Suppression of Botrytis Blight and Powdery Mildew of Begonia by Trichoderma hamatum 382 in peat and compost-amended potting mixes.

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Abstract

Composts may induce systemic resistance (ISR) in plants against root as well as foliar diseases, but this effect is highly variable in nature. It was shown recently that 2% of several different types of composts naturally induced ISR in plants. The research reported here revealed that inoculation of Trichoderma hamatum 382 (T382) into a light Sphagnum peat mix significantly reduced the severity of Botrytis blight and powdery mildew of begonia, probably through ISR. Inoculation of the mix with T382 also significantly increased plant dry weight and improved salability. Amendment of the peat mix with a batch of composted cow manure (5%; v/v) that naturally induced ISR in plants, also significantly decreased the severity of these diseases and improved plant quality. The degree of disease control provided by these ISR treatments did not differ significantly from that provided by foliar sprays with chlorothalonil or pipron for Botrytis blight and powdery mildew, respectively.

Introduction

Botrytis blight caused by Botrytis cinerea L. is an economically important disease of begonia. It causes lesions on flowers, leaves and stems during the entire cropping cycle, with the greatest losses occurring during transit and storage (5). It is particularly severe under high humidity and low light conditions. Control of the disease depends on timely applications of protective fungicides (7), but B. cinerea has developed resistance to several that are labeled for floricultural crops (4). Thus, it makes sense to incorporate alternative control strategies into integrated disease management strategies to prolong the useful life span of fungicides. Specific isolates of Trichoderma can reduce the severity of Botrytis blight by inducing systemic resistance in plants when applied as foliar sprays (3). Composts incorporated into potting mixes also can reduce severity of foliar diseases through induced systemic resistance (ISR) but the effect is variable (9). Inoculation of compost-amended mixes with Trichoderma hamatum 382 (T382) or Pythium oligandrum can augment this effect of composts (6, 8). The objectives of this work were to: 1) determine whether T382 incorporated into Sphagnum peat or compost-amended potting mixes can reduce the severity of Botrytis blight and powdery mildew; and 2) whether this effect is systemic in nature.

Material and Methods

Botrytis blight bioassay: Transplants of Hiemalis begonia (cv 'Barbara or Arosa', Oglevee Ltd., Connellsville, PA) were planted in a greenhouse (17-25^{0}C; 40-60%RH) in a Sphagnum peat perlite mix (6) or the same mix but amended (5%; v/v) with composted cow manure (2). The potting mixes had been inoculated during their formulation with a granular preparation of T382 received from Sylvan Bioproducts, Inc., Cabot, PA at a rate of 120 g. m^{-3} mix to establish a population density of 2x10^5 cfu T382 g^{-1} dw mix. Control mixes were not inoculated with T382. A topical weekly spray with chlorothalonil (Daconil, flowable, SDS Biotech K.K.) served as a fungicide control for Botrytis blight. All plants were drenched with metalaxyl-M (Subdue Maxx, LC, Sygenta) to control Pythium root rot. Three weeks after transplanting, the relative humidity in the greenhouse was increased to 40-85% and 24 hours later all plants were sprayed to run-off with a conidial suspension (2x10^5 cfu ml^{-1}) of a begonia isolate of B. cinerea. The severity of Botrytis blight was determined at 4-day intervals for 6 weeks thereafter. The experiment was a randomized complete block design consisting of 3 blocks with 3 plants each per treatment. The plants were rated weekly for disease severity on the basis of percent of total plant surface displaying symptoms. The AUDPC was determined for the entire rating period. The population of T382 in the potting mixes and in plants was determined on a selective medium and verified by PCR as described previously (6).

Powdery Mildew Bioassay: The design of the experiment and measurement of disease was identical to that described above for Botrytis blight except that the topical fungicide pipron (Pipron, liquid concentrate, SePRO Corp, Carmel, IN) was used. The source of powdery mildew was plants naturally infected with the pathogen that were distributed randomly throughout blocks.

