Final Project Report to the NYS IPM Program, Agricultural IPM 2000 – 2001

Title:
Evaluation of Two Commercially Available Composts for Managing Phytophthora Fruit Rot of Pumpkin

Project Leader(s):

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Type of grant:

Biological control and pest biology
Cultural methods; sanitation; physical controls
Systems comparison trials

Project location(s):

Research plots were located in Riverhead, Long Island and Schoharie, New York. Results may be applied throughout the Northeast or nationally.

Abstract:

The goal of this project was to evaluate commercially available composts for managing Phytophthora fruit rot of pumpkin. Five composts were screened for disease suppressiveness against common soil borne disease organisms in the greenhouse. One product stood out as highly suppressive. This compost (Nutribrew) was then applied to two fields with a history of *Phytophthora capsici.* In one field, no disease occurred. Pumpkin growth and yield was significantly improved where compost was applied, and 20 tons/a was adequate to achieve this improvement. The compost contributed to both nutrients as well as moisture conservation. In the other field, the disease pressure was high, and compost applications did not reduce the disease level. These results may suggest the need for several years of application before diseases may be reduced.

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 Scoharie 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.

Composted animal manures have long been known to provide benefits to soil systems by improving soil structure and nutrient availability. A secondary benefit of composts is the reported suppression of soil borne diseases. Previous studies 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. Compost products are particularly effective in the suppression of soilborne diseases caused by Pythium and Rhizoctonia. Of interest are dairy-manure and brewery-waste composts, which have been found to be more suppressive than composts made from other materials. 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. Brewery-waste compost and dairy manure compost have been shown to have high microbial activity and a high degree of suppressiveness in greenhouse and field trials.

There are several challenges in trying to incorporate composts into field management for disease control. One challenge faced in trying to maximize suppressivess is that compost quality is not static. Different compost types as well as different batches of one compost may vary in disease suppressiveness, and the suppressiveness of a batch may increase over time. While greenhouse evaluations are often positive, compost may not be able to sustain microbial activity under variable field conditions. In addition, compost may actually increase disease incidence, particularly if increased water holding capacity of composted soils contributes to disease severity beyond what can be suppressed by compost microbial activity.

As part of a long term effort to determine if suppressiveness of soil borne disease may occur under NY field conditions, we screened several commercially available composts for disease suppressiveness under greenhouse conditions. Our objective was to identify disease suppressive composts produced by NYS firms, particularly from farms composting dairy manure. A minimum degree of suppressiveness was to be 70% to be labeled as such. We also evaluated rates of composts and for effects on disease incidence. These rates were field applied to determine if any suppression of Phytophthora may be observed.

Objectives:

1) Identify disease suppressive composts produced in NYS, particularly from farms composting dairy manure or brewing by-products.
2) Determine potential field application rates of suppressive composts through greenhouse trials
3) Test efficacy of composts applied at two rates, to manage *Phytophthora capsici* in two grower fields with a history of this disease

Procedures:

GREENHOUSE COMPOST EXPERIMENTS

Experiments were conducted in the greenhouse to evaluate 5 compost products commercially available in New York for their ability to suppress the common damping-off diseases of many vegetables caused by *Pythium ultimum* and *Rhizocotnia solani*. Cucumber was the bioassay crop, based upon its susceptibility to these two pathogens. A high and a low rate of compost were mixed with peat-based media, and then inoculated or maintained disease-free. These compost rates were equivalent to 20 and 40 dry tons/acre land application. A completely randomized factorial design with six replicates was used, and factors tested included compost source, compost rate, and +/- inoculation with pathogen. Two controls were included: the peat based media and a commercial potting mix with compost incorporated (McEnroe Organics). Cucumber stand counts were evaluated 20 days after seeding, and the difference between the counts from the inoculated and noninoculated treatments were analyzed for statistical differences due to treatment factors. Those values of count difference closer to 0 indicated suppressiveness to the diseases.

