

2014 PROPOSAL FOR COLORADO POTATO ADMINISTRATIVE COMMITTEE, AREA II

TITLE: Effects on Reproduction by Columbia Root Knot Nematode *Meloidogyne chitwoodi* in the San Luis Valley Potato Cropping Systems through the use of Bio-control Products and Microbial Inoculants

FUNDING SOURCE: CPAC

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COOPERATORS:

San Luis Valley Potato Growers

NATURE, SCOPE, AND OBJECTIVES OF PROPOSED RESEARCH:

Columbia Root Knot Nematode (CRKN) is an established pest that causes quality defects in most potato growing areas, including the San Luis Valley of Colorado. The potential for economic damage from CRKN 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. Through the use of green manure crops and other biological controls, many farmers in the San Luis Valley have been able to lower the populations of CRKN in their fields, but not often to the point of being able to limit chemical controls.

Meloidogyne chitwoodi overwinter in the soil as both second stage juveniles (J2) and eggs that hatch into J2. These J2 invade potato roots and produce large numbers of eggs from which J2 hatch. These J2 invade tubers and cause quality defects or invade the roots again to produce more eggs and J2 that can infect and damage tubers later in the season. Any treatment that reduces early reproduction will reduce the number of J2 present to invade tubers. Several bio-control products and microbial inoculants are currently on the market but potato farmers have not had access to local research that would show whether these products can help them improve the quality of their crops and reduce damage from CRKN while reducing the need for chemical control. Four products will be tested to determine whether they are able to reduce CRKN reproduction. Two of the products are direct fungal predators of nematodes. The other two products contain organisms stated to be nematode predators, organisms that provide competition to nematodes, and others that protect roots and improve plant growth.

This project will be a cooperative effort between Oregon State University Nematology Lab, Agro Engineering, Inc., and Colorado State University San Luis Valley Research Station. Oregon State University will be responsible for most of the nematology lab work and all of the greenhouse trials, and nematode evaluation. Agro Engineering, Inc. will perform the nematode sampling, applications of biological products, field trialing, and reporting. Samuel Essah of Colorado State University San Luis Valley Research Station will be responsible for tuber harvesting along with sizing and grading tubers.

OBJECTIVES:

- 1: Evaluate bio-control products and microbial inoculants that are currently available to San Luis Valley potato farmers for CRKN reduction or control.
- 2: Measure and evaluate potato crop yield and quality differences between treatments and untreated control.
- 3: Evaluate labeled, commercially available bio-control agent MeloCon for its effect on CRKN populations when applied to a host, and alternatively when applied to a non-host crop at time of crop residue incorporation.
- 4: Inform San Luis Valley potato farmers of the utilization of bio-control products and microbial inoculants to reduce CRKN populations and tuber damage and improve potato quality and yield.

JUSTIFICATION, METHODS, PRODEDURES, AND FACILITIES (BY OBJECTIVE)

Objective 1: Evaluate bio-control products and microbial inoculants that are currently available to San Luis Valley potato farmers for their effects on CRKN populations and crop damage from CRKN.

Justification: Research has shown a substantial reduction of several different nematodes on tomatoes and barley plants in pot trials after applications of *Paecilomyces lilacinus*. Studies have shown infection of both eggs and mobile stages of nematodes. Establishing CRKN reduction or control through greenhouse pot trials and field trials will provide growers with a list of products that are potential alternatives to chemical controls. This will permit farmers to make an

informed choice when selecting bio-control products as to the relative effect the product may have on CRKN populations and CRKN damage.

Procedures: Products to Be Evaluated

Company	Product	Labeled in CO
Certis USA	MeloCon - Paecilomyces lilacinus	YES
Soil Guys	Bio Blend	YES
Holmes Enviro	Hyper Galaxy	YES
Innovak Global	NemaRoot - Paecilomyces lilacinus & NutriSorb	NO

Greenhouse Pot Trials – There will be five pots per treatment per sample date placed in a randomized block design. Moist sandy loam potting soil will be added to fill each gallon pot. To simulate pre-plant treatments, soil will be emptied from each pot into a dishpan. 5000 eggs of *M. chitwoodi* will be gently mixed into the soil, which will be returned to the pot. Product will be applied and mixed into the soil and soil will be returned to the pot. Two weeks later, pots will be planted with a three-week-old Stephens wheat seedling, an excellent CRKN host. Additional product applications will be made as per label recommendations. Plants will be harvested at 80 - 90 days. Plant and soil will be removed from the pot into a dishpan. Plants will be removed from soil, which will be mixed and weighed and 250 g sample removed for extraction of J2. Soil will be gently washed from roots and eggs extracted from them. Data to be collected are total eggs per plant, total J2 per pot, and reproduction factor. (Reproduction Factor = (Total eggs + Total J2)/ Initial eggs added).

