Journal of the Minnesota Academy of Science

Volume 51 | Number 3 Article 4

1985

Fungicides for Control of Pythium ultimum on Greenhouse-Grown Geraniums

Nancy L. Olson
University of Minnesota, St. Paul

F. L. Phleger
University of Minnesota, St. Paul

Fungicides for Control of *Pythium ultimum* on Greenhouse-Grown Geraniums

NANCY L. OLSON* and F. L. PFLEGER**

ABSTRACT—Subdue 2E applied by drench at 18.7 ppm to soil inoculated with *Pythium ultimum* and in which rooted cuttings of geranium had been planted, was found to be free of the fungus during the test period of 30 days, and caused no injury to the plants. Banrot 40W at 240 ppm and Truban 25E at 145 ppm were only slightly fungistatic.

Introduction

Soilborne diseases caused by various *Pythium* species are important limitations to the production of many types of greenhouse crops (1, 2, 3, 4). Direct plant losses and delayed growth of crops affected by various types of root and stem rotting diseases contribute to higher production costs, unpredictable growth, and reduction in plant quality at the time of sale. Sanitary growing practices as well as the use of soil fungicides are necessary for control of these soilborne diseases. The growing medium, containers, the plants, and poor cultural practices are potential avenues of entry for soilborne pathogens into the crop production cycle (4, 5).

Pasteurization of the growing media with steam heat or fumigants is often used to eliminate or reduce pathogen populations from the media before planting seeds or cuttings (2). However, the media may be recontaminated during any part of the growing cycle. Therefore, applications of soil fungicides at planting time and during the growing cycle have been effectively used to help prevent diseases caused by soilborne pathogens.

A variety of fungicides are available and used as soil drenches to help control root rot pathogens during the production of geranium (*Pelargonium hortorum* Bailey). Control of *Pythium* species by the use of soil fungicides should be based on the understanding and limitations of the fungicides used. The rationale for use of chemical disease control measures is generally based on the fact that root and stem rotting pathogens, such as *P. ultimum* Trow., are not readily controlled once they become established in plant roots (5).

The purpose of this research was to determine the effectiveness of three fungicides on control of *P. ultimum*-inoculated geranium plants.

Materials and Methods

The *P. ultimum* culture used in this experiment was isolated from infected poinsettia roots. Inoculum was prepared using the bean pod water technique (6). The inoculum was sprayed into pasteurized 1:1:1 (peat, loam, perlite) soil medium using an atomizer and the inoculum and soil medium mixed in a soil mixer at a concentration of 200 colony forming units (CFU)/g moist soil. This inoculated soil will be referred to hereafter as SWP (Soil With *Pythium*). Soil medium not inoculated with *P. ultimum* was sprayed with sterile water and will be referred to hereafter as SWIS (Sterile Water Inoculated Soil). The soil was incubated in the dark, in plastic containers at 21°C for 30 days. Soil samples were then taken to determine the CFU/g dry soil of *P. ultimum*. A 1:5 dilution of soil in sterile distilled water was prepared and well mixed before 1.0 ml was spread onto 15-20 ml of a solid medium selective for *Pythium* (7). Ten plates each were prepared in this manner for the SWIS-control and SWP-inoculated soils and incubated at 21°C in the dark. After 24 hours, the soil was washed from the agar surface under a stream of tap water, and colonies on the medium were counted using a dissecting microscope. Each CFU of *P. ultimum* was counted and marked with a probe dipped in stain. Colonies were counted again 6 hours later.

No CFU of *P. ultimum* developed in the SWIS control soil, and 29% of the original 200 CFU/g *P. ultimum* were recovered from the SWP, or 58 CFU/g dry soil. After *P. ultimum* CFU were determined, rooted geranium cuttings of 'Sincerity' were planted in 10 cm plastic pots containing either SWP or SWIS. They were then placed on a greenhouse bench and maintained at 18.3°C ± 3° nights and 21.1°C ± 3° days with a 12 hour photoperiod. All pots were set on inverted plastic saucers to avoid contamination between and within treatments. Plants were fertilized weekly with $CaNO_3$ and KNO_3 at 100 ppm. Samples of soil were taken monthly and tested to determine fertility levels.

Fungicides used and rates of application were Banrot 40W (5-ethoxy-3-trichloromethyl-1,2,4-thiodiazole, 15%; and Dimethyl 4,4-0-phenylenebis, 3-thioallophanate, 25%) at 240 ppm, Subdue 2E (metalaxyl, N-(2,6,dimethyl-phenyl)-N-(methoxyacetyl)-DL-alanine methyl ester, 25.11%) at 18.7 ppm and Turban 25E (5-ethoxy-3-trichloromethyl-1, 2, 4-thio-

*Graduate student, Department of Horticulture and Landscape Architecture, and **Professor, Department of Plant Pathology, University of Minnesota, St. Paul, MN 55108

diazole, 25%) at 145 ppm. The fungicides were applied as 100 ml soil drenches to the geraniums at 15, 45, and 75 days after potting. Geraniums were also planted in SWIS and in SWP as controls. These plants received no fungicide but were drenched with 100 ml distilled water at 15, 45, and 75 days after potting. Plants of each treatment were arranged in a randomized block designed with 4 replicates and 4 plants per replicate.

