Cradle Valley Farms
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RE: NRSAR Project Number FNE94-68
Final Project Report

COVER CROP NEMATODE SUPPRESSION

Acknowledgements: Many thanks to Dr. Marvin Pritts of Cornell University and Dr. John Potter of Agriculture Canada Experiment Station for their advice and assistance, and to Mr. Peter Mullin of Cornell Plant Pathology for his patience and thoroughness.

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Background: Nematodes are microscopic worm-like critters, the ones of interest to this study being those that feed upon the roots of plants, especially strawberries and raspberries. Nematodes damage plant roots directly by feeding, and indirectly by transmitting serious virus-like diseases or exposing damaged roots to other disease causing organisms . The dagger (Xiphinema) and Lesion (Pratylenchus) nematodes are most relevant to small fruit production, but they have plenty of cousins with all sorts of different characteristics. While studies have been done to relate the treatment of soils with certain cover crops and the reduction in nematode populations, we were interested in their effect on specifically the aforementioned types of nematodes on our specific soils. Fumigation being the alternative to either co-existing with nematodes or suppressing them with kinder tactics, we would opt for the latter.

The Plan: For full details, refer to the grant application. Generally, land that we intended to plant to small fruits the year following the study was plowed and planted to oats. Oats were harvested for hay in late July, followed by a Sudan Grass (cv "Trudan 8") or Marigold (cv "Sparky") cover crop, with the intention of these cover crops being to suppress nematodes.

To more accurately measure the success of our intentions, an experimental area was set aside where we established 16 plots measuring 20x20 feet, and subjected randomly selected plots each to one of four different treatments: replanted to oats,left fallow (Control), seeded to sudan grass, and seeded to marigold. Prior to seeding, nematode samples were taken (four subsamples from each plot to a depth of one foot), and the surface shallowly tilled (one inch). Seeding was done by drop spreader at rates approximating field broadcast (100 lb/a sudan grass,4 lb/a Marigold, 3 bu/acre Oats). In the Fall, we would resample the plots and compare nematode counts.

The Results: Refer to Appendix A for a summary of net changes in nematode populations, mean change for each treatment, and the sample standard error of the mean. A simple statistical test comparing the mean nematode population in the Control plots to the means of other plots indicate that there was no conclusive difference between treated and untreated plots, either for the nematodes of interest or other unfamiliar species that appeared. More involved and sophisticated analysis might be used to compare all the treatments to each other, but the high variation in results and the lack of consistent findings of nematode populations indicates such analysis might not be useful. Essentially, there is no apparent indication that treated areas behaved differently from the control or from each other.

Observations: There are some observations that may be useful in determining why the results are not consistent with similar experiments.

First, the length of time the cover crops were present may not have been sufficient to have a large effect. Cover crops were established at the end of July and most survived until about October 6, but growth was slow after a light frost on Sept 2 and the Marigold Treatment was killed entirely at that time. A longer time in residence may have been necessary.

Second, due to a very rainy summer a fine crop of weeds became established in our oat hay crop prior to establishing the cover crops and experimental plots. Residue from these weeds, as well as weeds surviving the shallow rototilling, may have acted as hosts to nematodes regardless of any supressing tendency of the cover crops. Good weed control, possibly with a systemic herbicide, prior to planting nematode suppressing cover crops might be an alternative.

Third, nematode populations are known to vary greatly from spot to spot and time to time, so higher sub-sampling rates within a plot and a higher number of plots would be useful to draw statistically significant conclusions. This increases sampling costs dramatically, of course, and a counter-argument might be that effective and consistent action of the nematode supressing qualities of certain cover crops, if they exist at a useful level, should be obvious even in small samples.

Lastly, the benefits of sudan grass in suppressing weeds, adding organic matter to the soil, and providing an acceptable mulch for strawberry fields and transplanted tissue culture raspberries (which respond poorly to herbicide applications), provide enough good reasons to establish it as a cover crop even if the nematode supressing qualities are weak or inconsistent. For growers not considering fumigation as an alternative, establishing sudan grass in the year prior to planting small fruits might still make good sense.

