

"Final Project Report to the New York State Potato Growers Inc. 2003-2004."

**1. Title:**

Evaluation of "Green Manure" Rotational Strategies for Potatoes in Upstate New York

**2. Project Leader(s):**

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**3. Cooperator(s):**

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**4. Type of grant:**

Cultural methods; sanitation; physical controls

**5. Project location(s):**

This work occurred in Franklin and Essex counties. Findings may be applied throughout the Northeast.

**6. Abstract:**

North Country potato growers are looking at rotational crops they are unfamiliar with. Sudangrass has been successfully employed throughout the state as an excellent way to increase organic matter, break up soil hard pans and decrease soil pathogens. In recent years, crops in the mustard family used as green manure have shown soil benefits as well. We looked at yellow mustard, oilseed radish and sudangrass as green manure treatments in a rotation with potato.

In 2002, pre treatment nematode and OM samples were taken from Malone and Lake Placid locations. The fields were then planted to mustard, oil-seed radish and sudangrass. In the fall, the cover crop treatments were plowed down as green manure. In May of 2003, those same fields were re-tested for nematodes and OM prior to planting potatoes. One field had the harvest evaluation carried out in the fall.

Results were very encouraging. Nematode levels were substantially reduced in the treatment fields. We found low numbers of nematode in the field that had been fallow for a year as well. We also averaged a 14% increase in yield with both Monona and Reba over the checks of those same varieties. While the sample number is small, we hope to continue doing this work for a few more years to see if the trends continue. Things we learned will also lead to new investigations.

**7. Background and justification:**

Potatoes are a high value crop. Any given year, up to half a potato growers soil resource is not making money. This being the situation, potato growers wish to maximize the benefits of rotational crops. Washington state potato growers and the University of Idaho have been experimenting with mustards (yellow mustard and oilseed radish) as green manure. Benefits reported include decreased nematode populations, increased soil quality and nutrient availability. Sudangrass has been employed successfully by New York onion growers. An increase in organic matter, better soil water penetration, augmented weed control and less soil pathogens have been shown as results from utilizing sudangrass. All three trial crops have been reported to control nematodes. The

nematodes colonize the mustard and oil-seed radish roots and when plowed down green, kill those nematodes in the plant. Sudangrass works as a natural fumigant. After it is plowed down green, as it decomposes, a natural cyanide-like chemical is released, killing the nematodes. Increased stand counts and yields have been documented in onions after sudangrass.

Traditional rotational crops include buckwheat and oats. While relatively inexpensive to plant and maintain, they provide little in soil benefits. Also, grass cover crops are known to harbor nematodes. If a field is going to be out of potato production, than it makes sense to help the soil as much as possible benefit the following crops. Three North Country potato growers located in Lake Placid, Chateaugay and in Malone participated, looking at the different rotational strategies.

Talking with the North Country potato growers, there were very interested in looking at different rotational ideas. They expressed they had no real idea of nematode levels in their soils. There was a suspicion among growers nematode levels might be high but no evidence. With the high expense of nematode testing, (\$30 per sample and 20 samples per field) most growers have never tested for nematodes. 2002 results surprised the growers with the high numbers. Results of the testing in 2002 proved the growers were correct in feeling nematode might be a problem

Rotation breaks the disease and insect cycle. We have chosen these rotational crops because of their specific strengths. There may not be a “silver bullet” rotational crop but by looking at different rotational strategies it is possible for growers to make better management decisions for their farms

## **8. Objectives:**

1 - To increase the potato grower's ability to make sound cultural and economic rotational crop decisions.

2 – To evaluate yellow mustard, oilseed radish and sudangrass for ease of establishment, root depth, bio-mass and economic feasibility.

3 – To evaluate the effectiveness of oriental mustard, oilseed radish and sudangrass in reducing nematodes, increasing soil quality and yield.

