Progress Report To The Oregon Processed Vegetable Commission
2001-2002

Title: Management of sweet corn and snap bean root rots with cover crops and organic amendments.

Principal Investigator: Alexandra G. Stone, Department of Horticulture

Telephone: (541) 737-5546

Graduate Student: Heather Darby, Department of Horticulture

Project Funding: $12,482

SUMMARY

- A one-time amendment of soil with sudangrass decreased the severity of root rot of corn by 20 % compared to the fallow control.
- Amendment of soil with annual ryegrass increased the severity of root rot of corn by 20% compared to the fallow control.
- Soil amendments had no effect on root rot or biomass of bean.
- An experiment is currently in progress to evaluate the effect of two or three serial soil amendments of cover crops and organic wastes on root rot of corn and bean.

INTRODUCTION

A root rot disease complex, likely caused by a variety of fungal pathogens emerged as a significant disease of corn during the 1990s, and currently is the most damaging disease of sweet corn in the Willamette Valley. Although work on selection of tolerant and resistant cultivars is ongoing, disease will continue to be a problem. Root rot of snap bean (caused by *Fusarium solani* f. sp. *phaseoli, Rhizoctonia solani,* and *Pythium* spp.) also causes crop loss, particularly in early spring plantings. Management of these diseases will require a better understanding of how cropping systems and soil management strategies affect their development.

Presently, farmers in the Willamette Valley use a variety of annual winter cover crops to cycle nutrients, protect soil from water and wind erosion, and suppress weeds. As the number of economical rotation crops becomes smaller, cover cropping and soil quality improvement practices may be the only means of suppressing root diseases. At this time there are no data on the effect of cover crops or organic amendments on suppression of root rots of sweet corn or snap bean in the Willamette Valley. Experiments were established in 2001 to determine the effect of 1) cover crop species and frequency of cover cropping and 2) organic waste amendment and frequency of amendment (1-3 serial applications) on suppression of root rot of sweet corn and of snap bean.

MATERIALS AND METHODS

In the spring of 2001 a container study was established. Soil was collected from areas in a field where corn had severe root rot symptoms. The soil was sampled in April, screened, and placed into 16 L plastic containers. The experimental design was a randomized complete block in a 14 x 3 factorial treatment design (42 treatments) replicated 4 times. The experiment included 14 soil amendments (cover crops, organic wastes, and fallow control) and 3 amendment dates. The treatments included 11 cover crop species (five cereals – annual ryegrass, oats, cereal ryegrass, triticale, and sudangrass; two legumes – common vetch and crimson clover; two mustards – yellow mustard and rape; *Phacelia*, and oilseed flax), raw (15 dry tons/A) and composted (25 dry tons/A) dairy manure, and an unamended control. Containers were arranged in shade houses outdoors at the OSU vegetable farm. Treatments were initiated in May. At this time, cover crops were seeded at recommended field rates and organic wastes were incorporated into the soil. Containers were watered as needed.

Cover Crop Amendment

Cover crops from all containers were harvested 2 mo. later. At harvest time, shoots were cut at the soil surface with pruning shears. Approximately 10 % of the total shoots were subsampled and weighed. The remaining shoots were weighed and cut into approximately 2.54 cm pieces. The top 15 cm of soil from the container was than placed into a 40 L plastic tub, and the roots were hand-harvested. The roots were treated the same as the shoots. Subsamples were oven dried at 60° C, and reweighed to determine moisture of the incorporated plant parts. The cut up pieces of shoots and roots were mixed into the top 15 cm of the soil, and the soil was placed back into the container. The cover crops were allowed to decompose for 6 wks. After decomposing for 6 wks, two-thirds of the containers were reseeded with cover crops and reamended with organic wastes. The remaining containers were used to evaluate the effect of a one-time soil amendment on suppression of root rot of corn and bean.

Corn and Bean Root Rot Bioassays

Soils were placed in 550 ml plastic tubes and placed on the greenhouse bench. Corn, cv Golden Jubilee and snapbean, cv Oregon 91G seeds, were surface disinfested in 10% bleach for 5 min. and rinsed in distilled water before planting into the plastic tubes. Plants were watered as needed and fertilized weekly with water soluble 15-30-15 at the recommended rate. At 4 wks bean plants were harvested, evaluated for symptoms of root rot, and shoots and roots were oven dried at 60° C and weighed. Rating of root rot of bean was based on the extent of surface discoloration of the root ball. The disease rating was based on a 0 to 5 scale where a score of 0 meant no infection and a score of 5 meant 80 % or more infection. Corn plants were harvested at 5 wks, plant height recorded, rootballs washed and evaluated for severity of root rot, and shoots and roots oven dried at 60° C and weighed. Disease was evaluated by visually assessing the percentage of the total root ball with lesions. Disease rating was based on a 0 to 10 scale where a score of 0 meant no lesions and a score of 10 meant greater than 51 % of the total root ball had disease lesions.

