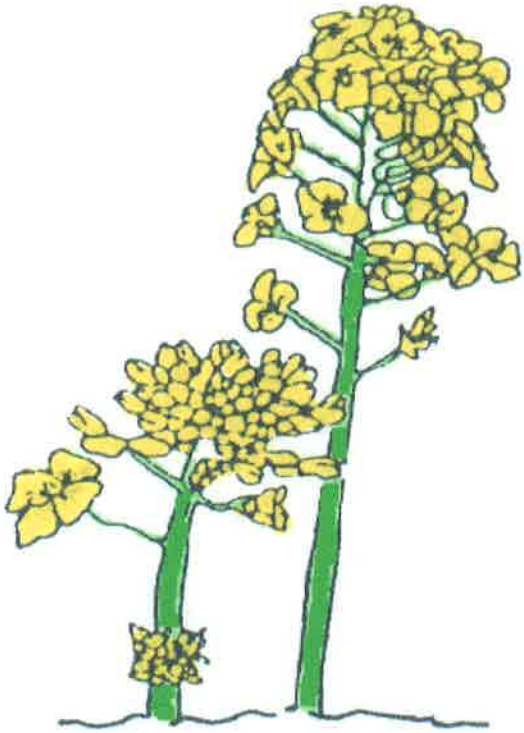

Using Biocontrol Crops to Enhance Potato Production

Research Report For 2003
San Luis Valley Research Center

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

PROJECT LEADER(S): Merlin A. Dillon, SLV Area Extension Agent, Agronomy, and technical expertise from Dr. Russ Ingham, Associate Professor and Nematologist, Oregon State University, Corvallis, OR

Project Justifcation

Nematodes, especially Columbia Root-knot nematode (CRKN), is becoming an increasingly more important pest of SLV potato production. CRKN can and has made entire potato fields unsalable. A grower could loose his entire crop investment which is about $1400 per acre. He might lose $175,000 income from one center pivot. *Verticillium* can reduce yields through the early-dying complex. CRKN is the target pest; however, some management programs will reduce both pests.

Green manure crops have shown great potential in reducing the impact of some of these pests. The effectiveness of these biocontrol crops is pretty well established. The 2003 field trial produced dramatic nematode density reduction by several cover crops. However, many questions still remain as to how these crops grow in our environment. Dedicating one entire crop year to a biocontrol cover crop is expensive (no crop income); however, growing a cover crop after barley increases water consumption. The focus of this research changed in 2003: to growing a green manure crop as a cover crop using limited water. Fumigants and fungicides can be used to control these pests; however, these chemicals are harsh, very expensive; and soon may not be available. A preplant fumigant or Vydate applied in-season are very destructive to beneficial organisms, to soil health and to grower quality of life.

Research in Idaho and other areas has shown the benefit of sorghum-sudan and rapeseed crops. Dr. Richard Zink and I conducted 3 years research into crop rotations showing the benefit of green manure corn and sorghum-sudan in reducing the *Verticillium* propagules per gram of soil (VPPG). Sorghum-sudan planted in early June and soil incorporated into the soil in August was highly beneficial. Now, we need to know how much sorghum-sudan dry matter is required to be incorporated, or how much benefit would accrue if the sorghum-sudan was hayed and then turned under.

Project Status:

This will be the 5th year of funding for this project. Previous trials have investigated the effect of cover crops grown after barley. The trial changed to water reduction cover crops in 2003. For the 2003 field trial, the starting nematode level was the May sample. Another set of nematode soil samples were taken in August just prior to cover crop incorporation, see Table 1. Yet another set of nematode samples will be taken on those same plots at potato planting time next Spring to verify the results of cover crop reductions in CRKN density..

New field trials will be established in 2004.

2003 Results Summary

An Alamosa County potato field with high nematode densities was grid sampled (April 21) before winter rye was killed. Columbia Root-knot nematode (CRKN) densities ranged from 17 to 2009 and averaged 256 / 250 g soil.

