

Title: Potato Disease Management – 2013 Proposal

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Funding requested from: CPAC

Nature and Objectives:

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 for fixed expenses: primarily labor (full time and hourly) and land rent. Each year the scope of work accomplished within this project expands, however, the base level funding request has remained relatively flat.

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. Seed borne diseases such as powdery scab, pink rot, and silver scurf seem to be increasing and are requiring increasingly sophisticated management schemes. New problems such as Zebra chip and the PVY^{NTN} & NTN strains are becoming threats to the Colorado potato industry. We have already identified sources of PVY^{NTN} in some SLV stocks and have seen tuber necrotic damage due to this virus strain. While growers seem to have a handle on control of the foliar phase of early blight, the tuber phase continues to be damaging on some cultivars (especially the specialty cultivars) and difficult to control. Potato late blight was found in the Valley in 2007, but was eradicated in 2008 by the SLV producers through the use of well timed fungicide applications, seed lot screening and numerous grower education programs. Currently, late blight quarantine measures appear to be working. There has been more than one interception of late blight infested tubers from out-of-state seed shipments which were not allowed for planting in the SLV. Post harvest test plots for certified seed as well as field inspections indicate that potato leaf roll levels are down significantly and represent a fairly low incidence in the overall crop. Potato virus Y, however, is now epidemic in many cultivars, not just Russet Norkotah. In the short term, certified seed stocks of several cultivars will still be quite limited. The Certified Seed Act for Colorado will help reduce inoculum as it is implemented in 2012, but will not be highly effective in the short term. The certified seed program will also have to do their part in lowering mosaic tolerances to help reduce inoculum in the seed. Also, it is critical that the potato industry flush out stocks with high levels of mosaic and consider the use of more resistant cultivars to replace the acreage of these more problematic ones. It is of note that the new cultivar releases from the Colorado cultivar development program are being screened for their reaction and symptomology to PVY and have, for the most part, performed adequately even during this serious epidemic.

Efficacy trials have become a permanent component of this overall research effort. These trials generate the basic information required by product manufacturers, the EPA and State Department of Agriculture for labeling and registration. Ongoing evaluation of products is essential to maintaining current labels as well as justifying Section 18, LSN24C, and Section 3 registrations for new products or established products with label variations. Availability of new crop care products to potato growers in Colorado is contingent upon scientifically valid data developed within the University on a regional basis. Resistance management among fungicides, both foliar and soil applied is becoming even more critical as many products have similar modes of action. Therefore, development of comprehensive season-long fungicide programs for potato which rotate various chemistries with different modes of action are now routine. There has been a steady movement of more of these types of trials to a controlled greenhouse environment due to the inability to accurately predict how disease in various field trials will develop.

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, especially from out-of-Valley sources, and the use of Plant Variety Protection for new cultivars 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. Redesigning the informational management sheets for each new cultivar that are grower friendly and useable is taking place. Disease management

summaries (silver scurf, pink rot, nematodes, PVY, powdery scab, etc.) are being formulated which outline the best management guidelines currently available for controlling specific diseases with emphasis on the practical grower tools available.

Methods, Procedures and Facilities:

Objective 1: *Efficacy trials:* Trials will continue at the SLV Research Center, but in a reduced capacity. Early blight, pink rot, and *Rhizoctonia* trials will be conducted on station under solid set irrigation. Trials will focus on testing new chemistries under SLV environmental conditions including the use of compost type products.

Objective 2: *Advanced selection disease evaluations:* Evaluation of advanced selections from the CSU Cultivar Development program for reactions to PLRV, PVY, and TRV as well as reactions to ring rot will be conducted. Evaluation for powdery scab, PVY, early blight tuber rot, dry rot, and soft rot will be conducted in the SLVRC Processing building or the isolation greenhouses. This portion of the project will be in cooperation with Dr. David Holm.

Objective 3: *Powdery scab management:* Focus will center on development of a continuing, effective management program which will use soil screening for spore load (using PCR performed at the SLVRC), cultivar rotation, irrigation management, and use of Omega (fluazinam). Additionally, screening environmentally friendly chemistries such as compost teas (as part of a larger EPA grant) will be conducted both on station and at off-station sites, if available. A comprehensive greenhouse study is continuing to examine the role of cultivar rotation in increasing or reducing the soil spore load. Finally, work is continuing on identifying green manure crops that might reduce inoculum load in the soil. This portion of the project will be in cooperation with Patrick O'Neil.

Objective 4: *Biological agent and green manure rotational trials:* Evaluation of biological agents, primarily compost and compost teas, and products to increase plant defense systems, as well as, green manure use, and corresponding yield and quality will be evaluated on station. This portion of the project will be funded by EPA and is in cooperation with Dr. Samuel Essah and Merl Dillon (returning as an hourly hire to work with this research project).

Objective 5: *BMP's for specific diseases:* Best management practices based on extensive literature reviews are being formulated for potential management for several diseases. Current field inspections have not identified Zebra chip to be present in Colorado certified seed, but the pathogen has been linked to Colorado produced potatoes in the past. This situation will continue to be monitored. Cultivar management sheets as well as these BMP's will be posted to the SLVRC web site in addition to being available for local producers.

