

Research Proposal For 2006

Submitted to:
SLV Research Committee
Colorado Potato Administrative Committee (Area II)

Title: *Using Biocontrol Crops to Enhance Potato Production*

Project Leader(s): Merlin A. Dillon, SLV Area Extension Agent, Agronomy with technical expertise and advice from Dr. Russ Ingham, Associate Professor and Nematologist, Oregon State University, Corvallis, OR.

Nature, Scope, and Objectives

Nematodes, especially Columbia Root-knot nematode (CRKN), are becoming an increasingly important pest of SLV potato production. CRKN can and has made entire potato fields unusable. A grower could lose his entire crop investment, about \$1400 per acre. For example, the grower might lose \$260,000 income from one center pivot. *Verticillium* has been a long-term problem and can reduce yields through the early-dying complex.

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. Biocontrol cover crops trials have been shown to reduce the density of CRKN and *Verticillium* propagules in soil.

This will be the 6th year of funding for this project. Complete results for the 2004-05 trial are now available.

OBJECTIVES FOR 2006:

- 1) To compare various green manure cover crops for benefit reduction of nematode (CRKN) and *Verticillium* propagule levels in the soil. Cover crop treatments are projected as: two varieties of sorghum-sudan, sordan hay, mustard, canola, and wet fallow. In cooperation with Dr. Daniel Manter, USDA-ARS, soil applied Alaska cedar will be applied to test for its effect on CRKN nematodes and *verticillium*.
- 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 what potato yield benefit might accrue when growing potatoes after green manure crop. (Research in cooperation with Dr. Jorge Delgado, USDA-ARS in Ft. Collins. Documenting higher potato yields following cover crop would justify more cover crop acreage.
- 5) Dr. Russ Ingham will analyze CRKN levels in 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 following potato crop.

Relationship of the Proposed Project to Overall Problem

Cover crops are being used successfully in other areas to reduce nematode numbers. Examples of crops being grown are mustards, oil seed radish, sorghum-sudangrass, and rapeseed. The short growing season in the San Luis Valley may make implementing a cover crop challenging, but if successful has the potential to be 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 biocontrol cover crop is expensive (no crop income); however, growing a cover crop after barley increases yearly water consumption. The focus of this research has changed to growing a green manure crop as a cover crop using limited water. Growers are again being asked to reduce groundwater consumption, maybe by 50% this year. 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. Biocontrol crops show promise to control these pests.

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. Biocontrol cover crops will be planted with small plot planter in designated plots. Nematodes will be sampled again in late October and my final sampling at potato planting time.

Tractor, planter and tools will be needed from the SLV Research Center. Soil will be packaged and sent off to the nematology 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 (2007) 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. The unreliability of using mustard may be determined after one more year. Sordan may also be shown less reliable than the Sordan green manure crop treatment. Sordan 79 may soon be shown more reliable than other varieties of sorghum-sudan. In the long-term (3-5 years), we should be able to show whether these green manure cover crops give a yield boost to the following potato crop.

Detailed Annual Budget

2006 Request:

Soil Nematode Analysis	\$4,500
<i>Verticillium</i> Analysis	\$1,200
Shipping Samples	\$ 500
Part-time Labor	\$2,000
Demonstration Seed	\$ 200
Mileage	\$ 300
Supplies	<u>\$ 300</u>
TOTAL	\$9,000

Budget Justification

Nematode analysis at Oregon State University cost \$25 each for research samples. This amount will allow for 180 samples. Likely I will analyze 45 samples at 4 different times (Preliminary, Planting, mid-October and Potato Planting).

Verticillium analysis is \$15 each. \$1350 will allow for 80 samples. I plan to analyze 40 at cover crop planting and 40 at potato planting the following Spring.

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

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

Demonstration seed is bought and provided to the cooperator to reimburse him for extra trouble, extra expenses and to insure better cooperation.

Mileage is necessary because the plots will be off-station, likely in Alamosa County.

Money for supplies are needed for soil bags, seed bags, etc.

c:/my documents/MSWord/research/cover crop/cpac 06 Research Proposal.wpd

Bio-fumigation Cover Crops to Enhance Potato Production

- **CPAC (Area II)
Research Report for
2004-05 and partial
Report for 2005-06.**
- **Merlin Dillon**
- **SLV Area Extension
Agronomist**



