scab, pink rot, etc.) and the use of alternative rotational crops has the potential benefit of managing these disease causing pathogens. This is an avenue of research that has not been widely explored in potato production systems and could benefit the potato industry here in Colorado.

Finally, evaluation of advanced clones from the CSU Cultivar Development Program for reaction to several critical diseases will continue as a permanent component of this research effort. The increasing threat of major diseases in the Valley make this work central to protecting grower and University interests. In addition, these evaluations provide valuable information to the producers of new cultivars so that the threat from many diseases is mitigated. Disease resistance/susceptibility information on several diseases affecting potatoes (bacterial soft rot, PVY, powdery scab, etc.) will be made available and be included in new cultivar management sheets developed for each new cultivar being released by the CSU breeding program.

Objectives:

Objective 1: *Spread of Pectobacterium sp. in seed operations:* A PhD level research program will continue, which is aimed at determining three points of interest. First, How *Pectobacterium sp.* are being introduced into a seed grower's farming operation. Second, the role equipment plays in the spread of this bacteria and in the contamination of seed stocks will be evaluated. Third, work will be done on the development of a series of management guidelines which will look at all aspects of a potato production system for the control of blackleg and tuber soft rot, caused by this genera of bacteria.

Objective 2: *Advanced selection disease evaluations:* Evaluation of advanced selections from the CSU Cultivar Development program for visual reactions to PVY and ring rot will be conducted. Evaluations for disease resistance/susceptibility to powdery scab, PVY, dry rot, and soft rot will be conducted through the use of field, greenhouse, and post-harvest trials. This portion of the project will be in cooperation with Dr. David Holm and Caroline Gray.

Objective 3: *Biological agent and green manure rotational trials:* A final report will be completed on the evaluation of green manure rotational treatments for the management of several potato diseases (powdery scab, blackleg/soft rot, black scurf, & silver scurf). This portion of the project has been funded by EPA and is in cooperation with Dr. Robert Davidson, Dr. Samuel Essah and Merlin Dillon (returning as an hourly hire to work with this research project).

Objective 4: *Mechanical spread of PVY*: Over the years, we have observed the spread of mosaic in potato fields through avenues which appear to be mechanical (e.g., roguing, late cultivations, etc.). While this has been the most likely explanation of what has been observed, a formal study evaluating this was conducted in the Valley with inconclusive results. This study will be continued this summer with some alterations to experimental design and testing protocol. Dr. Robert Davidson will function as a co-advisor on this project.

Objective 5: *Cultivar Management Sheets*: Continue to provide cultivar specific disease information for newly released cultivars. The purpose of this is to provide potato growers with user friendly, one page descriptions of the characteristics and best management for each potato cultivar released by the CSU breeding program. This portion of the project will be in cooperation with Dr. David Holm, Caroline Gray, Dr. Robert Davidson, Dr. Samuel Essah and Dr. Sastry Jayanty.

Objective 6: *Efficacy trials*: These trials will continue at the SLV Research Center, but in a reduced capacity. Early blight, pink rot, and black scurf trials will be conducted on station under solid set irrigation. The evaluation of fungicides to manage early blight will also include a more focused look at application timing of products in relation to the accumulation of early blight degree days. The focus of these studies will be on testing new chemistries (including the use of biological products), application timings and product rates under SLV environmental conditions.

Objective 7: *Use of flowering cover crops and companion crops for the reduction of PVY spread*: There is a growing demand for the use pest management strategies that do not include the use of pesticides. A study was started in 2014 and will be continued in the summer of 2015 that will evaluate the use of flowering cover crops planted alongside potatoes in order to attract beneficial, predatory insects to manage and feed upon aphids. In addition to evaluating flowering cover crops for PVY spread, the use of a mix of companion crop species will also be evaluated for PVY spread and Mycorrhizae growth in the potato crop. In 2014, results indicated that PVY spread was reduced when infected potato plants were planted adjacent to a flowering crop mix. Data for this study will be collected to evaluate PVY spread, yield differences, and Mycorrhizae growth. This portion of the project will be in cooperation with Brendon Rockey from Rockey Farms.

