The Safety and Efficacy of Fungicides for Use in Rhizoctonia Crown Rot Control of Directly Potted Unrooted Poinsettia Cuttings

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ABSTRACT

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Of quintozene, benomyl, and ethazole added as drenches to unrooted poinsettia (*Euphorbia pulcherrima*) cuttings, only benomyl controlled cutting rot caused by *Rhizoctonia solani* at rates that did not retard rooting. Quintozene and quintozene plus ethazole granular formulations incorporated into the potting medium before use also failed to control the disease except at rates that decreased rooting of the cuttings.

Additional keyword: fungus

For early plantings, many growers place freshly harvested poinsettia (*Euphorbia pulcherrima* Willd. ex Klotzsch) cuttings directly in pots containing a suitable planting medium for rooting and eventual growth. Such a practice saves time and labor but is apt to increase the prevalence of cutting rot caused by *Rhizoctonia solani* Kühn (5,13). The cutting is placed into a medium that may contain as much as one-third field soil. Such a medium may be infested with *Rhizoctonia*. Moreover, the pots are usually not in propagation facilities but are placed directly on greenhouse benches for growing without mist. The resulting intermittent dryness at the soil surface may favor infection with *Rhizoctonia* spp. (1). These benches may not have sufficient bottom heat to keep planting medium temperatures properly controlled. Rhizoctonia root and stem rot development has been observed on poinsettia to be worse below 16 C (13). Warmer planting medium, on the other hand, can increase the risk of initial *Rhizoctonia* infection. The fungus is reportedly more aggressive in attacking poinsettia above 17 C (2). Thus, critical temperature control is essential for proper plant health management.

Fungicides are commonly used in the greenhouse industry to help control Rhizoctonia crown rot and root rot diseases of potted poinsettias (8,10,11). Where plant temperature stress or planting medium contamination is likely to occur, chemicals can be used to assist in disease management. Little is known of the effects of presently available fungicides on unrooted cuttings (3,4). The purpose of this study was to examine the efficacy and phytotoxicity of chemical drenches that might be useful for the control of Rhizoctonia cutting rot of poinsettia. In addition, granular fungicides were examined for use in medium incorporation before sticking cuttings.

MATERIALS AND METHODS

R. solani (anastomosis group 4, multinucleate), previously isolated from

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Table 1. Effect of soil treatments on prevention of Rhizoctonia cutting rot of poinsettia

Treatment	Rate[x] (μg/g)	Percent healthy cuttings[y]
Uninfested medium	···	96
Infested medium	···	0
Quintozene 10G	115	0
Quintozene 10G	230	0
Quintozene 10G	460	0
MF 612[z]	197 + 86	4
MF 612	394 + 172	33
MF 612	788 + 344	79
Benomyl 50WP	88	67
Benomyl 50WP + ethazole 30WP	88 + 58	100
Quintozene 75WP	114	42
Quintozene 75WP + ethazole 30WP	114 + 58	50

[x] Amount of active ingredient per unit weight of moist planting medium at time of planting (12).
[y] Of 24 per treatment 10 days after treatment.
[z] Experimental granular consisting of 3.5% quintozene and 1.5% ethazole.

Table 2. Effect of fungicide treatment of *Rhizoctonia*-infested medium on severity of cutting rot of poinsettia

Treatment	Rate[w] (μg/g)	Average disease rating[x]	Percent healthy cuttings[y]
Benomyl 50WP	176	1.2 ab	38
Benomyl 50WP	88	1.2 ab	50
Benomyl 50WP + ethazole 30WP	88 + 58	0.7 a	46
Quintozene 75WP	114	1.6 ab	29
Quintozene 75WP + ethazole 30WP	114 + 58	2.0 b	21
Quintozene 10G	460	3.4 c	0
Quintozene 10G	921	2.0 b	8
Quintozene 10G	1,842	1.8 b	16
MF 612[z]	394 + 172	3.3 c	16
MF 612	788 + 344	2.0 b	25
MF 612	1,576 + 688	1.8 b	8
Check (infested medium)	···	5.0 d	0

[w] Amount of active ingredient per unit weight of moist planting medium at time of planting (12).
[x] 0 = No infection, 1 = 20% of cutting rotted, 2 = 40% rotted, 3 = 60% rotted, 4 = 80% rotted, and 5 = completely rotted. Letters indicate Duncan's multiple range groupings of treatments that do not differ significantly at the 0.05 level.
[y] Of 24 per treatment 18 days after treatment.
[z] Experimental granular consisting of 3.5% quintozene and 1.5% ethazole.