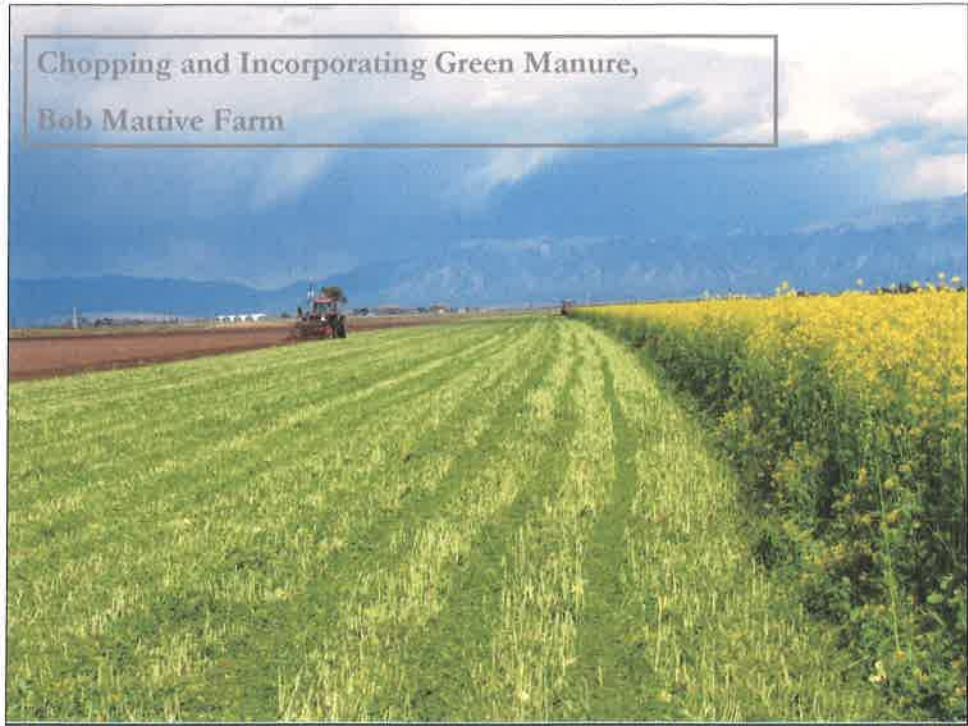
Each trial requires two years to complete. Cover crops are planted in June, incorporated two months later in August, intermediate nematode samples in October, and final nematode samples the next May (potato planting).

*Bob Mattwe Field
moldboard plow not recommended,*



What the green manure cover crops look like early in the season.

Chopping and Incorporating Green Manure,
Bob Mattive Farm



Treatments 04-05

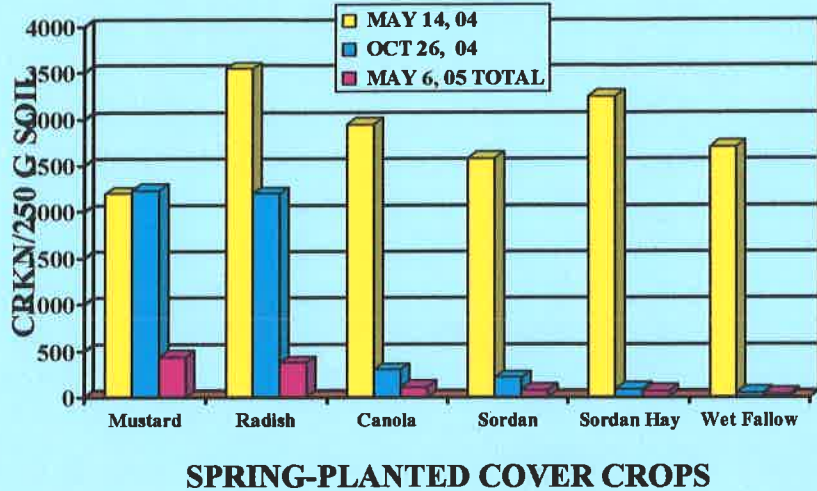
- 1. Mustard
- 2. Radish
- 3. Canola
- 4. Sordan
- 5. Sordan Hay
- 6. Wet Fallow

Treatments 05-06

- 1. Mustard
- 2. Canola
- 3. Sudan (HS)
- 4. Sordan 79
- 5. Sordan Hay
- 6. Wet Fallow
- 7. Alaska Cedar Chips