Bio-control cover crops were planted June 10 and chopped and disk incorporated on August 26. Soil samples were taken from each plot just prior to incorporating the crop residue (Aug 19). CRKN densities were reduced by all the cover crop treatments. Conceivably, the beneficial effects of decomposing crop residues could have further reduced nematode densities by the next potato planting.

Nematode densities were greatly reduced after winter rye incorporation. All cover crop treatments further reduced nematode densities by August sampling. Columbia Root Knot nematode densities were reduced from 256 / 250 g soil in April winter rye to 130 in May to <4 in August.

Introduction

Research in other states have indicated various benefits of including certain cover crops in a rotation. Benefits include weed suppression, disease suppression (*Verticillium*) and nematode

reduction. The benefits accrue from various actions of the cover crops: from non-host to cyanide production in sorghum-sudan or glucosinolates (GSL) in radish and mustard. Area potato growers (CPAC / Research Center Committee) funded research in 2003 to compare several biocontrol crops for their benefit on potato production. The bio-control treatments compared were sorghum-sudan, oilseed radish, mustard, wet fallow, dry fallow and barley trap crop. These were planted in small plots in June following winter rye planted after potatoes.

These plots were planted to the assigned cover crop on June 10 and chopped and disk incorporated August 26.. Wind erosion affected emergence of all crops; however, the barley was damaged the worst. The barley was thin, stunted, weedy and infested with Russian Wheat Aphids. The poor results from planting a barley trap crop should not indicate that barley cannot be used as a trap crop. It is likely that a robust barley crop killed at the correct time to could reduce nematode density.

Test Plot Establishment

The highest nematode density blocks (block 21 and 22) were selected for the trial. Thirty (30) small plots were laid out on block 21 and 30 plots in block 22 (a total of 60 plots). (6 treatments x 5 reps x 2 blocks). Five (5) dryland fallow plots were established in block #3 (CRKN = 1486/250 g soil).

Individual plots were established and sampled in May. The bio-control cover crops were planted June 10. Individual plot CRKN densities (May 22) ranged from 34 to 691 and averaged 130 / 250 g soil. Plots were assigned within each block so as to make the starting nematode levels more or less equal. These are the starting nematode densities and are shown in Table 1. The area in the dryland "pie" was planted to sorghum-sudan but watered for emergence only. The dry fallow plots were established and kept fallow, not planted. Roundup was applied to control weeds. Because of wind damage, treatment results are reported from only block 21 (1443 / 250 g soil).

