Influence of Polyethylene Oxide Seed Tape on Growth of *Rhizoctonia solani* and *Pythium aphanidermatum* and on Damping-off of Tomato

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ABSTRACT

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Seedling emergence from soil artificially infested with *Rhizoctonia solani* or *Pythium aphanidermatum* was greater when untreated tomato seed were placed in polyethylene oxide tape as compared to direct seeding. Radial growth of mycelium of *R. solani* and *P. aphanidermatum* was significantly reduced on media amended with polyethylene oxide tape. No significant differences were found in fresh or dry weights of seedlings, root-hypocotyl, or cotyledon fractions from tomato seed germinated in solutions containing various levels of polyethylene oxide.

Conventional methods of direct seeding small-seeded vegetable crops involve the use of a bulk-metering system and subsequent hand or machine thinning of the emerging plant stand to the desired plant density. Due to increased production costs, growers are interested in precision planting techniques which eliminate the need for thinning (2).

Chancellor (1) described a technique of precision planting whereby the desired number of seed, with desired spacing, were placed on a water-soluble paper tape. However, seedling emergence in field plots was less than acceptable. Recently, a polyethylene oxide (Polyox) tape (4) was developed as a seed carrier (Creative Agricultural Systems, Union Carbide Corp., Salinas, CA 93901). This tape (trade-named EVENSEED) dissolves in 1.0–1.5 min when placed in soil with adequate moisture for seed germination. The placement of seed on tape appears to be the most accurate of all methods for precision planting of small-seeded vegetable crops (3).

Uniformity of seedling emergence and increased plant stands obtained from polyox-taped seed are thought to be primarily due to spacing accuracy. However, differences in the incidence of damping-off, within tomato plantings comparing taped and nontaped seed, suggests that other factors may be involved (authors, *personal observation*).

This study was conducted to determine the effects of polyox tape on: emergence of tomato seedlings from soil artificially infested with *Rhizoctonia solani* Kühn or *Pythium aphanidermatum* (Edson) Fitzp.; growth of *R. solani* and *P. aphanidermatum* in culture; and seed germination and subsequent seedling growth of tomato.

MATERIALS AND METHODS

Soil from two fields in which tomatoes were grown the previous year was placed in flats in the greenhouse and planted with nontreated seed of tomato (*Lycopersicon esculentum* Mill., 'Tamu Chico III'). All seedlings were harvested and diseased tissue plated on Difco potato dextrose agar (PDA). Organisms most commonly isolated were *R. solani* and *P. aphanidermatum*.

Two lots of Tamu Chico III seed (Ferry Morse Seed Co., Mountain View, CA 94040), one treated with thiram (tetramethythiuram disulfide, 170 g per 45.4 kg of seed), the other nontreated, were subsequently utilized in this study. A portion of each seed lot was forwarded to Creative Agricultural Systems where each lot of seed was placed, in clumps of three seed every 23 cm, in polyox tape.

Seedling disease experiments were conducted in the greenhouse in artificially infested soil in bench beds. Four beds, each 1.6 m×1.3 m, were filled to a depth of 15 cm with a mixture of sand and Marietta silty clay loam (1:1, v/v) and planed to a uniform level. Two beds were infested with *R. solani* and two with *P. aphanidermatum*. Inoculum for infesting beds was prepared by blending a 3-day-old PDA culture of *R. solani* or *P. aphanidermatum* with 100 ml of water in a Waring Blendor. Twenty milliliters of the resulting suspension was placed on 400 cm^3 of a Perlite/cornmeal/Czapek's medium (10:1:2, v/v) in a 75×100-mm storage dish and incubated at 28 C for 14 days. Inoculum was removed from a dish, broken into individual particles, and scattered uniformly on the soil surface of a bench bed. Inoculum was mixed into the upper 5 cm of soil and the soil planed to a uniform level. Treatments were thiram-treated seed, nontreated seed, thiram-treated seed in polyox tape, and nontreated seed in polyox tape. Nontaped treatments were planted by hand-dropping 21 seeds in clumps of three seed every 23 cm within the row. Taped treatments were planted by placing 1.5 m of the polyox tape containing seven clumps of seed on the bed surface. Rows were 1.5 m long and 15 cm apart. Soil was added to the bed surface and gently planed so that all seed were at a depth of approximately 1.9 cm. There were two replications for each treatment in each bed resulting in four replications for each treatment for each organism. The experiment was repeated once. Emergence and postemergence damping-off were recorded daily.

