Use of Compost from Different Origins to Control Soilborne Pathogens in Potted Vegetables

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Abstract

Compost suppressiveness varies according to the type of wastes and the composting process, so the aim of this research was to evaluate the suppressiveness of composts produced from different origins for controlling soilborne pathogens in potted plants. Composts originated from green wastes and/or municipal biowastes, using a traditional composting system or an integrated biogas/composting system were used. Suppressiveness was tested in greenhouse on potted plants against *Fusarium oxysporum* f. sp. *basilici*/basil, *Pythium ultimum*/cucumber, *Rhizoctonia solani*/bean, *Phytophthora nicotianae*/tomato and *Phytophthora capsici*/pepper. Composts were blended with a peat substrate at different dosages (10, 20 and 50% vol./vol.) 14 days before seeding or transplanting. Pathogens were mixed into the substrate at 0.5 or 1 g of wheat kernels L^{-1} 7 days before seeding. Seeds of basil, cucumber and bean and seedlings of tomato and pepper were sown into 2 L pots in greenhouse. The number of alive plants and above ground biomass were measured 20-30 days after seeding or transplanting. The number of diseased cucumber, basil and pepper plants was significantly reduced by increasing dosages of municipal compost. The application of composts on tomato and bean did not increase significantly the number of alive plants compared to control.

INTRODUCTION

The mechanisms that underly the suppressiveness of compost are generally very complex and related to chemical and/or physical and/or microbiological properties (Hadar, 2011). Success or failure of compost for disease control depends on the nature of the raw materials from which the compost was prepared, on the composting process used and on the maturity and quality of the compost (Termorshuizen et al., 2006). Variability also depends on the pathosystem, as well as on soil type and conditions, like texture, pH and moisture, and the microbial component of compost also play an important role (Noble and Coventry, 2005).

The objective of the present work was to test different composts, originated from green wastes and/or municipal biowastes, using a windrow composting system or an integrated anaerobic/in vessel composting system for their activity against soil-borne pathogens in greenhouse on potted plants against *Fusarium oxysporum* f. sp. *basilici*/basil, *Pythium ultimum*/cucumber, *Rhizoctonia solani*/bean, *Phytophthora nicotianae*/tomato and *Phytophthora capsici*/pepper.

MATERIALS AND METHODS

Preparation of Compost Samples

Three types of composts produced by composting plants located in Regione Piemonte, Italy were sampled and used in the trials.

The first type (ACV), was prepared using green wastes and a windrow composting system in open area. The second type (ACB) was prepared using about 1/3 of green wastes and 2/3 of digestate from municipal biowastes in a windrow composting system in open area. The third type (ACM) was prepared using about 1/3 of green wastes and 2/3 of municipal biowastes in a vessel composting system.

A commercial substrate (sphagnum peat moss and perlite, Turco Silvestro, Italy) sterilised at 120°C for 20 min was used throughout the trials for comparative testing.

Evaluation of Compost Suppressiveness against Soil-Borne Pathogens under Greenhouse Conditions

Composts were blended with the peat substrate at different dosages (10, 20 and 50% vol./vol.) 14 days before seeding or transplanting. Substrate mixes were stored for 7 d at room temperature, consequently pathogens were mixed into the substrate at 0.5 or 1 g of wheat kernels L^{-1}. Five pots of 2 L volume were filled with the substrates and 10 seeds of basil, cucumber and bean and seedlings of tomato and pepper were sown or transplanted in each pot. The pots were put on a bench in the greenhouse with a randomized experimental block design. Germinated plants were counted 10 days after sowing, diseased plants were counted every 7 days. Twenty-thirty days from sowing healthy plants were counted and above-ground biomass was weighed.

Statistical Analysis

Analysis of variance was carried out with the statistical programme SPSS 17.0. After ANOVA, Tukey's "Honestly Significantly Different" was used as post-hoc analysis, with a significance defined at the $P<0.05$ level unless stated otherwise.

RESULTS AND DISCUSSION

The number of cucumber plants infected by *P. ultimum* was significantly reduced by composts, in particular ACB and ACV (Fig. 1). An increase in compost rate application generally increased the number of healthy plants; however, some phytotoxicity effects occurred when ACM was applied at 50% (v/v) dosage.