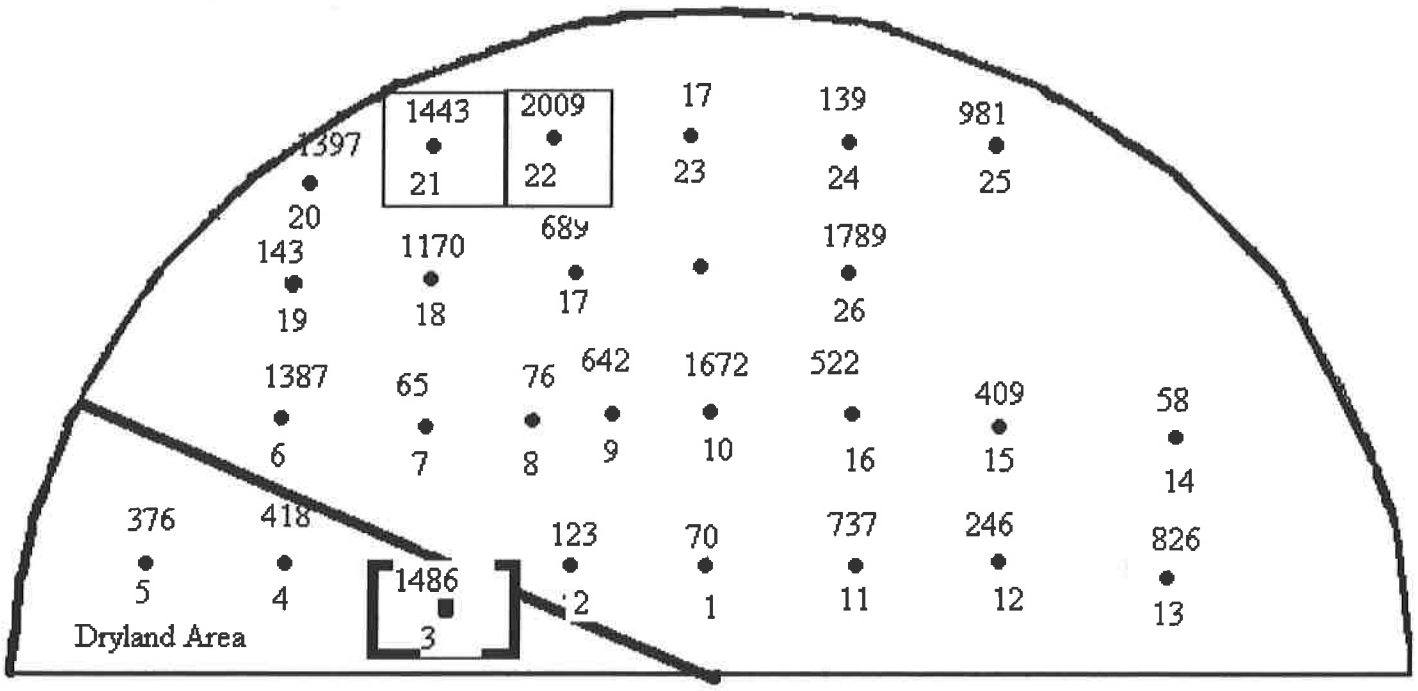

Figure 1. Initial grid-sample Columbia Root-knot nematode (CRKN) density with sample number locations in April prior to killing winter rye. Note the range and variability of nematode density (from 17 to 2009 per 250 g soil. Thirty (30) small plots were established in block 21 and 30 plots in block 22.. Five (5) small dryland fallow plots were established in block #3.

The cover crops other than barley trap crop grew very well and filled in the open spaces. It had a poor stand, the barley was stunted and infested with Russian Wheat Aphid. The sorghum-sudan, mustard and oil-seed radish grew about 4 feet tall with limited irrigation (Irrigated 7.5 inches). Irrigation was limited as each irrigation wet the soil about one foot only when the crop showed stress.

Results

CRKN densities were high in the selected field (1486 and 1443 / 250 g soil) in April. Densities were much lower in May after the winter rye was destroyed. The May samples are the start for the 2003 trial bio-control cover crop trial. August CRKN densities were reduced by all the cover crop treatments (Table 1.). CRKN densities ranged from 0 to 3 for all cover crops except barley trap crop. Sorghum-sudan reduced the nematode density to zero. Barley trap crop density was significantly higher. Barley reduced nematode levels less (statistically less) than other cover crops. The nematode density was not statistically different for the other bio-control cover crops. It was between 0 to 3 per 250 g soil for all the other cover crops. These low levels are great although still not quite zero. It is possible that the decomposing crop residues could have reduced nematode densities even further before the next potato crop. Nematodes will be sampled once more at potato planting next spring.

Table 1. Biocontrol cover crop effects on Columbia Root Knot Nematode (CRKN) density

		ROOT KNOT NEMATODES / 250 g soil			
	TREATMENTS	APR 03	MAY 03	AUG 03	MAY 04
1	DRY FALLOW	1486	48	3 b	
2	WET FALLOW	1443	117	2 b	
3	BARLEY TRAP CROP	"	147	94 a	
4	OILSEED RADISH	"	173	2 b	
5	MUSTARD	"	106	2 b	
6	SORGHUM-SUDAN	"	105	0 b	
7	SUDAN + COUNTER	"	105	1 b	
			NS	P=0.0001	

Discussion

** Counter, an insecticide/nematicide, was applied to one-half of the sudan plots. Counter did not improve control compared to sorghum-sudan alone; the sorghum-sudan level was zero.

** Wind erosion at emergence reduced the stand and vigor in barley trap crop. It was also heavily infested with Russian Wheat Aphids. Barley trap crop gave significantly less reduction in nematode level than the other treatments. A better stand and better vegetative growth, or better timing with nematode cycle, however, could have given different results.

