

**2012 PROPOSAL FOR COLORADO POTATO ADMINISTRATIVE COMMITTEE,
AREA II**

**TITLE: Rotational Crop Options for Powdery Scab Management in San Luis Valley
Potato Cropping Systems**

FUNDING SOURCE: CPAC

INVESTIGATORS:

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COOPERATORS:

San Luis Valley Potato Growers

NATURE, SCOPE AND OBJECTIVES OF PROPOSED RESEARCH:

Planting of multi-species cover, green manure, hay and forage crops for use in potato rotations have increased greatly among farmers in the San Luis Valley. Primary concerns in moving to multi-species crop mixes include improved pest management, potential water savings over traditional rotational crops, and improvement of soil health. Powdery Scab (*Spongospora subterranean*) is an established pest for many farmers in the San Luis Valley. The potential for economic damage to potato crops from Powdery Scab infection is substantial where pest populations are not kept in check, with consequences ranging from exclusion from premium markets with zero-tolerance standards for infection, to the near total loss of marketable crops from physical tuber damage. Trials on biofumigant crops preceding potatoes have also indicated the potential for specific crop types to reduce Powdery Scab inoculum. Greater than 50 different crop types, and many more cultivars of each, are on offer by seed suppliers to the San Luis Valley, for use by potato growers as rotational options. Little data concerning Powdery Scab host status for these crop types and cultivars exists. Determining the host status and biofumigant potential of crop types and cultivars included in rotations with potatoes is critical for the development of Powdery Scab management practices, as multi-species seedings of crops become more common in the San Luis Valley. Research is sparse on the Powdery Scab host status of commonly grown cultivars of rotational cash crops and of novel grain, cover, green manure, hay

{ call Phil -
PMTV screening
of soil -
BAIT PLANTS ??
PCR -
visit w/ Jim Cross

and forage crops and cultivars, creating opportunity for study in this area. This research program proposes to begin establishing the Powdery Scab host status, and the biofumigant potential of currently available rotational crops and cultivars for suppression of Powdery Scab. Future planting and management decisions for improved soil health, potato crop growth, and potato quality will be informed by the results of this research. The study will track crop growth and biomass accumulation through the season relative to plant population, water use, soil fertility and weather conditions, to establish baseline data for the studied crops and cultivars. This project will be a cooperative effort between Agro Engineering, Inc. and CSU SLV Research Center. The CSU Research Center will be responsible for pathology lab work and greenhouse trials, and Agro Engineering, Inc. will perform the field trialing and coordinate all other analyses through established lab cooperators.

OBJECTIVES:

1. Evaluate rotational crops and cultivars available to San Luis Valley potato farmers for growth effects on Powdery Scab inoculum levels.
2. Measure crop biomass relative to plant population, water use, soil fertility and weather conditions through the growing season on different rotational crops and cultivars available to San Luis Valley potato farmers. Measure in-season effects of rotational crop and cultivar choice on soil health.
3. Evaluate crops and cultivars available to San Luis Valley potato farmers for biofumigation potential against Powdery Scab.
4. Inform San Luis Valley potato farmers of the utilization of specific crops and cultivars for use in managing Powdery scab populations through rotational crops and mixes, and the resources required to produce the same.

JUSTIFICATION, METHODS, PROCEDURES AND FACILITIES (BY OBJECTIVE)

Objective 1: Evaluate rotational crops and cultivars available to San Luis Valley potato farmers for growth effects on Powdery Scab inoculum levels.

Justification: Literature on rotational crops has also indicated the potential for specific crop types to reduce Powdery Scab inoculum present in soil. As Powdery Scab is very challenging to culture for pot trial studies, only field trials will be used to rate relative host status of the different crop types and cultivars.

Procedures: Crops to Be Evaluated

Crop - Cultivar	Common Crop in SLV	Short-Water Potential	High Biofumigant Potential
1. Winter Cereal Rye – vns	x	x	
2. Forage Oats - Monida	x	x	
3. Sorghum x Sudan - Sordan 79	x	x	
4. Indian Mustard - Pacific Gold	x		x
5. Indian Mustard + Arugula Mix - Caliente	x		x
6. Oilseed Radish – Defender	x		x
7. Turnip Hybrid - Winfred	x	x	
8. Chickling Vetch – AC Greenfix	x	x	
9. Spring Forage Pea – '4010'	x	x	
10. Yellow Sweet Clover - vns	x	x	
11. Polyculture Mix with Terra Nova	x	x	x
12. Polyculture Mix with Sordan 79	x	x	x

Pot Trials – Rob Davidson – CSU San Luis Valley Research Center – Seeds of plants to be tested will be planted into seedling trays using soil of a known Powdery Scab infection severity (spore load quantified for each pot prior to planting). Cultivars evaluated will be placed on a greenhouse bench in a randomized block design with five replications. After growing for 85 days (approximate time green manure crops would be grown in San Luis Valley), soil samples from pots will be analyzed for Powdery Scab infection severity again, to determine host response.

