TITLE: Selection of cover crops for root rot suppression and yield enhancement in corn.

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2003 FUNDING: $14,668

OBJECTIVE: To identify specific cover crops that can be grown in rotation with corn to suppress corn root rot and improve corn yield.

SUMMARY:

- ✓ There were no significant effects of cover crop treatments on 6 leaf radicle rot severity or corn biomass in any OSU research station field trial.
- ✓ Strip-tilled Saia oats increased 6 leaf radicle rot severity relative to fallow and other cover crop treatments in an un-replicated (pseudo-replicated) on-farm trial; this effect was not observed in the OSU field station trial.
- ✓ Late summer cover crop biomass varied from 1.87 to 3.30 dry T/A, while winter cover crop biomass ranged from 1.84 to 4.48 dry T/A in OSU field station trials.
- ✓ Relationships between microbial activity and root rot severity have not yet been elucidated for cover cropped soils.
- ✓ It is not unusual to observe few treatment effects in single-season cover crop trials; multiple year trials are more likely to show treatment effects.

INTRODUCTION:

Improving soil quality through cover cropping or organic amendment can improve germination, plant growth, and yield and suppress root rots. We have shown that increasing microbial activity through soil amendment with organic wastes suppresses root rot of corn and bean. These same effects could be generated by high biomass cover cropping. We have shown in container trials that cover cropping can increase root and shoot biomass of corn.

Eastern Washington potato growers are rapidly adopting a two year wheat/mustard/potato rotation (20,000 A grown to mustard in 2002). Farmers claim the mustard improves soil and crop quality and increases yield. Fumigation for Verticillium wilt does not increase yields in mustard-treated fields, suggesting that the cover crop is suppressing Verticillium wilt. Suppression of Verticillium wilt from high biomass cover cropping (increasing microbial activity) has been reported by researchers at the University of Idaho, although this effect was only observed after two or three years of cover cropping (Davis, 1995).

OBJECTIVES:

1. Identify specific cover crops that suppress corn root rot and improve corn yield.
2. Determine the relationship between soil microbial activity (generated through the decomposition of high biomass cover crops) and suppression of root rot of corn.

HODS:

Experiment station field trials:

Trial A:

A 5 year field trial was established at the OSU Vegetable Research Farm in 2001. The objective of this trial is to investigate the impact of late summer cover cropping with sudangrass and amendment with fresh and composted manure on root rots and crop quality and yield in a corn/bean rotation. Sudangrass "Piper" was planted in August 2002 after bean harvest - alone and in combination with the fresh and composted manure amendments. The sudangrass was flailed and incorporated in October, and all treatment plots were planted to sweet corn "Jubilee" in 2003. Microbial activity, radicle rot severity, and crop yield and quality were evaluated.

Trial B:

A second field trial at the OSU Vegetable Research Farm was planted to cover crops in late summer and fall 2002 and was planted to sweet corn "Reward" (root rot intolerant) in 2003. The full trial consists of two separate field trials containing the same cover crop species treatments, but the cover crops are managed differently. In one trial, the cover crops are flailed and incorporated, and in the other they are sprayed out and strip-tilled. In each trial, cover crops were sown in 20' x 20' plots replicated four times in a randomized complete block design.

