Suppression of Rhizoctonia Damping-Off by Composted Hardwood Bark Medium

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ABSTRACT

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A postemergence inoculation method was used to evaluate the ability of a composted hardwood bark medium to suppress Rhizoctonia damping-off of seedlings in bedding plant flats. *Celosia argentea* 'Red Fox' seedlings were planted in two peat mixes and one composted bark mix and were inoculated at seedling emergence with one of two cultures of *Rhizoctonia solani* anastomosis group 4. After 6 days, significantly less damping-off had occurred in the composted bark mix than in the peat mixes. The highly virulent and moderately virulent isolates of *R. solani* caused 2.5 and 3 times more damping-off, respectively, in the peat mixes than in the composted bark mix in one test, and 4.0 and 9.5 times more damping-off in a subsequent test. The frequency of isolation of *R. solani* from symptomless seedlings taken from beyond the last damped-off seedling in a row decreased rapidly with increased distance in all soil mixes.

The greenhouse industry has relied on steam sterilization of soil in combination with fungicide drenches to control damping-off in seedling flats. Recently, attention has focused on the use of composted bark for disease control in greenhouse crops (2). Hoitink et al (4) demonstrated that species of *Phytophthora, Pythium,* and *Rhizoctonia* could not be isolated from infected plant tissue after incubation in an active compost pile. Composted hardwood bark prepared from a mixture of three tree species decreased Pythium and Phytophthora root rots in container-grown rhododendrons and azaleas (3).

In the bedding plant industry, damping-off is more of a problem in seedling flats than in transplant flats. Damping-off decreases in established seedlings because the environment is less favorable to pathogens and plant resistance is often greater (6).

We evaluated a composted hardwood bark mix for the suppression of Rhizoctonia damping-off of seedlings in seedling flats. Some of this work has been mentioned elsewhere (2).

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MATERIALS AND METHODS

Rhizoctonia damping-off was compared in a composted bark mix and two commonly used bedding plant peat mixes, Jiffy Mix (a peat-vermiculite mix) (Jiffy Products, Chicago, IL) and a 60% peat mix prepared with 10% sterile field soil, 15% vermiculite, and 15% perlite. The composted bark mix was made up of 50% composted bark, 20% peat, 20% perlite, and 10% sand. The mixes were prepared in a concrete mixer. The composted bark mix and the 60% peat mix were amended with 5 or 10 g of Osmocote 14-14-14 slow-release fertilizer per liter of soil. (Jiffy Mix was already amended with a slow-release fertilizer.) The pH of all planting mixes was initially 6.4 and remained between 6.4 and 6.8 throughout the study.

Celosia (*Celosia argentea* L. 'Red Fox') seedlings were used in all experiments. Seeds were sown in double rows in 16 × 12 × 6 cm rectangular flats filled with the test planting mix and adjusted with water to container capacity (7) to standardize the water content of the mixes. Flats were then placed in 91 × 183 cm plastic bags to maintain high humidity. Two 15-cm wooden stakes were placed in each flat to keep the bag from touching the emerging seedlings. Flats were incubated in a growth chamber at 27 C and 25,000 lux for 12 hr per day and at 21 C in darkness for 12 hr per day.

Two isolates of *R. solani* Kuehn (anastomosis group 4), one highly and one moderately virulent, were obtained from damped-off seedlings of salvia (*Salvia splendens*) and impatiens (*Impatiens wallerana*), respectively, during a 1975–1976 survey of the Ohio bedding plant industry. Isolates were grown on 20 ml of potato-dextrose agar in 90-mm plates for 4 days at 24 C.

Fig. 1. Celosia seedling damping-off caused by *Rhizoctonia solani* in peat (left) and composted bark (right) potting mixes.

Mycelial disks 12 mm in diameter were taken from the colony margin of the 4-day-old cultures and used to inoculate the flats of emerging seedlings. The disks were buried 0.5 cm below the surface of the planting media next to the first seedling at the end of each seedling row. Flats were then lightly misted, bagged, and returned to the growth chamber. After 6 days of incubation, the length of row (up to 16 cm) with damped-off seedlings was measured.

The effect of the soil mixes on damping-off caused by *R. solani* was compared in experiment 1. The peat mix and composted bark mix were amended at the start of the experiment with 10 g of Osmocote per liter. Each treatment was replicated eight times. In experiment 2, the effect of two concentrations of Osmocote (5 and 10 g/L of soil) added to composted bark mix on damping-off was compared with the effect of the standard Jiffy Mix. Each treatment was replicated eight times. Both experiments were repeated.