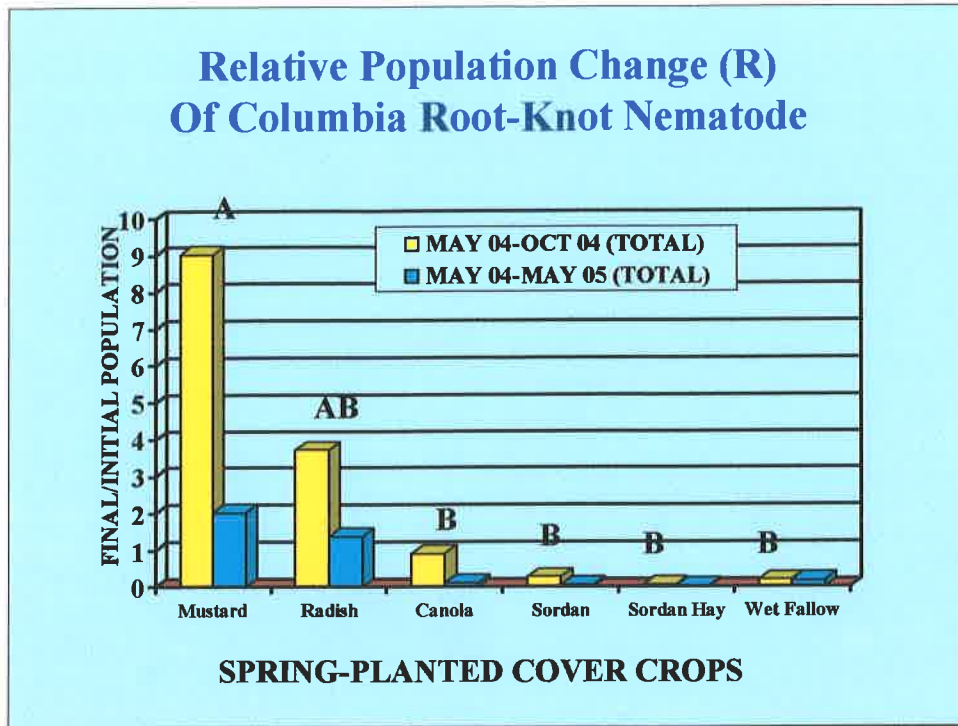
Cover crops: canola is commercial hybrid; Sordan is NK hybrid sorghum-sudan named Sordan 79; Sudan (HS) is another hybrid named Honeysweet; Sordan Hay has the above ground forage removed; Wet Fallow has nothing planted but weeds are controlled; Alaska Cedar Chips is wood chips added at cover crop planting.

Effects Of Spring Cover Crops On Columbia Root-Knot Nematode SAN LUIS VALLEY, CO - 2004-05



CRKN levels at the beginning, intermediate, and final sampling dates. When comparing May 04 vs Oct 04, sordan appears to be a better nonhost than the brassicas (mustard and radish). When comparing populations of Oct 04 vs the final sample in May 05, the brassica green manure affect seems to have reduced nematodes after Oct 04. Fungi may be able to decompose crop residues at relatively cool temperatures.

Relative Population Change (R) Of Columbia Root-Knot Nematode



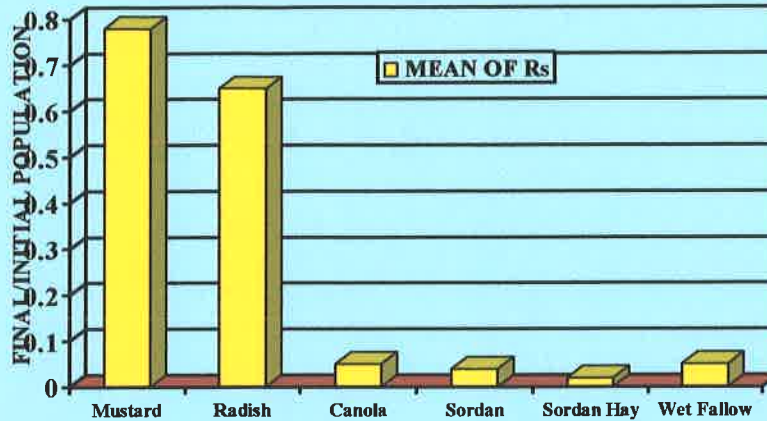
Final/initial ratios of CRKN for May 04-Oct 04 and for May 04-May05.

Radish and mustard did not reduce average CRKN populations by October.

Populations actually increased in some plots. Canola, sordan, sordan hay, and wet fallow treatments dramatically reduced populations by Oct 04. Comparing May 04-May 05, mustard and radish performed better, but still not nearly as affective as the better treatments.

*If over 1 = increase in pop.
from initial to final*

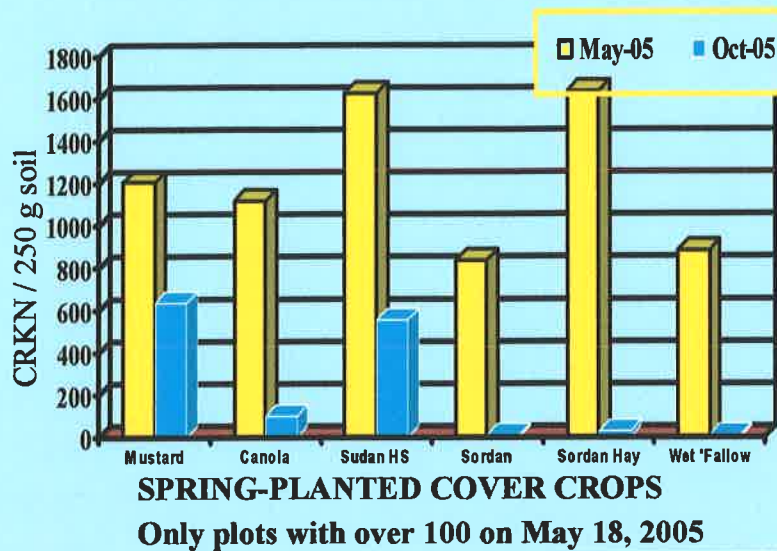
**Relative Population Change (R)
Of Columbia Root-Knot Nematode
MAY 14, 2004 (TOTAL) - MAY 6, 2005 (LIVE)**



