Title: Using Bio-control Green Manure Crops to Enhance Potato Production

CPAC (Area II) Research Proposal for 2007

Project Leader(s): Merlin A. Dillon, SLV Area Extension Agronomist

Cooperators include Dr. Russ Ingham, Oregon State University; Drs. Jorge Delgado and Dan Manter, ARS-Ft. Collins; and Dr. Samuel Essah, SLV Research Center.

Nature, Scope, and Objectives

This project will be broaden and expanded as a result of an EPA Grant in the amount of $50,900. After 26% overhead is taken, there still remains $40,397 for a 2-year trial that actually requires 3 years to complete. However, the funding will not be received until July or later. Expenses incurred prior to receiving that funding cannot be paid; therefore, funds are requested again for this year.

Columbia Root-knot nematodes **(CRKN)** have become an important pest of SLV potato production. CRKN can and has caused entire potato fields to be unusalable. Growers lose their entire crop investment, about $14-1500 per acre. As an example, a grower might lose $300,000 income from one center pivot of potatoes. Fumigant, applied preplant, or Vydate applied in-season are reasonably effective in controlling these pests. However, they are very destructive to beneficial organisms, to soil health and to grower quality of life. Growers love to grow potatoes but they hate it to have to use these harsh chemicals.

Green manure crops are proposed as a potato rotation crop that can reduce potato pests, reduce water consumption, and enhance potato yields and quality. Dillon samples the field and determines where to locate the trial. He then establishes the plots by planting the green manure crops. Nematode levels (CRKN) are determined by soil sampling and sending to Ingham's lab in Oregon. Sordan 79 sorghum-sudan, Sordan hay and wet fallow have reduced CRKN populations compared to the starting levels after potatoes. Delgado samples soil above ground biomass to determine nutrient uptake. He first discovered higher yields in potatoes grown after Sordan compared to wet fallow. Manter has produced data showing more fungal biomass and diversity after Sordan green manure than after wet fallow. Essah is now involved in harvesting larger yield samples regarding enhanced yield after green manure. Using green manures can reduce pesticide use and enhance potato production.

Complete results for the 2005-06 trial are now available.

OBJECTIVES FOR 2007:

1) To expand the number of green manure treatments and measure their effect on nematode (CRKN) and *Verticillium* propagule levels in the soil. Green manure treatments this year are proposed as:

a) sorghum-sudan var. Honeysweet
b) sorghum-sudan var Sordan 79
c) Sordan hay (above ground material removed)
d) mustard
e) canola
f) wet fallow (weeds are controlled)
g) Alaska cedar chips[1/]

Additional treatments this year will include:

h) spring barley

i) winter rye

[1/] In cooperation with Manter, USDA-ARS, soil applied Alaska cedar chips will be added but these samples not sent to Oregon State. Manter tests this treatment and other treatments for effect on soil fungal diversity and biomass.

2) To compare the effect of growing sorghum-sudan for green manure vs. hay on the reduction of CRKN nematode and *Verticillium* level in the soil prior to the following potato crop.
3) To compare canola to mustard green manure cover crop.
4) Another very important aspect of this research is to determine potato yield benefit for potatoes after a green manure crop. Research by Delgado, USDA-ARS, Ft.Collins and now corroborated by Essah has documented higher potato yields and bigger tubers for potatoes grown after Sordan green manure. Documenting higher potato yields following cover crop would justify more cover crop acreage.
5) Ingham analyzes CRKN levels in the tubers of the following potato crop. Reducing nematode levels for potato planting time is important; but it is even more important to determine how the cover crops affect nematode levels in the tubers of the following potato crop.

Relationship of the Proposed Project to Overall Problem

Green manure cover crops are being used successfully in this and other areas to reduce CRKN populations. Examples of crops being grown are mustards, oil seed radish, sorghum-sudangrass, and rapeseed. The short growing season in the San Luis Valley makes implementing a cover crop challenging, but if successful has the potential to provide a viable alternative to chemical control. We are particularly interested in screening crops that are cold tolerant and/or grow rapidly.

Green manure cover crops have shown great potential in reducing the impact of these pests. However, many questions still remain as to how these crops grow in our environment and how to use them to our best advantage. Also, will these cover crops be reliable in reducing CRKN density or will this depend on the year?