APPENDIX A

Summarized Data for selected nematodes
t-test comparing treated plots to Control
Raw Data for all nematodes
Copy of Grant Application

Ronchi Strawberry Study 1994
Nematode Population changes (net counts per 100 cc soil)

TREATMENT	Pratylenchus (Lesion)	Xiphinema (Dagger)	Filenchus	Aphelenchus
Control 1	0	0	-140	14
Control 2	-7	0	-69	0
Control 7	56	14	56	98
Control 12	10	0	10	0
Net:	59	14	-143	112
Mean:	14.75	3.5	-35.75	28
Sample s	28.4	7.0	86.6	47.1
Marigold 4	32	40	8	8
Marigold 5	-12	0	26	0
Marigold 6	65	0	78	39
Marigold 10	0	-42	-20	-42
Net:	85	-2	92	5
Mean:	21.25	-0.5	23	1.25
Sample s	34.6	33.5	41.3	33.4
Oats 8	16	32	16	16
Oats 11	11	11	-40	-40
Oats 13	-15	0	-64	-15
Oats 14	14	14	-45	30
Net:	26	57	-133	-9
Mean:	6.5	14.25	-33.25	-2.25
Sample s	14.5	13.3	34.4	31.4
Sudan 3	-26	12	-60	12
Sudan 9	44	30	-99	-94
Sudan 15	14	14	-102	14
Sudan 16	15	-21	-21	-36
Net:	47	35	-282	-104
Mean:	11.75	8.75	-70.5	-26
Sample s	28.8	21.4	38.1	50.9

Applying t-test in comparing means to control treatment mean, using 3 d.f and 95% confidence interval

t.025= 3.18

Population Mean = Sample mean +/- 3.18 x sample s

Population Mean=

	Pratylenchus	Xiphinema	Filenchus	Aphelenchus
Control population	105.0 to -75.5	25.8 to -18.8	239.6 to -311.1	177.9 to -121.9
Ctrl. sample	14.75	3.5	-35.75	28
Marigold	21.25	-0.5	23	1.25
Oats	6.5	14.25	-33.25	-2.25
Sudan	11.75	8.75	-70.5	-26

Using this simple test, there appears to be no indication that any treatment is different from the control treatment

Ronchi Strawberry Study, July-December 1994
Net and average change in nematode populations per treatment
Selected frequently-observed genera

Treatment	*Criconemella*	*Pratylenchus*	*Xiphinema*	*Filenchus*	*Aphelenchus*	*Tylenchorhynchus*	Non-parasites
Control 1	-14	0	0	-140	+14	0	-182
Control 2	-40	-7	0	-69	0	+11	+434
Control 7	+14	+56	+14	+56	+98	+14	+142
Control 12	-66	+10	0	+10	0	-38	+298
Net:	-106	+59	+14	-143	+112	-13	+692
Average:	-26.5	+14.75	+3.5	-35.75	+28	-3.25	+173
Marigold 4	-82	+32	+40	+8	+8	0	+538
Marigold 5	+26	-12	0	+26	0	+13	+525
Marigold 6	-46	+65	0	+78	+39	+13	+23
Marigold 10	-73	0	-42	-20	-42	0	+3674
Net:	-175	+85	-2	+92	+5	+26	+4760
Average:	-43.75	+21.25	-0.5	+23	+1.25	+6.5	+1190
Oats 8	0	+16	+32	+16	+16	0	-172
Oats 11	0	+11	+11	-40	-40	0	-136
Oats 13	-32	-15	0	-64	-15	-128	+970
Oats 14	0	+14	+14	-45	+30	0	+285
Net:	-32	+26	+57	-133	-9	-128	+947
Average:	-8	+6.5	+14.25	-33.25	-2.25	-32	+236.75
Sudan 3	-64	-26	+12	-60	+12	0	+192
Sudan 9	-26	+44	+30	-99	-94	-26	-10
Sudan 15	0	+14	+14	-102	+14	0	+462
Sudan 16	0	+15	-21	-21	-36	-36	+213
Net:	-90	+47	+35	-282	-104	-62	+857
Average:	-22.5	+11.75	+8.75	-70.5	-26	-15.5	+214.25

Ronchi Strawberry Study, Summer 1994
Unadilla, NY
Nematode counts per 100 cc soil (sucrose flotation)
Report date: 07/27/94

