Mixtures of soil, fresh cow dung and tap water at a ratio 1:1:2 were incubated for 14 days under uncontrolled conditions. The filtrates were sprayed on the underside of detached grape vine leaves of cv Muller-Thurgau in Petri dishes as well as on leaves on young grape vine plants. Two days later, the leaves were inoculated with suspensions of about 10,000 sporangia of Plasmopara viticola per mL. After seven days of incubation, the leaf area covered by the sporulating fungus was assessed. As compared to the untreated check, fungal development was suppressed in both test systems by around 95%. Soil type, length of incubation period of the mixture between 7 and 21 days and autoclaving had no significant influence on the efficacy of the filtrates. There is apparently no induced resistance, but rather a direct suppression of sporangia germination.

The efficacy of foliar sprays with compost water extracts (compost extracts) in reducing the severity of bacterial spot of tomato caused by Xanthomonas vesicatoria was investigated. Extracts prepared from composted cow manure, composted pine bark, an organic farm compost, or composted yard waste, applied as foliar sprays on tomato transplants, resulted in a moderate but statistically significant reduction in the severity of bacterial spot. The population of X. vesicatoria in infected leaves was reduced significantly by extracts prepared from composted cow manure. Efficacy of the water extracts was not affected by oxygen concentrations in the suspension during extraction, compost maturity, or sterilization by filtration or autoclaving. The degree of control provided by foliar sprays with the most effective compost extracts did not differ from that obtained with the plant activator acibenzolar-S-methyl. In the field in two growing seasons, foliar sprays with compost water extracts did not reduce the severity of foliar diseases, including bacterial spot. During the 1997 season, when the severity of bacterial spot in the field was high, foliar sprays with compost water extracts significantly reduced the incidence of bacterial spot on tomato fruit. Amending plot soil with several rates of composted yard waste did not lead to additional control of fruit disease over those only sprayed with extracts. Foliar sprays with a mixture of chlorothalonil and copper hydroxide or with acibenzolar-S-methyl reduced the severity of bacterial spot as well as incidence of spot on fruit.

A field experiment was conducted in Woodstock, New Brunswick, Canada to study the efficacy of compost tea and compost on reduction of tuber diseases in potato. A randomized complete block design replicated four times was established in a commercial field setting with four treatments (control, compost, compost tea and compost + compost tea). Tubers were assessed for disease severity, tuber number, tuber weight,
defects and total yield. Treatment of potato plants with compost, compost tea or a combination of compost + compost tea significantly reduced the severity of common scab tuber disease by 81, 42 and 81%, respectively, compared to the untreated control. Treatments were ineffective against the potato tuber diseases fusarium dry rot, black scurf and silver scurf. Potato plants treated with compost tea and a combination of compost + compost tea produced higher yield compared to all other treatments. However, the number and weight of knobby tubers were significantly higher in compost tea treatment and significantly lower in the combined treatment of both compost + compost tea compared to other treatments. This is the first study to report on the effect of compost and compost tea against common scab of potatoes.


The vast surface of the plant axis, stretching from root tips occasionally buried deeply in anoxic sediment, to apical meristems held far aloft, provides an extraordinarily diverse habitat for microorganisms. Each zone has to a greater or lesser extent its own cohort of microorganisms, in aggregate comprising representatives from all three primary domains of life—Bacteria, Archaea, and Eucarya. While the plant sets the stage for its microbial inhabitants, they, in turn, have established varied relationships with their large partner. These associations range from relatively inconsequential (transient epiphytic saprophytes) to substantial (epiphytic commensals, mutualistic symbionts, endophytes, or pathogens). Through recent technological breakthroughs, a much better perspective is beginning to emerge on the nature of these relationships, but still relatively little is known about the role of epiphytic microbial associations in the life of the plant.


The effects of three composts (C-1, C-2 and C-3) produced from Solid Olive Mill wastes (SOMW), Posidonia oceanica (Po) and Chicken Manure (CM), at different proportions, were tested on *Pythium aphanidermatum*. To evaluate the fungal pathogen inhibition, In vitro and In vivo tests were carried out. In vitro tests aimed to study the inhibitive effect of pure compost extracts and the isolated antagonist bacteria. In vivo tests drench and dip root inoculations were done on tomato seedlings. Pure extracts inhibited the fungal pathogen growth. Isolated bacteria also showed an antagonistic action on the mycelial growth of *P. aphanidermatum* and the 16sRNA identification showed that Bacillus subtilis and B. thuringiensis had the highest inhibition. In vivo tests showed that drench inoculated tomato seedlings sown in substrates with composts resisted to *P. aphanidermatum*. Root dip inoculated seedlings had a more sustained growth in substrates mixed with composts. Results showed that tested composts acted by both their chemical composition and microorganisms and could be used at appropriate proportions as biological fertilizers.

In the Quebec city area, strawberry (Fragaria x ananassa) production is strongly affected by verticillium wilt caused by Verticillium dahliae Kleb. To control the disease, pre-plant fumigation with metham sodium is commonly used. However, this practice implies serious risks for human health and the environment, and often leads to the eradication of beneficial organisms and to a negative shift in the biological equilibrium. Application of certain composts is known to provide natural control against several diseases and appears as an interesting alternative to soil fumigation for the control of strawberry verticillium wilt. The objective of the study was to evaluate the effect of four different compost extracts (bovine manure, marine residues, algae, and bark residues) on the mycelial growth of V. dahliae (strain F6). The compost extracts (sterile or non-sterile) were added at different concentrations to potato dextrose agar. After 2 weeks of culture (24°C) on the different media, radial growth was determined. At all concentrations, the four non-sterile extracts strongly reduced V. dahliae mycelial growth. In general, sterile extracts only slightly decreased mycelial growth. Further work (greenhouse and field assays) will be conducted to evaluate the effect of these composts on the incidence of strawberry verticillium wilt.


In greenhouse experiments the application of watery compost extracts onto primary leaves of barley cv. "Gerbel" showed a significant reduction in infestation of powdery mildew. Extracts from different types of composts were tested for their phytosanitary effects. Most compost extracts were able to reduce the infestation of powdery mildew up to 50-60% compared with the control. No significant difference between the types of compost extracts could be found. Further investigations refer to the effect of compost-substrates on the development of Erisyphe graminis f. sp. hordei. Different media of soil-compost mixtures reduced the number of colonies on the primary leaves significantly when barley seeds were sown directly into the mixtures. Increasing amounts of compost correlated with decreasing powdery mildew infections. In these experiments also several types of compost were tested. Sowing barley seeds in soil-compost mixtures and spraying compost extract onto the primary leaves of these plants, showed an additive effect in reducing disease severity.


Clarified water extracts of slurries of spent mushroom substrate (SMS) inhibited in vitro germination of conidia of the apple scab pathogen Venturia inaequalis by up to 98% relative to germination in Water controls. Inhibition of conidial germination increased with incubation time of slurries over 5 to 7 d and persisted for at least 14 d, at which time experiments were terminated. Compost slurries became anaerobic within 1 h when incubated without aeration. Aeration of slurries decreased efficacy of the resulting extracts compared to non-aerated controls. When aerated slurries were allowed to incubate without further aeration, extracts regained efficacy, becoming not significantly different from non-aerated controls. There was no
difference in efficacy between filtered (0.1 μm) and untreated extracts. Passage of filtrate through microconcentrators with molecular cut-off limits ranging from 100 to 3 kDa did not diminish activity of the extracts. Autoclaved extracts were less effective than untreated extracts but retained most of their efficacy. Extracts produced from sterile SMS were virtually ineffective compared with those from non-sterile SMS. When small volumes of slurry from raw SMS were added to slurries of sterile SMS and incubated for an additional period, efficacy of the inoculated SMS was enhanced compared to uninoculated controls. We conclude that a major inhibitory principle of the SMS extract is a low molecular weight, heat-stable, non-protein metabolite produced by anaerobic microorganisms in the compost. Copyright (C) 1996 Elsevier Science Ltd


Downy mildew caused by the obligate biotrophic oomycete *Plasmopara viticola* is one of the most important and devastating diseases of grapevine. Copper-based fungicides are used to control the disease in organic vineyards. However, since 2006, copper use has been limited by an European Commission regulation. In this study conducted from 2004 to 2007, we tested materials that might replace copper in organic viticulture, under controlled greenhouse and field conditions at two locations in Europe (northern Italy and Switzerland). We tested 112 different treatments, including biocontrol agents, materials of animal origin, homeopathic preparations, inorganic materials, microbial extracts, natural derivatives, plant extracts, physical methods and synthetic materials. Good control results were observed for two new copper formulations, but one of them induced phytotoxic effects. Two of the plant extracts provided good control on both leaves and clusters, and six of them controlled the infection on clusters only. One biocontrol agent reduced symptoms on leaves and bunches. Three of the other treatments provided good control on leaves, and four of them provided good control on bunches. Clay was as effective as copper on both leaves and bunches. Currently, even if there is no treatment that is as effective as copper for controlling grapevine downy mildew in organic vineyards, *Yucca schidigera* and *Salvia officinalis* extracts and *Trichoderma harzianum*, could be considered as promising candidates to be developed. This study may help the development of an integrated management program in which a less effective product is applied in combination with copper, to reduce the total quantities of copper applied. (C) 2011 Elsevier Ltd. All rights reserved.