Dedicating one entire crop year to a green manure crop is expensive (no crop income); however, growing a green manure cover crop can help reduce water consumption. Growers this year are again being asked to reduce groundwater consumption by 25%. Growers should be able to grow a green manure cover crop with about 1/2 the water of barley. Growing a cover crop provides crop cover during growth and crop residue after incorporation. Therefore, it is feasible for growers to grow green manure cover crops and save groundwater, build soil organic matter and protect the soil from wind erosion at the same time. Fumigants and fungicides can be used to control these pests; however, these chemicals are harsh, very expensive; and soon may not be available. Preplant fumigant or Vydate applied in-season are very destructive to beneficial organisms, to soil health and to grower quality of life. We must be able to rely on some alternative pest control such as biocontrol crops to manage these destructive pests. Green manure crops can be used as a preventive to reduce CRKN so that growers never need to use either Vydate or fumigant.

If there is a yield boost for growing potatoes after a green manure cover crop; this would more than compensate for the costs incurred in growing the green manure crop.

Method, Procedures and Facilities

A field trial will be established in a grower-cooperator field know to have infestation of CRKN. First, the field will be sampled on a 2-acre grid to determine where to locate the small plots. After results are back, small plots will be located and each plot sampled and treatments arranged according to the nematode level. Green manure cover crops will be planted with small plot planter in designated plots. Nematodes will be sampled in late October (intermediate sample) and the final sampling at potato planting time.

Tractor, planter and tools will be needed from the SLV Research Center. Soil will be packaged and sent to the nematode lab at Oregon State University. No other facility needs are anticipated.

Timeline of Proposed Research and Short Term and Longer Term Outcomes

A field trial is proposed to be conducted this summer on a cooperators field. Starting nematode levels and mid-October levels will be available by next Winter. Final pest samples would be soil sampled at potato planting time (2008) and would not be available until results are analyzed and reported after that.

Several years of research detailing and documenting the advantages of using green manure cover crops will help to increase growers adoption of this alternative method. Understanding the reliability of using these alternative methods will also determine their usefulness.

Milestones and major expected accomplishments. Sordan 79 green manure can be grown in rotation with potatoes to save water, save soil and reduce potato pests, specifically CRKN. Another sorghum-sudan and/or other green manures have not been as reliable. Using mustard may be determined unreliable after one or two more years. Sordan 79 harvested for hay may be less reliable than the Sordan green manure crop treatment. In the long-term (3-5 years), we should be able to prove whether these green manure cover crops give a yield and/or quality boost to the following potato crop.

Sordan green manure has been shown to enhance potato yield and potato size compared to wet fallow. If a spring barley treatment can be grown alongside the other green manures, we would be able to compare potatoes grown in rotation with Sordan green manure and spring barley. The very best rotation may turn out to be a 3-year rotation of potatoes, barley, Sordan. This would provide soil erosion protection after potatoes (spring barley) and prior to green manure planting. Providing CRKN population reductions and water savings at the same time as saving soil and enhancing potato yield and quality would provide growers with a more sustainable potato production system.

Detailed Annual Budget
2007 Request:

Soil Nematode Analysis	$2,700	
Verticillium Analysis	$1,000	
Shipping Samples	$ 200	
Potato tuber analysis	$1,000	(Samples shipped to Ingham, Ore. St. U.)
Part-time Labor	$ 400	
Mileage	$ 200	
Supplies	$ 100	
TOTAL	**$5,600**	

Budget Justification

For the first year of the EPA Grant, expenses are nearly the same as normal. The Grant cannot be used to pay analysis or labor that is used prior to receiving the grant (estimated August). The final analysis this year will be paid from the Grant; other expenses must be paid from local funds. Next year's request should include more expenses paid from the EPA grant.

Nematode analysis at Oregon State University is estimated at $35 each for research samples. The trial is being expanded to 10 treatments instead of 6. Samples are planned for 4 different times (Preliminary, Green Manure Planting, Intermediate and Potato Planting).

Verticillium analysis is budgeted at $20 each. Budget is for 50 samples each time. I plan to analyze 50 at cover crop planting and 50 at potato planting the following year.

Shipping charges are for sending soil samples to Corvallis, Oregon.

Labor is needed in soil sampling, planting, and to apply herbicide or insecticide on certain cover crops as required.

Mileage is requested since the plots will be off-station in Alamosa County.

Money for supplies is needed for soil bags, seed bags, herbicides, etc.

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Title: Using Biocontrol Green Manure Crops to Enhance Potato Production

2006 Research Report to CPAC Area II

By Merlin A. Dillon, Area Extension Agronomist, SLV Research Center, Center, CO.