** Nematode density was reduced following rye incorporation; however, it cannot be concluded that rye incorporation caused this reduction.

OBJECTIVES FOR 2004:

In cooperation with Dr. Russ Ingham, Nematologist at Oregon State University, a field trial will be established to determine the effects of certain bio-control cover crops on the population density of Columbia Root Knot nematode and *Verticillium*. Treatments this year will likely include mustard, sorghum-sudan green manure and sorghum-sudan hay.

Objectives and Methods:

1) To determine the benefit of various cover crops on nematode (CRKN) and *Verticillium* propagule levels in the soil.

2) To compare the effect of making sorghum-sudan hay vs. green manure on their benefits on

CRKN nematode and *Verticillium* levels in the soil prior to the following potato crop.

3) Treatments planned for 2004 Field Trial include:

a. Fallow
b. Mustard
c. High GLS Mustard
d. Sorghum-sudan NK Sordan
e. Other variety Sorghum-sudan
f. Sorghum-sudan for hay

4) A high glucosinolate mustard variety may be included.

5) Soil sampling is planned as survey samples (April), initial plot samples (May), prior to incorporation (August) and prior to potato planting (May 05). Soil samples will be sent to Dr. Inghams' nematode lab at Oregon State University.

6) Because of high variability of CRKN, five (5) replications are planned.

FUNDING ALLOCATION 2003 AND 2004 REQUEST:

2003 Allocation: $7,000.00

The 2003 allocation was spent as follows:

Soil analysis	$5,000
Part-time Labor	$1,600
Mileage	$ 200
Supplies	$ 200
TOTAL	**$7,000**

2004 Request:

Soil Nematode Analysis	$6,000
Verticillium Analysis	$1,800
Shipping Samples	$ 300
Part-time Labor	$2,000
Demonstration Seed	$ 200
Mileage	$ 200
Supplies	$ 200
TOTAL	**10,700**

Budget Justification

Nematode analysis at Oregon State University is $25 each for research samples. This amount will allow for 240 samples. Likely I will analyze 60 samples at 4 different times (Preliminary, Planting, Incorporation and Potato Planting).

Verticillium analysis is $15 each. $1800 will allow for 120 samples. I plan to analyze 60 at cover crop planting and 60 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. Nematode samples must be mailed to Oregon.