It is important to know about the mechanisms that suppress plant diseases when compost from vegetable residues and/or their liquid extracts (compost tea) are used in order to improve the efficiency of this suppressing effect on pathogens. In this study, we assessed the presence of siderophores in various grape marc aerated compost teas (ACT) and their suppressing effect on nine pathogens: *Rhizodonia solani*, *Fusarium oxysporum* f. sp. *radicis-lycopersici*, *Fusarium oxysporum* f. sp. *lycopersici* race 0, *Fusarium oxysporum* f. sp. *lycopersici* race 1, *Fusarium oxysporum* f. sp. *radicis-cucumerinum*, *Verticillium dahliae*, *Pythium aphanidermatum*, *Phytophthora parasitica* and the mycopathogen, *Verticillium fungicola*. Three concentrations (5, 10 and 15%) filtered, microfiltered and sterilized ACT were added to Petri dishes with a PDA medium, and 1 mM of ferric chloride (FeCl(3)). After adding this mixture, a 0.5 cm disc was placed at the center of each dish containing the vegetative and reproductive body of each of the fungi to be tested. All the dishes were incubated at 25 degrees C for seven days, except *R. solani* y *P. aphanidermatum*, which
The addition of 1 mM of FeCl(3) deactivated the siderophores present in the ACT, suppressing their inhibition of fungal development. The results obtained with the microfiltered ACT revealed that the microorganisms present in grape marc compost excreted siderophores into the medium which were responsible for inhibiting the growth of the 9 fungi tested. This activity was annulled by the addition of ferric chloride. The same results were achieved with the ACT obtained from filtering. This inhibition was not 100% after adding FeCl(3) due to the fact that the microorganisms present in this tea, exhibited other biocontrol mechanisms.


The experiments demonstrate the different influences of composts on some plant pathogens. In the first part of this work, it is shown that plant pathogens were inactivated during the thermophilic phase of the composting process. In this phase the high temperatures are the main mortality factor. The second part of this article shows the influence of compost-substrates and watery compost-extracts on several plant pathogens. Different medias of compost enriched soil reduced the number of colonies of Erysiphe graminis f. sp. hordei on the second and third leaves of barley plants. Under field conditions the application of compost-extracts on plants showed a significant reduction in infestation of powdery mildew and increasing yields of barley. In the third part, it is demonstrated that watery compost extracts have a high suppressice effect on Botrytis cinerea. Experiments with lettuce in the field and with leaves of French beans in the laboratory are presented. The Botrytis-effects of the compost-extracts are based on the antagonistic activity of micro-organisms in the extracts.


Compost water extracts (compost teas) are gaining popularity among organic growers, largely because of their disease suppressive activity when applied to foliage or soil. Production methods often include addition of supplemental constituents, particularly molasses, to stimulate plant-beneficial microbial populations. We have found that molasses amendments also favor regrowth of human pathogenic bacteria, raising public health concerns about potential contamination of treated crops, particularly produce intended for fresh consumption. Using disease outbreak strains marked with greenfluorescent protein (GFP) and spontaneous antibiotic-resistance, we found that regrowth of Salmonella enterica serovar Thompson and Escherichia coli O157:H7 was positively correlated with molasses concentration. For Salmonella, regrowth was also dependent on the type of starter compost material used. Salmonella populations increased from 1 at time 0 to over 1000 CFU ml(-1) in dairy manure compost tea with 1% molasses, and from 1 at time 0 to over 350,000 CFU ml-1 in chicken manure compost tea by 72 h. E. coli populations increased from 1 at time 0 to approximately 1000 CFU ml(-1) in both types of tea by 72 h. Pathogen regrowth did not occur when molasses was eliminated or kept to 0.2%.

Nonaerated compost teas produced from composted green waste of various ages were used to challenge the growth of Armillaria mellea, the causal agent of the Honey fungus white root-rot disease. Three trials were carried out: in vitro agar based assays over a period of 16 days employing repeated application of the teas; timber billet trials over a period of 30 days using a single pretreatment; and a pot trial using deliberately infected young beech trees watered with compost teas at 4 day intervals. The compost samples used were from a commercial source and sampled after storage for one, two, three and six months. Control treatments used distilled water applications in place of compost teas. In all cases compost tea applications inhibited the growth of rhizomorphs significantly and resulted in changes in their morphology. In the pot trials none of the treatments prevented infection, but rather slowed the development of wilt symptoms. Age of compost had an effect in all trials. The results indicate that such treatments may have potential in the treatment of this damaging infection and also highlight the significance of the maturity of green waste composts and teas proposed for the suppression of plant diseases.


In situ and in vitro experiments were carried out to determine the effect of various composts (leafy fruit compost (LFC), garden compost (GC), and crops compost (CC)) and their water extract on Pythium debaryanum, Fusarium oxysporum f.sp. lycopersici, Sclerotium bataticola. Compost water extract (CWE) of LFC, GC, and CC were found to contain Bacillus spp., Micrococcus spp., Staphylococcus spp. and Corynebacterium spp., and the fungi Aspergillus spp., Rhizopus spp., and Drechslera spp., and various Actinomycetes. In situ results indicated considerable decrease in fungal growth around the unautoclaved compost especially in the case of S. bataticola and F. oxysporum f.sp. lycopersici, compared to the autoclaved compost. In vitro tests showed that concentration of CWE at 5, 10 and 15% (v/v) suppressed the hyphal growth of S. bataticola by 83% using 5% CC and by 94.4% using 5% LFC or 10% GC, and F. oxysporum f.sp. lycopersici by 94.4% using either composts. CWE of GC decreased fungal dry weight of F. oxysporum f.sp. lycopersici by 97.7%, P. debaryanum by 92.8%, and S. bataticola by 84.4%; CC decreased F. oxysporum f.sp. lycopersici by 94%, P. debaryanum by 86.2%, and S. bataticola by 63.3%, while CWE of LFC was the least effective against the tested fungi. CWE produced clear inhibition zones against all the tested fungi. Microflora found in CWE have an important role in suppressing the growth of tested fungi. CWE contained neither antibiotics nor siderophores. The presence of protease, chitinase, lipase and beta-1,3 glucanase (lysogenic enzymes) in CWE indicates a possible role in fungal degradation.


Water extracts of fermented mature composts prepared from animal sources (cattle manure and chicken-cattle manure) and a plant source (grape marc) were tested in growth chamber experiments for their ability to control leaf grey mould on tomato and pepper plants and grey mould on grape berries. Disease was
reduced by 56-100% by extracts after a fermentation that lasted more than 10 days. In some cases, even a shorter fermentation time was sufficient. Addition of nutrients to the fermenting mass did not generally improve disease control. Pasteurization of the extracts nullified their efficacy in part and only in some cases. Two bacterial strains isolated from the extracts controlled grey mould effectively. Dilution of the extracts (25-fold) resulted in retention of their efficacy only when they were prepared from grape marc compost. In an experiment conducted under commercial greenhouse conditions, extract of cattle manure compost reduced tomato leaf grey mould significantly (p < 0.05) compared with the water control, but superior disease suppression was achieved with the fungicide vinclozolin. In another experiment, involving a heavy natural powdery mildew (Leveillula taurica) infestation on tomato leaves, partial control of the disease was obtained by all extracts tested.


Compost teas, made using an aerated brewing process, have been reported to have potential for controlling a range of plant diseases and improving crop health. Septoria leaf spot of tomato, caused by the fungus Septoria lycopersici, is a common and destructive disease of tomato in Kansas. A field trial was conducted at Wichita, Kansas during Summer 2003 to evaluate the potential of pre-plant compost, and compost tea applied as a foliar spray or through drip fertigation, to control Septoria leaf spot of tomato. The experimental design included three factors: Pre-plant application of 13N-13P-13K or vermicompost; fertigation with CaNO₃ or compost tea; and foliar spray with compost tea, fungicide (Dithane) or water. A split plot design was used with fertigation treatments as main plots and the other two factors as sub-plots. There were 3 replications. Tomato cultivar Merced was used and individual plots consisted of 5 plants grown on beds covered with red plastic mulch and supported by stake and weave system. Aerated compost tea was brewed weekly using a vermicompost-based recipe including alfalfa pellets, molasses, humic acid, fish emulsion and yucca extract and applied to plots starting 2 weeks after transplanting. Disease incidence and severity were recorded weekly for 3 weeks following the appearance of disease. Plots were harvested twice weekly and counts of No. 1, No 2 and cull grade tomatoes were recorded. There were no effects of pre-plant or fertigation treatments on Septoria leaf spot disease, but there was a significant effect due to foliar sprays, with mean severity of compost-tea-sprayed plots (26.3%) and fungicide-sprayed plots (31.9%) significantly lower than water-sprayed plots (45.9%) at trial termination.


The likely exploit of the aqueous extracts of aerated (ACT) and non-aerated (NCT) compost teas made from plant residues (rice ash, bean straw and vegetative food waste) as well as from chicken manure on suppressing early blight (Alternaria solani) in tomato and purple blight (Alternaria porri) in onion was assessed. Results showed that NCT compost tea extracts contained denser biodiversity of actinomycetes, bacteria, filamentous fungi and yeasts compared to ACT. Fortification of tea compost with some nutrient additives strengthened microbial population. Compost teas inhibited, in vitro, conidial germination and fungal growth. Ten-day-old extracts reduced activity on filter sterilization. In a greenhouse trial, spraying tomato and onion plants with all compost teas significantly reduced disease incidence and population counts of Alternaria blight. Moreover, treated plants exerted significant increases on the activities of both
peroxidase, beta-1,3-glucanase and chitinase. Field trials were conducted over 2 years to assess the effects of spraying compost teas on diseases development. The incidence of Alternaria blight was obviously reduced in tomato and onion plants sprayed with NCT compared to those sprayed either with ACT or non-sprayed ones. Foliar spraying with mixed NCT compost tea intensified microbial biomass more than ACT did. Higher marketable yields of tomato and onion were gained from tea compost-sprayed plants. Worth mentioning, in all trials, preparing compost teals with chicken manure consistently increased disease suppression and increased fruit yield.


Production of sporangia by Phytophthora cinnamomi, Phytophthora cryptogea, Phytophthora citricola, Phytophthora drechsleri and Phytophthora nicotianae var. nicotianae on Miracloth discs was compared in filter-sterilized and non-sterile leachates extracted from a pine-bark based container medium (NM) and a composted Eucalyptus-bark medium (CEB). Sporangial production of all species was suppressed in non-sterile CEB leachate; whereas, in sterile CEB leachate it was stimulated in comparison to the NM leachate. P. drechsleri and P. cryptogea appeared to require the presence of certain microorganisms to induce zoospore release. Chlamydospore production by P. cinnamomi was suppressed in CEB leachates. On cornmeal and water agar mixed with filter-sterilized or non-sterile leachate from NM and CEB, mycelial growth varied with leachate, agar type and Phytophthora species. Isolates within P. drechsleri and P. cinnamomi responded differently to the extracts.