Thanks to CPAC Research Committee for sponsoring this Field Trial. Many thanks to Dr. Russ Ingham, Associate Professor and Nematologist, Oregon State University, Corvallis, Or., Dr. Jorge Delgado and Dr. Daniel Manter, USDA-ARS, SPRN Research Unit, Ft. Collins, CO., and Dr. Samuel Essah, SLV Research Center.

CPAC Area II has funded this project since about 2001. Green manure crops are crops planted purposefully to be incorporated instead of harvested. Green manure crops are planted to reduce water use, reduce Columbia Root-knot nematodes (CRKN) levels, and improve soil health. CRKN are sampled four times in the two year rotation. In this series of 2-year trials, soils are sampled four times. First, a survey of the prospective field determines where high levels of CRKN are present. Second, green manure plots are established and sampled to determine the starting CRKN level. Green manure crops are then grown for about 60 days and then chopped and soil incorporated with a chisel or disk. The third nematode sample is in late October each year (a mid-rotation nematode level). The final CRKN level is in May (potato planting) the following year. The starting CRKN level is compared to final CRKN level. One final, important test is to actually grow the potato crop and see nematode damage in the tubers. Dr. Ingham initiated this part of the study; he harvests tubers for CRKN tuber damage analysis. Dr. Delgado determines potato yield (2' x 2') and nutrient uptake of potatoes. Dr. Essah has begun harvesting a larger plot sample (10 foot) for determining potato yield and grade. Dr. Manter analyses soil for fungal biomass and fungal diversity.

Several green manure crops have drastically reduced nematode levels as measured at potato planting and as shown in Figure 1 below. Mustard and canola were not as effective on CRKN as Sordan 79 sorghum-sudan, Sordan 79 harvested for hay or wet fallow.

Oilseed radish was used in the trial for two years. It was not extremely effective on CRKN; however, it has been reported effective on stubby root nematode. Radish was replaced with a second variety of sorghum-sudan. Honeysweet has been used in the trial for one and part of the second year. It too is not as effective as Sordan 79 for CRKN; however, it may have other benefits in the potato reduction

Columbia Root-knot nematode (CRKN) is a serious problem in a few fields in the San Luis Valley. CRKN can make potatoes unsalable. Even though few potato fields require fumigation or Vydate treatments, all farms in the Valley are vulnerable and may someday need treatment. Sordan 79 sorghum-sudan has been shown to reduce CRKN levels. ***The most important aspect of this research may be using Sordan 79 green manure to prevent CRKN problems requiring expensive nematicide treatments.***

Because of several drought years, growers are also being asked to reduce water use by at least 25%. Sordan grown as a green manure crop can grown on 5-10 inches of water compared to 16-18 inches for cash crops. Dr. Delgado and Dr. Essah are recently reporting potato yield increases for potatoes grown after Sordan compared to wet fallow. Improving potato yield will more than encourage growing Sordan green manure in rotation with potato.

Part I. Final results from 2005-06 Trial. Initial (May 05) and intermediate (Oct 05) results have been reported previously, but not the final nematode levels from May '06.

2005-06 Green Manure Cover Crop treatments:

1. Mustard
2. Canola
3. Sorghum-sudan variety Honeysweet (HS)
4. Sordan 79 sorghum-sudan

5. Sordan 79 Hay (hay removed)
6. Wet Fallow (Nothing planted; weeds controlled)
7. Manter (plots split lengthwise, fallow vs. Sordan/ plots split again for 2 rates of Alaska cedar).

Soil samples in May 05 determined that the initial Columbia root-knot nematode (CRKN) levels were quite high in the study area. Green manure cover crops were established in June on a farmers' field in NW Alamosa County and incorporated in late August. The Sordan hay treatment differs from Sordan in that the crop biomass was removed just prior to cover crop incorporation. Subsequent soil samples were taken in Oct 05 and the final samples in May 06. Results are shown in Figures below.

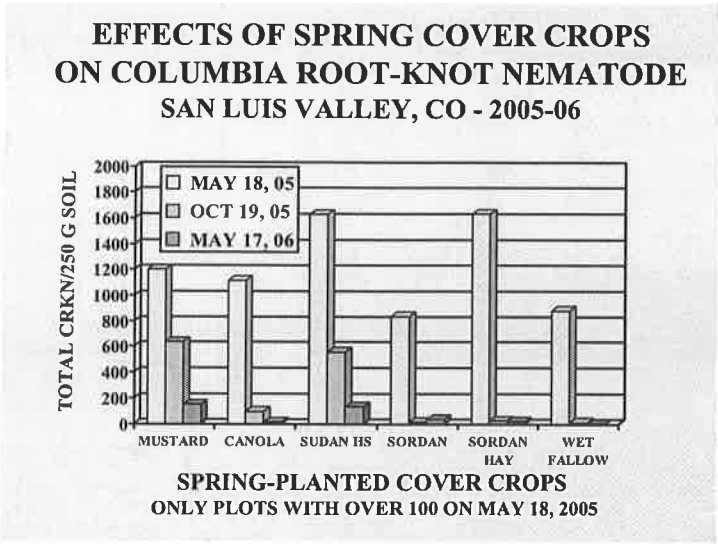
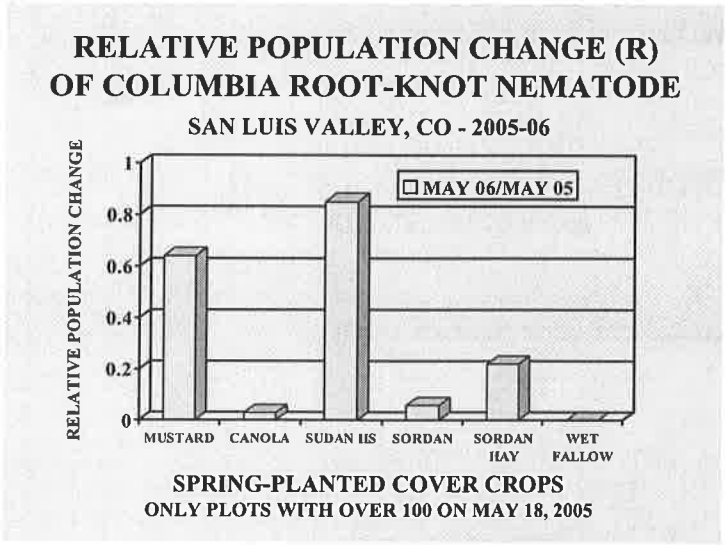


Figure 1. CRKN levels at the beginning, intermediate and final sampling dates as affected by cover crop treatments.

Good populations were present at the start of the trial, May 05. Comparing the populations in May 05 vs. Oct 05, Sordan appeared to be a better nonhost than the brassicas. Comparing populations in Oct 05 vs. May 06, the green manure effect of brassica and Honeysweet SS seems to occur after the October sampling. Sordan, sordan hay and wet fallow populations were very low by the Oct sampling.

Decomposition from Oct to May seems like a pretty cold period but it does include some warmer weather in late April and early May. Fungi in particular may be able to decompose crop residues at cool temperatures.



CRKN were further reduced by the May 06 sampling date. All treatments reduced CRKN compared to the starting levels. Canola, Sordan, Sordan Hay, and wet fallow were particularly effective in reducing CRKN populations for the potato planting time sampling.

Figure 2. CRKN reproductive index represents the ratio of final vs. initial CRKN levels, comparing nematode population levels from May 05 to May 06.

Canola reduced CRKN much more this time than in previous years. Sorghum-sudan var. Honeysweet and mustard were much less effective than canola, sordan, sordan hay and wet fallow.

Part 2. Partial results from 2006-07 trial

2006-07 Green Manure Cover Crop treatments:

1. Mustard
2. Canola
3. Honeysweet sorghum-sudan
4. Sordan 79 sorghum-sudan

5. Sordan 79 Hay (hay removed)
6. Wet Fallow (Nothing planted; weeds controlled)
7. ARS Manter (plot split for Sordan vs. Fallow, both have Alaska cedar chips)
   (This treatment not sampled for CRKN)

The same procedures were followed as for 2005-06. May 06 and Oct 06 samples have been analyzed. Final samples will be taken at potato planting (May 07). Dr. Russ Ingham will again sample nematodes in the growing potato crop next year (assuming funding is approved).

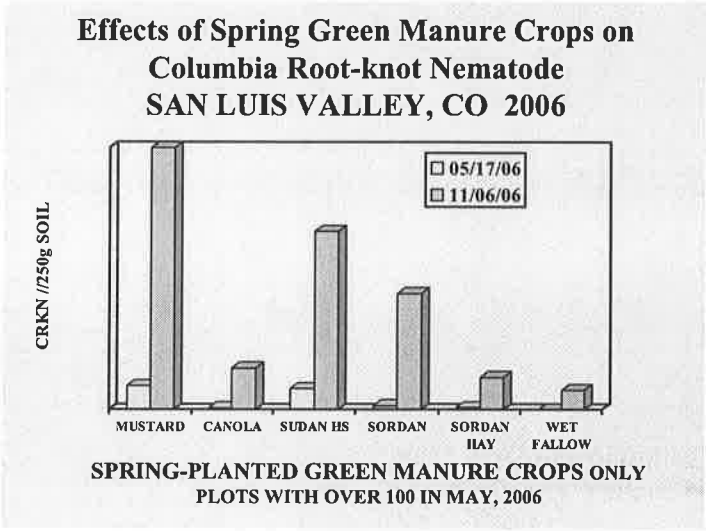


Figure 3. Comparison of starting nematode levels (CRKN) in May 06 vs. Nov 06 nematode levels.