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

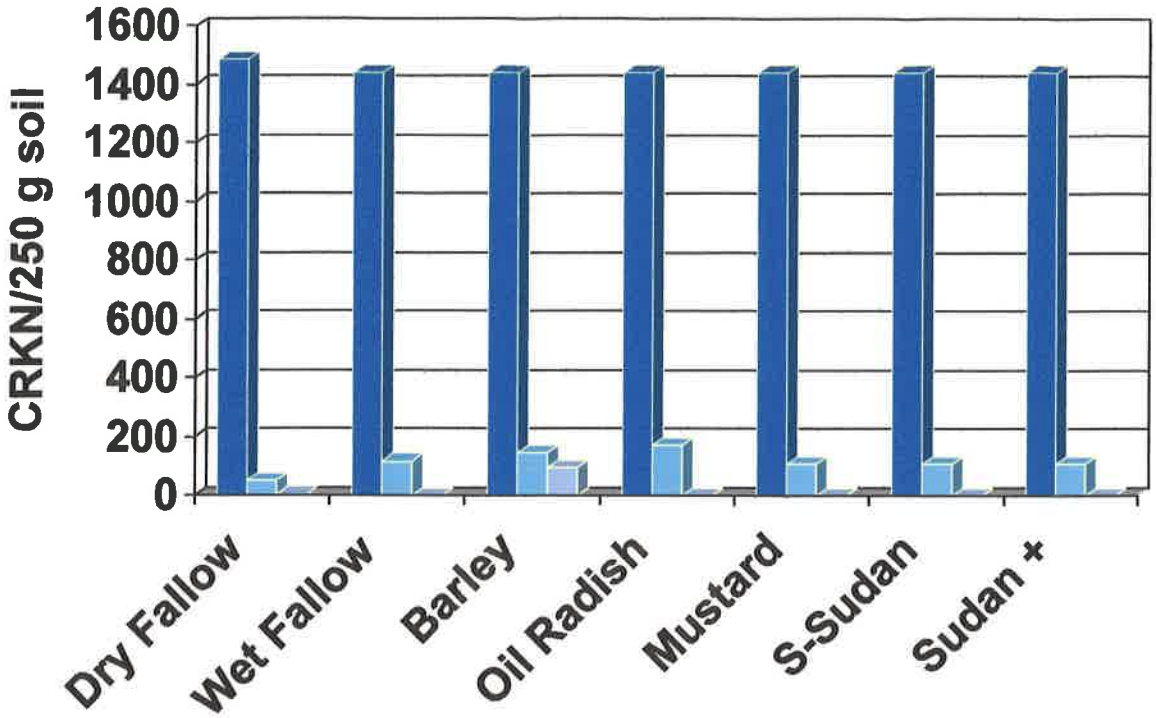

Figure 2. Grid-sample CRKN density at three dates (Apr-May-Aug) as affected by bio-control cover crop.

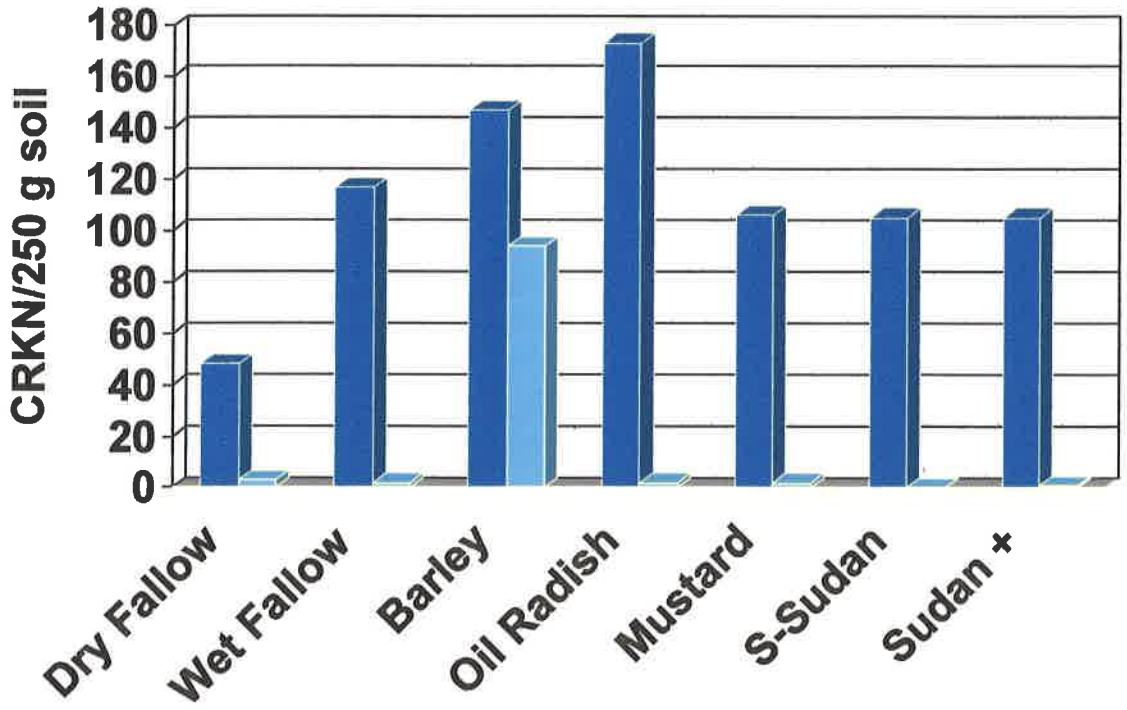

Figure 3. Grid-sample CRKN density at two dates (May (dark blue) vs. incorporation in Aug. (light blue)) as affected by bio-control cover crop.

My documents/wordPerfect/research/data03/biocontrol cover crop report 03.wpd