Compost (ACB) applied at 50% (v/v) significantly controlled the disease at high (1 g/L) and medium (0.5 g/L) inoculum density. At average inoculum density (0.5 g/L), compost application at 20% was sufficient to control the disease caused by *Phytophthora capsici* (Fig. 2).

Composts (ACB and ACV) applied at 20% (v/v) significantly reduced the number of wilted basil plants (Fig. 3). Composts produced from municipal wastes (ACB) caused a slight increase of the disease caused by *Rhizoctonia solani* on bean, while the other two composts were not suppressive (Fig. 3).

CONCLUSIONS

The use of compost in substrates can be a suitable strategy for controlling soil-borne diseases on vegetable crops, but results depend on type of composts and application rates.

Municipal compost produced from digestate of municipal wastes (ACB) generally showed to control diseases caused by *Fusarium oxysporum* f. sp. *basilici*, *Pythium ultimum*, *Phytophthora capsici* and *P. nicotianae* better than a traditional municipal compost (ACM). Moreover, traditional municipal compost (ACM), showed to be more phytotoxic when applied at high dosages (50% v/v).

Green compost (ACV) reduced diseases caused by *Fusarium oxysporum* f. sp. *basilici* and *Pythium ultimum* and was not phytotoxic when applied at high dosages (50% v/v).

In the case of *Rhizoctonia solani* on bean, one municipal compost (ACB) increased the disease, while no effect was observed by green compost and by the other municipal compost (ACM).

Future researches may focus on the characterization of composts in order to identify the common chemical-physical and microbiological characteristics responsible for suppressiveness.

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Figures

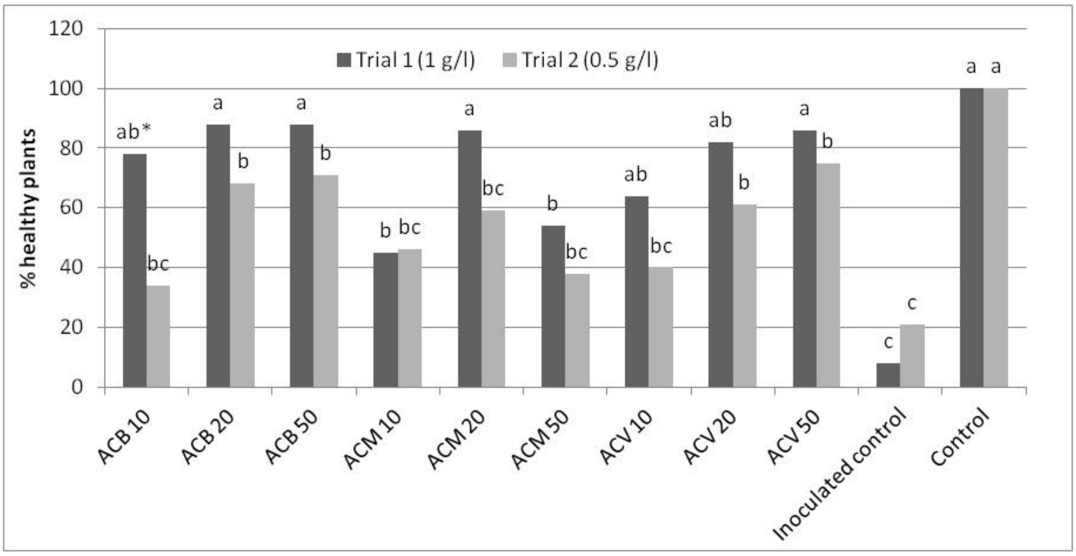

Fig. 1. Control of *Pythium ultimum* by different composts on potted cucumber plants. * Tukey's HSD test (P<0.05) within each trial. ACV = compost from green wastes, in a windrow composting system in open area; ACB = compost from 1/3 of green wastes plus 2/3 of digestate from municipal biowastes, in a windrow composting system in open area; ACM = compost from 1/3 of green wastes and 2/3 of municipal biowastes, in a in vessel composting system.