Compost tea (CT) is an unheated on-farm infusion of compost used as a spray or soil drench to promote plant growth and control foliar and root diseases. Because food safety involves all aspects from farm to fork, CT should meet basic microbiological criteria for water quality. This report describes the effects of two CT production processes, aerated and nonaerated, on growth and survival of foodborne pathogens and fecal coliforms. Seven commercially available nutrients used to supplement CT were tested individually and in combination for their effects on the growth of Escherichia coli and Salmonella. Compost containing 101 to 103 CFU/g initial concentrations of E. coli O157:H7 and Salmonella Enteritidis were used to assess growth and survival responses to aerated CT (36-h preparations) and nonaerated CT (8.5-day preparations). Pathogen and fecal coliform populations were undetectable by 8.5 days in nonaerated CT without nutrient supplements. E. coli O157:H7 decreased to below detection levels in aerated CT at 36 h without the use of supplements. In contrast, the addition of commercially formulated mixtures or combinations of nutrient supplements resulted in growth of E. coli O157: H7, Salmonella, and fecal coliforms by 1 to 4 log CFU/g in both aerated and nonaerated CT. When nutrient supplements were added, aerated CT sustained higher concentrations of E. coli O157:H7, Salmonella, and fecal coliforms than did nonaerated CT. Thus, addition of supplements supports growth of human pathogens from very low initial concentrations in both aerated and nonaerated CT and should be avoided when CT is used on fresh produce.

Interactions among populations of soil microorganisms might alter soil microenvironments sufficiently to allow populations collectively to inhabit sites which individually they could not inhabit. We tested the hypothesis that soluble microbial products in soil microenvironments mediate commensalistic interactions among populations involved in N\textsubscript{2}-fixation, denitrification, sulfate reduction and P solubilization. We measured the growth of bacteria in microcosms amended with sterile compost extract. Of the 7 Azospirillum isolates tested, 3 fixed more N\textsubscript{2} when amended with 50 mug compost extract-C ml\textsuperscript{-1} medium. Fixation of N\textsubscript{2}, by one isolate amended with NH\textsubscript{4}Cl or compost extract decreased with increasing concentrations (0.15-15 mug N ml\textsuperscript{-1} medium) of NH\textsubscript{4}Cl, but not with increasing concentrations of compost extract. Optical density of cultures of Bacillus sp. increased 6-fold with addition of 11 mug compost extract-C ml\textsuperscript{-1} medium under denitrifying conditions. Adding 6 mug compost extract-C ml\textsuperscript{-1} medium stimulated the growth of all 10 sulfate-reducing enrichment cultures, and three did not grow without compost extract. Addition of 10 mug compost extract-C ml\textsuperscript{-1} medium, however, increased microbial-P in only one of the 10 cultures in P-limiting medium. This evidence is consistent with the hypothesis that exchange of growth factors among populations in microenvironments contributes to control of microorganisms involved in element cycling.


The high incidence of various soil-borne and foliar diseases is a major production constraint in the profitable cultivation of French bean. Compost and compost teas have been widely explored as an eco-friendly option for controlling plant diseases in container mixes. However, there is limited information regarding their disease suppressive potential under field conditions especially against diseases of French bean. The aim of this study was to investigate the suppressive potential of six composted substrates (farmyard manure, poultry manure, vermicompost, spent mushroom compost, Lantana camara and Urtica sp.), in comparison to a recommended chemical fungicide (carbendazim), against soil-borne and foliar diseases of French bean under the conditions of western Indian Himalayas. The field experiment was conducted over two growing seasons and the composts applied as a soil amendment and later as foliar sprays of their fermented extracts. There was a high level of root rot suppression (&gt;33%) in the poultry manure, Lantana and Urtica compost treatments in both experimental years and these treatments were on par with the chemical seed treatment. All the compost treatments showed a moderate but significant reduction (&gt;20%) in angular leaf spot severity also but none was comparable to that of chemical sprays. There was considerable variability in the suppressiveness of different composts. Overall, poultry manure, composted Urtica sp. and composted Lantana camara treatments were superior to other composts in suppressing both Rhizoctonia root rot (Rhizoctonia solani Kuhn) and angular leaf spot (Phaeoisariopsis griseola (Sacc.) Ferraris). The different compost treatments exerted a significant effect on the population of Trichoderma spp. and fluorescent pseudomonads in the plant rhizosphere. The highest population of these antagonists was recovered from poultry manure and Urtica compost treatments indicating that it may be a major factor contributing towards the higher disease reduction observed in these treatments. All composts increased yield over the control with maximum yields recorded in poultry manure and Urtica treatments.
Although Lantana compost suppressed disease, the yield levels in this treatment were quite low indicating that the compost may be phytotoxic. Our results suggest that application of composts and compost extracts derived from poultry manure and Urtica sp. has the potential to provide effective control of diseases and improve yield in bean under field conditions. (C) 2009 Elsevier Ltd. All rights reserved.


The application of bark-compost to farmland has been reported to suppress soil-borne diseases, including Fusarium wilt. The “bacterial type” microflora of the compost has been considered to play the significant role in disease control. Using the disk-diffusion technique, we found that acetone extracts of the bark-compost possessed strong antifungal activity against Fusarium oxysporum f. sp. cucumerinum. The extracts were relatively stable against heat treatment at 100°C and the antifungal extracts were also active against Gibberella zeae, Helminthosporium signoidem and Glomerella cingulata, fungi of interest to plant pathologists, but they were inactive against yeasts and procaryotic organisms. There might be a parallel between this selective antimicrobial activity of the acetone extracts of the bark-compost and the formation of the “bacterial type” microflora of the compost. Furthermore, we partially purified the acetone extracts by reverse-phase HPLC and found at least 10 active antifungal peaks in the chromatogram. These antifungal agents appear to be relatively low polar lipids.


Eucalyptus is the major commercial forestry tree species in South Africa. Application of organic fertilizers for raising eucalypt seedlings has not been much studied. Prolong use of chemical fertilizers in the nurseries and at planting sites can be detrimental to the soils and surrounding environment. Vermicompost leachate (VCL) is a liquid generated by earthworms and microorganisms during the conversion of organic matter into vermicompost. Four-year-old seeds of Eucalyptus dunnii, E. nitens and E. smithii were subjected to VCL at different (1:5, 1:10 and 1:20 v/v) concentrations. In comparison to the control, seedling emergence percentage of all three species improved significantly (p<0.05), more than two to three times, when treated with VCL. Treated seedlings showed better growth performance than the untreated seedlings at both first and second harvests (75 and 150 days after sowing, respectively). However, some of the growth parameters were not significantly different from the control. Eucalyptus dunnii achieved the highest seedling vigour index (SVI) at the lowest VCL concentration of 1:5. In contrast, the SVI of E. nitens was maximum at the highest concentration of VCL (1:20). The best SVI of E. smithii was obtained at a VCL concentration of 1:10. These results suggest that the influence of VCL on SVI of eucalypt species tested was concentration-dependent. The absolute seedling vigour rate per day was also improved with all the tested concentrations of VCL with some exceptions for E. dunnii seedlings. The order of response to VCL by the species can be summarized as E. smithii>E. nitens>E. dunnii. The results of this study suggest that VCL can be supplemented with chemical fertilizers. The liquid nature of VCL should be a convenient application both in nurseries and field conditions. However, trials under field conditions are required.
Growth of a nonpathogenic E. coli strain (K12-MG1655, ATCC 700926) in aerated and nonaerated compost teas containing molasses, kelp and carrot juice was examined. Teas were prepared using four different compost types that had undetectable levels of indigenous E. coli. Three of the composts were produced by turn pile windrow composting method using dairy, swine and horse manure as feedstock, while the fourth, a vermicompost, was produced by feeding separated dairy solids to worms Eisenia fetida. Molasses and kelp enhanced the growth of E. coli in inoculated teas and the E. coli density was positively correlated with nutrient concentrations ranging from 0.1 to 8.0 g/L. Irrespective of the presence of molasses and kelp, E. coli was not detected in noninoculated teas. Even though E. coli is a facultative anaerobe, its growth was significantly higher in nonaerated teas than in aerated teas. Without aeration, dissolved oxygen in teas declined rapidly and fell below 0.1 mg/L within 20 h, whereas continuous aeration at 0.8 L/min maintained an aerobic condition (> 5 mg/L dissolved oxygen) in teas during the 48 h brewing period. The pH values of nonaerated teas were significantly lower than those of aerated teas and were always slightly acidic. E. coli growth in different compost types was significantly different. The density of E. coli was lowest in teas made with vermicompost and highest in teas made with swine manure compost. E. coli proliferations in both aerated and nonaerated swine manure compost teas were inhibited by carrot juice. Carrot juice lowered dissolved oxygen in aerated teas. The total bacterial densities in noninoculated compost teas were not reduced by carrot juice.