This situation is very unusual in that CRKN levels were very low in May 06; probably because of environmental conditions. The winter rye cover crop had a very poor stand and winter-spring moisture was very low; rye was not irrigated. The Oct 06 populations actually show higher populations than the starting levels. This is a result of sampling, probably CRKN were not detected by the 1 foot soil sample in May 06. Higher populations in Nov 06 indicates CRKN were present but not detected in the earlier sample. Values in Nov 06 were pretty much as expected with some exceptions; Sordan was higher than Sordan Hay; and canola was much lower than mustard. These intermediate results show best results with canola, Sordan Hay, and Wet Fallow. These cover crops produced lower nematode levels compared to Honey Sweet or mustard. More definitive results are to be found in the final sample, May 07.

Summary: Bio-fumigation Green Manure Crop Trial

2005-06 Trial

- Nematode (CRKN) levels were fairly high in the beginning of the study. All spring green manure cover crops reduced populations of CRKN. In the spring following potatoes (May 06), CRKN averaged near 1000 per 250 g soil. By fall following incorporation of the cover crops (Oct 06), CRKN were substantially reduced for most treatments. CRKN levels for mustard and Honeysweet sudan were still much higher than other treatments.

- Sordan 79 was very effective in reducing CRKN after cover crop incorporation. Sordan 79 seemed to be a better nonhost than the brassicas. Results here suggest that incorporating sorghum-sudan stubble (Sordan Hay treatment) had little additional effect. However, incorporating the total biomass with soil surface crop residue for protection would also be a better soil management practice.

- Canola was also better than mustard or Honeysweet sorghum-sudan in reducing CRKN.

2006-07 Trial

Nematode levels were very low this year for starting samples prior to green manure cover crop treatments. For the intermediate sampling (Nov 06), canola , Sordan Hay, and wet fallow treatments were very effective in reducing CRKN levels. These green manure cover crops were much more effective than mustard or Honeysweet sorghum-sudan.

Green Manures Increase Potato Yield and Cartons (Dr. Delgado)

The sorghum-sudan, mustard, radish, and canola average dry matter production with limited irrigation was 3000, 4300, 4500, and 6261 lbs per acre, respectively. These cover crops were produced with an average of 7 inches of irrigation, 9 to 11 inches less than for a barley or potato crop. Farmers can grow the green manure cover crop with limited irrigation and could either sell the aboveground biomass for hay (sorghum-sudan) or incorporate it as a green manure crop.

Mustard, radish, and canola had higher Ca content than the sorghum-sudan. Sorghum-sudan extracted twice the amount of Cu and Mn than radish, canola, or mustard. Additionally, sorghum-sudan Zn content was higher than that of the mustard and canola. Cover crops can be used as green manures to cycle nutrients to other important crops such as potato.

Under commercial farm operations, the total marketable ***tuber yield was increased by 12 to 30%*** when potatoes followed a sorghum-sudan green manure instead of wet fallow plots. For the potatoes following sorghum-sudan, tuber quality was better, with ***40% higher production of tubers greater than 8 ounces (cartons)*** when compared to tuber quality and production rates that followed a wet fallow plot.

Green Manure Crops Increase Fungal Biomass and Diversity (Dr. Manter)

The effects of various green manure cover crops (Sordan 79, mustard, canola, Honeysweet sorghum-sudan, and wet fallow) to influence soil fungal biomass and diversity were tested in a potato field in the San Luis Valley, Colorado. Soil samples (0-5 cm depth) were randomly selected from each cover crop plot and soil fungal communities were analyzed based on fungal DNA profiles. All cover crops increased the soil fungal biomass as compared to the wet fallow treatment, with the greatest fungal biomass in the sordan 79 plots. On average, 13 different fungal species were identified in each of the various green manure crops. Of these species, three are known potato pathogens (*Fusarium equiseti*, *Verticillium* sp., and *Alternaria solani*). Green manure cover crops differed in their ability to suppress, or reduce biomass of these pathogenic species. For example, mustard significantly reduced the biomass of all three species; whereas, sordan 79 significantly reduced both *Verticillium* sp. and *Alternaria solani*. Sordan 79 appears to be a beneficial green manure cover crop in potato rotations since it promotes total soil fungal biomass and diversity and presumably a healthier soil, and at the same time can limit the proliferation and abundance of some potato pathogens in the soil.

