

Efficacy of *Trichoderma viride* in controlling the loose smut of wheat caused by *Ustilago segetum* var. *tritici* at multilocation

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ABSTRACT: The application of *Trichoderma viride* on loose smut infected seeds (*Ustilago segetum* var. *tritici*) or in soil, reduced the smutted tillers up to 17.5 per cent. However, treatment of *T. viride* alone was not as effective as carboxin seed treatment in the control of loose smut. