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Field evaluation of *Trichoderma viride* Pers. ex. S. F. Gray and *Pseudomonas fluorescens* Migula against foliar diseases of groundnut and sunflower

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ABSTRACT: **Two biocontrol agents *viz.*, *Trichoderma viride* Pers. ex. S. F. Gray and *Pseudomonas fluorescens* Migula were evaluated against foliar diseases of groundnut and sunflower. Their efficacy was compared with that of commonly used fungicides. The results revealed that *T. viride* was equally effective as that of fungicides in controlling early and late leaf spots and rust in groundnut, and *Alternaria* blight in sunflower in both the crops. *Pseudomonas fluorescens* was ineffective.**

KEY WORDS: Biological control, foliar diseases, groundnut, *Pseudomonas fluorescens*, sunflower, *Trichoderma viride*

Early leaf spot (*Cercospora arachidicola* Hori.), late leaf spot (*Phaeoisariopsis personata* (Berk & Curt.) V. Artx.) and rust (*Puccinia arachidis* Speg.) are the most prevalent and highly destructive diseases of groundnut, which cause yield losses up to 70 per cent (Subrahmanyam *et al.*, 1980). The leaf blight of sunflower caused by *Alternaria helianthi* (Hansf.) Tubaki & Nishihara is a serious foliar disease which cause losses up to 80 per cent (Balasubrahmanyam and Kolte, 1980). Most of the varieties/hybrids of groundnut and sunflower are highly susceptible to these diseases. Spraying with fungicides is the common practice adopted for the control of foliar pathogens. However, constant uses will lead development of resistance to fungicides in the pathogens. Their use also affects the growth of native biocontrol agents in the phyllosphere. Biological control of foliar pathogens with antagonistic fungi offers an ideal remedy to problems arising out of constant fungicide application. Govindasamy and Balasubramanian (1989) have demonstrated the biocontrol potential of *T. harzianum* in controlling rust disease in groundnut under green house condition. However, field evaluation using these biocontrol agents and their formulated products have not been attempted as yet against foliar diseases of groundnut and sunflower. Therefore, an attempt was made to evaluate the biocontrol potential of *T. viride* and *P. fluorescens* against foliar diseases of these crops in field and the results are reported in this paper.

MATERIALS AND METHODS

Formulations of *T. viride* and *P. fluorescens*

An effective strain of *T. viride*, isolated from soil was grown in 150ml molasses yeast medium (Papavizas *et al.*, 1984) in 500ml Erlenmeyer flasks. Each flask was inoculated with one ml of conidial suspension (1x 10^7 conidia/ml) and incubated at 28 ± 2°C for 10 days. Cultures were harvested and the mycelial mat was homogenized using a mixer grinder. The homogenate was mixed with pre-sterilized talc powder at 1:2 (v/w) and air dried for 3 to 4 days. The dried formulation was then ground to powder and sieved by using a 125m test sieve. Gum arabic at 10 g/kg was added to this formulation as a sticking agent. This formulation containing conidia, chlamydospores and mycelial fragments of *T. viride*, was used in further field studies. A formulated product of *P. fluorescens* was obtained from the Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore. The population of *T. viride* and *P. fluorescens in* these formulations was estimated as 22×10^9 and 7×10^8 cfu/g, respectively, at the time of use.

Field experiment on groundnut

The experiment was conducted during kharif, 1997 using randomized block design (RBD) with three plot replications. Individual plot size was $10.5m^2$ with spacing between rows and plants maintained at 10 and 20cm, respectively. Groundnut cv. JL-24 was used. Standard agronomic practices were followed for raising the crop. The crop was sprayed thrice with chemical fungicides and biocontrol agents at vegetative, flowering and peg initiation stages. The doses for chemical fungicides and biocontrol agents used for foliar spray in groundnut are presented in Table 1.

Table 1. Doses of chemical fungicides and biocontrol agents

Treatment	Dose (g/lit)
Carbendazim	1.0
Chlorothalonil	2.0
Mancozeb	2.5
Triadimefon	2.0
Carbendazim + mancozeb	2.0
T. viride	2.0
P. fluorescens	2.0

Field experiment on sunflower

Exploded block design (EBD) (Rothamsted, 1974; Ramachander *et al.*, 1989) was adopted for experiment on sunflower during kharif, 1998. In the EBD, the treatments are evaluated in a relatively large plots separated by fallow. Only one replication is maintained per treatment. Each plot measured $92m^2$ and was separated by 20m fallow. The distance between rows and plants was maintained at 60 and 30cm, respectively. Sunflower hybrid NSH-413 was used as test crop. All the recommended agronomic practices were adopted for raising the crops. The crops were sprayed thrice with chemical fungicides and biocontrol agents each at vegetative, flowering and seed development stages. The doses for chemical fungicides and biocontrol agents used for sunflower are presented in Table 1.

Sampling and rating for diseases

In both the crops, twenty-five plants were selected at random/plot and scoring of diseases was done according to scale given by Mayee and Datar (1986). Both the crops were harvested at maturity and pod/achene yield recorded.

