Comparative Activity of Dexon and Terrazole against Phytophthora and Pythium

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Dexon (*p*-dimethylaminobenzenediazo sodium sulfonate) is active against several *Phytophthora* and *Pythium* spp., and has been used as a soil fungicide to reduce root diseases caused by these fungi in a number of plants, including zinnia (3), pine and spruce (6), chrysanthemum (5), petunia (4), avocado (7, 8), and fir (2). Control of pineapple root rot (*Phytophthora cinnamomi* Rands and *Phytophthora parasitica* Dast.) and papaya root rot (*Pythium aphanidermatum* [Edson] Fitzp.) was not consistent in the field using Dexon (R. B. Hine, *unpublished data*). Less information is available in the literature concerning the fungicidal activity of the relatively new fungicide Terrazole (5-ethoxy-3-trichloromethyl-1,2,4-thiadiazole), although it is reported to be active in controlling *Pythium* root rot of zinnia (3), and to have systemic activity against *Rhizoctonia solani* in cotton (1).

The activities of the two chemicals against *Phytophthora* and *Pythium* spp. were compared, following preliminary work indicating that Terrazole had activity as great or greater than Dexon against some pythiaceous fungi.

Dexon and Terrazole were kept in darkness during all experiments, as Dexon is degraded rapidly in the presence of light.

The two fungicides were tested in agar in at least two experiments replicated at least four times/treatment to determine their activity against *Pythium* and *Phytophthora*. Minimum concentrations (μg/ml) of fungicides in agar necessary to prevent growth of mycelium of several fungi were: *Phytophthora palmivora* Butl. (Dexon-50, Terrazole-10); *P. parasitica* (Dexon-20, Terrazole-50); *Pythium aphanidermatum* (Dexon-5, Terrazole-10); and *P. spinosum* Sawada (Dexon-5, Terrazole-20).

Gila silt loam from Marana, Arizona (pH 7.8), and Superstition sand from Yuma, Arizona (pH 8.2), were used in all subsequent studies. The silt loam and sand had an 11.7% and 2.7% moisture retention, respectively, at 15 atmospheres tension, 22.0% and 4.8% at one-third atmosphere, and 29.5% and 6.3% at one-tenth atmosphere. Dexon and Terrazole were mixed with the air-dried, screened soils (8-mesh) as 35% wettable powders. All rates are based on the active ingredient of the two fungicides.

A single isolate of *P. palmivora, P. aphanidermatum, P. spinosum,* and *Pythium ultimum* Trow., and isolates of *P. parasitica* from tomato, citrus, and tobacco were used. Inocula were produced by placing autoclaved sugar beet seed on 2% water agar in petri dish cultures of the fungi. Fourteen to 28 days after inoculation, five infested seed were placed in each of four petri dishes containing 100 g of air-dry, treated Gila silt loam or Superstition sand. Forty and 25 ml of tap water were added, respectively. After 3 days, seed were recovered by washing the soils through a 10-mesh screen. Seed were then cultured on 2% water agar containing 125 μg/ml of chloramphenicol and 100 μg/ml of pimaricin.

Incorporation of Dexon and Terrazole into Gila silt loam at concentrations as high as 100 μg/g (w/w, air-dry soil) did not eliminate *P. parasitica* from colonized seed planted and recovered from treated soil. Recoveries of the different isolates ranged from 100 (all viable) to 73% with Dexon, and 95 to 44% with Terrazole. Concentrations of 5, 10, and 50 μg/g were less effective. Neither chemical at 100 μg/g eliminated *P. spinosum* or *P. ultimum* from colonized seed planted in treated soils. Dexon, however, was more active than Terrazole against these two *Pythium* spp. Growth of *P. spinosum* and *P. ultimum* from recovered seed was 47% and 19%, respectively, with Terrazole.

P. palmivora and *P. aphanidermatum* were used in other experiments. Dexon and Terrazole were incorporated into the two soils at 10, 50, 100, and 200 μg/g, or drenches of 500 μg/ml concentrations were applied to the soil surface with sufficient water to move the water front through the area where the infested seed were located. Five infested seed of each of the two fungi were placed at depths of 5, 40, and 80 mm in each of two columns of soil 100-mm high. Two columns drenched with tap water served as controls. After 3 days, the infested seed were recovered from the two soils as previously described.

Terrazole was more active than Dexon in eliminating *P. palmivora* from infested seed placed in the sand in which chemicals were incorporated. Viability of *P. palmivora* from seed recovered from Gila silt loam and Superstition sand treated with Terrazole at 50 μg/g was 88% and 15%, respectively. At 100 or 200 μg/g concentrations, *P. palmivora* was not recoverable from seed taken from Superstition sand, and only 5% recoverable from seed from the silt loam. Dexon at 100 or 200 μg/g concentrations greatly reduced, but did not eliminate, *P. palmivora* from seed planted in either soil. Dexon was more effective than Terrazole in reducing populations of *P. aphanidermatum* at 200 μg/g in both soils. Dexon at 200 μg/g completely eliminated *P. aphanidermatum* from both soils in all experiments. Concentrations of Terrazole as high as 200 μg/g did not eliminate *P. aphanidermatum* from seed from either soil (Table 1).

Neither fungicide in the soil-drenching experiments eliminated *P. aphanidermatum* or *P. palmivora* from infested seed placed at a depth of 5 mm in Gila silt loam or Superstition sand, and both were less effective at greater depths.

Both fungicides at concentrations of 1 to 5 μg/ml prevented zoospore formation in water cultures of *P. aphanidermatum* and *P. spinosum*. Inactivation of *P. palmivora* zoospores occurred after 1-hr exposure to concentrations of 25 μg/ml Terrazole, but not at 50 μg/ml Dexon.

TABLE 1. Per cent infested sugar beet seed having viable *Phytophthora palmivora* and *Pythium aphanidermatum* after recovery from soils treated with Dexon and Terrazole[a]

Treatment	Concn. (μg/g)[b]	*P. palmivora*		*P. aphanidermatum*	
		Gila silt loam	Superstition sand	Gila silt loam	Superstition sand
Control	0	100	100	100	100
Dexon	10	90	90	55	80
	50	90	38	26	24
	100	22	8	13	16
	200	5	16	0	0
Terrazole	10	90	26	60	57
	50	88	15	53	54
	100	5	0	5	0
	200	5	0	10	4

[a] Averages of two trials; isolations made from at least 40 seed recovered 3 days after treatment.
[b] Active chemical (w/w) in air-dry soil.

These studies demonstrate the difficulty of eradicating populations of some *Phytophthora* and *Pythium* spp. by use of these chemicals incorporated into soil or drenched onto the soil surface. Microscopic examination revealed chlamydospore (*Phytophthora* spp.) and heavy oospore (*Pythium* spp.) production in and on the sugar beet seed, undoubtedly a factor in survival of these fungi despite high rates of fungicide application.

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