FIELD COMPOST EXPERIMENTS

Two rates (20 and 40 dry tons/acre) of the brewery compost were be applied to a commercial pumpkin field (Rennsalear County) with a history of *Phytophthora capsici*. Fertilizer was applied on 6/20/01 and worked into soil. Compost was spread on 6/21/01 using a Gehl scavenger II sidewinder manure spreader. The field was seeded on 6/22/01 with the pumpkin variety Racer using the grower's vacuum seeder. No supplemental irrigation was applied. Plots consist of 4 30' rows and were replicated 4 times. The plot was harvested on Oct 10, 2001.

Another experiment was conducted at the Long Island Horticultural Research and Extension Center, in a field (Haven loam soil) where Phytophthora blight developed in 1991 to 1993 and 1995 to 1999. On 21 May, 333 lb/A of 15-15-15 fertilizer (50 lb/A of N) was broadcast over the entire field and incorporated. Additional fertilizer was applied to the plots and incorporated on 27 Jun. Nontreated plots received an additional 333 lb/A of 15-15-15 fertilizer and the compost plots received 54 lb/A of 46-0-0 (25 lb/A of N). A randomized complete block design with eight replications was used. Phytophthora blight data from a previous experiment was used to determine plot location. The low area running diagonally through the center of the field was not used since blight was more severe previously in this area than elsewhere in the field. Adjacent plots with similar previous severity values were selected to be a replication, consequently the plots in some replications were oriented side-by-side and in others they were end-to-end. Plots were 28.3 ft wide and 51 ft long with 20 ft space between plots. Composted brewery was spread on 12 June at a rate of approximately 45 wet tons/A (20 dry tons/A) with a Millcreek compost spreader, then hand-raked as needed to obtain even distribution. The compost was incorporated by disking to a maximum of 6 in. deep on 16 Jun. An experimental pumpkin hybrid with a high level of powdery mildew resistance was selected to minimize the need for pesticide applications because tractor traffic through the field could move Phytophthora and compact the soil creating favorable conditions for blight. Pumpkin seed were planted in the plots on 28 Jun at approximately 24-in. within row plant spacing. Each plot contained three rows spaced 68 in. apart. Weeds and insects were controlled by applying Curbit EC (2 pt/treated A), Command 4EC (1.3 pt/treated A), and Admire 2F (16 fl. oz./ treated A) in a 10-inch band over the planted rows on 29 Jun; these were incorporated lightly by irrigating (approx. 0.25 in.). Hand weeding was also done. No additional pesticides were applied. Oats were planted on 24 Jul in the low area of the field and between plots to minimize the potential for movement of Phytophthora between plots in rain runoff. Soil drainage was improved by subsoiling on 25 Jul between rows before vines grew over. Plots were examined weekly for symptoms of foliar blight and fruit rot due to Phytophthora beginning 18 Jul. Average monthly high and low temperatures (F) were 80/63 in Jun, 80/63 in Jul, 84/68 in Aug, 75/59 in Sep, and 66/50 in Oct. Rainfall (in.) was 6.08, 3.43, 4.86, 2.98 and 1.97 occurring on 8, 9, 8, 5, and 4 days for these months, respectively. The field was irrigated (approx. 1.0 in.) on 20 Jul, 10 Aug and 7 Sep when soil was dry due to inadequate rainfall.

Results and discussion:

GREENHOUSE COMPOST EVALUATIONS

The results confirmed that *Pythium ultimum* and *Rhizoctonia solani* damp-off could be suppressed by the amendment of compost products to peat-based media in the greenhouse (Figure 1 A and B). For *Rhizoctonia* suppression, only Nutribrew and Earthworks composts were suppressive, at a low rate, and New Milford and Nutribrew at the high rate (Figure 1A). All composts demonstrated some level of disease suppression to Pythium in comparison to the peat-based control. Overall, the Nutribrew and New Milford composts provided the most and McEnroe the least suppression, compared to the control. New Milford composts were more effective at the high (40 Mg/ha equivalency) rate than the low (10 Mg/ha equivalency) rate.

The McEnroe compost was the only product in this experiment with low suppression of the organisms. However, the McEnroe premium mix used as a control was suppressive to both organisms. The background of the compost was similar to Toad Hollow and Earthworks composts for feedstocks, method and facility of production. All three of these products were also well-cured composts at the time of collection. Further testing with different batches of compost from the same producers will demonstrate whether the disease suppressive quality of the product is consistent. There were no negative effects on crop growth from any compost amendment to peat media. Therefore, the incorporation of commercially available compost into greenhouse mixes can potentially reduce the impact of *Pythium ultimum* damp-off of vegetable seedlings, however suppression of Rhizoctonia was more variable. The most consistent suppression was observed with the Nutribrew product, so this was used for field experiments.