Objective 8: *Evaluate different strategies for managing powdery scab*: Based on what we know about *Spongospora subterranea* (the causal agent of powdery scab), the use of different cultural management strategies may provide some practical tools that can be employed by potato growers to control this disease. Powdery scab requires cool, wet soil conditions in order to infect susceptible tubers. Both of these soil conditions (cool & wet) can be altered based on how potatoes are grown in the valley (e.g. timing of planting, hill structure, irrigation rate & timing, etc). Preliminary information on hill structure, planting timing, soil temperatures and soil moistures will be collected in the summer of 2015. This information will be used in 2016 to evaluate new cultural management strategies for reducing powdery scab.

Resource needs at the SLVRC:

All resources necessary to conduct these projects are currently available or will be purchased as needed.

Relationship of Proposed Research to Overall Problem:

The proposed research is driven by the mix of disease problems that limit potato production and quality of the crop in the San Luis Valley. The specific components of this research effort have been identified by SLV potato growers through annual surveys and direct contacts.

Potential for Leveraging Outside Funding:

Historically, funds granted by the CPAC to the Potato Disease Management research project have been used to leverage outside funds from agricultural chemical companies, Colorado Certified Potato Growers' Association, CSU, AES, Colorado Dept. of Agriculture, and USDA-CSREES. Based on previous years, for each dollar of base level funding from the CPAC, there have been two to three dollars leveraged from outside (non-Colorado potato industry) sources.

Time line for Proposed Research:

These projects are in various stages of completion. For efficacy trials, data are generated each year and used in registration and labeling of new products and local use recommendations for existing and new products. Data from cultivar evaluation studies is derived year-to-year and used by the CSU Cultivar Development Program and states in the Western Regional Cultivar Development Program in the long term assessment of new releases, development of cultural management sheets for each cultivar released, and in preparing applications for Federal Plant Variety Protection. Research on powdery scab was formally started in 2001 and was primarily focused on field evaluations. Currently, the project is focused more on the greenhouse and understanding how the pathogen populations and disease expression change over time based on which cultivars and rotational crops are grown. This is expected to continue. Several approaches to control and management of this disease are being pursued. Objective 1 is my PhD project and will be completed (including summaries) within the next 1 to 1 1/2 years. Objective 3 will be completed within the next year. Objectives 4 & 7 are relatively new projects and will continue to be evaluated over the next two to three years. Objective 8 is a new project and will require 3 to 4 years until completion.

Progress in 2014:

- ▶ Continued to verify that the 650 DD model used for early blight is accurate and should be an excellent starting point for fungicide applications. Demonstrated that fungicide programs involving two to three applications, with one of the applications being a Strobilurin or Fluopyram/Pyrimethanil class fungicide, reduced disease to acceptable levels.
- ▶ Continued to evaluate several chemistries for the management of black scurf and pink rot. Identified several that have the potential to be used in a potato producer's operation for the management of these diseases.
- ▶ Continued to work closely with the local consultants/field men, the Federal/State Inspection Service and growers to keep late blight out of the SLV potato crop. Recorded late blight severity units at three Valley locations (Blanca, Hooper, and Sargent). Early blight and nematode degree days were also calculated and reported on the SLVRC web page and phone message (at SLVRC) throughout the 2014 season to assist in timely, effective application of fungicides and/or nematicides.
- ▶ Continued to provide a crop water use (ET) report to the SLV Agricultural Industry throughout the summer. The report was made available via phone message, radio message, internet, and newspaper. This is a project that the CSU potato pathology program has continued to provide to the industry and was inherited from Merlin Dillon (retired CSU extension agronomist).
- ▶ Continued work as co-investigators in a NRCS/EPA project involving several two and three year potato rotations. These rotations include a variety of standard, alternative and green manure crops and soil amendments in order to demonstrate differences in yield, soil health, potential water savings, and potential disease reduction. The field evaluations for this project were completed in 2014 and final report will be available this year. Also involved in this project are Merlin Dillon, Dr. Robert Davidson, Dr. Samuel Essah and Dr. Jorge Delgado.
- ▶ Continued my PhD research project, which included evaluating the use of green manure crops for the management of black leg caused by *Pectobacterium* sp. Also, I continued working with four seed potato growers evaluating their seed operations and seed generation levels in order to determine the avenues of how these bacteria can enter seed lots. This portion of the project will be aimed at determining when and possibly how these bacteria are entering into seed operations, when the seed is originating from nuclear greenhouse stocks, which is free from the bacteria. The data collection for this project will be finished by the end of the 2015 growing season.