## **9. Procedures:**

While small plot trials would work to evaluate the culture of these rotational crops, each grower wanted to evaluate the cover crop treatments under actual production conditions. This meant employing field sized test plots (15 acre fields with 5 acre treatments). Neighboring fields were the check. In 2002, fields in Malone and Lake Placid were sampled for nematodes and organic matter prior to planting in oil-seed radish, mustard and sudangrass. Before frost, the fields were plowed in as green manure. In May of 2003, prior to potato planting, fields were again sampled for nematodes and OM.

Prof. Karen Snover-Cliff, Director of the Cornell Diagnostic Lab recommended April or May as being the time when nematode activity is high. In May 2003, nematode samples were again taken from all three locations. The general recommendation for nematode sampling is about 10 sample per field. Each of those samples needs to be a subset of 10 more samples. For our trial, we decided each acre of the field would be sampled 10 times. Those ten samples were mixed together and then one sample was taken and submitted per acre. That sample then was sent to the Cornell Diagnostic Lab. Each of

those samples had two reps of nematode tests done. Those two reps were then averaged.

The Chateaugay grower's field lay fallow during 2002 and we did not process his 2002 samples. In the spring of 2003, we sampled for nematodes and OM. Following the sampling, the field was planted to mustard, sudangrass and oats. It was felt oil-seed radish seed was too difficult to locate and too expensive to continue using it in the trial. This field will hopefully be planted to potatoes in 2004 so we can continue to evaluate the treatments.

Only one of the two potato fields was harvest evaluated. The harvest evaluation was carried out at the Malone location. The other field was harvested before we could get in to do the evaluation. Five foot sections of potato row for each sample were dug up, potatoes counted and weighed. There were twenty samples per field.

## 10. Results:

### Malone

#### Soil organic matter (OM)

2002 - 2.7%, 2.6%, 2.6%

2003 - 2.9%, 2.0%, 2.4%

The cover crops did not have a significant impact on OM. The sudangrass had the higher OM while the mustard had the lowest impact on OM.

#### Nematode levels

2002 Pratylenchus sp.	2003 Pratylenchus sp.	2002 Free living (beneficials)	2003 Free living (beneficials)
36	27	6	120
132	18	282	81
138	15	180	66
300	12	120	183
114	3	228	38
312	17	198	44
280	3	210	21
240	0	120	48
120	0	348	0
	18		93
	9		62
	6		87
Average per sample 185.78	Average per sample 10.67	Average per sample 188.00	Average per sample 70.25
<b><u>94.25% reduction</u></b>		<b><u>62.63% reduction</u></b>	

For *pratylenchus* sp. (lesion) nematode, numbers above 150 are over thresholds established for implementing management practices according to the Cornell Diagnostic Laboratory.

One location in Malone had low levels of *Hoplolaimus* sp. (lance) nematodes. For 2003, this was the only sample from the three locations to have this nematode.

### Harvest evaluation results

The grower in Malone planted half the field in Monona and half the field in Reba. This gave us the added opportunity to evaluate two different varieties response to the cover crop treatments. While the way the field was planted did not allow all the treatments to be compared, it did give a good look at the differences varieties can make with the same growing conditions. It must be noted the checks were neighboring fields planted to the same varieties. This grower's standard practice is to rotate with sudangrass. You will note our Reba – Sudangrass treatment was essentially the same as the check because they both had the same rotation.

The important thing to notice is the increase in yield over the check. We averaged a 14 % increase in yield with the cover crop/green manure treatments.

Monona – Mustard

15.05 lbs./sample average with a 46.6 potatoes average = 16.6 % yield over the check

Monona – Oil-seed radish

14.25 lbs./sample average with a 37 potatoes average = 12.3 % yield over the check

Monona – Check

12.15 lbs. /sample average with a 37 potatoes average

Reba – Oil-seed radish

14 lbs./sample average with a 39.4 potatoes average = 20.7 % yield over the check

Reba – Sudangrass

11.8 lbs./sample average with a 34 potatoes average = 5.9 % yield over the check

Reba – Check

11.1 lbs. /sample average with 30 potatoes average

### Lake Placid location

Soil organic matter (OM)

**2002** - 5.5%, 5.8%, 5.8%,

2003 – 5.0%, 5.5%, 5.3%

Essentially, the OM did not change at either location. Since the cover crops were plowed down green, they break down more quickly and probably do not affect OM as much as higher lignin materials might. If higher OM is a desired outcome, allow the cover crops to be hit by frost and then plow down. While this helps OM, it does not aid in the other beneficial aspects of the cover crop we are looking at here.