Future Goals

- To document a "yield bump" when potatoes follow certain green manure cover crops. A quality (size) increase would also be very important in increasing farmer potato income. A small increase in potato yield or quality would improve grower income more than the expense of growing a green manure crop.

- To continue document increases in soil fungal biomass and diversity.

2007 PROPOSAL FOR THE SLV RESEARCH CENTER COMMITTEE AND THE COLORADO POTATO ADMINISTRATIVE COMMITTEE (AREA II)

TITLE: Management of Nematodes on Potato in the San Luis Valley, Colorado

PROJECT LEADERS:
Russell E. Ingham, Professor and Research Nematologist
Nick David, Graduate Student
Department of Botany & Plant Pathology
Oregon State University
Corvallis, OR 97331-2902
(541) 737-5255

COOPERATORS:
Merlin Dillon, Extension Agronomist, SLVRC
Agro Engineering, 0210 Rd 2 South, Alamosa, CO
Mike Edwards, Norm McKinley and Tom Brooks, Dupont
Jerome Otto, Dow AgroSciences
San Luis Valley Potato Growers

NATURE, SCOPE AND OBJECTIVES OF PROPOSED RESEARCH

The Columbia root-knot nematode (*Meloidogyne chitwoodi*, CRKN) has become a threat to quality potato production in the San Luis Valley. In addition to the fresh market, which has low tolerance for tubers expressing symptoms of root-knot infection, the SLV also produces potato for seed and export markets, which have no tolerance for root-knot infection in tubers. Separate management strategies may need to be developed for crops destined for these different markets. Nematode management for fresh market may be based on fumigation with Telone, Vydate C-LV or, potentially green manure cover crops, perhaps in combination with Vydate C-LV. Various aspects of these different management strategies are addressed in this proposal. Corky ringspot (CRS) disease occurs sporadically in the SLV but can be a major production concern where it does occur. This research program will initiate reliable and economical approaches to control this virus disease that is vectored by stubby-root nematodes (*Paratrichodorus allius*).

OBJECTIVES

1. Determine the success of CRKN suppression by different rates of Telone II two years after application.

2. Determine the effect of various green manure cover crops on potato tuber damage caused by CRKN in a field with low CRKN densities.

3. Evaluate sudangrass cultivars for suppression of CRKN.

4. Evaluate the performance of Vydate for control of Corky Ringspot in the SLV.

JUSTIFICATION, METHODS, PROCEDURES AND FACILITIES (BY OBJECTIVE)

Objective 1. Telone II is the most effective nematicide registered for use on potato. However, at an estimate cost of $11/gal plus $45/acre for application, the labeled rate of 20 gpa costs $265/acre which is considered to be expensive by SLV potato growers. While this expense is not as costly as the rejection if a potato crop due to excessive symptoms of infection by Columbia root-knot nematode (CRKN), Telone fumigation may be more economically attractive to SLV growers if costs could be reduced. Two ways to reduce cost are to reduce the rate of product applied and to try and get sufficient suppression for two potato crops with one Telone application. These procedures would be very risky in other, warmer growing regions where CRKN reproduce rapidly, but it may be appropriate for domestic fresh market crops in the SLV which has a shorter, cooler growing season and, thus, fewer generations of CRKN.

Two trials were initiated in fall of 2004 to examine the effects of Telone II at rates of 12, 15, and 20 gpa on CRKN. All three treatments provided excellent control of CRKN populations and almost no tuber infection was present in the 2005 potato crop in either trial. One of these fields was planted to barley in 2006 and the other was planted to sudangrass. Plots from both trials will be resampled at planting of potato in 2007 to determine if populations have remained suppressed to the extent that chemical control would not be required for the 2007 crop season. Plots in the field planted to sudangrass will be sampled again at harvest and tuber samples will be collected and examined for symptoms of CRKN infection at harvest and after incubation. This field also had plots that received no Telone in 2004. This grower plans to use Vydate in this field so the plots will be split with one half covered with a tarp during Vydate application (untreated) and the other half exposed and treated with Vydate. Thus, the following treatments will be evaluated.