Currently there is a lack of effective seed treatments for bacterial pathogens, with Cu-based compounds (the only chemical treatments permitted under organic farming standards) only providing partial control. The aim of this study was to quantify the effect of alternative treatments for the control of bacterial canker (Clayibacter michiganensis subsp. michiganensis), a major seed-borne bacterial disease in tomato. Treatments assessed were acidified nitrite (a treatment previously shown to control the seed-borne fungal disease Didymella lycopersici), antagonistic strains of Bacillus spp. and compost extracts, which were not previously evaluated as treatments for seed-borne diseases. Efficacy of treatments was determined in a seed disinfection assay. Ten-minute immersion of seed in 300 mmol l(-1) acidified nitrite resulted in 98% being pathogen free. Copper hydroxide, certain strains of Bacillus spp. and all compost extracts resulted in 100% pathogen free seed. (C) 2011 Royal Netherlands Society for Agricultural Sciences. Published by Elsevier B.V. All rights reserved.
In vitro experiments by direct confrontation, were conducted to assess the inhibitory effect of nine compost extracts, made with different mixtures of animal manure proportions, on some phytopathogenic fungi (Fusarium oxysporum f. sp. radicis-lycopersici, F. solani, F. graminearum, Fusicoccum amygdalis, Alternaria sp., Colletotrichum coccodes, Botrytis cinerea, Sclerotinia sclerotiorum, Aspergillus niger, Rhizoctonia solani, R. bataticola, Pythium sp. and Verticillium dahliae). Compost extracts decreased the radial growth of all fungi tested, except for Aspergillus niger. In fact, fungal radial growth inhibition ranged from 0 for A. niger to 63.17% for V. dahliae. Higher antifungal activity was also noted against F. oxysporum f. sp. radicis-lycopersici and F. solani with 38.12 and 31.87%, respectively. However, lesser inhibition, of about 10.33%, was obtained against R. bataticola. Compost extract C2, based on 60% cattle manure, 30% sheep manure and 10% ground straw and compost extract C7, based on 40% cattle manure, 40% sheep manure and 20% vegetable wastes, were found to be the most effective against the fungi tested. These extracts contain an important microflora which seem to be involved in this antifungal activity.

Compost extracts reduced infection of grapevine by B. cinerea. Detached leaf bioassays demonstrated that the suppression could be enhanced to 90-95%. For provinf fungicidal effects of compost extracts, cattle manure, horse manure and grape marc compost was investigated after a fermentation period of 8 days. These conditions promoted a number of bacteria of the genus Pseudomonas and spore forming genera. Previous studies have evaluated the microbial composition of the extract. The highest number of completely mesophilic aerobic bacteria was found in the cattle compost. Microorganisms were therefore isolated from extracts of that compost; a collection of 45 strains was obtained. Eight isolates reduced the disease level of B. cinerea to more than 98%. Subsequently a field trial was performed with the red wine cv. 'Domina' in the Ahr-valley, Germany. Due to prevailing weather conditions in 1991 there was a late infection of B. cinerea on berries. The treatments with compost extracts reduced the infection significantly and after addition of casein (0.5%) and pine needle oil (0.05%) before application of the extracts, the results were similar to those achieved with conventional fungicides.

Watery fermentation extracts of well composted organic materials reduced disease incidence and intensity in various host-pathogen combinations, if applied prophylactically to plant surfaces. The effect against Erisyple polygoni on bushbeans and against Phytophthora infestans on tomatoes under heavy infection pressure in the greenhouse were remarkable. Treatments with compost extracts, extraction times of 7 or 14 days, reduced the attack significantly. After addition of casein (0.5%) just before praying the extracts, the results were similar to those achieved after application of netsulfur or antracol. To enhance our knowledge of the mechanisms of action of such biological interventions on plant surfaces, the dynamics of microbial development on leaf surfaces were studied in detail. The phyllosphere of treated leaves was characterized by total number of CFU’s, pseudomonads, enterobacteria and spore forming bacteria. Significant differences between treatments were observed. The total number of CFU’s, pseudomonads and spore forming bacteria increased after spraying extracts onto the leaves. The highest microbial population was established on the leaves after application of extracts added with casein (0.5%). There was a clear correlation between the microbial population established on the leaf surfaces on the potential disease suppression.


Composted organic wastes as soil amendments can partly suppress some soil borne pathogens such as Pythium spp. and Phizoctonia solani. Therefore we decided to test the capacity of water extracts of composted organic material on plant health. They are effective if applied by dipping or spraying. To produce effective extracts, compost has to be covered with water for periods between 3 and 7 days (=extraction time) under outdoor conditions. Disease development of some host-parasite systems was significantly reduced in the laboratory and greenhouse experiments. Infection of grapevine leaves c.v. Muller-Thurgau by Plasmopara and Uncinula infections were only minimal in the untreated check plots, due to the prevailing weather conditions, there was a strong outbreak of Pseudopeziza tracheiphila. Treatment with compost extract reduced this attack significantly. As this is the first report of a successful application of compost extracts under outdoor conditions further research on this method was initiated.


Compost teas are fermented watery extracts of composted materials that are used for their ability to decrease plant disease. Non-aerated compost teas (NCT) prepared from five types of compost were tested for their ability to inhibit the growth of Alternaria solani, Botrytis cinerea, and Phytophthora infestans in vitro. Weekly applications of NCT were also used in greenhouse trials to assess their suppressive effect on powdery mildew (Oidium neolycopersici) and gray mold (B. cinerea) on tomato plants. All NCT significantly inhibited the mycelial growth of A. solani (37-66%), B. cinerea (57-75%), and P. infestans (100%), whereas sterilized teas did not inhibit growth of the tested pathogens. Although NCT failed to efficiently control powdery mildew, they were able to control tomato gray mold for up to 9 weeks in
Various biological amendments, including commercial biocontrol agents, microbial inoculants, mycorrhizae, and an aerobic compost tea (ACT), were evaluated, alone and in conjunction with different crop rotations, for their efficacy in introducing beneficial microorganisms, affecting soil microbial community characteristics (SMCC), and reducing soilborne diseases of potato in greenhouse and field trials in Maine. Most amendments successfully delivered microorganisms into the soil, altering microbial populations and activity in accordance with the particular organisms added, and significantly altering SMCC (as determined by FAME analysis) to various degrees from 2 to 24 weeks. Amendment effects were greatest early on (2 weeks after amendment), but effects associated with crop treatment became more dominant at subsequent assessments (10 and 24 weeks after amendment). In field trials, effects on microbial characteristics, soilborne diseases and tuber yield were variable, with some microbial inoculants and a biostimulant producing no significant effects, whereas arbuscular mycorrhizae, reduced stem canker and black scurf by 17-28%. When used in three different 2 yr crop rotations (barley/ryegrass, barley/clover, and potato, all followed by potato), biological amendments reduced soilborne disease and improved yield in some rotations, but not others. Soil-applied ACT and the combination of ACT with a mixture of beneficial microorganisms (Mix) reduced stem canker, black scurf, and common scab on tubers by 18-33% and increased yield 20-23% in the barley/ryegrass rotation, but not in the other rotations. Mix also reduced disease (20-32%) in the barley/clover rotation only. None of the amendments significantly reduced disease in continuous potato plots. Both crop rotation and amendment treatments significantly affected SMCC, but rotation effects were more dominant. These results indicate that certain rotations were better able to support the added beneficial organisms from amendments and enable more effective biological control, and also that favorable crop rotations may be more effective than amendments in manipulating or altering SMCC. Establishment and persistence of amendment effects may depend on many factors, but an effective and supportive crop rotation is apparently important. Published by Elsevier Ltd.
agricultural and horticultural crop production. Most reports on pest control using such organic amendments relate to tropical or and climates. The majority of recent work on the use of organic amendments for prevention and control of diseases relates to container-produced plants, particularly ornamentals. However, there is growing interest in the potential for using composts to prevent and control diseases in temperate agricultural and horticultural field crops and information concerning their use and effectiveness is slowly increasing. The impact of uncomposted plant residues, composts, manures, and compost extracts/teas on pests and diseases is discussed in relation to sustainable temperate field and protected cropping systems. The factors affecting efficacy or such organic amendments in preventing and controlling pests and disease are examined and the mechanisms through which control is achieved are described.


Extracts made from livestock manure composts could significantly control sweet pepper (*Capsicum* Fusarium wilt (*Fusarium oxysporum* f.sp. *vasinfectum*). In a greenhouse pot test, the relative disease control efficiency of compost extracts with pig, horse and cow manure were 88.5, 56.6 and 65.5%, respectively. Studies on possible mechanisms showed that the compost extracts had a mycolytic effect on chlamydospores and microspores. Strong, antagonistic bacteria of sweet pepper *Fusarium* wilt were isolated from the compost extracts. The activity of Beta-1,3-dextranase, polyphenol oxidase [catechol oxidase] and phenylalanine ammonia lyase of sweet pepper was raised by 12, 367 and 20% when treated with compost extracts. In addition, the nutritional effect, which resulted in strong plants, provided defence against pathogens.


Compost extracts made from livestock manures have shown certain protection against cucumber wilt (*Fusarium oxysporum* f. sp. cucumerinum). The relative efficacies of compost extract from pig, horse and cow manure were 58.9% - 92.5%, 18.6% - 72.1%, and 38.5% - 72.8%, respectively. Results show that the possible mechanisms involve the inhibition of conidia germination by compost extracts and the antagonistic effect of microorganisms in the compost

Clarified compost tea of three different plant sources of slurries of spent mushroom substrate (SMS), path and/or rice straw, were used as inhibitors for different foliar and soil borne pathogens. Fusarium solani Mart sacc., Macrophomina phaseolina Tassi and Rhizoctonia solani Kuhn proved to be the most dominant isolated fungi from roots of bean plants infected with root rot disease in Noubaria district (El-Behera Governorate, Egypt). Meanwhile, Fusarium oxysporium, Phythium spp. and Sclerotium rolfsii were frequently recorded. Pathogenicity test proved that the most effective fungi on beans were F. solani and R. solani, followed by M. phaseolina. In greenhouse trials, soil amendment with compost tea (1) (SMS) showed high effect in reducing root rot incidence caused by F. solani, R. solani and M. phaseolinae at pre-emergence damping-off stage. The same treatment reduced root rot disease after 45 days caused by the previous three pathogens. Seed treatment with compost tea reduced root rot diseases at the pre- and post emergence stages. Meanwhile, coating seeds with compost tea had a good effect in reducing root rot incidence under field conditions. After 40 and 60 days of sowing, amended soil increased fresh pods yield in the two successive seasons 2009 and 2010. It possessed a strong antifungal active effect against soil borne pathogens. It is worth to recommend the practical use of compost tea or seed treatments to control soil borne plant pathogens as a substitute of chemical fungicides without any risk to human, animal and environment.


