Selective Soil Fungicides as an Aid in the Identification of Soil-Borne Plant Pathogens

W. A. Haglund, R. L. Gabrielson, and D. R. Tompkins

Associate Plant Pathologists, Department of Plant Pathology, Washington State University, Northwestern Washington Research and Extension Unit, Mount Vernon, Washington 98273 and Western Washington Research and Extension Center, Puyallup, Washington 98371, respectively; and Assistant Horticulturist, formerly Washington State University, Western Washington Research and Extension Center, Puyallup, Washington, now Associate Professor, Department of Horticultural Food Science, University of Arkansas, Fayetteville, Arkansas 72701.

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ABSTRACT

The employment of specific soil fungicides confirmed that *Pythium ultimum* is the primary pathogen causing pre- and postemergence damping-off and reduction in yield of cucumbers in western Washington. Dexon (*p*-dimethylaminobenzenediazo sodium sulfonate) and Lanstan (1-chloro-2-nitropropane) were equally effective for disease control, whereas the incidence of disease was consistently higher in the Terraclor (pentachloronitrobenzene)-treated plots than in the nontreated control.

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In western Washington, pre- and postemergence damping-off of cucumbers, *Cucumis sativus* L., is a serious problem aggravated by the cool, moist spring weather (3, 9). *Pythium ultimum* Trow and *Pythium irregulare* Buis. were consistently isolated from diseased field plants. *Pythium ultimum* was pathogenic in greenhouse tests, and caused both pre- and postemergence damping-off of cucumbers, while *P. irregulare* was relatively nonvirulent. Isolation and reinoculation of pasteurized soil in the greenhouse indicated that *P. ultimum* was a primary pathogen involved in this soil-borne problem. Due to the complex nature of soil-borne diseases, completion of Koch's postulates may not elucidate the true importance of this organism under natural field conditions. Therefore, additional field and greenhouse studies were designed utilizing broad and narrow spectrum soil fungicides to develop additional data concerning the specific pathogen in question by inhibiting or eliminating specific groups of organisms in the soil.

The availability of effective soil fungicides selectively active and inactive against Phycomycetes and other soil fungi made cucumber damping-off in western Washington an ideal model to test the value of this diagnostic approach.

MATERIALS AND METHODS.—Lanstan (1-chloro-2-nitropropane) was used as a general biocide. Dexon (*p*-dimethylaminobenzenediazo sodium sulfonate) and Terraclor (pentachloronitrobenzene) were used for their selectivity against Phycomycetes and Basidiomycetes, respecitvely (1, 4, 5, 7, 8). In all greenhouse and field trials, the cucumber cultivar, SMR18, was used.

In the field, fungicides were sprayed on the soil surface and immediately incorporated with an L-blade rotary tiller. Treatments were applied in a band and incorporated ca. 4 inches deep. Lanstan was applied at 75 lb. of active ingredient/acre, and Dexon and Terraclor at ca. 24-26 and 42 lb./acre active material, respectively. In 1966, Lanstan- and Dexon-treated plots were additionally treated with an 8-inch band of petroleum mulch at 0.1 gal/square yard. Field tests were planted on 7 May 1965 and 10 May 1966. Each replicate consisted of one row, and all treatments were uniformly thinned 1 month after planting. Plant spacings were 9 inches and 6 inches, respectively, in 1965 and 1966.

In greenhouse tests, fungicides were incorporated into naturally infested field soil, pasteurized field soil, and pasteurized field soil reinfested with *P. ultimum* (one 7-day-old petri dish culture/0.25 ft^3 of soil) by blending for 5 min in a cement mixer. Trials were conducted in 6-inch plastic pots, and each replicate consisted of one pot sown with 20 seeds.

RESULTS.—Table 1 presents the data obtained from field studies in 1965 and 1966. Effective control of the disease by both Dexon and Lanstan, coupled with increased pre- and postemergence damping-off with Terraclor, provided additional proof that the primary disease agent was a Phycomycete.