poinsettia, was cultured on millet seed in 250-ml flasks. Sixty milliliters of seed were placed in the flasks with 40 ml of water and autoclaved three times in 72 hr. The flasks were then seeded with fungal mycelium from a PDA culture of the fungal isolate. The flasks were incubated for 1 wk at 22 C and shaken every 24 hr. One flask of inoculum was mixed with 0.28 m^3 of sterilized potting medium and stored in a plastic bag at 22 C for another week before use.

The fungicides used were: pentachloronitrobenzene (quintozene, Terraclor 75WP and 10G, Olin Chemical Corp., Little Rock, AR), methyl 1-(butylcarbamoyl)-2-benzimidazolecarbamate (benomyl, Benlate 50WP, DuPont Chemical Co., Wilmington, DE), 5-ethoxy-3-(trichloromethyl)-1,2,4-thiadiazole (ethazole, Truban 30WP, Mallinckrodt Chemical Works, St. Louis, MO), and an experimental granular consisting of 3.5% quintozene and 1.5% ethazole (MF 612, Mallinckrodt).

Before each experiment, freshly harvested C-1 poinsettia cuttings were shipped by air from The Ecke Poinsettia Ranch, Encinitas, CA. Upon arrival, the cuttings were immediately stuck into infested potting medium (soil:peat:perlite, 1:1:1, v/v) in 7.6-cm peat pots. The pots were then moved to a greenhouse bench and the medium temperature was kept at 21 C. Intermittent mist (15 sec/6 min) was applied to the cuttings during daylight hours. There were 24 cuttings per treatment in each experiment.

The granular fungicides were mixed into the infested medium just before filling the pots and sticking the cuttings. Cuttings were then watered-in with tap water. The other treatments were applied as drenches to the cuttings immediately after sticking at the rate of 1 L of drench per 0.09 m^2 of pots, a rate that thoroughly wetted the medium. No additional tap water was used for watering-in these cuttings. Application rates were computed for both granular and drench-applied fungicides as the amount of active ingredient per unit weight of moist planting medium at time of planting (12).

RESULTS

In each experiment, *Rhizoctonia* occurrence was visually noted as a result of the typical lower stem lesion. Isolations of *Rhizoctonia* from diseased plants further confirmed the activity of the pathogen. In the first experiment, disease occurrence was tabulated 10 days after cuttings were stuck. Ethazole improved the control whenever it was added to either benomyl or quintozene (Table 1).

In the second experiment, the amount of rot in each cutting was noted along with the number of cuttings that remained healthy 18 days after treatment (Table 2). The amount of rot per cutting was rated on a 0–5 scale, where 0 = no infection, 1 = 20% of the cutting rotted, 2 = 40% rotted, 3 = 60% rotted, 4 = 80% rotted, and 5 = completely rotted. The untreated controls were completely destroyed 18 days after sticking. The addition of ethazole to the benomyl treatment again improved disease control. When ethazole was added with quintozene, however, resulting cutting rot was worse. Of the granulars, MF 612 at 788 + 344 μg/g of quintozene and ethazole, respectively, resulted in good disease control.

In a third experiment, higher rates of the granular materials were tested. As in experiment 2, the addition of ethazole to the quintozene treatment resulted in more disease than with quintozene alone (Table 3). The granular treatments also tended to increase disease severity as application rates were increased. This may have been because of phytotoxicity to the cuttings that increased their susceptibility to *Rhizoctonia* spp. Therefore, some of the cuttings that were used in this experiment were kept another 23 days and observed for the amount of rooting. Rooting was decreased in all but the uninfested check treatment.

A final experiment was conducted with uninfested planting medium. Thirty-seven days after treatment, the amount of rooting of the cuttings was recorded (Table 4). A previously published method (3) was used to rate the comparative size of the root masses on a 0–5 scale, where 0 = no roots and 5 = root mass 7.5 cm or more in diameter. Average rooting was decreased below that of the check plants for all treatments except the quintozene 10G at 921 μg/g and the benomyl drench at 88 μg/g. The addition of ethazole to the treatments reduced the rooting in every instance.

