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Integration of soil solarization and *Trichoderma viride* Pers.: Fr. to control damping-off of tomato (*Lycopersicum esculentum* Mill.)

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ABSTRACT: **Efforts were made to control the damping off of tomato caused by *Pythium aphanidermatum* by using *Trichoderma viride* alone or in combination with soil solarization. *T. viride* along with soil solarization effectively reduced the pre and post-emergence damping off by 75.23 per cent and 88.34 per cent, respectively over control with concomitant increase in seedling vigour index and biomass of tomato.**

KEY WORDS: Damping-off, integrated control, *Pythium aphanidermatum*, soil solarization, tomato, *Trichoderma viride*

Tomato is a commercially important crop throughout the world and it is affected by various diseases and the most serious one is the damping-off caused by several species of *Pythium*, which accounts for severe crop loss. Due to wide host range, soil-borne nature and prolonged survival of propagules in soil by saprophytic growth and by resistant resisting structures which persist for many years (Hendrix and Campbell, 1973), the direct control of *Pythium* spp. is difficult and expensive. Under field conditions, fungicide application is neither feasible nor practicable owing to high cost and environmental concerns. The approach on implementation of biocontrol is the introduction of an antagonistic preparation to the ecosystem. Among several antagonistic species of *Trichoderma, T. viride* has proved to be a very effective biocontrol agent against a range of economically important aerial and soil-borne plant pathogens (Chet, 1987). Biological control using *T. viride* in integration with soil solarization offers a more reliable approach in managing soil-borne plant pathogens. This helps the plant to attain better growth and yield by the destruction of the resting propagules of many soil-borne pathogens without any environmental hazards (Katan *et al.*, 1983).

The present investigation was undertaken to explore the feasibility of using *T. viride* for the management of damping-off of tomato caused by *P. aphanidermatum* and its efficacy in integration with soil solarization under *in vitro* conditions.

Preparation of *P. aphanidermatum* inoculum

Liquid inoculum of *P. aphanidermatum* was prepared following the procedure of Kauraw and Singh (1982). A homogenous suspension of the fungal hyphae was obtained by macerating the mycelial mat with sterile distilled water in a warring blender. This inoculum was added to soil at 100ml/kg soil.

Preparation of *T. viride* inoculum

Trichoderma viride was multiplied in wheat bran and peat mixture (Sivan *et al.*, 1984). The medium contains wheat bran and peat soil at 1:1 ratio (V/V). The moisture content of the medium was adjusted to 50 per cent (W/W). The substrate mixture was autoclaved in polypropylene bags (20x15cm) for three successive days. Then the substrate mixture was inoculated with *T. viride* and incubated in an illuminated chamber for 14 days at 30°C.

The nursery beds of each one m^2 area were prepared. Totally 20 sub-plots were prepared in five rows and each treatment was replicated four times. The treatments were allotted to the individual plots by following randomized block design (RBD). *P. aphanidermatum* inoculum was added to soil at 100ml/ kg in the respective plots. They were irrigated copiously and covered with polythene sheet (300 gauge) in the respective plot. Care was taken to avoid formation of air pockets while sealing. The external open ends were sealed with soil. The plots were exposed to sunlight for 25 days. On 26th day, the polythene sheet was removed and earthed up and brought to fine tilth. *T. viride* was applied @ 200g/m^2 area to the respective pots by way of uniform sprinkling and incorporation into soil. The tomato seeds @ 5 g/m^2 area were sowed in the plots, two days after inoculation of *T. viride* into the soil. The tomato seeds treated with Arassan @ 4 g/kg of seeds and treated seeds were sowed in the respective plots. The seeds were sown in rows with an inter row spacing of 10cm. The seedbeds were covered with paddy straw and regularly watered as per requirement. The seedlings were observed continuously for 30 days to record the germination and disease incidence was calculated based on germination percentage at 7 and 14 days after sowing (DAS).

The shoot length, root length and dry matter production were recorded at 30 days old tomato seedlings and seedling vigour index were calculated by using the formula given by Abdul Baki and Anderson (1973).

Seedling Vigour Index = (Root length (cm) + Shoot length (cm) X Germination (%)

Effect of treatments on Damping-off of tomato

Trichoderma viride inoculation with soil solarization reduced the pre and post-emergence of damping-off caused by *P. aphanidermatum*. *T. viride* along with soil solarization recorded 22.78 per cent as pre-emergence and 5.06 per cent as post-emergence damping-off at 7 and 14 DAS, respectively. The results showed that soil inoculation of *T. viride* with soil solarization was found to be very effective in reducing the pre and post-emergence damping off by 75.23 per cent and 88.34 per cent, respectively over control (Table 1). This was followed by soil solarization alone. The *T. viride* alone applied as soil inoculation was also found to be effective in reducing the damping-off incidence. *P. aphanidermatum* inoculation (control) increased unchecked and ultimately reduced seed germination with 87.94 per cent as pre-emergence and 43.42 per cent as post-emergence damping off. Soil solarization during hot summer month increases soil temperature to levels lethal to many soil borne plant pathogens and at the same time enhanced the activity of some beneficial organisms such as *Trichoderma* spp. or actinomycetes (Katan, 1981). The soil application of *T. viride* before sowing of seeds in *Pythium* infected soil gave good control of seedling disease (Liu and Vaughan, 1965).

Effect on plant growth parameters of tomato

The present investigation showed that soil solarization in combination with introduction of *T. viride* enhanced the root and shoot length, seedling vigour index and dry matter production of tomato seedlings and ultimately minimized the damping-off incidence caused by *P. aphanidermatum*. The findings of Katan (1981) and Liu and Vaughan (1965) lends support to the present study. Increased plant growth by *Trichoderma* spp. has been reported as an added advantage (Chung *et al.*, 1988).

The results indicate that the integration of soil solarization with *T. viride* can serve as an

Table 1. Effect of integration of soil solarization and inoculation of *T. viride* on the damping-off incidence and seedling growth in tomato

Sl. No.	Treatment	Disease incidence (%)		Per cent reduction over control		Root length (cm)	Shoot length (cm)	Seedling vigour index	Dry matter production (mg m^{-2})
		Pre-emergence	Post emergence	Pre-emergence	Post emergence				
1.	*P. aphanidermatum* + soil solarization	34.97 (32.85)	21.14 (13.01)	52.33 (62.65)	56.81 (70.04)	2.0	10.1	1075.0	564
2.	*P. aphanidermatum* + *T.viride*	35.61 (33.91)	25.29 (18.26)	51.44 (61.14)	49.57 (57.95)	2.5	10.3	1096.5	518
3.	*P.aphanidermatum* + soil solarization + *T. viride*	28.51 (22.78)	13.04 (5.06)	60.15 (75.23)	70.04 (88.34)	3.0	10.8	1182.0	656
4.	*P. aphanidermatum* + Arassan 75% WP	38.33 (38.47)	25.08 (17.97)	48.59 (56.25)	49.96 (58.61)	1.9	9.8	1006.0	463
5.	*P. aphanidermatum* alone (control)	69.68 (87.94)	41.22 (43.42)	-	-	1.4	7.4	610.0	288
	CD (P=0.05)	1.18	2.52	-	-	0.38	0.47	43.52	58.12

Figures in parentheses are original values.

excellent food base to improve the proliferation and antagonist activity of *T. viride*. This may lead to effective biological control of damping-off of tomato caused by *Pythium aphanidermatum*.

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