Field Trials – Agro Engineering, Inc – The cooperating farmer will make available a portion of a field in rotation with potatoes, with a known history of Powdery Scab damage to tubers, to be divided into plots of 18’ x 20’, and sampled for Powdery Scab prior to planting. For all field trial sampling, 30 cores of 0-12” depth will be taken from the central 10’ x 10’ portion of each plot, with samples mixed and then split for Powdery Scab and fertility analysis. The majority of plots will contain monoculture crop and/or cultivar plantings, along with a limited number of polyculture blends to be evaluated during this initial year of the project. Plots will be arranged in a randomized block design with five replications. Planting will be done using a broadcast seeder, with incorporation directly following. High seed rates for each crop and cultivar will be used to limit effects of weed competition. At the end of the crop cycle for the treatments soil samples will be taken to determine Powdery Scab levels, in response to the growth of the crop.

Objective 2: Measure crop biomass relative to plant population, water use, soil fertility and weather conditions through the growing season on different rotational crops and cultivars available to San Luis Valley potato farmers. Measure in-season effects of rotational crop and cultivar choice on soil health.

Justification: Many of the crops and cultivars to be evaluated are new to San Luis Valley potato rotations, leaving in question the productivity and resource demands of each. Tracking incremental crop development relative to seeding rate, plant population, water use, soil fertility and temperature is necessary to evaluate the resource requirement for these crops. Previous trials have documented significant changes in soil tilth following one season of cover cropping. Changes in water infiltration rates, aggregate stability, and earthworm activity will be used as measures of soil health status in response to rotational crop type and cultivar grown.

Procedures: Agro Engineering, Inc – Using the field trial area described in Objective 1, measurement and record of soil health indicators to include earthworm activity, water infiltration rate, aggregate stability, soil fertility and soil moisture will be made pre-plant, and again prior to crop incorporation. Measures of seeding rate, established plant density, and temperatures during planting and establishment period will be made. Aboveground biomass measurements will be taken from plots incrementally throughout the growing season, to track biomass relative to water, soil fertility, seed rate and degree day accumulation. Relative feed value of aboveground biomass will be analyzed prior to incorporation of treatments.

Objective 3: Evaluate crops and cultivars available to San Luis Valley potato farmers for biofumigation potential against Powdery Scab.

Justification: Trials have documented varied responses of Powdery Scab populations to incorporation of aboveground biomass based on crop and cultivar. Using the field trials described in Objective 1, aboveground biomass will be mowed and incorporated, with Powdery Scab populations to be evaluated following incorporation. Testing following incorporation will help distinguish potential biofumigant effects on established populations, differentiating host status from biofumigant effects. This is significant for farms considering haying/ensiling of rotational crop, windrow grazing of cover crops, or reducing tillage of crop residues between potato plantings.

Procedures:

Pot Trials – Rob Davidson – CSU San Luis Valley Research Center – Pots from Objective 1 will have above-ground biomass harvested, shredded, and incorporated into the same pot in which it was grown at 86 days growth. Sampling to determine Powdery Scab levels 4 weeks following incorporation of above-ground biomass into moist soil will allow for the determination of biofumigant potential against Powdery Scab upon incorporation of the plant's biomass.

Field Trials – Agro Engineering, Inc – same field location as described in Objective 1 - with incorporation to be done using flail mowing and discing immediately following. Sampling will occur two to four weeks following incorporation of aboveground biomass to determine effect on Powdery Scab levels in soils. The soil health indicators measured in Objective 2 will be repeated following crop biomass incorporation, to distinguish tillage effects on these factors. Those crops and cultivars which appear to have biofumigation potential will be evaluated in more detail using pot trials in years to come.

Objective 4: Inform San Luis Valley potato farmers of the utilization of specific crops and cultivars for use in managing Powdery Scab populations through rotational crops and mixes, and the resources required to produce the same.

Justification: Relating the findings of this study to potato farmers of the San Luis Valley will allow for improved decision making regarding rotational crop selection and use. This information will be made available to CPAC during the winter following the study period in time to inform farm plans for the following planting season.