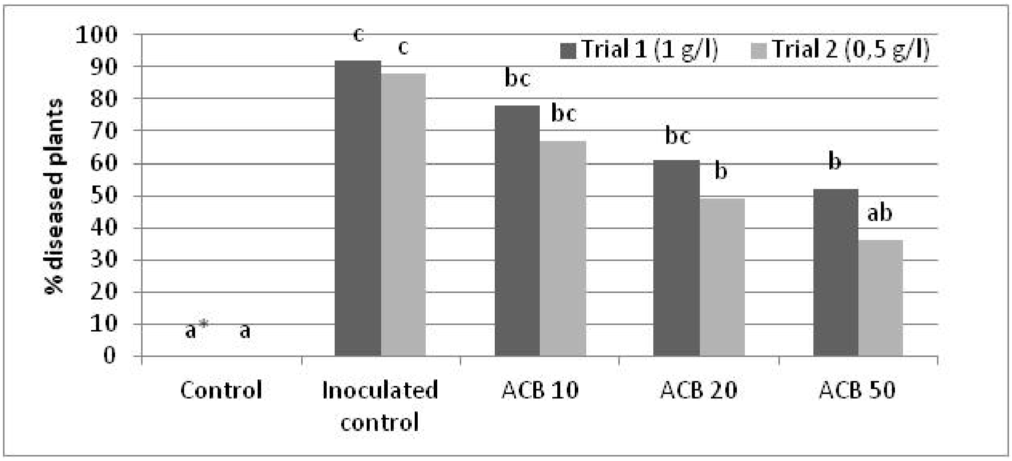

Fig. 2. Control of *Phytophthora capsici* by different application dosages of compost on potted pepper plants. * Tukey's HSD test (P<0.05) within each trial. ACB = compost from 1/3 of green wastes plus 2/3 of digestate from municipal biowastes, in a windrow composting system in open area.

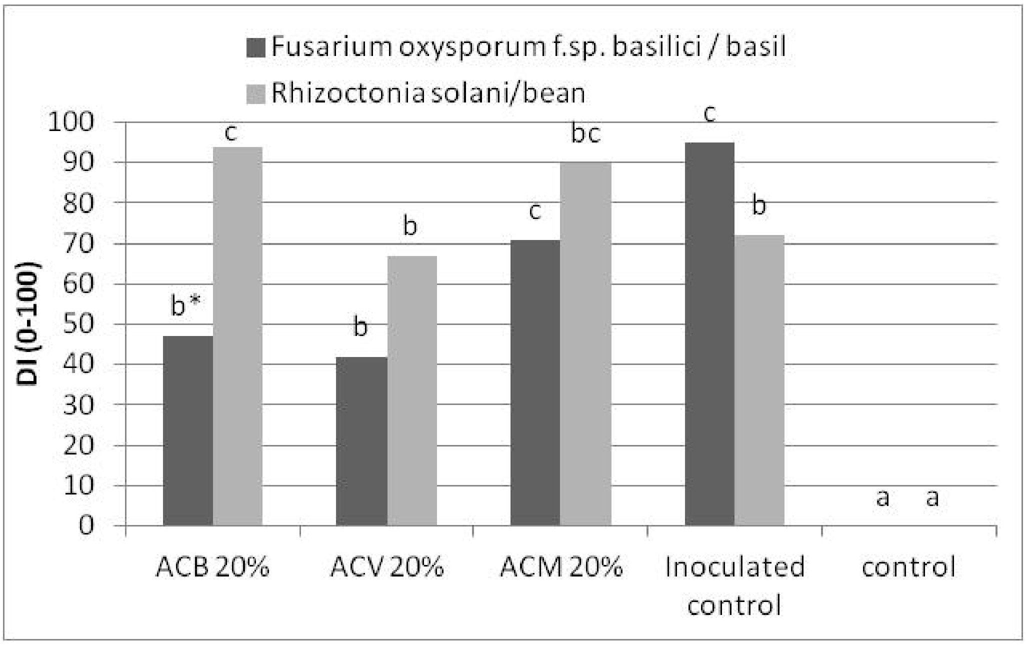

Fig. 3. Control of *Fusarium oxysporum* f. sp. *basilici* and *Rhizoctonia solani* by different composts on potted basil and bean plants. * Tukey's HSD test (P<0.05). ACV = compost from green wastes, in a windrow composting system in open area; ACB = compost from 1/3 of green wastes plus 2/3 of digestate from municipal biowastes, in a windrow composting system in open area; ACM = compost from 1/3 of green wastes and 2/3 of municipal biowastes, in a in vessel composting system.