# Effect of Fungicide Drenches on Root Initiation by Geranium Cuttings

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## ABSTRACT

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Cuttings of Yours Truly and Easham cultivars of zonal geraniums (*Pelargonium* × *hortorum*) and Dark Pink, a cultivar of ivy geranium (*Pelargonium peltatum*), were rooted in peat and perlite (1:1, v/v) that had been treated with six commercially available fungicides alone and in combinations and compared with cuttings rooted in untreated mix. In general, the fungicides tested neither enhanced nor inhibited root initiation. Caution is urged in extrapolating these results to other media, plant materials, seedling production, other fungicides, and different timing of application.

Use of dry heat, steam heat, aerated steam heat, and broad-spectrum chemical fumigants are the most commonly employed methods for eliminating or greatly reducing pest populations in soil and soilless mixes used in the production of greenhouse crops. Heat treatments leave no chemical residues that are toxic to the crops to be planted but require electricity, oil, coal, or gas and equipment to produce the steam or dry heat. As fuel costs rise, growers seek other methods of treating soil. Many new growers are installing compact greenhouse heating units that do not produce the large volumes of steam necessary for treating soil. Broad-spectrum fungicides and fumigants can be used instead. Although these pesticides are highly effective, residues toxic to certain crops remain in the soil at very low concentrations. Most fumigants must be used outdoors or in well-ventilated indoor areas where there are no valuable plants that could be damaged by escaping fumes. In addition, 2 wk or more of aeration time is required after treatment to allow excess fumigant to escape before planting. These factors combine to make warm weather periods the best time to employ chemical fumigants and essentially rule out cold weather application periods. This restricts the flexibility of the greenhouse operation and necessitates having facilities for storing large volumes of treated soil. As an alternative to heat and broad-spectrum fumigants, application of less broad-spectrum fungicides has been suggested. A major concern is whether the fungicide drenches of propagation media will be phytotoxic and inhibit plant growth and development.

Our experiments were done to determine whether certain commercially available fungicides used alone and in various combinations enhance or inhibit root initiation of geraniums vegetatively propagated in a peat and perlite mix.

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## MATERIALS AND METHODS

Plastic flats (17 × 10.8 cm, 6.4 cm deep) were filled with about 950 $cm^3$ of peat and perlite (1:1, v/v). The following fungicides were then applied to the moistened mix: fenaminosulf, 100 ml/flat of 0.41 g a.i./L (Lesan 35% wp, Mobay Chemical Corp., Cherry Hill, NJ 08034); ethazol, 200 ml/flat of 0.23 g a.i./L (Truban, 30% wp, Mallinckrodt Inc., St. Louis, MO 63147); ethazol, 0.34 g/flat or 0.017 g a.i./flat (Truban, 5% granular, Mallinckrodt, Inc.); ethazol plus dimethyl 4,4-0-phenylenbis (3-thioallophanate), 100 ml/flat of 0.24 a.i./L (Banrot, 40% wp, Mallinckrodt, Inc.); benomyl, 200 ml/flat of 0.59 g a.i./L (Benlate, 50% wp E.I. du Pont de Nemours & Co., Agricultural Chemicals, Wilmington, DE 19898); quintozene, 240 ml/flat of 0.74 g a.i./L (Terraclor, 75% wp, Olin Corp. Agricultural Division, Little Rock, AR 72203); metalaxyl, 100 ml/flat of 0.009 g a.i./L (Subdue 2E, 25% emulsifiable concentrate, Ciba-Geigy Corp., Agricultural Division, Greensboro, NC 27409). Combinations of fenaminosulf plus quintozene, fenaminosulf plus benomyl, ethazol (30%) plus benomyl, metalaxyl plus benomyl, and ethazol (5% granular) plus benomyl were also applied, each at the same rate as above. All of these rates are the highest rates recommended on each product label. Check flats received no fungicide treatment. No rooting hormones were applied to the cuttings.

A split-plot design was employed in which 10 cuttings were placed in each of two flats per treatment and placed in one greenhouse and two identical flats per treatment were placed in another greenhouse. All flats were placed in a random arrangement in a tent of 2-mil clear polyethylene plastic covered with a single layer of cheesecloth. The plants were misted one to three times per day. Each week, the flats were moved to new locations at random under the tent. The geraniums propagated were: experiment 1, zonal geranium Yours Truly (*Pelargonium* × *hortorum*); experiment 2, ivy geranium Dark Pink (*Pelargonium peltatum*); and experiment 3, zonal geranium Easham (J.P. Bartlett, South Sudbury, MA 01776). The number of main roots developing from the base of each cutting was counted after washing the cuttings free of peat and perlite 3 wk after the experiments were begun.