Results from greenhouse studies on cucumbers grown in naturally infested field soil, pasteurized field soil, and pasteurized field soil reinfested with *P. ultimum* paralleled the data from the field studies (Table 2). In the pasteurized soil, emergence, survival, and fresh weight of cucumber seedlings were similar in all treatments. However, in pasteurized soil reinfested with *P. ultimum*, seedling weight and damping-off control were significantly greater than the control with Lanstan and Dexon, and significantly less with Terraclor. In naturally infested field soil, the inoculum potential under greenhouse conditions was obviously less, and differences were not so dramatic. Fresh weight of seedlings was significantly higher with Dexon and Lanstan than

TABLE 1. Effect of Lanstan (1-chloro-2-nitropropane), Dexon (*p*-dimethylaminobenzenediazo sodium sulfonate), and Terraclor (pentachloronitrobenzene) on stand, postemergence damping-off (PEDO), and yield of field-grown cucumbers

	1965[a]				1966[b]			
Treatment	Rate, lb./acre	Stand, total[c]	PEDO, %	Yield, %	Rate, lb./acre	Stand, total[c]	PEDO, %	Yield, %
Lanstan	75	150	9	124	75	268	5	180
Dexon	24	144	21	123	26	321	2	155
Terraclor	40	50	78	33	42	197	35	61
Control	0	113	33	100	0	276	21	100
LSD 5%		31	11			78	9	

[a] 1965 data is based on five replications of each treatment. Stand and PEDO counts based on 30 ft of row; yield from 40 ft of row.

[b] 1966 data is based on five replications of each treatment. Stand and PEDO counts based on 40 ft of row; yield from 50 ft of row.

[c] Total stand equals total emergence, healthy + damped-off; all treatments were seeded at a uniform rate.

TABLE 2. Effect of Lanstan (1-chloro-2-nitropropane), Dexon (*p*-dimethylaminobenzenediazo sodium sulfonate), and Terraclor (pentachloronitrobenzene) on the emergence, postemergence damping-off (PEDO), and seedling weight of cucumbers grown in field soil in the greenhouse[a]

Soil pretreatment	Fungicide treatment	Rate[b], lb./acre	Total emergence at 20 days	% PEDO	Seedling[c] weight
Steam pasteurized	Lanstan	50	95 a	0 a	245 a
	Dexon	25	93 a	0 a	262 a
	Terraclor	40	94 a	0 a	279 a
	Control	0	97 a	0 a	260 a
Steam pasteurized plus *P. ultimum*	Lanstan	50	93 a	1 a	197 a
	Dexon	25	91 a	2 a	201 a
	Terraclor	40	82 a	42 c	53 c
	Control	0	87 a	22 b	109 b
Nontreated	Lanstan	50	93 a	3 a	144 a
	Dexon	25	97 a	1 a	133 a
	Terraclor	40	93 a	5 a	90 b
	Control	0	92 a	3 a	124 ab

[a] Data based on 10 replications of 20 seeds each. Numbers with the same letter are not different at the 5% level of significance as determined by the Student Newman Keules multiple range test (2).

[b] Rates calculated on 1.04 g/0.5 ft^3 of soil as being equal to 100 lb./acre 6 inches deep.

[c] Total fresh weight of seedlings harvested from five replications of 20 seeds each in grams of green plant tissue 30 days after seeding.

with Terraclor, but not significantly different than the untreated check.

DISCUSSION.—The increase in disease incidence, as measured by postemergence damping-off and yield of cucumbers after applications of Terraclor to field soil and pasteurized soil infested with *P. ultimum* correlates with published results (1, 6). This increase in damping-off and reduction in yield cannot be attributed to direct phytotoxicity because of the lack of detrimental effect of Terraclor we observed in pasteurized soil in the absence of *P. ultimum*. The selective disease control and aggravation by Dexon and Terraclor, respectively, has offered additional proof that *P. ultimum* is the primary cause of damping-off and yield reduction of cucumbers in western Washington.

The selective action of a number of chemicals to soil fungi has been studied and reviewed by Kreutzer (8). A number of highly effective, selective fungicides have since or are now being developed. Determination of the specific effects of these fungicides on the activity of various soil-borne microorganisms can provide a most useful tool for ascertaining the relative importance of various organisms involved in root rot complexes.

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