The effect of polyox tape on the mycelial growth of *R. solani* and *P. aphanidermatum* was studied on water agar (1.5%, w/v) amended prior to autoclaving with 0, 1,200, 2,500, 5,000, 10,000, and 20,000 μg/ml of polyox tape. Mycelial plugs, 5 mm in diameter,

TABLE 1. Effect of polyox tape on emergence of tomato seed in soil infested with *Rhizoctonia solani* or *Pythium aphanidermatum*[y]

Treatments	Emergence (%)	
	R. solani	*P. aphanidermatum*
Thiram-treated seed	68.8 a[z]	67.8 a
Thiram-treated seed in polyox tape	59.4 a	68.5 a
Nontreated seed in polyox tape	51.9 a	47.0 a
Nontreated seed	18.1 b	5.9 b

[y]Average of two tests.
[z]Means followed by the same letter within a column are not significantly different ($P = 0.05$) according to Duncan's new multiple range test.

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cut from 2-day-old PDA cultures of *R. solani* or *P. aphanidermatum*, were transferred to the center of the plates. All treatments were incubated at room temperature. Radial growth of mycelium was measured daily in two directions, and an average for five replications was calculated. The experiment was repeated once.

Sheets of Whatman No. 1 filter paper were placed (one per dish) in petri dishes and watered with 2 ml of a 0, 1,200, 2,500, 5,000, or 10,000 μg/ml polyox tape solution to determine the effect of polyox tape on germination of thiram-treated and nontreated seed. Each petri dish contained 20 seed and each treatment was replicated five times. Plates were placed in an incubator at 20–30 C for 14 days (5). Normal and abnormal seedlings (distorted root-hypocotyl) were counted. Normal seedlings from nontreated seed were cut into a cotyledon and root-hypocotyl section. Fresh weights of cotyledon and root-hypocotyl sections were obtained. Seedling parts were placed in an oven at 105 C for 24 hr, removed, and dry weights were obtained.

TABLE 2. Radial growth of *Rhizoctonia solani* and *Pythium aphanidermatum* on water agar amended with various levels of polyox tape[w]

Polyox (μg/ml)	*R. solani* Radial growth[x] (mm)	*R. solani* Reduction (%)	*P. aphanidermatum* Radial growth[y] (mm)	*P. aphanidermatum* Reduction (%)
0	82.0 a[z]	...	84.9 a[z]	...
1,200	37.9 b	53.7	42.5 b	49.9
2,500	30.6 c	62.6	35.6 b	58.0
5,000	28.0 c	65.8	26.9 b	68.3
10,000	29.4 c	64.1	21.7 b	74.5
20,000	27.8 c	66.1	12.5 b	85.2

[w] Average of two tests.
[x] Growth at 96 hr.
[y] Growth at 48 hr.
[z] Means followed by the same letter within a column are not significantly different ($P = 0.05$) according to Duncan's new multiple range test.

RESULTS

Emergence of tomato seedlings from soil artificially infested with *R. solani* or *P. aphanidermatum* was greater ($P = 0.05$) when nontreated seed were placed in polyox tape (Table 1). Emergence of polyox-taped nontreated seed was not statistically different from that obtained with thiram-treated seed.

Radial mycelial growth of *R. solani* and *P. aphanidermatum,* at 96 and 48 hr, respectively, was significantly less on media amended with polyox tape than on unamended media (Table 2). The addition of 1,200 μg/ml of polyox tape to water agar resulted in reductions of 53.7 and 49.9% in mycelial growth of *R. solani* and *P. aphanidermatum*, respectively. Increased levels of polyox tape led to a slight decrease in growth of *R. solani*. In contrast, although not statistically significant, increased levels of polyox tape led to progressively less growth of *P. aphanidermatum*.

No difference was evident in the number of normal or abnormal seedlings obtained when seed was germinated in various levels of polyox tape solutions. Also, no difference was found in fresh or dry weight of seedlings, root-hypocotyl, or cotyledon fractions.

DISCUSSION

The attainment of higher populations of tomato seedlings in soil artificially infested with *R. solani* or *P. aphanidermatum*, when untreated seed were placed in polyox tape, suggests that the polyox tape reduced the incidence of seedling disease. The failure to show a significant effect on seed germination or seedling vigor suggests that the beneficial effect of polyox tape on reducing seedling disease is on the causal organisms. Mycelial growth studies showing reduced growth of *R. solani* and *P. aphanidermatum* in the presence of polyox tape are supportive of this contention. The effect is apparently fungistatic; ie, growth of *R. solani* and *P. aphanidermatum* was impeded at the rates of polyox tape added to agar medium.

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