Procedures: Data collected from pot trials and field trials in Objectives 1 – 3 will be analyzed statistically and findings from the study summarized into reports and presented to CPAC and San Luis Valley farmers.

ENHANCEMENT OF COMPETITIVENESS OF COLORADO POTATO GROWERS

Development of low cost and reduced pesticide-intensive measures for powdery scab control are required to maintain Colorado's competitive advantage relative to other potato growing regions. Research in pest management, to avoid buildup of Powdery Scab, while allowing maximum economic return to farms through crop rotation options, is critical for the long-term viability of the state's potato producers. Information currently available from research on alternate crops for their Powdery Scab host and biofumigant status is very limited. This lack of information also limits the options Colorado potato farmers have for making informed decisions to minimize risk, maximize economic returns, and build soil health.

EXTENSION-OUTREACH PLAN

The cooperating investigators will work together to form recommendations for the most effective and economical use of alternative crops and cultivars, relative to Powdery Scab control, and the resource investment required. Findings from this study will be communicated to potato growers at the 2013 Southern Rocky Mountain Agricultural Conference. These results and recommendations will be made available to CPAC for communication to its membership electronically, as well.

POTENTIAL OF PROPOSED RESEARCH TO OBTAIN FURTHER FUNDING

Demand for more diverse rotational crop options for the San Luis Valley has given additional incentive for seed suppliers to provide crops and cultivars best suited to local potato rotations. The number of crop types and cultivars proposed for evaluation through this study is not exhaustive, but is a starting point for this line of inquiry. Additional crop types and cultivars beyond those already listed in this proposal will be included in this trial, provided seed suppliers fund the cost of these additions. Rio Grande Commodities, Colorado Seed, Wilbur Ellis, Farm Service Center, Monte Vista COOP, Green Cover Seeds and other prospective suppliers of alternative crop seeds will be contacted for additional entries and funding, following review of this proposal by the Research Advisory Committee.

TIMELINE AND OUTCOMES

All fieldwork associated with these trials will be completed by fall of 2012. Funding for additional measurements of changes in soil health into the following crop season, resulting from 2012 field trial treatments, will be addressed in our 2013 proposal. Continued screening of cultivars and crop types for Powdery Scab host status will also be addressed in our future proposals. The immediate (1-year) outcome of this study will be to better inform crop rotation decisions for the 2013 planting season. Longer-term (3-5 year) outcomes from the research completed in 2012 will include reduced dependence on costly and hazardous chemical controls

of Powdery Scab, increased potato market value due to exceptional quality, reduced water use from alternative rotational crop planting, increased crop diversity, and greater rotation opportunities for potato farmers.

BUDGET AND JUSTIFICATION

		Rate Per Entry (=5 replicates)	Flat Rate	Expense Category			Expense Amounts		
				Lab Fees	Labor	Equipment	Lab Fees	Labor	Equipment
Objective 1									
Pot Trials	Rob Davidson will cover all costs								
Field Trials	Field Prep & Incorporation		\$100						\$100
	Seeder		\$50						\$50
	Plot Layout		\$100		100%			\$100	
	Planting		\$400		100%			\$400	
	Pre-Plant P.Scab Tests	\$150		93%	7%		\$1,674	\$126	
	End-Of-Crop P.Scab Tests	\$150		93%	7%		\$1,674	\$126	
	objective totals:	\$300	\$650						
Objective 2									
Field Trials	Preplant Soil Health Tests	\$188		50%	50%		\$1,125	\$1,125	
	Biomass	\$125			100%			\$1,500	
	End-Of-Crop Soil Health Tests	\$300		71%	29%		\$2,556	\$1,044	
	objective totals:	\$613							
Objective 3									
Pot Trials	Rob Davidson will cover all costs								
Field Trials	Post-Incorp Soil Health	\$175		50%	50%		\$1,050	\$1,050	
	Post-Incorp P.Scab Tests	\$150		71%	29%		\$1,278	\$522	
	Flailing & Tillage		\$150			100%			\$150
	objective totals:	\$325	\$150						
Objective 4									
Data Analysis	Stats., Communicate Findings		\$3,000		100%			\$3,000	
	objective totals:		\$3,000						
				Category Totals:			\$9,357	\$8,993	\$300
				Percent of Budget:			50%	48%	2%
				Expense Category:			Lab Fees	Labor	Equipment
To Complete All Objectives									
	Number of Entries		12						
	Flat Fees	\$3,800							
	Per Entry Fees	\$1,238							
	Total Cost Per Entry		\$1,554						
	Total Cost		\$18,650						