Rhizosphere soil samples (8) were taken before the second and third drenches and again 15 days after the third drench, to determine CFU/g dry soil of *P. ultimum.* A sterile probe was used to gently remove soil immediately adjacent to the roots. Every pot was sampled and soil from each pot was combined within treatments and within blocks. Dilutions of 1:5 soil in sterile water were used at first to determine the CFU of *P. ultimum;* however, a 1:50 dilution was used thereafter to facilitate counting and to avoid colony overlap. Dry weights of roots and shoots of plants were also determined at the conclusion of the experiment. The roots were gently washed free of soil, and severed roots and shoots were individually placed in labeled paper bags and placed in an oven for 72 hours at 60°C before weighing. All senescent flowers or yellow leaves previously removed from the plants were retained, dried, and included in final treatment weights.

Results

Thirty days after the first drench, soil treated with Subdue 2E was found to be free of *P. ultimum* and data taken after the second and third drenches substantiated the initial findings. *Pythium ultimum* populations varied considerably between and within pots treated with Banrot 40W (27-117 CFU/g dry soil) and Truban 25E (126-192 CFU/g dry soil). Neither fungicide reduced the CFU/g of *P. ultimum* in dry soil. In fact, the CFU/g of *P. ultimum* in dry soil receiving Banrot 40W and Truban 25E were greater than the SWIS control by 29% and 163%, respectively. Soil samples taken from SWP contained the highest population density of *P. ultimum* and increased 193% (Figure 1).

The spacing between plants was probably insufficient as two of the four treatment blocks from the SWIS-controls were found to be contaminated with *P. ultimum* (Figure 1). Insufficient care during watering or fertilizing the plants probably accounts for spread of the pathogen to the SWIS-controls. To prevent further contamination, all plants were spaced farther apart.

Thirty days after the second drench, soil from plants treated with Subdue 2E remained free of *P. ultimum,* but the plants began to have scattered marginal necrosis on the newly expanded leaves, indicative of toxicity (9). At the same time, in soil treated with Banrot 40W and Truban 25E, there was a marked increase in CFU/g dry soil of *P. ultimum,* comparable to the increases seen in SWP-inoculated soil (Figure 1). Colony-forming units/g dry soil of *P. ultimum* obtained from soil treated with Banrot 40W or Truban 25E increased by 1,329% and 853%, respectively. SWP increased 988% over the same time period.

Soil treated with Banrot 40W or Truban 25E resulted in an 18% and 6% increase, respectively, of *P. ultimum* 15 days following the third drench. CFU of *P. ultimum* from SWP decreased 17%. There were 185 CFU/g dry soil in two contaminated control pots while the remaining plants of SWIS-controls and plants treated with Subdue 2E remained free of *P. ultimum* at the final sampling.

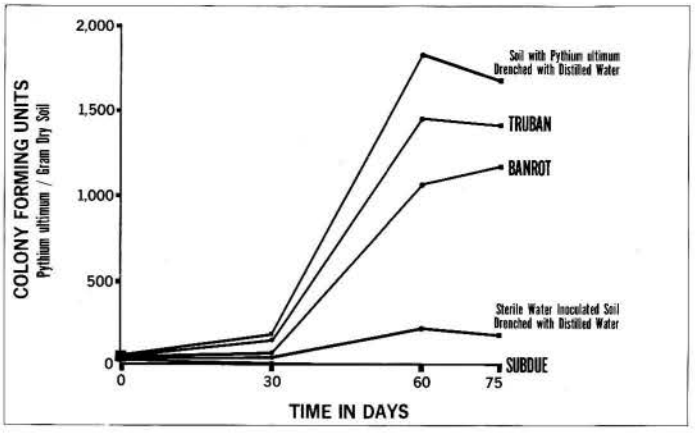

Figure 1. Fungicide effectiveness of Banrot 40W, Truban 25E, and Subdue 2E on colony forming units (CFU) of *Pythium ultimum* in soil sampled at 0 time, 30, 60, and 75 days. Each fungicide was applied as a soil drench immediately after soil samples were taken to determine CFU of *P. ultimum.*

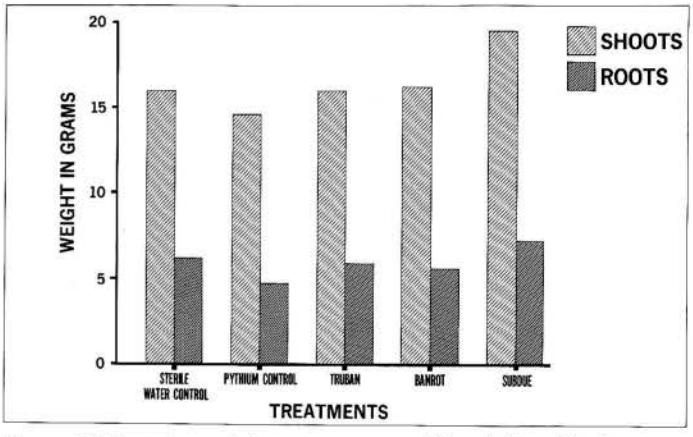

Figure 2. Plant dry weight as a measure of fungicide effectiveness for control of *Pythium ultimum* after 75 days growth of 'Sincerity' geranium.

Shoot dry weight of plants from all treatments was significantly greater (HSD = 0.05) than shoot dry weight obtained from the SWP-inoculated plants. There were no significant differences between shoot dry weight from SWIS-controls, Banrot 40W, and Truban 25E treatments. Plant shoot dry weight from Subdue 2E treated plants was 29% greater than in the SWIS-controls. Again, root dry weight in all treatments was significantly greater (HSD = 0.05) than in SWP-inoculated plants, whereas no significant differences were found among SWIS-controls, Banrot 40W, and Truban 25E treatments. Dry weights of roots from Subdue 2E-treated plants were 11% greater than root dry weights from SWIS-control plants (Figure 2).

Discussion

All of the fungicide treatments resulted in lower population densities of *P. ultimum* than occurred in SWP-inoculated soil. The final CFU count of *P. ultimum* showed a slight decline in SWP-inoculated soil and Truban 25E-treated soil. This may be due to insufficient root substrate or lack of suitable infection sites to allow for continued growth of *P. ultimum* populations. Population densities of *P. ultimum* continued to increase in soil of plants treated with Banrot 40W but remained

26% lower than Truban 25E-treated plants and 42% lower than SWP-inoculated plants.

Chase (10) hypothesized in a previous study that metalaxyl (Subdue) may produce a positive growth response in plants. This is a possible explanation for the significantly greater dry weights of plants treated with Subdue 2E when compared with SWIS-control plants.

Although phytotoxic effects in plants treated with Subdue 2E were minimal, they were significant enough to be of concern to commercial growers. An earlier study (9), showed that geranium plants growing in soil containing 1000 CFU/g dry soil of *P. ultimum* and subsequently treated with Subdue 2E at 8.5 ppm yielded zero CFU/g dry soil of the pathogen from rhizosphere sampled soil. At this rate, Subdue 2E was not phytotoxic.

Conclusion

Subdue 2E applied to soil at the rate of 8.5 ppm provided excellent control of *P. ultimum* and was not toxic to geranium. The lack of adequate disease control with Truban 25E and Banrot 40W could be attributed to the initial moderate populations of CFU/g dry soil of *P. ultimum* inoculum in the soil. At the population level of 58 CFU/g dry soil, the disease was not controlled. However, Banrot 40W and Truban 25E were somewhat fungistatic when compared with SWP-inoculated control.

References

1. Agrios, G.N. 1978. *Plant Pathology.* New York: Academic Press, p. 629.
2. Baker, K.F. 1957. The U.C. system for producing healthy container-grown crops. Calif. *Agri. Expt. Sta. Manual,* U. of C. Berkeley, Calif. 23:123-96.
3. Boodley, J.W. 1981. Sterilization (pasteurization) of growing media. In: *The Commercial Greenhouse,* pp. 109-16. Albany, New York: Delmar Publishers.
4. Nichols, L.P., and Nelson, P.E. 1982. *Pythium* blackleg. In: J.W. Masterlez and E.J. Holcomb (eds.), *Geraniums III. A Manual on Culture of Geraniums as a Greenhouse Crop*, pp. 208-9. Penn. Flower Growers, University Park, PA.
5. Colbaugh, P.F., and Terrell, S.J. 1981. Influence of soil fungicides on production efficacy of peperomia *Grisco argentea. Internat. Plant Prop. Soc. Proc.* 31: 634-41.
6. Pieczarka, I.J., and Abawi, G.S. 1978. Population and biology of *Pythium* species associated with snap bean roots in soils in New York. *Phytopathology* 68: 409-16.
7. Mircetich, S.N. 1971. The role of *Pythium* in feeder roots of diseased and symptomless peach trees and orchard soils in peach tree decline. *Phytopathology* 61: 357-60.
8. Kaye, J.W., Pfleger, F.L., and Stewart, E.L. 1984. Interaction *Glomus fasciculatum* and *Pythium ultimum* in greenhouse-grown poinsettia. *Can. J. Bot.* 62: 1575-79.
9. Olson, N.L., and Pfleger, F.L. 1985. Phytotoxic reaction of flowering plants to metalaxyl. *Minn. State Flor. Bull.* 33: 2-5.
10. Chase, A.R. 1985. Subdue 2E-phytotoxicity on three foliage plants. *Foliage Digest* 8: 5-8.