The data were analyzed using two-way analysis of variance and Duncan's multiple range test (4). Main plots were greenhouse sections and subplots were treatments.

## RESULTS

In all experiments, the number of roots and root volume produced by the cuttings varied greatly regardless of the fungicide. This is reflected in the fact that although some statistically significant differences in the numbers of roots initiated were detected, most of the treatments were similar to one another (Table 1). No trend emerged from the experiments. In general, the fungicides tested alone and in various combinations at the highest recommended rates neither enhanced nor inhibited root initiation of the geranium cultivars propagated in peat and perlite.

## DISCUSSION

The fungicides tested are those commonly employed by greenhouse operators for controlling *Pythium* and *Rhizoctonia*, two fungi that often contaminate potting media and propagation beds. The experiments reported suggest that the fungicides tested neither enhance nor inhibit root initiation by geranium cuttings propagated in peat and perlite (1:1, v/v). Thus, under similar conditions, such treatments can be safely used to protect geranium cuttings during the rooting process where federal and state regulations allow.

Caution must be exercised in extrapolating the results presented here to other vegetatively propagated crops, seedling

**Table 1.** Number of roots initited at stem base of geranium cuttings of three cultivars after 3 wk in peat and perlite (1:1,v/v) that had been treated with fungicides

| | Mean number of roots initiated from stem base | | |
|---|---|---|---|
| **Fungicide and rate (a.i.)** | **Yours Truly** | **Dark Pink** | **Easham** |
| Fenaminosulf (0.41 g/L) | 11.7 bc[z] | 5.4 ab | 10.9 bc |
| Ethazol (0.23 g/L) | 8.1 abc | 4.9 ab | 10.1 bc |
| Ethazol (granular) (0.017 g/flat) | 6.0 ab | 3.0 a | 3.8 a |
| Ethazol plus dimethyl 4,4-0-phenylenbis (3-thioallophanate) (0.24 g/L) | 7.7 abc | 5.2 ab | 7.9 ab |
| Benomyl (0.59 g/L) | 8.0 abc | 3.5 a | 10.6 bc |
| Quintozene (0.74 g/L) | 9.4 abc | 6.6 b | 7.6 ab |
| Metalaxyl (0.009 g/L) | 10.9 bc | 5.5 ab | 8.0 ab |
| Fenaminosulf + quintozene (0.41 + 0.74 g/L) | 9.7 abc | 4.2 ab | 11.0 bc |
| Fenaminosulf + benomyl (0.41 + 0.59 g/L) | 9.4 abc | 5.5 ab | 10.2 bc |
| Ethazol + benomyl (0.23 + 0.59 g/L) | 11.4 bc | 3.1 a | 9.7 bc |
| Ethazol (granular) + benomyl (0.017 g/flat + 0.59 g/L) | 12.6 c | 3.8 ab | 7.5 ab |
| Metalaxyl + benomyl (0.009 + 0.59 g/L) | 5.2 a | 3.1 a | 13.7 c |
| Check (no treatment) | 6.4 ab | 4.7 ab | 6.1 ab |

[z]Values not followed by the same letter were significantly different at $P = 0.05$ according to Duncan's multiple range test (4).

production, other potting and propagation media, and drench treatments applied after sticking cuttings. Peterson (3) reported that benomyl, benomyl plus ethazol, ethazol plus dimethyl 4,4-0-phenylenbis(3-thioallophanate), and fenaminosulf plus quintozene applied after sticking all inhibited poinsettia rooting in foam rooting cubes as compared with cuttings not treated with a fungicide. These materials, however, did not cause toxicity in previous poinsettia experiments (2) employing soil:peat:perlite (2:1:1), even at higher than label-recommended rates. Boodley (1) reported that rooting of Barbara Ecke Supreme and Paul Mikkelson poinsettias in peat:vermiculite:perlite (2:1:1) was suppressed by fenaminosulf and fenaminosulf plus quintozene as compared with controls.

All chemical treatments of potting mixes introduce one more variable into the production of greenhouse plants. Phytotoxicity is possible if recommended rates of the material are exceeded purposely or by accident. Because of the many factors that interact and determine whether phytotoxicity occurs, including type of plant, type of chemical, and potting mix treated, any chemical should always be used initially on a trial basis and the plants compared with plants propagated in untreated mix. Because fungicide treatments have been shown occasionally to inhibit rather than enhance plant growth as compared with untreated plants, fungicides should be used cautiously, particularly when a wide variety of plant genera are to be grown.

Mixes prepared with field soil or sand as constituents require more than fungicide treatment to eliminate pests that could damage the crop. Nematodes, bacteria, insects, and weeds must also be eliminated. Heat or broad-spectrum fumigants are necessary for treating these mixes and fungicides alone do not replace these treatments.

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