Nematode levels

2002

2003

2002

2003

Pratylenchus sp.	Pratylenchus sp.	Free living (beneficials)	Free living (beneficials)
240	11	174	45
144	24	246	81
390	12	90	57
288	33	282	39
240	21	280	50
162	18	114	24
120	21	162	15
366	66	156	219
18	9	0	111
0	21	12	24
96	42	276	57
120	75	36	50
192	24	30	36
	50		50
Average per sample	Average per sample	Average per sample	Average per sample
182.77	30.50	142.92	61.29

**83.31% reduction**

**57.11% reduction**

The soil at the Lake Placid location had a fairly high soil organic matter level before the trial. This grower uses a buckwheat rotation on his fields and feels it gives him good results.

#### Chateaugay location

2003 Pratylenchus sp.	2003 Free living
15	72
12	21
12	21
3	24
3	9
0	3
6	3
15	24
3	3
0	21
9	24
3	21
21	45
Average per sample	Average per sample
7.7	22.38

At first I did not understand why the sample numbers from Chateaugay were lower than the other treatment samples. When I talked to Prof. George Abawi, Plant Pathology Dept., and Karen Snover-Cliff from the diagnostic lab, they said for years, a

recommendation for nematodes was to leave the field fallow. Without a crop host, nematodes will die. The grower had planned to plant the cover crop treatments in 2002. He plowed the field but circumstances did not allow for the trial on his farm that year. In 2003, after the samples were taken, the grower planted the field to mustard, sudangrass and oats (as the check). We will take samples next spring and again after the potato crop to see if levels remain low.

## **Discussion**

The most striking result of this trial is the drastic reduction in nematode levels at all three locations. It is well documented these particular cover crops reduce nematode levels in the soil. This is not new. It is new here in New York. The cost of implementing one of these cover crops into a production system must always be weighed against the added benefit. Sudangrass at the 50 lbs./acre planting rate is \$24.00 minus labor and machinery costs. Yellow mustard at the 8 lbs./acre planting rate is \$12.00 and oil-seed radish at the 25 lbs./acre planting rate is \$55.00. If you can receive a 15-20% yield increase, it may be worthwhile to incorporate this strategy into your production system.

Also note that the free living beneficial nematodes were reduced at a lower rate than the harmful *Pratylenchus* sp. Nematodes. Again, Karen Snover-Cliff from the Diagnostic lab confirmed this as the beneficials do not attack roots and are "free living" therefore are not as susceptible to green manure treatments of this kind.

It must also be noted the low levels of nematodes at the location which was fallow for the previous year. It was plowed in late June but not planted to any crop. We will look at this again.

Next spring, we will sample in the same locations we took the samples this year. It will be interesting to see if after a favored crop (potatoes) the nematode levels will be high in the spring.

We will hopefully evaluate the 2003 field planted to the cover crop/green manure treatments for both nematodes and yield. We will continue with the trials on the other two farms as well.

Field trials on grower's farms under actual production conditions and pressures are difficult and not always successful. While challenges are there, the benefits are also present. Growers can see first hand the results and not guess if something will work on their farm. Hopefully, we will continue obtaining good results with on farm trials.

Trials using cultural methods to deal with problems are a good way for growers and Cooperative Extension to show the public they are good stewards of the land. With the public's increased awareness of environmental issues, growers need positive examples of how they are taking care of the land.

These results will be available at the NYS Vegetable Conference and reports will be distributed for publication in Cooperative Extension and other agricultural publications.

## **Budget note:**

Because of personal problems during the summer of 2003, much of the planned work did not get done. As a result, of the \$4000 received from the Potato Growers, we have \$3014.05 remaining. I would like to request this money be carried over and we continue with this trial again for 2004 and 05.