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Biological Control of Damping-off Disease of Tomato Caused by *Pythium indicum* Balakrishnan

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ABSTRACT

A pot culture experiment was conducted to find out the efficacy of antagonists in the control of damping-off disease of tomato caused by *Pythium indicum* Balakrishnan. Soil inoculation with *Trichoderma viride* Pers., *T. harzianum* Rifai, and *Laetisaria arvalis* Burdsall, gave good control of the pathogen and the treated pots recorded 78.2, 70.9 and 72.2 per cent seed germination respectively as against 19.3 per cent in the control. Seed treatment with *T. viride, T. harzianum* and *L. arvalis* was also found to be equally good. The results obtained were comparable to soil drenching with fungicides like fenaminosulf, copper oxychloride and seed treatment with captan or thiram. However, improved seedling vigour was noticed in the treatments with antagonists than with fungicides.

Key Words : Tomato, damping-off, biological control, seedling vigour

Seed treatment and soil application of antagonists like *Trichoderma viride* Pers., *T.harzianum* Rifai., and *Laetisaria arvalis* Burdsall., were found to be useful in the control of *Pythium* spp. (Harman *et al.*, 1980; Martin *et al.*, 1983; Sivan *et al.*, 1984). Inoculation of steamed glass house soil with *Bacillus subtilis* Cohn. prevented damping-off of pepper seedlings caused by *Pythium ultimum* Trow. (Broadbent *et al.*, 1971). Singh and Reddy (1979) reported strains of *Streptomyces* spp. suppressing the growth of *Pythium aphanidermatum* (Edson) Fitz. causing damping-off disease in tomato. In the present study, the fungal antagonists *T. viride*, *T. harzianum* and *L. arvalis* and the bacterial antagonists *B. subtilis* and a *Streptomyces* sp. were used and the results compared with chemical control.

MATERIALS AND METHODS

P. indicum was multiplied in sand-maize medium (Muthusamy, 1972) and the inoculum was mixed at the rate of one part of the inoculum to twenty parts of sterile soil. Cultures of *T. viride* and *T. harzianum* were multiplied in wheat bran-peat soil medium (Sivan *et al.*, 1984). The inoculum was mixed with the soil at the rate of 5 g per kg. *L. arvalis* was prepared following the procedure of Martin *et al.* (1984) and mixed at the rate of 5 g/kg of soil. Regarding soil application of *B.subtilis*, the method followed by Venkata Subbiah (1985) was used. Multiplication and soil application of *Streptomyces* sp. were done following the procedure of Rothrock and Gottlieb (1984).

The antagonists were soil inoculated 7 days prior to the introduction of the pathogen inoculum. Later, untreated tomato seeds (var. Marutham) having good germination rate were sown at the rate of 50 seeds per pot. The pots were irrigated uniformly daily. The number of seeds germinated on 7th day and the final number of seedlings surviving on the 21st day in each treatment were counted and the final germination per cent was calculated. The fungicides fenaminosulf 0.060 g a.i./lit, copper oxychloride 1.125 g a.i./lit and captan 0.075 g a.i./lit were drenched in the pathogen inoculated pots 24h before sowing tomato seeds.

In the second experiment, tomato seeds were treated with *T. viride* and *T. harzianum* before sowing following the procedure of

Sivan *et al.* (1984). *L. arvalis* sclerotia were harvested and used as per the procedures followed by Martin *et al.* (1984). A 48 h old *B.subtilis* culture grown on nutrient glucose agar was centrifuged at 3000 g for 10 min. The resulting pellet was resuspended in 10 ml of sterile distilled water. From this, 3 ml was used for treating 10 g of tomato seeds. The seeds were shade-dried for 12 h before sowing. The final concentration of bacteria at the time of seed treatment was 6.6 to 6.8 x 10^8 cfu. Following the method of Rothrock and Gottlieb (1984), pelleting of *Streptomyces* sp. was made and it was used at the rate of 2 mg of the pellet suspended in 3 ml of sterile distilled water for treating 10 g of tomato seeds. This suspension contained 4.8 to 5.2 x 10^{12} cfu/ml. Seed dressing with captan and thiram was done at the rate of 2 g/kg of seeds. The seeds were treated with fungicides 24 h before sowing. As in soil inoculation studies, prior to sowing, the pathogen inoculum was mixed in sterile soil taken in pots and immediately the tomato seeds treated with various antagonists and chemicals were sown (50 seeds/pot). The germination per cent of seeds was worked out as mentioned earlier.

RESULTS AND DISCUSSION

Soil inoculation of *T. viride*, *T. harzianum* and *L. arvalis* and soil drenching with fenaminosulf and copper oxychloride effectively controlled *P. indicum* (Table 1).

However, soil inoculation of *T. viride* was superior as evidenced by the increased root length, shoot length and dry matter production of seedlings in the treated pots. Similar results were also obtained by Martin *et al.* (1984) and Sivan *et al.* (1984). A reduction in the comparative efficacy of captan over the antagonists was observed by Harman *et al.* (1980). Muthusamy (1972) reported moderate phytotoxicity of fenaminosulf on tomato seedlings. Organic pesticides are degraded by soil microbes resulting in newer compounds much more deleterious to plants (Leach *et al.*, 1960). These are the probable reasons for the reduced seedling health in fungicidal treatments. Seed treatment with fungal antagonists was found to be as effective as thiram and captan seed treatment (Table 2).