Field Trials – The cooperating farmer will make available a portion of a field in rotation with potatoes, with a known history of CRKN, to be pre-screened for nematodes prior to rowing out plots for potatoes. Plots with highest CRKN counts will then be resampled to pinpoint the study area. Once infested areas have been identified, one cultivar of potatoes will be planted throughout the treatment area by the farmer. 25 replicated 20' X 17' plots, with 10' buffers will be laid out in the areas with highest nematode counts. At planting, nematode samples will be taken from the middle two rows of each plot, concentrating sampling to a 10 ft. row length per plot. Products will be applied as per product-supplier or label recommendations, simulating grower practice as closely as possible. The EPA and Colorado Dept. of Agriculture have been contacted regarding Innovak Global's NemaRoot product, which is not yet labeled in Colorado. They are not requiring crop destruction since the plots are less than 10 acres.

Product	At Plant	30 Days or Emergence	Hooking	800 GDD Application	Vine kill
MeloCon	5 plots	5 plots			
Bio Blend	5 plots	5 plots	5 plots		
Hyper Galaxy	5 plots	5 plots		5 plots	5 plots
NemaRoot	5 plots	5 plots		5 plots	

Objective 2: Measure and evaluate potato crop yield and quality differences between treatments and untreated control.

Justification: These bio-control products and microbial inoculants claim to reduce or control nematodes as part of an integrated pest management approach. Two of the products also have organisms that are reported to increase yield and tuber quality. Farmers in the San Luis Valley have limited opportunity to test these statements. This trial will allow evaluation of these products in a field situation that will provide results that farmers can use to inform their decisions for the 2015 cropping season.

Procedures: Several days prior to the crop harvest, nematode samples will be taken from the middle two rows of each plot, concentrating sampling to a 10 ft. row length per plot. 25 tubers will be collected from that same area of each plot to be incubated and shipped to OSU for analysis of internal and external nematode damage. Dr. Samuel Essah and his team will harvest the entire area of each plot and grade the tubers for yield, size, and internal and external defects.

Objective 3: Evaluate labeled, commercially available bio-control agent MeloCon for its effect on CRKN populations when applied to a host, and alternatively when applied to a non-host crop at time of crop residue incorporation.

Justification: *Paecilomyces lilacinus* has been shown in scientific studies to reduce the number of nematode eggs in the soil and to have additional effects on J2 nematodes. MeloCon is the only *Paecilomyces lilacinus* product currently labeled in Colorado. This study will test application of MeloCon to host and non-host crops to see whether nematode reduction or control can be achieved with application to a living plant immediately before incorporating crop residue into the soil. This information would assist farmers in deciding whether a late summer / early fall application of *Paecilomyces lilacinus* would be a useful investment towards reducing CRKN populations and associated risk preceding potatoes.

Procedures:

Greenhouse Pot Trials – There will be five pots per treatment placed in a randomized block design. Moist sandy loam potting soil will be added to fill each gallon pot; 10 pots will be planted to Stephens wheat, an excellent CRKN host, 10 pots will be planted to C-69 barley, and 10 plants will be planted to Sordan 79 sorghum sudangrass. 5000 eggs of *M. chitwoodi* will be added to each pot after plants have reached 3" in height. Plants will be harvested at 80 – 90 days. At harvest, plant and soil will be removed from pot into a dishpan. The plant will be removed from the soil, which will be mixed, weighed and 250 g sample removed for extraction of J2. Roots and tops will be chopped into ½" pieces and mixed into the remaining soil in the dishpan. 5 pots of each crop type will receive MeloCon at the 2 lb. /acre rate as well as the plant material. The other 5 pots will receive the vegetation only. Soil will be returned to the pots, which will be left for 30 days, after which 250 g soil from each pot will be removed for extraction of J2. Stephens wheat will be planted into each of the pots and harvested after 60 days. At harvest, plant and soil will be removed from the pot into a dishpan and a 250 g sample removed for extraction of J2. Soil will be gently washed from roots and eggs extracted from them. Data to be collected are

total eggs per plant, total J2 per pot, and reproduction factor. $\text{Reproduction factor} = (\text{Total eggs} + \text{Total J2}) / \text{Initial eggs added}$.

