"Final Project Report to the NYS IPM Program, Agricultural IPM 2002–2003."

1. Title: Evaluation of Composts for Managing *Phytophthora capsici*

2. Project Leader(s):

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3. Cooperator(s):

4. Type of grant:

Cultural methods; sanitation; physical controls

5. Project location(s):

National application

6. Abstract:

The goal of this long-term project is to evaluate commercially available composts for managing *Phytophthora capsici* on vegetables. This disease is very persistent in soils, and causes severe losses of both plants and harvestable fruit, under warm, moist conditions. Fungicides have only been moderately successful at providing control. A combination of good cultural practices and enhancing soil quality and disease suppressiveness is one strategy for management. In this project, we are trying to reduce the levels of disease in a research field that has a long history of Phytophthora. We are comparing the annual applications of compost to this field with the standard best management practices to determine if composts can suppress this disease. Compost is known to suppress other soil-borne diseases. Last year, we grew pumpkins on the plots, and all died form Phytophthora. One-year compost application did not suppress the disease. This year, we grew a non-susceptible crop, sweet corn, as part of the crop rotation. Compost did not supply significant amounts nitrogen to the crop, but did stimulate soil microbial activity. After a second compost application, soils were suppressive to another soil-borne disease, *Pythium ultimum*. Sweet corn yields were higher in composted plots, due to improved soil conditions but not excess nutrients. Tissue tests confirmed no difference in nitrogen content of leaves. Next season, snap beans will be grown in these plots. This crop is susceptible to other soil borne diseases that may be affected by compost amendments.

7. Background and justification:

Phytophthora fruit rot of cucurbits (*Phytophthora capsici*) is a major concern for many growers because an effective management program (including pesticides) has not been identified and severe losses have resulted. This disease has been increasing in importance in New York and elsewhere in the U.S. Within the past 20 years it has gone from being uncommon to a serious problem on Long Island and in the Capital District. In 1999, it appeared in Orange and Schoharie counties for the first time. It would not be surprising if Phytophthora fruit rot appeared in other areas of New York in the future. After the disease occurs on a farm it tends to reoccur every year. Identifying effective management practices would benefit most vegetable growers because this pathogen affects all cucurbits (cucumber, melon, squash, pumpkin) and it also affects peppers, tomatoes and eggplants. Research on managing Phytophthora has been conducted in Riverhead since 1992. Management practices that have been evaluated include fungicides, a 2-year rotation, yard-waste compost, organic and plastic mulches, solarization (solar heating of soil) and sorghum sudan grass. Most of these practices were ineffective or only moderately effective.

Other researchers have demonstrated compost-based suppression of several vegetable diseases, including club root on cabbage, lettuce drop, and Rhizoctonia root rots of pea, bean and radish, Fusarium wilt of cucumbers, and Phytophthora crown rot of peppers, through greenhouse and some field studies (2,3,4,5,6). The yard-waste compost tested previously for Phytophthora management at Riverhead, NY may have been insufficiently effective because it had low microbial activity. In addition, it was incorporated into a sandy loam soil, which inherently has low microbial activity.

We are taking a long-term approach to examine the efficacy of composts against Phytophthora. Our hypothesis is that regular additions of compost, when integrated with other management strategies, will reduce Phytophthora incidence in susceptible crops. Last year, we applied a highly disease suppressive compost to two locations that had a history of Phytophthora- one location on Long Island and the other in the capital district. On Long Island, compost additions did not reduce the incidence of this disease on pumpkins. In the Capital District, there was no disease pressure, and compost enhanced pumpkin growth and yield. This year, we reapplied compost to the Long Island plots, and planted sweet corn, a rotation crop. Our goal is to assess the effects of first and second year compost additions on soil disease suppressiveness and fertility.

8. Objectives:

1. Evaluate residual effect of compost applied in 2001 on soil fertility and microbial activity.
2. Evaluate effect of added compost to soil fertility and microbial activity.
3. Determine if soils amended with compost in year 1 and years 1+2 are suppressive to Pythium ultimum.
4. Assess growth and productivity of sweet corn.
5. Project evaluation will integrate soil fertility and corn yield, to assess compost contributions to crop productivity.

9. Procedures:

Plots were established in 2001, at the Long Island Horticulture Research Center. Sixteen plots (8 control, 8 composted) were paired based upon previous history of Phytophthora incidence. Soils were collected before amendment with compost (May 15) to assess residual soil nitrate, ammonium, mineralizable N, total carbon and nitrogen. Soil microbial activity was not analyzed. The same soil nitrogen analyses were repeated after compost amendment in 2002. Compost (locally-available leaf based) was added at a rate of 20 dry tons/acre on May 29 and 30, 2002. Soils were sampled July 15, to repeat analysis of soil mineral N. These soils were also used to assess suppressiveness to *Pythium ultimum* of cucumbers. One half of the soil samples was inoculated with Pythium (2 gm/l) and the other half left non-inoculated. The soils were placed in a growth chamber at 65 F, to optimize the development of the disease. Cucumber seeds (10 per pot) planted and seedling emergence was recorded as counts over a three-week period. Four replicates were used.