FIELD EXPERIMENTS

Renselear

There was no disease pressure detected in this grower field in this season. The application of 20 or 40 dry tons per acre Nutribrew compost, however, significantly increased plant stand, marketable number and weight of fruit (Table 1). Generally there was no difference between the two rates for yield effects; therefore, application of 20 t/a would be adequate for yield and other quality improvements. The higher rate did increase the yield of fruit on a per plant basis, but did not affect average fruit size or the number per plant. This suggested that compost additions had a significant effect on crop growth, via nutrient additions as well as water conservation (mulch effect). The plot was not irrigated and midseason differences in crop growth were clearly noticable. In addition, the composted plots had lower percent of weed coverage in the plots compared to the noncomposted control.

Riverhead

Phytophthora blight was observed first on 1 Aug in a nontreated plot (15% of foliage affected) and the compost-treated plot (3%) in that replication (Table 2). This treated plot was 1 of 3 that had visible evidence that some compost washed out of it during a severe rain storm on 17 Jun (4.25 in). Rain on 26 Jul (1.1 in) most likely provided favorable conditions for disease onset. Soil in these two plots looked wetter than other plots following rain earlier in the summer when plants were small and soil was readily visible. Symptoms were observed in two more plots on 14 Aug and all plots except one treated plots on 24 Aug. More than 0.75 in. rain fell on 10, 20, and 24 Aug. First symptom observed in many plots was collapse of vines that were extending out of the plot. Many fruit were affected by Phytophthora fruit rot. Additionally, many plants died before producing fruit. Numerous affected fruit with abundant sporulation and new symptoms of vine collapse were observed on 7 Sep despite dry conditions. The only rainfall since 24 Aug was 0.1 in. on 28 Aug. Evidently, heavy dews occurring during that time provided favorable conditions for disease development. No significant differences were detected in proportion of the canopy wilting or dead from Phytophthora blight or in the number of asymptomatic fruit. There was a lot of variation among plots for both treatments.

Summary

Several commercially available composts tested in the greenhouse demonstrated ability to suppress common soil borne diseases. When one particularly suppressive compost was applied to the field (Nutribrew), it enhanced crop yield and reduced weed competition under disease free conditions. However, when applied about two weeks before seeding pumpkin in a field with high disease pressure, this product did not suppress Phytophthora blight. Thus, one application of a highly suppressive compost was unable to suppress this devistating disease. Additional research is needed to determine if repeated applications, over time, may provide suppression. Both fields that received compost will be maintained for several years, to determine if repeated applications of suppressive compost integrated with other good cultural practices (raised beds and drip) could reduce losses from this disease. While costs of compost application remain high, growers may be able justify this expense if benefits could be demonstrated over several years and across several crops.