Analysis

Treatments were compared with analysis of variance and treatment means separation was obtained using a LSD test when significant F-tests ($P \leq 0.05$) were observed.

Current Status

Two-thirds of the containers were reseeded with cover crops and reamended with organic wastes in mid-August. The cover crops were harvested and incorporated into the soil in mid-October. Soils are currently being screened from the second amendment date. An additional cycle was planted at the beginning of December, for a total of three serial treatments, approximating three years of consecutive cover cropping or organic amendment.

RESULTS

Cover Crop Biomass

The amount of shoot, root, and total biomass of cover crops incorporated into soil differed significantly among treatments (Table 1). Oilseed flax, yellow mustard, common vetch, cereal rye, and triticale had significantly less shoot biomass than the annual ryegrass, sudangrass, oats, crimson clover, *Phacelia* and rapeseed. *Phacelia* had 42% more shoot biomass than triticale. Grass species had significantly greater amounts of root biomass than non-grass species. There was 89% more root biomass amended to the soil from annual ryegrass than yellow mustard. Annual ryegrass had the greatest amount of total biomass amended into soil, which was 50% more total biomass than oilseed flax.

Table 1. Amount of cover crop biomass amended to soil naturally infested with root rot pathogens of corn on amendment date 1.

	Cover Crop Biomass		
Treatment	Shoot	Root	Total
	G	g	g
CEREALS			
annual ryegrass	35.2d†	25.2a	60.4a
oats	38.4cd	13.4c	51.8bc
cereal ryegrass	30.8e	10.2d	41.0ef
triticale	25.8f	13.4c	39.2fg
sudangrass	36.4d	20.4b	56.8ab
LEGUMES			
common vetch	30.8e	3.42ef	34.2gh
crimson clover	44.7ab	4.46e	49.2cd
MUSTARDS			
yellow mustard	28.2ef	2.73ef	30.9h
rapeseed	41.8bc	3.59ef	45.4de
OTHERS			
Phacelia	46.2a	2.38f	48.6cd
oilseed flax	27.2ef	3.04ef	30.2h

† Treatments followed by the same letter are not significantly different ($P < 0.05$).

Effect of Soil Amendments on Biomass and Root Rot of Corn

Soil amended one time with cover crops or organic wastes did not significantly increase plant height or biomass of sweet corn (Table 2). Severity of root rot of corn however, varied significantly among treatments (Fig. 1). Soil amended with annual ryegrass, yellow mustard, cereal ryegrass, oats, or crimson clover had significantly more root rot than soils amended with rapeseed, *Phacelia*, or sudangrass. Soil amended with sudangrass decreased the severity of root rot by 20 % compared to the fallow control. Amendment of soil with annual ryegrass increased the severity of root rot by 20% compared to the fallow control. Root rot of corn grown in soil amended with annual ryegrass was 33 % more severe compared to sudangrass. Corn planted in soil amended with organic wastes had as much as 22 % less root rot than corn grown in soils amended with annual rye grass. The amount of disease however, did not differ significantly from the fallow control.

Table 2. Effect of soil amendments on height and biomass of corn on amendment date 1.

Treatment	Height	Biomass
	cm	g
CEREALS		
annual rye	107	4.63
oats	105	4.50
cereal rye	105	4.38
triticale	104	3.75
sudangrass	105	4.50
LEGUMES		
common vetch	106	5.13
crimson clover	106	4.75
MUSTARDS		
yellow mustard	99.1	3.75
rapeseed	91.9	4.63
OTHERS		
Phacelia	104	4.00
oilseed flax	108	5.13
ORGANIC WASTES		
manure	104	3.88
compost	101	4.17
CONTROL		
fallow	104	4.50
LSD ($P < 0.05$)	NS	NS