- ▶ A new strategy for screening potato germplasm was evaluated (new clones and cultivars commonly grown in the SLV) for determining PVY resistance. This new approach utilized an existing field of Russet Norkotah potatoes with a relatively high level of PVY. After the first year of evaluating this new approach, the data collected matched the expected disease levels in the cultivars used as controls. Several new potato developed by the breeding program were found to be relatively resistant to PVY using this new strategy. This new strategy will be used again in 2015.
- ▶ A new strategy was evaluated which utilized a flowering crop mix to reduce spread of PVY. Results indicated that PVY spread was reduced when PVY infected potato plants were planted adjacent to the flowering crop mix. This may provide an additional tool potato producers can use to battle this disease.
- ▶ A study evaluating the use of green manure crops to reduce powdery scab levels in a greenhouse was completed in the spring of 2014 (in cooperation with Patrick O'Neil from Agro Engineering). Results indicate several green manures that can be used in rotation with potatoes that have the potential to reduce powdery scab levels.

Objectives and Expected Accomplishments for 2015:

- ▶ Supply a comprehensive data package on the disease reactions of all new potato clones released from CSU. Reduce potential for the release of problematic cultivars. Make the management sheets more user friendly and applicable to SLV grower's conditions.
- ▶ Continue to develop a multi-component management regime for powdery scab for use where a determined degree of control is economically justified. Included in this effort is the development of long term management strategies to reduce potential build up of powdery scab in SLV soils by determining the best potato cultivars to use in rotation under various field scenarios.
- ▶ Generate information for potato growers, through efficacy trials, that can be used to reduce expenditures on fungicides based on specific data for crop care products addressing rates, combinations, sequences, rotations, season-long programs, application timing, and less costly generic alternatives. Additionally, provide timely information about late blight potential in the Valley through the monitoring of field environmental conditions throughout the Valley.
- ▶ Continue to evaluate flowering crop mixes, companion crops, green manures, cover crops and cultural management practices to manage disease problems (including PVY, powdery scab, black leg, etc.) and/or increase plant defense systems.
- ▶ Continue my PhD project which is directed at identifying inoculum sources for *Pectobacterium* sp., how this inoculum moves into the seed system, cultivar relationships to this problem, and development of specific management techniques to reduce or eliminate the spread of this pathogen.

Funding History: 2000, \$21,000; '01, \$18,000; '02, \$27,000; '03, \$25,000; '04, \$29,000; '05, \$20,000; '06, \$25,000; '07, \$25,000; '08, \$30,000; '09, \$33,000; '10, \$33,000; '11, \$33,000; '12, \$33,000; '13, \$25,000; '14, \$28,000.

Funding Overview:

This is the annual general request for funds to support approximately 50% of the cost of a range of research projects related to control and management of potato diseases specific to the San Luis Valley. For the most part, these are long term projects designed to address evolving chronic disease problems which limit potato production. Funds being requested are primarily for labor, operating expenses, and land rent. Each year the scope of work accomplished within this project expands, however, the base level funding request has remained relatively flat.

Funding acquired from this proposal will support objectives 1, 2, 4, 5, 7 and 8. Objectives 1 & 3 have been funded by an EPA/NRCS grant. Objective 6 will be funded through the support of chemical company cooperators.

Budget for 2015:

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| Labor: Part time field plot, greenhouse & lab labor | \$16,000 |
| Labor: Andrew's PhD Project | \$2,500 |
| Labor: Summer technician for ET and Degree Day Reporting | \$2,500 |
| Travel Expenses: National Meetings and Workshops | \$2,000 |
| <u>Various equipment and supplies</u> | <u>\$5,000</u> |
| Total: | \$28,000 |

References:

1. Peters, R. D., Sturz, A. V., Carter, M. R., and Sanderson, J. B. (2003). Developing Disease-Suppressive Soils through Crop Rotation and Tillage Management Practices. *Soil and Tillage Research* 72, 181-192.