SPRING-PLANTED COVER CROPS

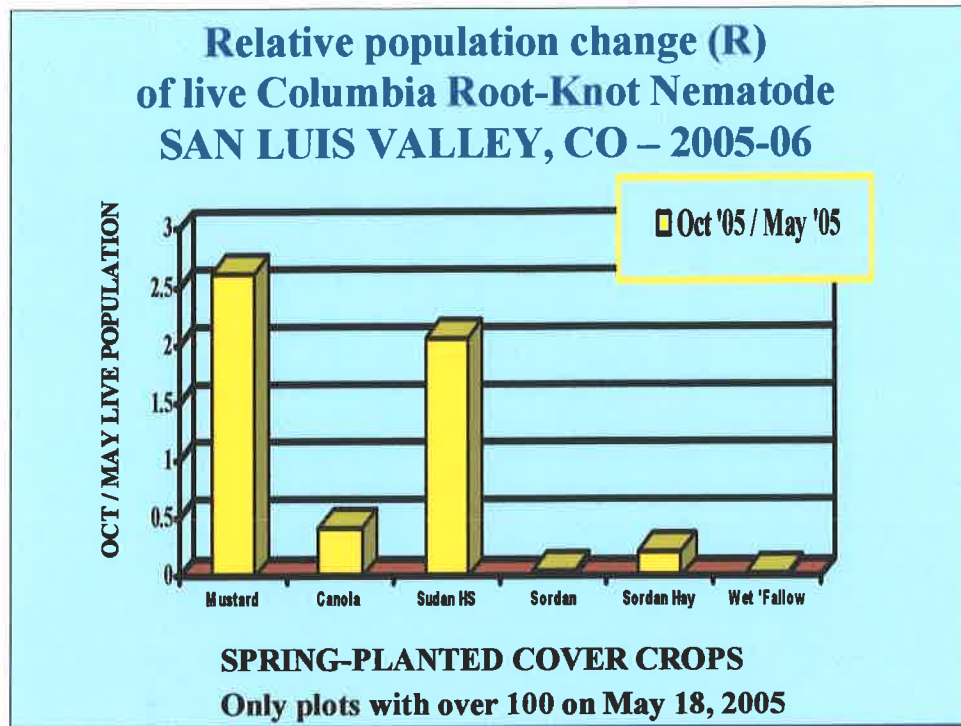
Relative nematode population change as a ratio of final live vs. initial total populations as affected by green manure cover crop treatments comparing May 04 to May 05. Final live population provides the better relative nematode threat remaining at potato planting. Mustard and radish Rs were just under one because some live populations were higher than total populations the previous year in one (mustard) and two (radish) plots. So, even though the overall field population of CRKN may be reduced by a mustard or radish cover crop, there may be pockets where populations actually increase with these treatments. R values for canola, Sordan, Sordan Hay, and wet fallow were very low. These treatments were very effective in reducing CRKN populations after one potato crop and prior to planting potatoes in this field in 2005.

**Effects of Spring Cover Crops on
Columbia Root-Knot Nematode
SAN LUIS VALLEY, CO – 2005-06** *New*



2005-06 Trial Partial Results.

Comparison of cover crop effects on starting CRKN population vs. the Oct 05 intermediate population. This intermediate sampling again shows poor results for mustard and also for Sudan HS. Sudan (Honeysweet) reduced CRKN much less than Sordan 79. Canola again shows good reduction in population by Oct 05. Sordan, Sordan Hay, and Wet Fallow show excellent CRKN reduction.



Relative population change from May 05 to Oct 05. Oct/May ratio shows that CRKN levels were reduced by Sordan, Sordan Hay and Wet Fallow.

Bio-fumigation Cover Crops to Enhance Potato Production

- Summary
- 1. Green manure cover crops of Sordan, Sordan Hay and Wet Fallow reduced CRKN very effectively.
- 2. Future: Document any yield "Bump" from growing potatoes after green manure crop.

An improvement in potato yield would help justify the added cost of growing a green manure crop. Idaho estimates a 40 cwt 'bump' worth \$120-320 per acre.

2. Jorge Delgado - following crop -
higher yields - this year yields equal
expected. but 12% more large
potatoes!

Russ - follow nematode pop. in potatoes