After application of compost, fertilizer was broadcast (100N-100P_2O_5-100K_2O lb/A) (June 3) and additional N was applied as a sidedress (60 lb N/A) to insure adequate nutrients for crop growth. The sweet corn cultivar ‘Delectable’ was direct seeded into the field plots on June 24. Sweet corn is not susceptible to Phytophthora, and crop rotation is suggested for managing this disease. Plant samples were taken on July 15 to assess plant growth differences. Additional leaf samples were collected on August 16, for complete tissue analysis. Sweet corn was harvested on September 9, and ears evaluated for marketability and yield.

Due to the long-term nature of this project, evaluation will be on-going, but final assessment of the efficacy of compost for managing Phytophthora will not occur for two years. By observing all of the best management practices currently available with the addition of compost, we hope to demonstrate reductions in disease when the next susceptible crop is planted (2004).

10. Results and discussion:

SOIL CHARACTERISTICS

Compost applied last year and this year affected soil nutrient measurements from early and mid season samples (Table 1). In May, plots that had received compost in 2001 had significantly lower soil N than non-composted plots. The application of compost increased mineral N levels by about 10 lb per acre. The nitrogen mineralization potential was higher among compost plots both at early and mid season samplings, indicating that previous years' application of organic matter contributed to this season's N budget. Total N availability at the July sampling indicated adequate N in all plots for crop fertility with no difference among plots. This was anticipated based upon the fertilizer program and desire to minimize fertility effects on crop growth. Composted plots had higher pH ($P<0.06$), soluble salts ($P<0.06$), total carbon ($P<0.06$) and nitrogen ($P<0.07$).

Soils from the July sample date were used to evaluate compost-based suppressiveness to *Pythium ultimum*, in a growth chamber bioassay. The inoculum used was effective at causing damp-off disease ($P<0.0016$). Those plots that had been composted for two seasons enhanced crop emergence in both inoculated (+40%) and non-inoculated plots (+15%), and were suppressive to the disease ($P<0.02$).

CROP TISSUE NUTRIENTS AND YIELD

Compost applications had no effect on early season tissue nutrient levels or on ear leaf nitrogen content. Compost did increase plant height ($P<0.01$) and crop yield ($P<0.06$) by about 20% compared to non-composted plots. Thus, compost amendment most likely improved other soil physical conditions or moisture holding capacity in this sandy loam soil, to improve plant growth. Under the hot dry conditions experienced this previous summer, this yield improvement could have been quite significant in a grower's field.

IMPLICATIONS FOR GROWER USE

The results thus far for compost to reduce soil borne diseases appear promising. Composted plots demonstrated disease suppressiveness to a soil-borne disease. Although not Phytophthora, this type of suppressiveness indicated that soil microbial populations and organisms may be shifting (beyond scope of grant to assess in detail). Compost did not provide excessive nitrogen to the crop, risking leaching losses. Phosphorous contributions must be included in developing cost-benefit analysis of compost use, and will be used for determining amendment rates next season. Last season's evaluation of compost on a grower farm that had no disease pressure showed similar benefits to soil moisture holding capacity and nutrient availability from compost amendments. These factors will contribute to disease tolerance in crops, by providing improved growing conditions and plant health.

As previously stated, we will only plant a Phytophthora susceptible crop to this field in two years. Next season, we plan to grow snap beans, which are susceptible to a root rot complex caused by several disease organisms. We anticipate that compost impacts on soil disease will accrue over several seasons.

Table 1. Soil nitate, ammonium, total mineral N and N mineralization potential before and after compost amendment, Long Island 2002.

Treatment	Nitrate (lb/a)	Ammonium (lb/a)	Total avail. N (lb/a)	N min. potential (ug/g/wk)
Compost	71	7	77	3.3
No Compost	70	19	89	0.6
May	16	15	32	2.1
July	125	10	135	1.5
May-compost	8	6	14	3.3
May-no compost	25	25	50	0.9
July- compost	133	8	141	3.5
July-no compost	115	13	129	0.2
Significance (P>F)				
Compost treatment	NS	0.0001	NS	0.0024
Date	0.0001	0.0001	0.0001	NS
Compost*date	0.046	0.0001	0.0115	NS

Table 2. Yield of sweet corn variety 'Delectable' when grown on plots with and without compost amendment for two years.

Treatment	Ave. height (cm)	Mkt Ear Wt (lb per plot)	Percent Mkt	Ave. Ear Wt. (lb)	Yield per acre (lb)
Compost	34	17.7	0.73	0.75	10264
No Compost	29	13.8	0.66	0.64	8015
Significance (P>F)	0.01	0.06	NS	NS	0.06

11. References:

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