Objective 4: Inform San Luis Valley potato farmers of the utilization of bio-control products and microbial inoculants to reduce CRKN populations and tuber damage and improve potato quality and yield.

Justification: Relating the findings of this study to potato farmers of the San Luis Valley will allow for improved decision making regarding selection and use of bio-control products for control of CRKN and improving the yield and quality of their potato crop.

Procedures: Statistical analysis on data collected from pot trials and field trials in Objectives 1, 2, and 3 will be performed and findings from the study summarized into reports and presented to CPAC and San Luis Valley farmers. Relating the findings of this study to potato farmers of the San Luis Valley will allow for improved decision making regarding biological nematode control products and their 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.

ENHANCEMENT OF COMPETITIVENESS OF COLORADO POTATO GROWERS

Development of reduced cost and reduced pesticide-intensive measures for nematode control are required to maintain Colorado's competitive advantage relative to other potato growing regions. Research in pest management to reduce CRKN populations while allowing maximum economic return to farms, is critical for the long-term viability of the state's potato producers. Limited information from research is currently available on these biological nematode control products. This lack of information also limits the options Colorado potato farmers have for making informed decisions to minimize risk, maximize economic returns, build soil health, and reduce the reliance on chemical nematicides and fumigants.

EXTENSION-OUTREACH PLAN

The cooperating investigators will work together to form recommendations for the most effective and economical use of biological nematode control relative to CRKN and the resource and investment required. Findings from this study will be communicated to potato growers in early 2015. These results and recommendations will be made available to CPAC for communication to its membership electronically.

POTENTIAL OF PROPOSED RESEARCH TO OBTAIN FURTHER FUNDING

There is potential for additional funding from both Innovak Global and Certis USA, the manufacturers of NemaRoot and MeloCon, respectively

TIMELINE AND OUTCOMES

All fieldwork associated with these trials will be completed by fall of 2014. All greenhouse trials and tuber analysis for CRKN damage will be completed by December 2014.

Budget and Justification

Objective	Description	Rate per pot / plot	Flat Rate	Expense Category			Expense Amounts			Total	
				Lab Fees	Labor	Equip.	Lab Fees	Labor	Equip.		
Objective 1	Pot Trials	5 Treatments * 5 replications	\$167		100%			\$3,500		\$3,500	
Objective 1	Field Trials	Pre-screen nematode sampling									
		15 first sampling + 35 second	\$55		91%	8%	\$2,500	\$250		\$2,750	
		Plot layout		\$400		100%		\$400		\$400	
		Plot nematode sampling - 2 occasi	\$55		91%	8%	\$2,500	\$250		\$2,750	
		Plot treatment - 4 times * 25 plots		\$900		100%		\$900		\$900	
										objective total	\$10,300
Objective 2	Harvest nematode sampling		\$55		91%	8%	\$1,250	\$125		\$1,375	
	Plot harvest Dr. Essah		\$3,000		100%			\$3,000		\$3,000	
	Tuber Storage and Shipment		\$600		100%			\$600		\$600	
	Tuber evaluation OSU * 25 plots	\$50		100%			\$1,250			\$1,250	
										objective total	\$6,225
Objective 3	6 Treatments OSU * 5 replications	\$210		100%			\$6,300			\$6,300	
										objective total	\$6,300
Objective 4	Statistical Analysis		\$600					\$600		\$600	
	Data Analysis, Report, Communicate Findings		\$2,400					\$2,400		\$2,400	
										objective total	\$3,000
Category Totals							\$17,300	\$8,525	\$0	\$25,825	
Percent of Budget							67%	33%	0%		
Expense Category							Lab Fees	Labor	Equip.		
Total cost							\$25,825.00				

* (- Pot trials - most important -
 + trts. to be used. use all w/ claims
 they kill eggs -
 * ((Could easily double cost of proposal
 to add in other trts. -
 \$16-17,000

no pay

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