Cover crops were chosen based on their demonstrated ability to suppress pathogens and/or enhance plant growth, or their widespread use in the Willamette Valley. Four mixtures of species are included in the trial. Sudangrass "Piper" was planted on August 10, 2002, and the fifteen others were planted on Sept. 20, 2002. The treatments initially were: Foenugreek, Phacelia, Saia Oats, Common Vetch, Crimson Clover, Meadowfoam, Berseem Clover, Sudangrass "Piper", Biomaster Pea, Rape "Dwarf Essex", Mustard Mix "Caliente", and the mixtures Oats/Common Vetch, Phacelia/Vetch/Crimson Clover, Common Vetch/Biomaster Pea, and Saia Oats/Biomaster Pea. Some of the species/mixtures grew poorly and were sprayed out (Biomaster Pea, Foenugreek, Saia oat/common vetch, Saia oat/Biomaster pea, common vetch/Biomaster pea). In the spring of 2003, aboveground cover crop biomass measurements were taken. Cover crops in one half of the field were flailed and incorporated and allowed to decompose for at least three weeks. On the other half of the field, cover crops were sprayed out and strip-tilled. Sweet corn "Reward" was planted on June 16, thinned on July 3, and evaluated for root rot severity at the 6 leaf stage on July 25. Because the corn was planted late, the crop was not brought to harvest. Instead, corn biomass measurements were taken on July 28, and the corn was flailed and incorporated on August 14th. This trial was replanted in the same location on September 8, 2003. New species were planted to replace failed treatments: mustard "NemFix", triticale "Trios 102", chickling vetch, and white mustard "Braco". This field trial was established on a field with a large weed seed bank; it has been difficult to establish weakly competitive cover crops such as clovers and to manage the weeds. For this reason, this trial will likely be terminated after this cropping season.

Trial C:

A third field trial was established in August 2003 to evaluate the impact of late summer and winter cover crops on root rot severity and yield of corn. The trial was established on a field which has been in continuous corn for more than 10 years; it has high root rot potential and very few weed seeds. The summer cover crops treatments include: mustard blend "Caliente", mustard "Braco", Saia oats, sudangrass "Piper", Sorghum sudangrass hybrid "Cadan 99B", rape "Dwarf Essex", Caliente/Cadan 99B mix, Cadan 99B/Crotolaria mix, Cadan 99B/Saia oats mix, Caliente/oats mix, Caliente/Crotolaria mix, and an unamended control (12 treatments). Winter cover crops include: mustard "Braco", mustard mix "Caliente", Saia oats, and an unamended control (4 treatments). Cover crops were sown in 15' x 15' plots replicated three times in a randomized complete block design. Summer cover crop treatments were flailed and incorporated in October. Winter cover crops were sown in mid-September and will be flailed and incorporated in spring 2004. Corn will be planted in May 2004 and root rot, microbial activity, and corn yield will be evaluated.

On-farm demonstration trial: An on-farm demonstration trial was planted in early September, 2002 at Kenagy Family Farm (Peter Kenagy) in Albany. The trial was planted to winter cover crops: Berseem clover, foenugreek, Phacelia, oats, common vetch, winter pea "Biomaster", and mustard blend "Caliente". Cover crops were planted in 25 ft. strips the length of the field. One strip was left fallow as a control. The field was divided into three sections (across the treatment strips) to delineate three "blocks". Soil was sampled from three locations in each treatment strip (representing the three "plots"). Cone tube corn root rot bioassays were conducted on each soil sample (as described above) to determine corn root rot disease potential in each "plot". Disease severity was moderate to high across all plots. The foenugreek and winter pea "Biomoaster" grew poorly and root rot data was not taken on those treatments. Cover crop biomass was estimated on April 30, 2003; biomass samples were collected with a walk-behind flail chopper/harvester. Corn SSJ+ was planted in June, 2003 and root rot was evaluated at the 6 leaf stage and at harvest. Yield was not evaluated as the field had a serious symphylan infestation which was distributed unevenly through the field.

RESULTS:

Objective 1: Identify specific cover crops that suppress corn root rot and improve corn yield.

Experiment station field trials:

Trial A:

There was no significant difference in 6 leaf radicle rot severity between late summer sudangrass cover-cropped and late summer fallow treatments (data not shown).

Trial B:
Cover crop biomass for each treatment is reported in Table 1. The mean dry biomass for Phacelia and Saia oats was significantly higher than the mean dry biomass for Meadowfoam and Berseem clover. There were no significant differences in 6 leaf radicle rot severity or corn biomass among treatments in the flailed/incorporated and the sprayed strip-tilled field trials (Tables 2a and b; data for separate sections planted to sudangrass and oats not shown).