Data analysis: The effect of potting mix and control treatments on dry weight of plants and AUDPC was determined by ANOVA. The effect of mix treatment on salability was determined with the nonparametric relative-treatment effects analysis of Brunner and Puri (1).

Results

T382 significantly ($P<0.05$) reduced the severity of Botrytis blight on plants in the Sphagnum peat mix in two of three experiments (Table 1, Fig.1). Chlorothalonil was significantly ($P<0.05$) less effective than T382 in one of these experiments. The composted cow manure-amended mix was even more suppressive than the T382-inoculated peat mix. Neither T382 nor chlorothalonil further reduced the severity of Botrytis blight in this compost mix. These results were consistent among three experiments. Chlorothalonil and T382 did not consistantly increase salability of begonia plants in the peat mix. However, the compost-amended mix consistently increased salability. Neither T382 nor chlorothalonil further improved salability in the compost mix.

T382 and pipron significantly ($P<0.05$) reduced the severity of powdery mildew in the peat mix and improved salability (Table 2). The composted cow manure-amended mix also suppressed the disease and improved salability. Neither pesticide treatment (T382 or pipron) improved this effect. Finally, T382 was not recovered on a Trichoderma selective medium from the foliage or stems of begonia plants suggesting that this batch of compost induced SR naturally.

Conclusions

T382 and the ISR-active composted cow manure-amended potting mix were as effective as foliar sprays with Chlorothalonil or Pipron for control of Botrytis blight or powdery mildew, respectively. Spatial separation of T382 and the pathogens on the plant suggested that the protective effect was due to ISR.

Table1. Control of Botrytis blight of Hiemalis Begonia cv. Barbara in potting mixes inoculated with Trichoderma hamatum 382.

Potting Mix	Pesticide Treatment	DISEASE SEVERITY (AUDPC)[1] Exp.1	Exp.2	Exp.3	SALABILITY[2] Exp.1 median	Exp.1 rank	Exp.2 median	Exp.2 rank	Exp.3 median	Exp.3 rank
Peat	control	1609.4a	1402.4a	712.9a	-	-	2.0	14.4b	2.0	14.3a
Peat	chlorothalonil	708.1b	844.8a	229.3bc	-	-	2.0	16.5b	4.0	26.6ab
Peat	T382	408.1b	84.9b	536.9ab	-	-	4.0	35.7a	4.0	39.1b
SD compost	control	942.5b	88.1b	92.1c	-	-	3.0	23.1b	2.0	19.9ab
SD compost	chlorothalonil	840.0b	52.5b	101.6c	-	-	4.0	34.6a	4.0	30.4b
SD compost	T382	460.6b	55.0b	149.6c	-	-	4.0	40.7a	4.0	34.8b

1) Area Under the Disease Progress Curve based on mean disease severity ratings made during the growing cycle (n=9); numbers with the same letters do not differ significantly.
2) Mean salability (n=9) at flowering based on 5=asymptomatic with 1 or more flower stalks with at least 1 flower open and 1=dead plant.

Figure 1. Effects of various chemical and biological pesticides on Botrytis blight of begonia at 3 weeks after transplanting.

peat + chlorothalonil | peat + T382 | peat | SD compost | SD compost + T382 | SD compost + chlorothalonil

Table2. Control of Powdery Mildew of Hiemalis Begonia cv. Barbara in potting mixes inoculated with Trichoderma hamatum 382.

Potting Mix	Pesticide Treatment	Disease Severity[1] (AUDPC)	Salability[2] median	rank
Peat	control	1402.8a	2.6a	
Peat	chlorothalonil	363.2bc	3.7b	
Peat	T382	100.3c	4.4c	
SD compost	control	347.3bc	3.8bc	
SD compost	chlorothalonil	216.8bc	4.1bc	
SD compost	T382	521.4b	3.8bc	

1) Area Under the Disease Progress Curve based on mean disease severity ratings made during the growing cycle (n=9); numbers with the same letters do not differ significantly.
2) Mean salability (n=9) at flowering based on 5=asymptomatic with 1 or more flower stalks with at least 1 flower open and 1=dead plant.

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