Manure-straw mixtures were composted and water extracts, made by incubating compost in water for 3 to 18 days, were assessed for antagonistic activity against Botrytis cinerea, using a range of tests. Extracts of all ages inhibited conidial germination on glass slides and reduced mycelial growth on agar. Mixing extracts of all ages with droplets of suspensions of B. cinerea conidia on detached Phaseolus bean leaves suppressed lesion development, but only 3- to 8-day-old extracts had an effect when sprayed onto leaves 2 days before inoculation. Extracts contained a large and varied microbial population of actinomycetes (0.3 to 2.4 x 10(5) c.f.u. ml-1), bacteria (1.5 to 5.6 x 10(10) c.f.u. ml-1), filamentous fungi (25.0 to 45.5 c.f.u. ml-1) and yeasts (26.1 to 62.6 c.f.u. ml-1). Eight- and 18-day-old extracts lost activity completely on filter sterilization or autoclaving. Weekly sprays of 8-day-old extracts onto lettuce in the glasshouse had no effect on the incidence of grey mould, but significantly reduced its severity and increased marketable yield. The use of compost extracts in biocontrol of plant diseases and their possible mode of action is discussed.


Compost tea is gaining importance as an alternative to chemical fertilizers and pesticides. The microbial Population in the Compost tea contributes toward its effectiveness. An attempt was made to enhance the biological activity of Compost tea by fortification with microbial Substrates. Humic acid and yeast extract
When used as microbial starter during brewing of Compost tea significantly (P <= 0.05) enhanced the microbial population. There was a ten to hundred fold percentage increase for total bacteria, fungi and actinomycetes compared to control. The stability of microbial enriched compost tea was maintained up to four months of storage based on significantly higher number of viable cell counts when compared to Compost tea Without Substrates (control). The viable microbial Cell Counts over a storage period of six months was 8.5x10^9, 4.6x10^6, 3.5x10^4, 3.9x10^4, 1.4x10^5, 4.8x10^4 and 7.3x10^5 for other bacteria, Pseudomonas sp., lactic acid bacteria., actinomycetes sp., yeast, Trichoderma sp. and other Fungi, respectively. There were very low viable microbial cell Counts recovered in compost tea without substrates, where Trichoderma sp. and actinomycetes completely lost their viability in control.

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Aqueous extracts of organic matter prepared by mixing organic matter, composted or not, to water in anaerobic conditions have presented a good control level of various plant pathogens. The extracts were obtained by mixing vermicompost and organic compost with water at the ratio 1:1 in plastic containers and anaerobically incubated for 10 days, without stirring, at 25degreeC + 2. The aqueous extracts were tested on the mycelial growth of Colletotrichum sp., Alternaria solani, Botrytis cinerea, Sclerotinia sclerotiorum, Sclerotium rolfsii, Rhizoctonia solani and Fusarium oxysporum f. sp. lycopersici and upon the germination of urediniospores of Hemileia vastatrix. Also the inhibitory effects of both the vermicompost and organic compost on soil fungi were studied The mycelial growth of B. cinerea, S. sclerotiorum, S. rolfsii, R. solani and F. oxysporum f. sp. lycopersici was inhibited by the aqueous extracts of vermicompost and organic compost. No inhibition of A. solani and Colletotrichum sp. occurred. Germination of H. vastatrix urediniospores was inhibited at concentrations above 5% of the extracts. By assessing the effects of the vermicompost and of the organic compost on F. oxysporum and S. rolfsii, it was verified that both non-autoclaved materials reduced the mycelial growth of those fungi, when compared to the autoclaved substracts.


Control of late blight by alternative products is important for reduction of fungicide inputs and potato production costs. The efficacy of essential oils and biopesticides for inhibition of growth of Phytophthora infestans on media and suppression of late blight on potato plants in growth chambers was examined. Growth of pathogen isolates of diverse genotypes was evaluated on Rye B media amended with essential oils (lavender, thyme, thyme borneal, and oregano) and the biopesticide Serenade (Bacillus subtilis strain QST 713). Over 90% inhibition of pathogen growth was achieved with oregano and Serenade amendments. The protective foliar application of Serenade, an aerated compost tea (ACT), Effective Microorganism mix (EM), and oregano, resulted in disease suppression of 5-40% relative to the untreated control. ACT had no significant suppressive effects (0-15% reduction), EM resulted in mild suppression (15-30% reduction),
and oregano and Serenade consistently resulted in moderate disease reduction (20-40%). No oil or biological treatment produced disease control comparable to the chemical control chlorothalonil, which resulted in disease reductions of 80-98%. Both oregano and Serenade resulted in some phytotoxicity at high doses. These results suggest that the natural products and biological amendments tested are not sufficient for effective late blight control by themselves; however, when used in combination with other established disease control practices, these approaches may contribute to improved, integrated, and more sustainable management options for late blight.


Vermicompost at concentration 40 
ug/ml caused a 50 % reduction of zoosporangia formation of Phytophthora cryptogea. Amendment of soil extract with 1000 
ug of vermicompost/ml completely inhibited the pathogen sporulation. Peat drench with vermicompost immediately after planting of gerbera, ivy, carnation or cyclamen significantly suppressed the spread of diseases. The compound applied at concentration 25 % caused the decrease of about 50 % of propagule numbers of Fusarium oxysporum f. sp. dianthi in peat naturally infested with the pathogen.


Onion seeds treated with leachates of composts prepared from alfalfa and sunflower stalks, at the dosages of 10% and 20% respectively, were inoculated with Aspergillus niger van Tieghem, causal agent of onion black mold disease. The ability of the leachates to induce the production of antifungal compounds and to control black mold were tested at seedling and set stages. Leachates from both composts were able to reduce disease incidence in sets, but not disease severity in onion seedlings. Extracts from treated seedlings and sets were fractionated by thin layer chromatography for their content of antifungal compounds. There were no significant differences between the fractions of alfalfa and sunflower compost leachates in the inhibition of the mycelium growth of A. niger, with the exception of one fraction. The presence of fluorescent pseudomonads and Pantoae agglomerans [synonym: Erwinia herbicola (Lohnis)] bacteria was determined in both leachates. The population of P. agglomerans was higher in the sunflower compost leachate compared to the alfalfa leachate. The tested strains of both bacteria were able to inhibit mycelium growth of the fungal pathogen in agar tests. This study suggests the possible role of beneficial bacteria in the induction of antifungal compounds in onion against A. niger during seedling and set stages.
Aerobic compost extract (ACE) is a watery extract of compost and a type of compost tea that is applied by horticultural producers to fruit and foliage of crops for improved plant health and crop protection. ACE was prepared using compost sampled from commercial open windrows during the cooling phase of composting when the internal windrow temperature was approximately 50 degrees C. Escherichia coli, Listeria monocytogenes and Bacillus cereus were not detected (<1 cfu per 100 g) in this compost. E. coli M23 strep is a nonpathogenic strain that has growth characteristics similar to strains of E. coli pathogenic to humans. ACE was inoculated with E. coli M23 strep(r) at 1 x 10(7) cfu ml(-1) at the beginning of extraction. No significant change in the number of E. coli M23 strep(r) was observed up to 72 h later. However, there was a significant increase in E. coli M23 strep(r) numbers by 72 h when 0.8% fish hydrolysate or 1% molasses were introduced to ACE 24 h after extraction commenced. Introduction of 0.5-2% liquid kelp or a mixture of 1.7% liquid kelp and 0.8% fish hydrolysate lead to a decline in the number of E. coli M23 strep(r). There was no relationship between the number of E. coli M23 strep(r) and the abundance of culturable bacteria and fungi in ACEs amended with nutrients, although a low oxygen concentration, pH and high conductivity was associated with increased E. coli M23 strep(r) numbers in an ACE amended with 1% molasses. The results imply that methods should be identified and imposed to assure that human enteric pathogens do not contaminate amended ACEs, during or after preparation, and/or are prevented from attaining levels that pose a risk to humans consuming fruit and vegetables treated with amended ACE.
The aim of this study was to evaluate the feasibility of using some organic solutions as a plant nutrient source for tomato (Lycopersicum esculentum Mill) grown under greenhouse conditions, and the yield and quality of the fruits. Four nutrient sources were compared (Steiner nutrient solution, compost tea, vermicompost tea and vermicompost leachate). The evaluated variables were: a) yield, b) fruit quality, c) foliar nitrogen and sap petiole nitrogen, and d) chlorophyll relative content. The results showed significant differences in all variables. The highest leaf N total contents and N-NO(3)(-) in sap petioles, chlorophyll content and increased performance, was obtained with inorganic fertilizer. However, there were lower values of soluble solids compared to those obtained with organic fertilization treatments. Within the organic fertilization treatments, vermicompost tea stood out with better performance. The results suggest that vermicompost tea can be an environmentally friendly alternative compared to conventional use of nutrient solutions in greenhouse production.


Evaluation of fertility sources for certified organic greenhouse vegetable production is necessary for further industry growth. Two experiments tested the effects of municipal solid waste compost (MSWC) and water extract tea made from it on potted greenhouse tomatoes. The first used MSWC alone (two levels) and soil tea drench alone (three application frequencies). The second used MSWC and tea in factorial combination at three levels (0, 1x, and 2x). The greatest yield and leaf tissue potassium (K) were obtained using the greatest level combinations of compost and foliar tea spray, and this was significantly greater than conventional nitrogen-phosphorus-potassium (NPK) fertilizer yield. Tissue magnesium (Mg) was affected by compost because of the antagonism from compost K. Tea increased tissue sodium (Na). No significant differences in heavy-metal tissue concentrations were found between treatments. While MSWC is an effective soil fertility amendment, the benefits of using tea may be increased with more frequent application.