Analyses of data

The data obtained from experiments on groundnut and sunflower were analysed statistically using one way ANOVA and Student's T test, respectively.

RESULTS AND DISCUSSION

Among fungicides and biocontrol agents evaluated, carbendazim was most effective in controlling early leaf spot in groundnut, which registered the least disease score. This was followed by *T. viride*. However, there was no significant difference for the control of early leaf spot amongst the treatments *viz.*, carbendazim, *T. viride*, chlorothalonil and triadimefon. Spraying of mancozeb and *P. fluorescens* was less effective for the control of early leaf spot. Though, spraying of *T. viride* recorded the least score for late leaf spot with maximum decrease (29.7 %) over control, this treatment was not significantly

Table 2. Effect of fungicides and biocontrol agents on diseases of groundnut

Treatment	Disease score		
	ELS	LLS	Rust
Carbendazim	0.7^{a} (80.0)	5.7^{ab} (23.0)	4.7^{abc} (17.5)
Chlorothalonil	1.6^{abc} (54.3)	7.4^{ab} (00.0)	2.6^{a} (54.4)
Mancozeb	1.8^{bc} (48.6)	7.4^{ab} (00.0)	3.9^{abc} (31.6)
Triadimefon	1.7^{abc} (51.4)	6.6^{ab} (10.8)	4.6^{abc} (19.3)
T. viride	0.9^{ab} (74.3)	5.2^{a} (29.7)	3.3^{ab} (42.1)
P. fluorescens	2.5^{cd} (28.6)	6.9^{ab} (6.8)	5.1^{bc} (10.5)
Control	3.5^{d}	7.4^{ab}	5.7^{c}

ELS: Early leaf spot; LLS: Late leaf spot
In a column, means followed by the same letter are not significantly different at P = 0.05.
Values in brackets are per cent decrease as compared to control.

different as compared to rest of the treatment evaluated. Application of chlorothalonil and *T. viride* recorded a fewer score for rust, as compared to other treatments (Table 2). Except for carbendazim, *P. fluorescens* and unsprayed control, rest of the treatments registered significantly higher pod yields. Maximum pod yield was recorded in triadimefon sprayed plots (Table 3). Empirical observations in this plot revealed that the plants were stunted and supported smaller leaves as compared to rest of the treatments. However, leaves were retained on the plants till maturity.

Table 3. Pod yield in groundnut

Treatment	Pod yield (kg/ha)	Increase over control (%)
Carbendazim	1070^{b}	55.7
Chlorothalonil	1254^{ab}	82.5
Mancozeb	1195^{ab}	73.9
Triadimefon	1394^{a}	103.0
T. viride	1183^{ab}	72.2
P. fluorescens	757^{c}	10.2
Control	687^{c}	

In a column, means followed by the same letter are not significantly different (P = 0.05).

This might have contributed to sustained photosynthesis and as a consequent marginal increase in pod yield.

An overall analysis of data obtained for the control of diseases in groundnut revealed that among the biocontrol agents evaluated, *T. viride* was the best and its efficacy in controlling major diseases of groundnut was on par with many commonly used fungicides. *P. fluorescens* was ineffective. Though good reduction of early and late leaf spots ensued after application of carbendazim, this was not reflected in increase in pod yield.

In sunflower, spraying of carbendazim + mancozeb and *T. viride* significantly reduced the leaf blight when scoring done at flowering and seed development. Reduction in disease was also commensurate with increase in the yield of achene (Table 4). Chandra *et al.* (1998) also reported that spraying of carbendazim + mancozeb significantly reduced the leaf spot in groundnut than when either of these was sprayed.

Pseudomonas fluorescens is reported effective against the blast disease in rice (Valasubramanian, 1994) and finger millet (Viji and Gnanamanickam, 1996). But, our observations

Table 4. Effect of fungicides and biocontrol agents on disease and achene yield in sunflower

Treatment	Disease score		
	Flowering	Seed development	Yield (kg/ha)
Carbendazim	5.8[b] (21.6)	7.8[cd] (13.3)	818 (36)
Mancozeb	7.0[c] (5.4)	8.2[d] (8.9)	760 (31)
Carbendazim + Mancozeb	3.8[a] (48.6)	5.0[a] (44.4)	1170 (55)
T. viride	4.2[a] (43.2)	6.2[ab] (31.1)	1040 (49)
P. fluorescens	5.4[b] (27.0)	6.6[bc] (26.7)	994 (47)
Control	7.4[c]	9.0[d]	526

In a column, means followed by the same letter are not significantly different at P = 0.05.
Values in brackets are per cent decrease in disease and increase in yield as compared to control.

revealed that this agent in not effective against foliar diseases of groundnut and sunflower. Jacobsen and Backman (1993) have described that biological control products could control a relatively narrow spectrum of disease on specific crop hosts. Probably, *P. fluorescens* conforms to the descriptions of Jacobsen and Backman and has restricted effectiveness only against blast diseases in rice and finger millet.

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