A third experiment, similar to experiment 2, was performed to determine if *R. solani* could be isolated from symptomless celosia seedlings taken from beyond the margin of damping-off in the Jiffy and composted bark mixes (the latter mix amended with 10 g/L of Osmocote). The highly virulent isolate of *R. solani* was used for inoculum as described. After 6 days, the distances seedlings had damped-off down the rows were measured. Symptomless seedlings 0, 4, and 8 cm beyond the seedlings with damping-off were plated on Ko and Hora's medium (5) and assayed for the presence of *R. solani*.

Table 1. Celosia seedling damping-off caused by two isolates of *Rhizoctonia solani* in peat and bark container mixes[x]

Treatment	Isolate: Highly virulent	Isolate: Moderately virulent
Experiment 1		
Jiffy Mix	11.4 a	10.7 a
60% Peat mix amended with 10 g/L Osmocote[y]	11.6 a	10.7 a
Composted bark amended with 10 g/L Osmocote[z]	4.6 b	3.3 b
Experiment 2		
Jiffy Mix	13.7 a	5.7 a
Composted bark amended with 5 g/L Osmocote	2.9 b	1.1 b
Composted bark amended with 10 g/L Osmocote	3.4 b	0.6 c

[x] Figures represent length of row in centimeters (maximum 16 cm) with damped-off seedlings 6 days after inoculation. Values in the same column followed by the same letter are not significantly different ($P = 0.05$), according to Duncan's multiple range test.

[y] 60% Peat, 10% sterile field soil, 15% vermiculite, 15% perlite. Osmocote is a slow-release fertilizer.

[z] 50% Bark, 20% peat, 20% perlite, 10% sand.

RESULTS

Damping-off was significantly ($P = 0.05$) greater in the peat mixes than in the composted bark mix (Fig. 1 and Table 1). The highly virulent and moderately virulent isolates of *R. solani* caused 2.5 and 3 times as much damping-off, respectively, in the Jiffy Mix and 60% peat mix as in the composted bark mix in experiment 1, and 4.0 and 9.5 times as much damping-off in experiment 2.

Reducing the concentration of Osmocote added to the composted bark mix from 10 g/L to 5 g/L in the second experiment did not change significantly the amount of damping-off caused by the virulent isolate, but did affect the moderately virulent isolate (Table 1), which caused significantly ($P = 0.05$) more damping-off at the 5 g/L amendment level than at the 10 g/L level. As in the first experiment, both isolates of *R. solani* caused significantly ($P = 0.05$) more damping-off in Jiffy Mix than in the composted bark mix.

In the third experiment, damping-off was again significantly greater in the Jiffy Mix (12.3 cm) than in the composted bark mix (3.1 cm). *R. solani* was isolated from a relatively high number of seedlings next to the last damped-off seedling in the 20 rows. Isolations decreased as the distance from the last damped-off plant increased. When results from the two tests were combined, *R. solani* was isolated from an average of 45% of seedlings at 0 cm, 10% at 4 cm, and 3% at 8 cm in the composted bark mix and from 63% of seedlings at 0 cm and 8% at 4 cm in Jiffy Mix. No isolations could be made from seedlings at 8 cm in Jiffy Mix because the seedling rows were only 16 cm long and damping-off always exceeded 10 cm.

DISCUSSION

Composted hardwood bark reduced the incidence of Rhizoctonia damping-off in celosia seedlings in bedding plant flats compared with Jiffy Mix and a 60% peat planting mix. Several factors may have contributed to the reduction of *R. solani* damping-off in composted bark. Because the initial inoculum density was the same in each medium, the rate of saprophytic growth and/or the rate of infection must have been reduced. In general, *R. solani* grows more rapidly in sterilized than in nonsterilized mixes, which results in an increased inoculum potential in sterile media (1,6). Because the peat mix was sterile, saprophytic growth and seedling infection were not impeded by other microorganisms, whereas in composted bark, the pathogen had to compete with established microorganisms. Hoitink (2) discussed some possible mechanisms of suppression in composted bark media.

Isolation of *R. solani* from symptomless seedlings beyond the margin of damped-off seedlings dropped off rapidly with increasing distance in both composted bark mix and Jiffy Mix. However, the results indicated that *R. solani* can be carried on apparently healthy seedlings in flats infested with *R. solani*. Use of composted bark mix could reduce the spread of *R. solani* when a seedling or transplant flat becomes infested. *R. solani* spreads rapidly from plant to plant in peat mix; composted bark mix effectively reduces movement of the pathogen. This inhibition effect could be significant in a greenhouse, where reinfestation can occur easily. Although the practicality of the observed reduction of seedling damping-off in commercial bedding plant applications remains to be demonstrated, composted bark has potential merit as a disease control measure.

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