Sample:		RS1	RS2	RS3	RS4	RS5	RS6	RS7	RS8	RS9	RS10	RS11	RS12	RS13	RS14
Genera:	Frequency														
Non-parasites	16	588	160	456	230	190	432	726	396	540	462	400	342	832	240
Criconemella	9	42	40	76	138	0	72	0	0	36	84	0	76	32	0
Filenchus	9	168	80	0	0	0	0	0	0	109	42	40	0	64	60
Pratylenchus	6	42	40	38	0	38	0	0	0	36	0	0	0	32	0
Aphelenchus	5	0	0	0	0	0	0	0	0	144	42	40	0	32	0
Tylenchorhynchus	4	0	0	0	0	0	0	0	0	36	0	0	38	128	0
Aphelenchoides	3	0	0	38	46	0	0	0	0	0	0	0	0	32	0
Paratrophurus	3	0	40	0	0	0	0	0	36	0	0	40	0	0	0
Xiphinema	2	0	0	0	0	0	0	0	0	0	42	0	0	0	0
Paratylenchus	1	0	0	0	0	0	0	0	0	0	0	0	0	64	0
Predators	1	0	40	0	0	0	0	0	0	0	0	0	0	0	0
Tylenchus	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coslenchus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Helicotylenchus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ditylenchus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hoplolaimus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psilenchus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Ronchi Strawberry Study, Summer 1994
Unadilla, NY
Nematode counts per 100 cc soil (sucrose flotation)
Report date: 07/27/94

	Sample: RS15	RS16
Genera:	Frequency	
Non-parasites	238	432
Criconemella	0	0
Filenchus	102	36
Pratylenchus	0	0
Aphelenchus	0	36
Tylenchorhynchus	0	36
Aphelenchoides	0	0
Paratrophurus	0	0
Xiphinema	0	36
Paratylenchus	0	0
Predators	0	0
Tylenchus	0	0
Coslenchus	0	0
Helicotylenchus	0	0
Ditylenchus	0	0
Hoplolaimus	0	0
Psilenchus	0	0

Ronchi Strawberry Study, Summer 1994
Unadilla, NY
Nematode counts per 100 cc soil (sucrose flotation)
Report date: 12/10/94

Genera:	Frequency	Sample: 1	2	3	4	5	6	7	8	9	10	11	12	13	14
Non-parasites	16	406	594	648	768	715	455	868	224	530	4136	264	640	1802	525
Criconemella	9	28	0	12	56	26	26	14	0	10	11	0	10	0	0
Filenchus	13	28	11	60	8	26	78	56	16	10	22	0	10	0	15
Pratylenchus	15	42	33	12	32	26	65	56	16	80	0	11	10	17	30
Aphelenchus	10	14	0	12	8	0	39	98	16	50	0	0	0	17	30
Tylenchorhynchus	5	0	11	0	0	13	13	14	0	10	0	0	0	0	0
Aphelenchoides	1	0	0	0	0	0	0	0	0	0	0	0	0	0	15
Paratrophurus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Xiphinema	8	0	0	12	40	0	0	14	32	30	0	11	0	0	0
Paratylenchus	2	0	0	0	0	0	0	14	0	0	0	0	10	0	0
Predators	3	0	0	0	0	0	0	0	0	0	0	0	20	0	0
Tylenchus	3	0	0	0	0	20	26	0	0	0	0	66	0	0	0
Coslenchus	6	0	0	24	0	0	26	28	0	20	0	11	10	0	0
Helicotylenchus	1	0	0	0	8	0	0	0	0	0	0	0	0	0	0
Ditylenchus	1	0	0	0	0	0	0	0	0	10	0	0	0	0	0
Hoplolaimus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psilenchus	4	0	0	24	0	13	0	0	0	0	0	0	0	0	15

Ronchi Strawberry Study, Summer 1994
Unadilla, NY
Nematode counts per 100 cc soil (sucrose flotation)
Report date: 12/10/94

Genera:	Frequency	Sample: 15	16
Non-parasites		700	645
Criconemella		0	0
Filenchus		0	15
Pratylenchus		14	15
Aphelenchus		14	0
Tylenchorhynchus		0	0
Aphelenchoides		0	0
Paratrophurus		0	0
Xiphinema		14	15
Paratylenchus		0	0
Predators		14	30
Tylenchus		0	0
Coslenchus		0	0
Helicotylenchus		0	0
Ditylenchus		0	0
Hoplolaimus		0	0
Psilenchus		0	15