2005	2006	2007
1. No Telone-Potato	Sudangrass	Potato-No Vydate
2. No Telone-Potato	Sudangrass	Potato-Vydate
3. 12 gpa Telone-Potato	Sudangrass	Potato-No Vydate
4. 12 gpa Telone-Potato	Sudangrass	Potato-Vydate
5. 15 gpa Telone-Potato	Sudangrass	Potato-No Vydate
6. 15 gpa Telone-Potato	Sudangrass	Potato-Vydate
7. 20 gpa Telone-Potato	Sudangrass	Potato-No Vydate
8. 20 gpa Telone-Potato	Sudangrass	Potato-Vydate

Objective 2. Two trials have been completed demonstrating that green manure crops can reduce high populations of CRKN and reduce tuber symptoms of CRKN sufficiently to provide acceptable tuber quality for domestic markets that have a low tolerance for CRKN. However, no information is available to determine if green manure crops can reduce low populations of CRKN sufficiently for this strategy to be effective for export markets that have zero tolerance for CRKN. During 2006, Merlin Dillon planted several green manure cover crops on June 13 in a field with low average population densities of CRKN. Each cover crop was replicated five times in a randomized block design and nematode samples were taken on June 12 and November 6. Effects of the cover crops on CRKN are illustrated in figure 1. This field will be planted to potato by the grower in 2007 and thus, provides an excellent opportunity to follow the effects of these cover crops on CRKN suppression through the potato crop, as well as examine the amount

of protection these cover crops may provide for suppression of tuber damage by CRKN. Soil will be sampled for nematodes at planting and at harvest of potato, and tubers will be evaluated for symptoms of CRKN infection at harvest and after an incubation period.

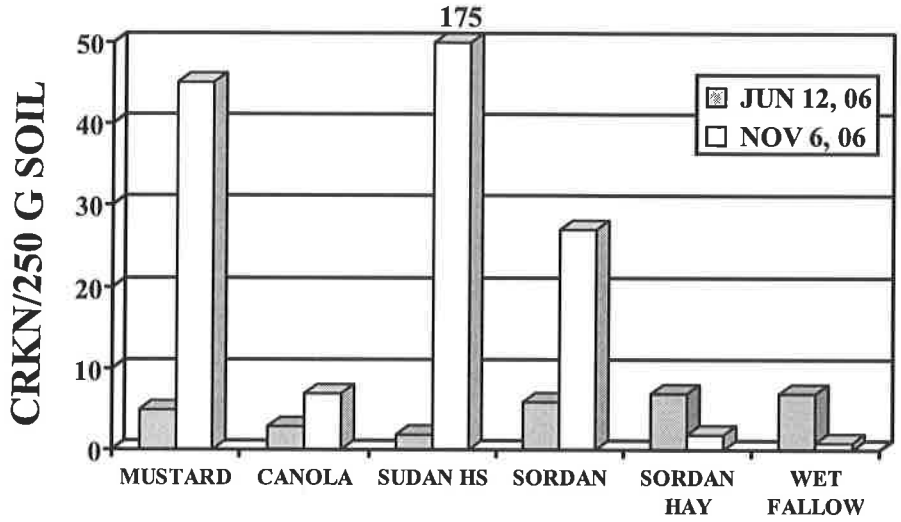


Figure 1. Effects of spring-planted cover crops on populations of Columbia root-knot nematode (*Meloidogyne chitwoodi*) in the San Luis Valley during 2005.

Objective 3. Trials have documented that sorghum-sudan cv Sordan 79 is effective at suppressing populations of CRKN in the SLV. Honey sweet, another sorghum-sudan hybrid available in the SLV, has not been as effective at suppressing CRKN populations. However, symptoms of CRKN in tubers grown after both cultivars were acceptable for domestic markets when tubers were evaluated at harvest. When tubers were incubated to reveal late season infection, damage was higher in tubers grown in Honey sweet plots than after Sordan 79. Variation in the suppressiveness of different cultivars of sudan and sorghum-sudan hybrids has also been observed in the Pacific Northwest. It is important to know the reaction of CRKN to different sudan or sorghum-sudan cultivars to determine if a variety exists that is more suppressive than Sordan 79 or if there are cultivars that may actually increase CRKN and thus should be avoided in potato rotations. Furthermore, cultivars that are equal or superior to Sordan 79 need to be identified should Sordan 79 be discontinued. Very little screening of sudan cultivars has been completed, however.