Trial C: Rape "Dwarf Essex" biomass was significantly lower than the biomass of the Sorghum sudangrass hybrid "Cadan 99B"/Crotolaria mixture (Table 3), but there were no other treatment effects on cover crop biomass. No disease data has been collected, as this trial was initiated this summer.

On-farm demonstration trial: Cover crop biomass estimates are reported in Table 4. Percent radicle necrosis at the 6 leaf stage in field-grown corn was numerically much higher in the Saia oat treatment than in the other treatments (Table 4).

Table 1. Trial B cover crop biomass: flailed/incorporated section

Cover crop	Biomass (dry T/A)
Phacelia	4.48 b[1]
Saia oats	4.10 b
Crimson clover	3.34 ab
Rape "Dwarf Essex"	3.34 ab
Phacelia/vetch/crimson clover	3.28 ab
Mustard mix "Caliente"	3.27 ab
Common vetch	3.10 ab
Meadowfoam	1.97 a
Berseem clover	1.84 a
	$P < 0.05$

[1] Means followed by the same letter are not significantly different.

Table 2a. Trial B incorporated section: root rot severity and corn biomass

Cover crop	Radicle rot severity (% necrotic)	Corn biomass (dry g/10 plants)
Control	7.25	2.00
Phacelia	7.88	2.11
Common vetch	8.13	1.87
Meadowfoam	8.63	2.25
Dwarf Essex rape	11.50	1.71
Mustard mix "Caliente"	13.55	2.11
Saia oats	12.15	1.83
Crimson clover	10.26	2.24
Berseem clover	8.00	1.96
Phacelia/vetch/crim clover	10.38	2.06
	NSD, $P<0.05$	NSD, $P<0.05$

Table 2b. Trial B strip-tilled section: root rot severity and corn biomass

Cover crop	Radicle rot severity (% necrotic)	Corn biomass (dry g/10 plants)
Control	6.88	1.82
Phacelia	7.25	1.63
Common vetch	11.25	1.84
Meadowfoam	8.44	1.66
Dwarf Essex rape	24.50	1.71
Mustard mix "Caliente"	11.54	1.70
Saia oats	9.38	2.20
Crimson clover	16.00	1.90
Berseem clover	5.75	1.94
Phacelia/vetch/crim clover	11.50	2.04
	NSD, $P<0.05$	NSD, $P<0.05$

Table 3. Trial C cover crop biomass: late summer cover crops

Cover crop	Biomass (dry T/A)
Saia oats	2.25 ab
Sorghum sudangrass "Cadan 99B"	3.06 ab
Sudangrass "Piper"	3.03 ab
Mustard mix "Caliente"	2.66 ab
Mustard mix "Caliente" and Saia oats	2.81 ab[1]
Mustard "Braco"	2.87 ab
Rape "Dwarf Essex"	1.87 a
"Caliente" and "Cadan 99B"	2.93 ab
"Cadan 99B" and Crotolaria	3.30 b
"Cadan 99B" and Oats	2.35 ab
"Caliente" and Crotolaria	2.94 ab
	$P < 0.05$

[1] Means followed by the same letter are not significantly different.

Table 4. Kenagy Farm demonstration trial: winter cover crop biomass and 6 leaf radicle rot severity

Cover crops (strip-tilled)	Biomass (dry T/A)	6 leaf radicle rot (% necrosis)
Saia oats	1.90	65.31
Fallow A	NA	15.96
Phacelia	2.33	30.14
Common vetch	2.08	25.72
Berseem clover	0.82	10.99
Mustard mix "Caliente" (flailed/incorporated)	2.10	17.43
Fallow B	NA	12.99
This trial was not replicated.		

Objective 2: Determine the relationship between soil microbial activity (generated through the decomposition of high biomass cover crops) and suppression of root rot of corn.

RESULTS: The microbial activity data for OSU Trial 1 has not yet been analyzed. Microbial activity will also be measured on OSU Trial 3 next summer.