However, improved seedling vigour was noticed only in fungal antagonists treated pots. Ruppel *et al.* (1983) and Martin *et al.* (1984) found that pelleting of sugarbeet and table beet seeds with *T. harzianum* and *L. arvalis* was superior to metalaxyl seed treatment in the control of damping-off disease caused by*Pythium ultimum* Trow. *Trichoderma* spp. might have produced some growth regulating

Table 1. Efficacy of soil inoculation of certain antagonists in the control of *P. indicum* in sterile soil

Soil application	Seed germination (per cent)	Root length (cm)	Shoot length (cm)	Dry matter production (mg/plant)
T. viride	78.2^{ab}	2.2^{a}	12.2^{a}	40.7^{a}
T. harzianum	70.9^{ab}	2.7^{a}	9.8^{b}	33.9^{b}
L. arvalis	72.2^{ab}	1.6^{b}	7.1c	27.0^{c}
B. subtilis	58.7^{c}	1.3^{c}	4.8^{e}	17.3^{ef}
Streptomyces sp.	44.5^{d}	1.3^{c}	4.7^{e}	15.5^{f}
Fenaminosulf	72.2^{ab}	1.8^{b}	5.5^{d}	13.8^{f}
Copper oxychloride	63.8^{abc}	1.9^{ab}	5.7^{d}	21.8^{de}
Captan	61.9^{bc}	1.8b	6.2^{c}	18.7^{ef}
Pathogen-inoculated control	19.3^{e}	1.0d	4.8^{e}	16.8^{ef}
Pathogen-uninoculated control	76.4^{a}	1.3c	6.6^{c}	26.7^{cd}

In each column, figures followed by same letter do not differ significantly (P = 0.05) by DMRT

Table 2. Comparison of seed treatments of antagonist and seed dressing with fungicides in the control of *P. indicum*

Soil application	Seed germination (per cent)	Root length (cm)	Shoot length (cm)	Dry matter production (mg/plant)
T. viride	79.9[a]	3.1[a]	9.9[a]	47.8a
T. harzianum	71.8[ab]	2.3[abc]	8.9[a]	39.4[b]
L. arvalis	70.4[ab]	2.2[bc]	6.6b	24.2[c]
B. subtilis	53.3[c]	1.9[bc]	5.5[b]	27.5[c]
Streptomyces sp.	39.3[d]	1.8[c]	4.9[b]	22.7[c]
Captan	60.9[bc]	2.0[bc]	6.2[b]	23.9[cd]
Thiram	74.9[a]	1.9[bc]	6.4[b]	25.2[c]
Untreated seeds in pathogen inoculated soil	20.9[e]	1.7c	4.9[b]	18.1[d]
Untreated seeds in pathogen uninoculated control	80.8[a]	2.0bc	6.2[b]	24.2[c]

In each column, figures followed by same letter do not differ significantly (P = 0.05) by DMRT

substances resulting in increased seedling health. Similar observations were made by Windham *et al.* (1986) and Chang *et al.* (1986).

REFERENCES

BROADBENT, P., BAKER, K.F. and WATER WORTH, Y. 1971. Bacteria and actinomycetes antagonistic to fungal root pathogens in Australian soils. *Aust. J. Biol. Sci.*, **24**, 925-944.

CHANG, Y.C., CHANG, Y.C., BAKER, N., KLEIFELD, O. and CHET, I. 1986. Increased growth of plants in the presence of the biological control agent *Trichoderma harzianum*. *Plant Dis.*, **70**, 145-148.

HARMAN, G.E., CHET, I. and BAKER, R. 1981. Factors affecting *Trichoderma hamatum* applied to seeds as a biocontrol agent. *Phytopathol.*, **71**, 569-572.

LEACH, L.D., GARBER, R.H. and TOLMSOFF, W.J. 1960. Selective protection afforded by certain seed and soil fungicides. *Phytopathol.*, **50**, 643-644.

MARTIN, S.B., ABAWI, G.S. and HOCH, H.C. 1984. Influence of the antagonist *Laetisaria arvalis* on infection of tablebeets by *Phoma betae*. *Phytopathol.*, **74**, 1092-1096.

MARTIN, S.B., HOCH, H.C. and ABAWI, G.S. 1983. Population dynamics of *Laetisaria arvalis* and low temperature *Pythium* sp. in untreated and pasteurised beet field soils. *Phytopathol.*, **73**, 1445-1449.

MUTHUSAMY, M. 1972. Studies on damping-off of tomato incited by *Pythium aphanidermatum* (Edson) Fitz. M.Sc (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, 110 pp.

ROTHROCK, C.S. and GOTTLIEB, D. 1984. Role of antibiosis in antagonism of *Streptomyces hygroscopicus* Var. *geldanus* to *Rhizoctonia solani* in soil. *Can. J. Microbiol.*, **30**, 1440-1447.

RUPPEL, E.G. BAKER, R., HARMAN, G.E., HUBBARD, J.P., HECHER, D.J. and CHET, I. 1983. Field tests of *Trichoderma harzianum* Rifai., as a biocontrol agent of seedling disease in several crops and *Rhizoctonia* root rot in sugarbeet. *Crop Protection*, **2**, 399-408.

SINGH, R.S. and REDDY, C.S. 1979. Suppression of damping-off of tomato and seedling blight of chickpea and sugarbeet by strains of *Streptomyces diastaticus*. *Indian Phytopath.*, **32**, 374-377.

SIVAN, A.A., ELAD, Y. and CHET, I. 1984. Biological control effects of a new isolate of *Trichoderma harzianum* on *Pythium aphanidermatum*. *Phytopathol.*, **74**, 498-501.

VENKATASUBBIAH, P. 1985. Efficacy of *Bacillus subtilis* as a biocontrol agent for collar rot pathogen of coffee. *Geobios*, **12**, 101- 104.

WINDHAM, M.T., ELAD, Y. and BAKER, R. 1986. A mechanism for increased plant growth induced by *Trichoderma* spp. *Phytopathol.*, **76**, 518-521.