Objective 6: *Pectobacterium carotovora:* Andrew Houser will be conducting a PhD level research program aimed at determining three points of interest. First, how are the bacteria being introduced into the average grower's farming Secondly, what role does equipment play in the spread of low levels of bacteria and contamination of seed stocks. Finally, development of a measurement system for the various generation levels of certified seed to help predict when and how bad a soft rot situation may become based upon cultivars grown.

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 and ranked 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. In general terms, 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. It is, however, only by virtue of consistent base level funding that assures the presence of the project Research Associates, Andrew Houser and Steve Keller, that these outside sources of funding can be secured.

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 the field. Currently, the project is focused more on the greenhouse and understanding how the fungus populations change over time based on cultivars grown. Additional work on soil inoculum reductions through the use of green manures is being cooperatively managed with Patrick O'Neil from Agro Engineering. This is expected to continue for the coming two to three years. Several approaches to control and management of this disease are being pursued. The study of biologicals and compost teas will last two more years.

Progress in 2012:

- < Confirmed the cost effectiveness and the ability to control foliar early blight disease when applying three fungicides at the proper time. 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 class fungicide (especially when utilized as a first application treatment), reduced disease to acceptable levels. Proved that use of fungicides over years does not only significantly reduce the threat of disease, but also increases the yield of potatoes. Demonstrated to growers that as use of fungicides have increased, the separation between the untreated controls and the treated plots has reduced, indicating that there is a better opportunity for organic producers to maintain their crops with no fungicide treatments and that commercial production is seeing a benefit from fungicide application.
- < Worked closely with the local consultants/field men, the Federal/State Inspection Service and growers to keep late blight out of the SLV potato crop. More than one imported seed lot was confirmed as having late blight in 2010 and these lots were removed for planting in the SLV. In 2011/2012 no lots with issues were reported. Recorded late blight severity units at three valley locations (Blanca, Hooper, and Sargent), calculated and reported on the SLVRC web page and on phone message (at SLVRC) the early blight and nematode degree days throughout 2012 season to assist in timely, effective application of fungicides and/or insecticides.
- < Continued to work closely with seed growers on all phases of roguing and virus control in the field. Working with producers to document how a seed grower could best keep PVY to a minimal level through the use of several management options. Developed a series of worksheets from the certification program data that indicated how PVY has continued to develop in the past few years in the seed program in the SLV.
- < Continued work as co-investigators in a NRCS/EPA project involving a number of 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 and potential water savings. Also involved in this project are Merlin Dillon, Dr. Samuel Essah and Dr. Jorge Delgado.
- < Worked closely with the Leader of the Cultivar Development program and Samuel Essah to develop comprehensive cultivar management sheets for the newest cultivars being released to SLV producers.

Objectives and Expected Accomplishments for 2013:

- < 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. Conduct earlier screening of new germplasm for resistance to powdery scab and potato virus Y in the greenhouse. Restructure and prioritize critical information necessary for growth of new and existing cultivars through the cultivar management sheets. Make the management sheets more user friendly and applicable to SLV grower's conditions.
- < Continue work toward the development of a long term management strategies for pink rot, nematodes, and silver scurf in the SLV using existing research information and supplementing with focused research under SLV conditions. Continue to finalize how growers should raise PVY susceptible cultivars to produce stocks with the lowest levels of PVY increase possible. Best management practices for all phases of production are being formulated with the last several years of PVY research and available to growers through mailings and on the web.
- < Communicate the 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. Continue use of the PCR test developed by Christ et al. for soil assays representing the potential spore population in the soils for local producers. Continue studies in a greenhouse setting to verify efficacy of certain chemistries as well as cultivar rotation in reducing powdery scab root galling and tuber symptoms. Continue a trial in a greenhouse setting that would incorporate the use of various rotational crops/trap crops in rotation with potato cultivars that are relatively resistant to root galling (i.e. Mesa Russet) that would potentially reduce the level of inoculum in the soil (in cooperation with Patrick O'Neil from Agro Engineering). Preliminary research in this area was conducted by Xinshun Qu and Barbara Christ. Their work indicated that some crop species can induce powdery scab root infections, but not produce sporeballs. This prevents the completion of the lifecycle of *Spongospora subterranea* (the causal agent of powdery scab), thereby potentially reducing the level of inoculum in the soil.
- < 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 by continued cooperation in the effort to inspect all out-of-state seed sources, pursue more aggressive fungicide spray programs, and provide consistent communication with the overall industry during the season.
- < Continue to evaluate biological chemistries, compost, compost teas, green manures and other products to manage disease problems and/or increase plant defense systems and corresponding yield and quality.
- < Begin project directed at identifying inoculum sources for *Pectobacterium carotovora* subspp., how this inoculum moves into the seed system, cultivar relationships to this problem, and development of specific management techniques to reduce or eliminate these rotting problems.

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.

Budget for 2013: \$25,000

Labor: Full time (50% Research Associate) + part time plot labor	\$20,000
Various equipment and supplies	\$ 5,000