Biodynamic (BD) agriculture, a form of organic agriculture, includes the use of specially fermented preparations, but peer-reviewed studies on their efficacy are rare. Composting of a grape pomace and
manure mixture was studied in two years (2002 and 2005) with and without the BD compost preparations. Water extracts of finished composts were then used to fertigate wheat seedlings, with and without added inorganic fertilizer. BD-treated mixtures had significantly greater dehydrogenase activity than did untreated (control) mixtures during composting, suggesting greater microbial activity in BD-treated compost. In both years there was a distinct compost effect on wheat shoot and root biomass irrespective of supplemental fertilizer. Shoot biomass was highest in all treatments receiving 1% compost extract. Wheat seedlings that received 1% compost extract in 2005 grew similar root and shoot biomass as fertilized seedlings, despite only containing 30% as much nitrogen as the fertilizer treatment. In both years seedlings that received fertilizer plus 1% compost extract produced 22-61% more shoot biomass and 40-66% more root biomass than seedlings that received fertilizer alone, even at higher rates. In 2002 a 1% extract of BD compost grew 7% taller wheat seedlings than did 1% extract of untreated compost. At 0.1% only BD extract grew taller plants than water, but in 2002 only. No effect on shoot or root biomass was seen at 0.1%. Our results support the use of compost extracts as fertilizer substitutes or supplements, testimonial reports on the growth promoting effects of compost extracts, and the occasional superiority of BD compost to untreated compost. (C) 2010 Published by Elsevier Ltd.


This study presents the effect of Liquid Compost 17,actor (LCF) seed treatments on plant height in greenhouse trials, and plant density, plant height and seed yield of chickpea in field conditions. The greenhouse trials were organized in a randomized block design, while in field experiments were established in a factorial complete randomized block design conducted in Moscow and Genesee, Idaho, USA locations during 2003 and 2004. In the greenhouse, LCF 1:64 had the highest plant growth, and was statistically similar to LCF 1:110, LCF 1:128 and LCF 1:140, but different to the non-treated control. The orthogonal contrasts of LCF treatments vs non-treated control, LCF 1:64 vs LCF 1:110, and LCF 1:140 were significant, and LCF 1:64 vs LCF 1:128 was highly significant. In the first year of field experiments, LCF 1:64+Maxim+Apron had the highest plant density and seed yield followed by LCF 1:64 and LCF 1:128 in both locations. In the second year of field trials, LCF 1:128 and Apron had the highest plant density; LCF 1:64 and LCF 1:128+Maxim were the best for plant height; and LCF 1:128+Apron showed the best seed yield in Moscow, while in Genesee LCF 1:64+Maxim was the best for plant density followed by LCF 1:128, LCF 1:128 and their combinations; LCF 1:128, LCF 1:64+maxim+Apron and LCF 1:64 had the greatest effect on plant height; and LCF 1:64, Apron+Maxim and Apron had the greatest seed yield. LCF seed treatments significantly increased plant density, plant height and seed yield of chickpea showing the potential of LCF to be used alone or in combination with Apron or Maxim as plant growth regulator.

Aqueous fermentation extracts of composted microbiologically active substrates reduced significantly the infestation of grapevine leaves with Plasmopara viticola under growth chamber conditions. Enhancement of efficacy was available through the enrichment of the extracts with nutrients - like sucrose and brewer's yeast - or with a natural surfactant (methylized cellulose). Studies on the microbial composition of the phyllosphere showed that the quantity of the total number of colony forming units, of yeasts/filamentous fungi, of enterobacteria, of pseudomonads and of aerobic bacilli depends on the specific amendments to the extracts and on the microclimatic conditions. They are responsible for the differences in efficiency of the various extracts against P. viticola. Appropriate investigations on the phyllosphere in a field experiment resulted in a different composition of the microflora, though the same combinations of extract amendments were used. This is caused by the varying environmental conditions. In spite of the changed microflora, the disease suppressing effects against Urcinula necator were preserved.


Watery extracts of composted organic materials of various origin, composition and extraction were tested affecting different stages of cucumber mildew. None of the extracts had an influence on conidial germination, whereas all of the following stages like penetration, haustoria, secondary hyphae, efficiency of haustoria, conidiophors, sporulation, number of colony and growth rate were evidently reduced. Histochemical and microscopical studies revealed post-infectional defence reactions. They were characterized by morphological and biochemical changes of the host cell, especially the host cell walls like papillae, lignification and necrotic reactions. these results correspond with former findings and support their interpretation withing the context of 'induced resistance'.


Watery extracts of composted organic wastes caused a significant reduction of secondary hyphae development in sugar beet powdery mildew, Erisyphe betae. Microscopical and histochemical studies revealed morphological changes in the host cell walls. They were characterized by halos in the penetration areas, by papillae, by necrotic reactions and by deformation of hyphae ends. It was concluded that compost extracts act largely through induced defence reactions of the host.
We investigated the effects of water extracts of composts (CWE) from commercial compost facilities for controlling root and foliar infection of pepper plants by Phytophthora capsici. Among 47 CWE tested, CWE from composts Iljuk-3, Iljuk-7, Shinong-8, and Shinong-9 significantly ($P < 0.05$) inhibited zoospore germination, germ tube elongation, mycelial growth, and population of P. capsici. All selected CWE significantly ($P < 0.05$) reduced the disease incidence and severity in the seedling and plant assays compared with the controls. However, there were no significant differences in zoospore germination, disease incidence, and disease severity between treatments of untreated, autoclaved, and filtered CWE. In addition, CWE significantly ($P < 0.05$) suppressed leaf infection of P. capsici through induced systemic resistance (ISR) in plants root-drenched with CWE. The tested CWE enhanced the expression of the pathogenesis-related genes, CABPRI, CABGLU, C4Chi2, CaPR-4, CAPO1, or CaPR-10 as well as beta-1,3-glucanase, chitinase, and peroxidase activities, which resulted in enhanced plant defense against P. capsici in pepper plants. Moreover, the CWE enhanced the chemical and structural defenses of the plants, including $H(2)O(2)$ generation in the leaves and lignin accumulation in the stems. The CWE could also suppress other fungal pathogens (Colletotrichum coccodes in pepper leaves and C. orbiculare in cucumber leaves) through ISR; however, it failed to inhibit other bacterial pathogens (Xanthomonas campestris pv. vesicatoria in pepper leaves and Pseudomonas syringae pv. lachrymans in cucumber leaves). These results suggest that a heat-stable chemical(s) in the CWE can suppress root and foliar infection by P. capsici in pepper plants. In addition, these suppressions might result from direct inhibition of development and population of P capsici for root infection, as well as indirect inhibition of foliar infection through ISR with broad-spectrum protection.
pathogens on plant leaves that enhanced PR gene expression, defense-related enzyme production, and hydrogen peroxide generation rapidly and effectively immediately after pathogen infection. Thus, the CWEs might suppress anthracnoses on leaves of both pepper and cucumber through primed (priming-mediated) systemic resistance.


An increasing body of experimental evidence indicates that plant disease can be suppressed by treating plant surfaces with a variety of water-based compost preparations, referred to in the literature as watery fermented compost extracts or compost teas. The terms nonaerated compost teas (NCT) and aerated compost teas (ACT) are used in this review to refer to the common production methods that diverge in the intent to actively aerate. Very little data directly compares the efficacy of NCT and ACT for plant disease suppression. A variety of foliar plant pathogens and/or diseases have been suppressed by applications of NCT while few controlled studies have examined ACT. For some diseases the level of control would be considered inadequate for conventional agriculture; organic producers with limited control options consider partial disease control to be an important improvement. For both compost tea production methods, decisions that influence pathogen suppression include choice of compost feedstocks, compost age, water ratio, fermentation time, added nutrients, temperature and pH. Application technology choices include the dilution ratio, application equipment, timing, rates, spray adjuncts and adding specific microbial antagonists. Increased understanding of compost tea microbiology and the survival and interactions of microbes on plants surfaces should make it possible to modify compost tea production practices and application technology to optimize delivery of a microflora with multiple modes of pathogen suppression. Innovative growers and practitioners are leading the development of new compost tea production methods and uses, generating many potential research opportunities. The use of compost tea as part of an integrated plant health management strategy will require much additional whole systems research by a cohesive team of farmers and experts in composting, plant pathology, phyllosphere biology, molecular microbial ecology, fermentation science, plant physiology, plant breeding, soil science, and horticulture.


Compost tea is being used increasingly in agricultural production to control plant diseases. However, there has been limited investigation relating disease control efficacy to various compost tea production methods, particularly compost tea produced with active aeration and additives to increase microbial population densities in compost tea. Aerated compost tea (ACT) and nonaerated compost tea (NCT), produced with or without additives, was investigated for the suppression of damping-off of cucumber caused by Pythium ultimum. Compost tea was used to drench soilless container medium inoculated with P. ultimum; effect on damping-off ranged from not suppressive to consistently suppressive depending on the method used to produce the tea. The most consistent formulation for damping-off suppression was ACT produced with kelp and humic acid additives. Producing ACT with a molasses-based additive inconsistently suppressed
damping-off; evidence suggests that residual nutrients can interfere with disease suppression. Heating or diluting compost tea negated suppression. Across all compost tea samples, there was no significant relationship of bacterial populations, measured as active cells, total cells, or CFU, to disease suppression. However, for all ACT produced without the molasses-based additive, there was a threshold of bacterial population density (6 log(10) active cells per ml, 7.48 log(10) total cells per ml, or 7 log(10) CFU per ml) above which compost teas were suppressive.


The use of compost teas in agriculture and urban landscapes is increasing, but there is conflicting information on which methods are suitable for obtaining compost teas that suppress disease when applied to plants. Numerous compost tea production parameters (compost source, aeration, nutrient additives, production duration, and use of application adjuvants) were tested for suppressing gray mold (Botrytis cinerea) on geranium. While individual compost tea batches did significantly reduce disease, the majority of compost teas did not significantly suppress gray mold of geranium. For nonaerated compost tea (NCT), the most consistent, significant disease suppression was associated with particular compost samples and increased production time, with little effect of periodic stirring or the addition of nutrients at the onset of production. Continuously aerating compost tea did not significantly increase disease suppression compared with nonaerated compost teas. Preparing aerated compost tea (ACT) with nutrient additives did not consistently increase disease suppression; however, 67% of ACT batches made with a mixture of kelp extract, rock dust, and humic acid significantly reduced disease. Applying ACT with spray adjuvants significantly reduced disease compared with ACT with no adjuvants. The variability in gray mold suppression from NCT and ACT applications indicates that disease control would not be commercially acceptable unless there are no other alternatives due to production constraints, e.g., organic standards.