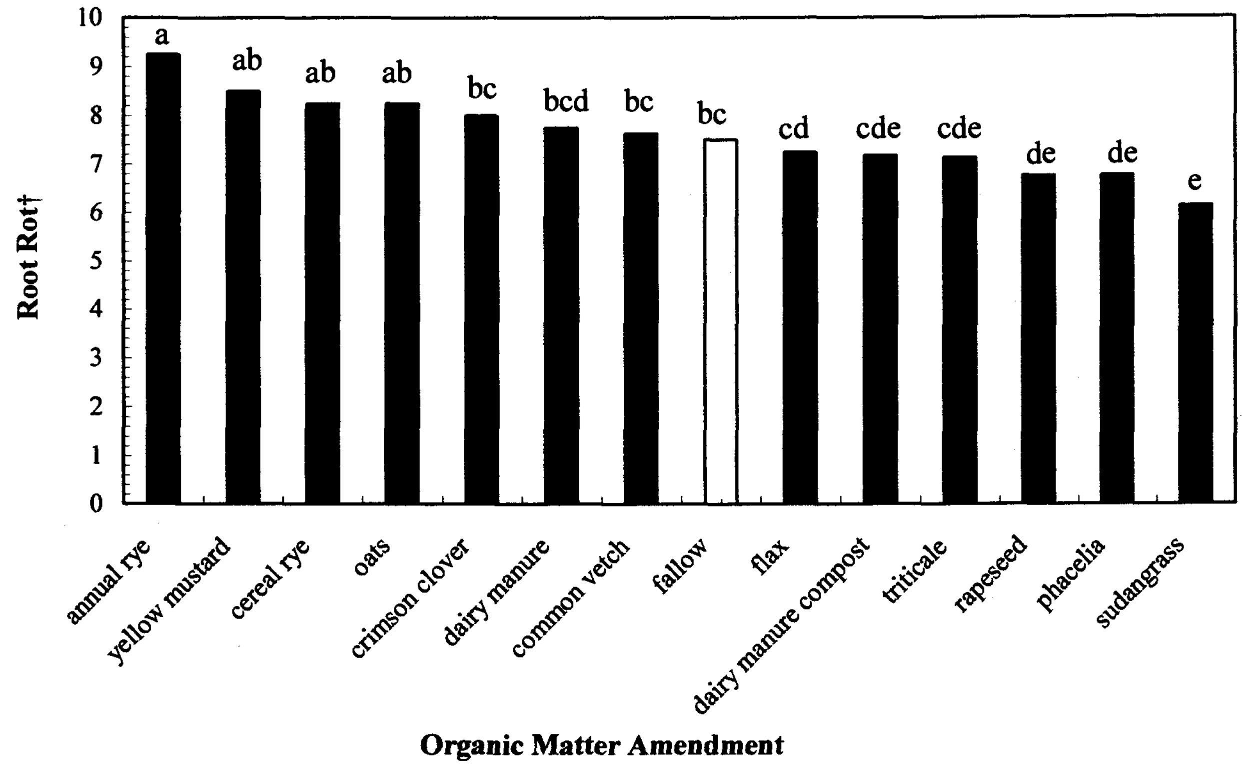

Fig. 1. Effect of soil amendments on root rot of sweet corn. Treatments with the same letter are not significantly different ($P < 0.05$). †Disease rating based on a 0 – 10 scale (0 = healthy and 10 = >51 % necrotic).

Effect of Soil Amendments on Biomass and Root Rot of Bean

One-time amendment to soil of cover crops or organic wastes had no significant effect on bean biomass or severity of root rot (Table 3). However, disease was least severe with annual ryegrass and most severe with *Phacelia*. Soil amended with yellow mustard was the only treatment that had less root rot of bean than the fallow control.

Table 3. Effect of soil amendments on biomass and root rot severity of bean on amendment date 1.

Treatment	Biomass	Root rot†
	g	
CEREALS		
annual ryegrass	0.799	1.83
oats	0.921	2.04
cereal ryegrass	0.828	2.31
triticale	0.860	2.06
sudangrass	0.703	2.73
LEGUMES		
common vetch	0.769	2.50
crimson clover	0.907	2.38
MUSTARDS		
yellow mustard	0.562	1.33
rapeseed	0.772	2.02
OTHERS		
Phacelia	0.723	3.00
oilseed flax	0.825	2.29
ORGANIC WASTES		
manure	0.836	2.38
compost	0.715	2.17
CONTROL		
fallow	0.786	1.63
LSD ($P < 0.05$)	NS	NS

† Disease rating based on a 0 – 5 scale (0 = healthy and 5 = more than 80 percent of root with lesion)