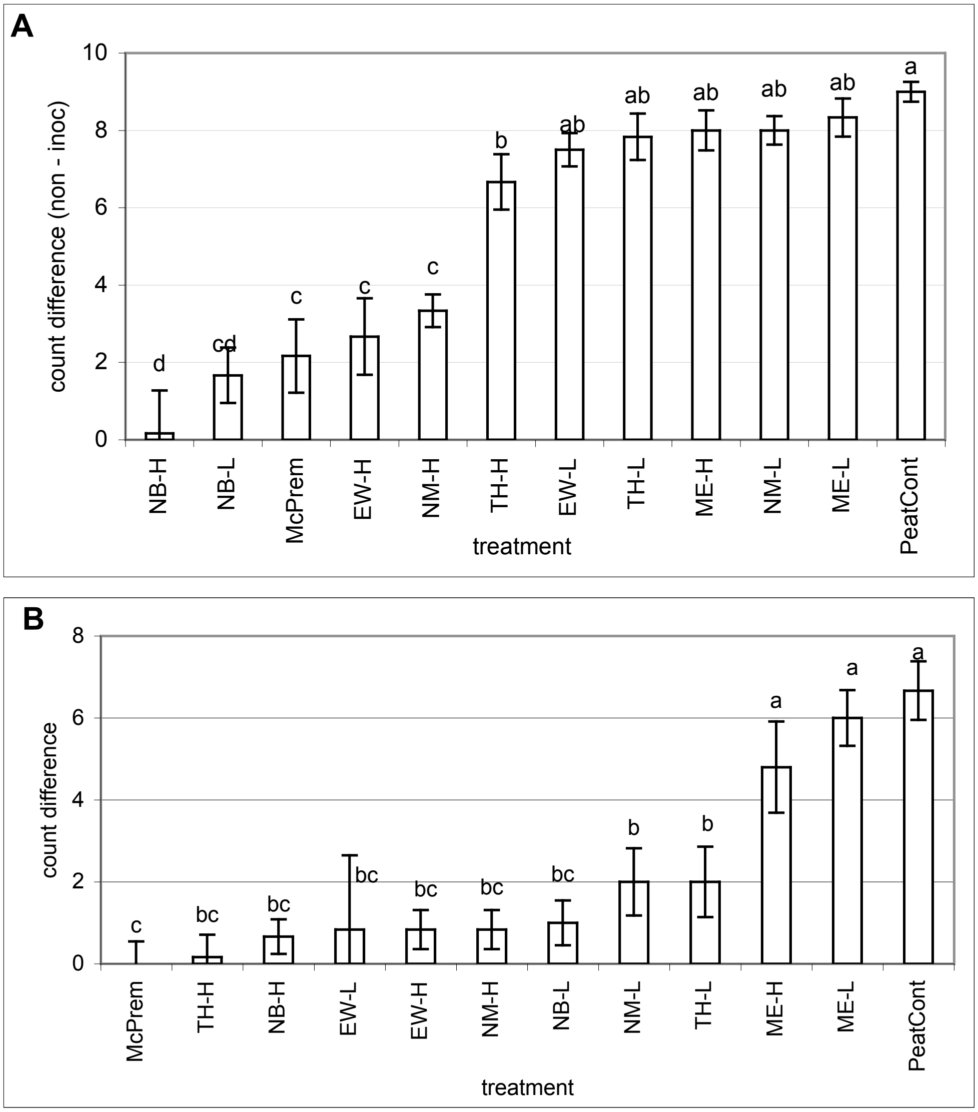
Table 1. Marketable pumpkin numbers and yield from plots treated with either 20, 40 or no brewery compost. Percent weed cover estimated at the end of the season. Field located in Rennsalear county, New York.

Compost rate	Marketable No.	Marketable Wt.	Average Fruit Size	Plant stand	Yield per plant	Fruit no. per plant	Percent Weed cover
0	24 b	259 b	10.7	24 b	11.2 b	1.0	34 a
20	33 a	340 a	10.8	30 a	11.7 b	1.1	7 b
40	31 a	367 a	11.7	27 ab	14.8 a	1.3	5 b
Significance of differences							
Compost rate	***	***	ns	*	*	ns	*

Table 2. Incidence of Phytophthora on pumpkins grown in compost and noncompost plots in Riverhead New York, 2001.

	Proportion of canopy wilting or dead from Phytophthora blight *				Healthy fruit (#)
Treatment	24 Aug	31 Aug	7 Sep	17 Sep	20 Sep
Nontreated Control	8.4	35.3 (6-97)	51.7 (9-99)	70.1 (13-99)	20.5 (4-41)
Compost	17.8	51.6 (1-100)	66.7 (2-100)	80.8 (4-100)	11.5 (0-48)
P-value	0.138	0.415	0.408	0.570	0.290

* Average (range).



Figures 1 A and B. Difference in plant count between noninoculated and inoculated treatments of compost amended peat medias. Figure A represents results from the Rhizoctonia screening and Figure B represents the Pythium screening. For composts, first two letters represent compost source (NB= Nutribrew; NM=New Milford; EW= Earthworks; ME= McEnroe Organics; TH= Toad Hollow; IV= Intervale Foundation), followed by rate of amendment at either L (20%) or H (50%). Control treatments were an unamended peat-lite mix (PeatCont) or organic standard control (McPrem). Values closer to 0 indicate suppressiveness of media to pathogen.