The use of compost tea extracts to control leaf diseases is an alternative that enables the use of chemicals in agriculture to be reduced. However, little is known about the mechanisms responsible. We examined an aerated aerated compost tea prepared from composted market and garden Wastes and tested its effect on naturally Occurring powdery mildew disease produced by the foliar pathogen Erysiphe polygoni in tomato plants (Lycopersicon esculentum cv. Roma) grown in perlite in an unheated greenhouse. Untreated plants showed whitish patches of powdery mildew, while in the treated plants the mycelium could hardly be seen and leaves only showed localized yellow spots corresponding to former sites of infection. Tea compost reduced disease incidence by 19% when used as a preventive treatment and eradicated the pathogen on the leaves when applied as a curative treatment. Treatment was not associated with increased peroxidase or chitinase activity in the leaves and induction Of local resistance is unlikely to have been responsible. Instead, the effects of the compost could be due to die presence of bacteria and fungi, which may act as
antagonists to the pathogen. The compost was rich in inorganic salts, organic carbon and phenols, which can affect pathogen growth and phyllosphere microorganisms.


The potential of water extracts produced from rice straw (RST) and empty fruit bunch of oil palm (EFB) comports fortified with Trichoderma harzianum for the control of Choanephora wet rot of okra caused by Choanephora cucurbitarum was studied under field conditions. Disease severity was lowest in plants treated with Trichoderma-fortified RST extracts (9.56%) with a disease index of 1, mancozeb, (Dithane M-45(R) (2gl(-1) of water), Trichoderma-fortified EFB compost extracts, extracts of RST and EFB, and an aqueous suspension of T harzianum recorded disease severity values of 10.25%, 19.38%, 37.56%, 53.71% and 56.36%, with a disease index of 1, 1, 2, 3 and 3, respectively. There was a reduction of 85.04% in Choanephora wet rot severity on okra treated with Trichoderma-fortified RST extracts during 12 weeks of assessment in the field, which was comparable to the conventional fungicide Dithane M-45(R), suggesting that application of extracts produced from well-matured compost fortified with biocontrol agents could be an alternative control strategy. (C) 2007 Elsevier Ltd. All rights reserved.


Vermicompost (VC) is a nutritionally rich natural organic fertilizer, which releases nutrients relatively slowly in the soil. It improves quality of the plants along with physical and biological properties of soil, i.e., soil aeration, water-holding capacity and ecological balance of microbial soil biota. Aqueous extracts of vermicompost (AVC) inhibited spore germination of several fungi. They also affected the development of powdery mildews on balsam (Impatiens balsamina) and pea (Pisum sativum) caused by Erysiphe cichoracearum and Erysiphe pisi, respectively, in the field at very low concentrations (0.1-0.5%). Soil amendment with VC (1-5%) induced synthesis of phenolic acids in pea. Maximum phenolic acids were detected in pea plants treated with 4% VC followed by 3% as compared to control. The induction of phenolic acids in plants was correlated with the degree of resistance in treated as compared to non-treated (control) pea plants. The growth of plants grown in VC-amended soil was much better than the growth of plants raised in non-amended soil.

Microbiologically active extracts reducing significantly the infestation of lettuce (Lactuca sativa) and beans (Phaseolus vulgaris) by B. cinerea are obtained when mixing composted organic material with water in a relation of 1:4 followed by filtration through a cheesecloth. Protective sprayings in greenhouse with extracts from composted horse manure with an extraction time of 4 days could highly significantly reduce the disease intensity of young lettuce (cv. Maikonig). The same extract inhibited the development of lesions caused by B. cinerea on detached French bean leaves (cv. Processor) in moist chambers up to nearly 70%. In both experiments the time lag between the spraying of the extract and the artificial inoculation with B. cinerea was 2 days. In vitro 7 different composts with extraction times of 1 hour, 1 day, 2 days, 4 days, 8 days, 16 days, and 32 days were tested on their effect on the germination of conidia of B. cinerea. The best results were obtained by composted cattle manure, composted grape marc, and composted horse manure that completely suppressed the germination of conidia after extraction times between 8 and 16 days.

Further investigations with extracts that lost their efficiency by sterile filtration, point out the involvement of microorganisms in the process of controlling B. cinerea by extracts of composted organic material.


The search for replacements for synthetic fungicides has prompted the examination of a range of plant-based composts and extracts as alternative crop-protection agents. A study was established to compare the relative efficacy of the commercially available Jolly Farmer (JF) compost tea, of an Acadia SeaPlants Inc. (ASL) powdered-kelp product, and of Manzate (R) 75 DF (dry flowable) as foliar protectants against the potato late blight pathogen Phytophthora infestans. Population density, community structure, and antibiosis ability of phylloplane bacteria present on potato foliage ('Russet Burbank') were compared before and after foliar treatment. Bacteria recovered using culture-dependent means were characterized by fatty acid methyl ester (FAME) analysis and partial sequencing of their 16S ribosomal RNA genes. Autotrophic bacterial-population densities on the phylloplane varied with year, and tended to be lowest following Manzate 75 DF treatments. Phyllobacteria communities recovered from posttreatment phylloplanes often bore little resemblance to their tank-mixture counterparts, for all three treatments, and were significantly (P = 0.05) less effective at inhibiting P. infestans growth, in vitro, compared with foliar communities before the treatments. Manzate 75 DF was the most effective treatment (P = 0.05) for controlling P. infestans infection and disease development in vivo. Both JF compost tea and ASL powdered kelp were similar in their inability to protect potato leaves from P infestans severity. Phyllobacterial populations established following Manzate 75 DF treatment proved to have significantly (P = 0.01) fewer antibiotic-producing strains (in vitro) than naturally occurring leaf populations prior to foliar treatment. Accordingly, it appears that Manzate 75 DF derives little if any additive or synergistic plant-protectant properties from the naturally established phylloflora.

Foliar treatment with aq. extracts of a mixture of manure, straw and soil (MSS) reduced the number of scab [Venturia inaequalis] spots on apple fruits in comparison with controls treated with tap water and plants treated with a commercial compost extract made from grape residues. When fruits with >4 scab spots were disregarded, treatment with MSS extracts resulted in a yield increase of >20% in comparison with the control.


In field trials, tomato cv. Brigade plants inoculated in summer 1993 with Alternaria solani were sprayed with 14-day-old compost extract (CEX) prepared in a ratio of 1:5 compost to water (v/v). A significant reduction in disease index was observed in the CEX treated plants, as well as in the fungicide (copper compound) treatment, compared with controls (inoculated but not treated further). The yield of CEX treated plants was significantly higher than in the controls, similarly to the fungicide treated plants. In the summer of 1994, 7- and 14-day-old extracts were sprayed. Disease index in plants treated with either CEX or the fungicide was reduced compared with the controls. Yields of these treatments were significantly improved (20.9, 19.9 and 13.9% by fungicide treatment, 14-day-old CEX and 7-day-old CEX, respectively).


Experiments were conducted to determine the effects of treatments on Clavibacter michiganensis subsp. michiganensis in vitro and on young seedlings inoculated with the pathogen under greenhouse conditions. Lysozyme was bactericidal at 10 g/l concentration in vitro. Tomato plants treated with lysozyme at 10 g/l and 100 g/l showed significantly higher plant height compared with the inoculated control plants, and plants in these treatments were as tall as those observed in untreated uninoculated control plants. Treatments with B. subtilis (Quadra 136) and Trichoderma harzianum (RootShield(R)), lysozyme, vermicompostea, Rhodosporidium diobovatum (S33), B. subtilis (Quadra 137) applied as a spray at 0.3 g/l, 0.6 g/l, 10 g/l, concentrated, 1 x 10(9) CFU/ml, and 0.5 g/l, respectively, have the ability to prevent the incidence of bacterial canker of tomato plants caused by C. michiganensis subsp. michiganensis under greenhouse conditions.

A field experiment has compared in 1991 several methods used or potentially usable in organic farming to control Phytophthora infestans in potato crop. These methods were as follows: Bordeaux mixture (two different formulations), leaf fertilization (with bacterial activator), isotherapeutic solutions, compost extract (horse manure and wood chips). The Bordeaux mixture was either a mixture of CuSO4 and Ca(OH)2 prepared just before use, or a ready for use powder (Duclos). At apparition of the first P. infestans lesions in the trial, an artificial inoculation was carried out in all experimental plots, in order to homogenize the infection. In these conditions of heavy infection only the Bordeaux mixtures were effective to protect partially the foliage against disease. Despite the complete destruction of the foliage in the control plots and those of some treatments, any tuber batch showed signs on infection during a six months conservation.


This study determined feedstock effects on earthworm populations and the quality of resulting vermicomposts produced from different types of feedstocks using different vermicomposting durations. Feedstock combinations (Kitchen Paper Waste (KPW), Kitchen Yard Waste (KYW), Cattle Manure Yard Waste (CMY)), three durations of vermicomposting (45, 68 or 90 days), and two seed germination methods (with two concentrations of vermicompost) for radish, marigold and upland cress, served as the independent variables. The worms (Eisenia fetida) doubled their weight by day 68 in KPW and CMY vermicomposts and day 90 KPW vermicompost produced the greatest weight of worms. The direct seed germination method (seeding into soil or vermicompost-soil mixtures) indicated that KPW and KYW feedstocks decreased germination compared to the control, even in mature vermicompost. Seed germination was greater in the water extract method; however, most of the vermicompost extracts suppressed germination of the three seed species compared to the water controls. Vermicomposts from all three feedstocks increased leaf area and biomass compared to the control, especially in the 10% vermicompost:soil mix. Thus, seed germination and leaf area or plant biomass for these three species are contrasting vermicompost quality indicators.