In this trial, six cultivars of sudan or sorghum-sudan hybrids will be planted in a randomized block design with five replications in a field which is known to be infested with CRKN and which will be planted to sudan by the grower. Test cultivars will likely include Sordan 79, Honey sweet Standard, Honey sweet II, Croplan Standard, Grazex II and piper, although grower input in this list would be appreciated. Samples for nematode analyses will be collected in the

spring before plots are planted and in the fall after incorporation. In 2008, funds will be requested to sample these plots at planting and harvest of the potato crop and to evaluate tuber infection. Evaluation of performance of these different varieties will provide information needed by growers to request specific cultivars when buying seed.

Objective 4. Corky ringspot (CRS) has been reported to occur after canola by growers in the SLV, suggesting that this crop is ineffective at controlling the stubby-root nematode vector. Vydate has been effective at controlling CRS in Oregon and Florida if applications are made early. However, this management strategy has not been tested in the SLV. A grower with a field history of CRS will follow canola with a potato cultivar sensitive to expressing symptoms of symptoms of CRS. The grower will treat the field with Vydate with an in-furrow application, a chemigated application 30 days after planting and a third application three weeks later. If the field also has CRKN, additional applications may be made. The grower will leave some rows untreated with the in-furrow application. Tarps will be placed over four–row wide by 25 ft long plots in this untreated area to establish untreated controls. Other plots in this area will receive all chemigated applications to test he effectiveness of a Vydate program without an in-furrow treatment. Thus, the three treatments to be tested will include:

1. Untreated Control
2. Chemigation applications at 30 and 51 days after planting
3. In-furrow plus chemigation applications at 30 and 51 days after planting

Each treatment will be replicated five times. Nematode samples will be taken at planting and at harvest. Tuber samples will be collected, sliced and scored for symptom expression of CRS. If CRKN is present in this field, tubers will be evaluated for CRKN symptoms as well.

RELATIONSHIP OF PROPOSED RESEARCH TO OVERALL PROBLEM

A considerable percentage of potato acreage in the western United States is infested with root-knot nematodes. Even minimal damage to tubers from root-knot nematodes can result in substantial decrease in crop value. Control measures utilized in other regions have been effective but are too expensive for the narrow profit margins from production in the SLV. Nematode management guidelines and treatment options must be developed specifically for the unique growing conditions in the San Luis Valley. Research in the SLV is complemented by biological and treatment schedule research in other production areas in an attempt to develop a comprehensive management plan for nematode control that can be applied to all production areas.

POTENTIAL OF PROPOSED RESEARCH RESULTS TO OBTAIN OTHER FUNDING

Dow and DuPont have contributed substantially to funding, labor and product for various objectives completed by this project in the past. Support from DuPont for 2007 is unknown at this time but DOW has expressed interest in contributing to another the Telone rate trial in fall of 2007 if a suitable site and cooperating grower can be located. Work on green manure crops in cooperation with Merlin Dillon and others contributed to the successful funding of a grant submitted to EPA in 2007. Results from this research project may also provide necessary data for preparation of a Western Region IPM proposal, which would provide funding for CRKN nematode research in the San Luis Valley.

TIMELINE AND OUTCOMES

All fieldwork associated with these trials will be completed by fall of 2007 except for the sudan variety trial which will continue through the potato year in 2008. We intend to establish another Telone II rate trial in fall of 2007 to collect supporting data to pursue a reduced rate label for the SLV. Funds for that trial, including work that will occur in 2007 will be requested from CPAC and Dow AgroSciences in our proposal for 2008.

Short-term outcomes will include recommendations of the most effective and/or economical use of Telone for CRKN control in the SLV. This project will also contribute to developing guidelines for using green manure corps, particularly sudan cultivars for CRKN suppression. This project also will provide the first information on control of CRS in the SLV with Vydate. Major milestones and accomplishments expected include better understanding of the relationship between Columbia root-knot nematode and potato, and the establishment of the most reliable and economical methods for SLV growers to protect potato crops from losses due to nematode damage.

FUNDING REQUEST:

2006 Allocation: $15,000

2006 Request:

Nematode Processing of Soil and Tuber Samples	$12,750
Travel	5,000
Labor	5,500
Shipping Samples to Oregon	3,200
Misc services and supplies	3,700
Total Cost of Project	$30,150
Total CPAC Request	**$30,150**

**Note: If the objective on sudan cultivar trial is approved, Merlin Dillon will need $500 for his effort in this objective.

This budget includes work for all the objectives as described. However, there is some flexibility in the budget by reducing the effort under some objectives and/or eliminating other objectives to meet the needed support for the research if this is necessary due to CPAC budget constraints. Priority ranking of objectives by the project leaders would be for objectives 1 and 2 since considerable effort and expense has been expended to establish these research opportunities and if they are not pursued at this time these opportunities will be lost.