DISCUSSION

Because of the fear of retarding rooting and subsequent crop performance, many growers refrain from applying soil fungicides to unrooted cuttings of ornamental plants (3,4,8). The results of this study indicate that of the materials tested, only benomyl at 88 μg/g satisfactorily controlled Rhizoctonia cutting rot of poinsettia without damage to the cuttings. Quintozene was reported by Boodley (3) to be safe on poinsettia cuttings in tests done in soilless medium. In our study, using a potting medium containing soil, we noted retardation of rooting at levels of quintozene necessary to control disease. The results suggest that the addition of ethazole to the benomyl treatment enhances the level of

Table 3. Effect of fungicide treatment of *Rhizoctonia*-infested medium on severity of cutting rot of poinsettia

Treatment	Rate[w] (μg/g)	Average disease rating[x]	Percent healthy cuttings[y]
Check (uninfested medium)	···	0.1 a	79
Benomyl 50WP	88	1.6 b	29
Benomyl 50WP + ethazole 30WP	88 + 58	1.9 bc	21
Quintozene 75WP	114	1.7 b	8
Quintozene 75WP + ethazole 30WP	114 + 58	2.6 cd	4
Quintozene 10G	1,842	2.0 bcd	12
Quintozene 10G	3,684	2.6 cd	8
Quintozene 10G	7,368	2.9 d	4
MF 612[z]	788 + 344	2.4 bcd	8
MF 612	1,576 + 688	2.5 bcd	4
MF 612	3,152 + 3,176	4.0 e	0
Check (infested medium)	···	2.6 cd	0

[w] Amount of active ingredient per unit weight of moist planting medium at time of planting (12).
[x] 0 = No infection, 1 = 20% of cutting rotted, 2 = 40% rotted, 3 = 60% rotted, 4 = 80% rotted, and 5 = completely rotted. Letters indicate Duncan's multiple range groupings of treatments that do not differ significantly at the 0.05 level.
[y] Of 24 per treatment 13 days after treatment.
[z] Experimental granular consisting of 3.5% quintozene and 1.5% ethazole.

Table 4. Effect of fungicides on root development of poinsettia cuttings

Treatment	Rate[x] (μg/g)	Average amount of rotting[y]
Benomyl 50WP	88	3.2 ab
Benomyl 50WP + ethazole 30WP	88 + 58	2.3 bc
Quintozene 75WP	114	2.5 bc
Quintozene 75WP + ethazole 30WP	114 + 58	1.8 cd
Quintozene 10G	921	3.9 a
Quintozene 10G	1,842	2.6 c
Quintozene 10G	3,684	2.3 bc
MF 612[z]	394 + 172	1.7 cd
MF 612	788 + 344	0.5 e
MF 612	1,576 + 688	0.2 e
Check (no treatment)	···	3.1 ab

[x] Amount of active ingredient per unit weight of moist planting medium at time of planting (12).
[y] Of 24 cuttings in each treatment on a 0–5 scale, where 0 = no roots and 5 = root mass 7.5 cm or more in diameter.
[z] Experimental granular consisting of 3.5% quintozene and 1.5% ethazole.

cutting rot control. Marked reduction of rooting was noted, however, whenever ethazole was combined with benomyl or quintozene.

The granular materials appeared to control the fungus at optimum rates near 1,842 μg/g for the quintozene 10G and 788 and 344 μg/g of quintozene and ethazole in MF 612. These rates damaged the cuttings, however. The granulars incorporated into the potting medium failed to control disease at rates comparable to those of the same chemicals used as drenches. Similar results have also been observed for root rot control on established plants (12). Ko and Lockwood (6) suggested that organic matter absorbs quintozene. With the highly organic potting medium used in our study, the drenches may have been much more concentrated in the upper portion of the medium in the pot. Thus, the dosage may have been much higher near the area of *Rhizoctonia* infection (at or just below the medium surface) (2,5,7). Conversely, lower concentrations of fungicide in the lower portions of the medium in the pot may have been less inhibitory to the rooting of the cuttings. Fungicides applied as premixed granules may be more evenly distributed throughout the planting medium. Further studies on distribution, movement, and breakdown of fungicides applied as drenches or as preplant-incorporated granulars to highly organic potting medium should be made to fully evaluate the usefulness of granulars for control of crown or root rots of container-grown plants (9).

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