The effect of compost extracts on strawberry yields and in the suppression of grey mould, Botrytis cinerea, in strawberries was studied over a period of two growing seasons on an organic, market garden farm in the southern interior of British Columbia. Composts were prepared both anaerobically and aerobically as well as at a 8:1 and 4:1 water to compost dilution in order to determine if preparation method and concentration changed any suppressive effect. Anaerobically prepared compost extract had little effect on strawberry yields yet reduced the severity (0.38 +/- 0.16%) of Botrytis cinerea compared to water sprays (1.02 +/- 0.36). Aerobically prepared extracts improved yields (1.70 +/- 0.08 t/ha) over the control (1.36 +/- 0.11 t/ha) and water spray (1.37 +/- 0.09) treatments and also reduced disease severity. Dilute extract reduced the incidence of the disease to a greater extent than all other treatments. (C) 2004 by The Haworth Press, Inc. All rights reserved.
Watery fermentation extracts of well-composted organic materials reduced disease incidence and intensity in various host pathogen combinations, if applied prophylactically to plant surfaces. Successes were achieved in the following systems: Plasmopara viticola, Uncinula necator and Pseudopeziza tracheiphila on grape vine; Phytophthora infestans on potatoes and tomatoes; Erysiphe graminis on barley; Erisyphe betae on sugar beets; Sphaerotheca fuliginea on cucumbers and Botrytis cinerea on strawberries and beans. Induced resistance is one of the mechanisms involved, but direct fungus inhibition has been observed.

We have previously studied the effect of water extracts from composted organic wastes on downy mildew of grapes. As the disease outbreak was suppressed by spray applications, we tried the same approach with Phytophthora infestans on tomato leaves and potato tubers under laboratory and greenhouse conditions. In both cases there was a strong control effect. Composted wastes of different raw materials were equally effective. Various extraction times and modes of application were studied. The extracts had no direct effect on zoospore release. Sterile filtration or heat treatment left the extracts ineffective. Studies to use the effect within biological or integrated control programs were initiated.

Watery extracts of composted manure-straw-soil mixtures induced increased resistance of grapevine leaves against downy mildew, Plasmopara viticola, if applied by dipping or spraying. The extracts had no direct fungicidal or fungitoxic effects.
The effects of compost application on leaf diseases was studied. Soil amendments increased resistance of barley and wheat against Erysiphe graminis and cucumbers against Sphaerotheca fuliginea. Watery extracts of composts were effective against Phytophthora infestans tomatoes and potatoes and Botrytis cinerea on phaseolus beans and strawberries. Amendments of the extracts with selected microorganisms increased and stabilized their efficiency. In field experiments some treatments equalled the efficiency of registered fungicides.


Watery extracts of composted cattle manure, composted sea algae, composted grape marc and composted horse manure significantly reduced the infection of cucumber leaves (Cucumis sativus) by Pseudoperonospora cubensis. 26 months old compost of greenplant plus manure was inefficient. The effectivity of the extracts from horse manure decreased with increasing age of the composts. All efficient extracts inhibited the germination of sporangia with zoospores. No induced resistance of the host was observed. The extracts had no curative effects.


Synthetic fungicides are being lost from the arsenal of measures available to growers for the management of foliar diseases because of environmental and health concerns; aqueous extracts of composts are among the biocontrol methods that have been suggested for their replacement. Of more than thirty compost materials tested, the anaerobically fermented aqueous extract of spent mushroom substrate (SMS) was most effective for the inhibition of germination of conidia of Venturia inaequalis, causal agent of apple scab, in an in vitro test. The compost extract was as good as or better than any other for the inhibition of disease in a seedling assay; however, there was no significant difference from water controls in field tests at two sites during the 1993 field season. The material was most inhibitory to conidial germination after five to nine days incubation in ratios from 2:1 to 4:1, water:SMS (volume). The extract maintained its inhibitory properties after autoclaving and after filter sterilization. Two genera of bacteria were consistently isolated from the extract, a pseudomonad and a Bacillus. There also appeared to be a volatile germination inhibitor. The extract maintained efficacy after storage at -20 degree C, 4 degree C and at room temperature for at least four months. It has also been screened with promising results, both in vitro and in planta, for inhibition of conidial germination of Cochliobolus carbonum and Sphaeropsis sapinea and the diseases they cause on maize and red pine, respectively. Neither conidial germination of Alternaria panax nor of leaf blight of ginseng, the disease it causes, was suppressed. Aqueous extracts of SMS from the same source behaved consistently among lots collected on different dates. Extracts prepared from SMS from different
producers who used similar methods for production of substrate and spawn from the same source supported different mycoflora and showed differences among levels of conidial inhibition/disease suppression.


To control apple scab disease caused by Venturia inaequalis, aqueous extracts from two sources of spent mushroom substrate (SMS), anaerobically fermented for 7 days and amended with spreader-sticker, were applied at weekly intervals to apple trees (cv. McIntosh) from green-tip to petal-fall and biweekly thereafter. Trials were conducted for three seasons at two locations in Wisconsin. Both extracts significantly reduced (alpha = 0.05) the leaf area affected by scab relative to water and spreader-sticker controls as evaluated by the Horsfall-Barratt scale. Disease incidence was similarly decreased but to a lesser extent. Extracts were not as effective in inhibiting disease as captan sprayed at the same intervals. No difference was detected between extracts with and without spreader-sticker. Higher populations of bacteria, which persisted for at least 1 month after the final spray, were detected on leaves treated with the extracts. No differences were found in total numbers of fungi. Inhibitory activity of extracts, assessed as in vitro inhibition of Venturia conidia germination, was monitored over time for extracts prepared from SMS stored under different conditions. For one source of SMS, neither time nor storage conditions (outdoors uncovered or indoors in sheds) affected inhibitory activity of extracts. Decline in efficacy of the other source was apparent by 13 weeks relative to unstored compost, although not between storage regimens.


We examined the effect of compost sample size (50 to 5000 g) on the precision of estimates of inhibition of Venturia inaequalis (Cke) Winter conidial germination induced by extracts of anaerobically-incubated composts. Composts were prepared from vegetable material; some were amended with manure. Variability due to sample size was considered as a function of extract efficacy (high, medium or low) and compost heterogeneity (high or low). Extract efficacy was characterized as ability to inhibit more than 75% of the conidia (high), 75 to 40% (medium), or fewer than 40% (low). Heterogeneity was characterized as visual or tactile presence (high) or absence (low) of parent material in the compost. To address the question of sample size-related variability we partitioned individual extract incubations (samples) into aliquots (sub-samples), and aliquots into microtiter plate wells (sub-sub-samples). For this nested design, the largest component of variation was consistently found to be that associated with wells; aliquots were a negligible source of variation. Sample size over the range examined was generally of small importance for extracts of medium and high efficacy, but not low efficacy, independent of compost heterogeneity. For previously untested composts, particularly those of high heterogeneity, statistical analyses of our data suggest that samples of at least 500 g circumvent potentially large errors and consequent difficulties to detect differences among composts or effects of experimental variables. Copyright (C) 1996 Elsevier Science Ltd
The effect of foliar sprays with aqueous vermicompost extracts on growth, yields, morphological and chemical fruit quality and natural infection with late blight disease (Phytophthora infestans (Mont.) de Bary) on three tomato varieties (Lycopersicon esculentum Mill., cv. Diplom F1, cv. Matina, cv. Rheinlands Ruhm) was investigated in a field experiment. Extracts were prepared of vermicompost produced from fruit, vegetable and cotton waste by redworms (Eisenia fetida Sav., Lumbricidae); tap water served as control treatment. Foliar application (spraying) of vermicompost extracts did not affect plant growth, biomass or nutrient allocation, or yields and number of fruits of the three tomato varieties; however, for several dates it significantly reduced the number of flowers produced. Foliar vermicompost spraying either increased or decreased peel firmness dependent on tomato variety and increased fruit circumference consistently as well as contents of nitrogen but decreased L-ascorbic acid compared with water sprayed fruits. All other measured parameters of fruit quality (dry matter, C, N, P, K, Ca, Mg, glucose and fructose content) were similar for vermicompost and water sprayed plants. Natural infection of leaves, stems and fruits by P infestans was generally very low under the experimental conditions; however, across varieties, only half as many vermicompost sprayed plants showed clear signs of P. infestans infection as water sprayed plants; the severity of the infection was unaffected by the two spraying treatments. In conclusion, these results suggest that the use of vermicompost might be considered more in organic farming not only as a substitute for peat in potting media but also as foliar sprays for fertilization and biological disease prevention.


A biocontrol agent-fortified compost mix, suppressive to several diseases caused by soilborne plant pathogens, induced systemic acquired resistance (SAR) in cucumber against anthracnose caused by Colletotrichum orbiculare and in Arabidopsis against bacterial speck caused by Pseudomonas syringae pv. maculicola KD4326. A peat mix conducive to soilborne diseases did not induce SAR. The population size of P. syringae pv. maculicola KD4326 was significantly lower in leaves of Arabidopsis plants grown in the compost mix compared to those grown in the peat mix. Autoclaving destroyed the SAR-inducing effect of the compost mix, and inoculation of the autoclaved mix with nonautoclaved compost mix or Pantoea agglomerans 278A restored the effect, suggesting the SAR-inducing activity of the compost mix was biological in nature. Topical sprays with water extract prepared from the compost mix reduced symptoms of bacterial speck and the population size of pathogenic KD4326 in Arabidopsis grown in the peat mix but not in the compost mix. The peat mix water extract applied as a spray did not control bacterial speck on plants grown in either mix. Topical sprays with salicylic acid (SA) reduced the severity of bacterial speck on plants in the peat mix but did not further reduce the severity of symptoms on plants in the compost mix. The activity of the compost water extract was heat-stable and passed through a 0.2-μm membrane filter.
beta-1,3-Glucanase activity was low in cucumber plants grown in either mix, but when infected with C. orbiculare, this activity was induced to significantly higher levels in plants grown in the compost mix than in plants grown in the pear mix. Similar results were obtained for beta-D-glucuronidase (GUS) activity driven by a PR2 (beta-1,3-glucanase) gene promoter in transgenic Arabidopsis plants grown in the compost or peat mix. GUS activity was induced with topical sprays of the compost water extract or SA in plants not inoculated with the pathogen, suggesting that compost-induced disease suppression more than likely involved the potentiation of resistance responses rather than their activation and that compost-induced SAR differed from SAR induced by pathogens, SA, or compost water extract.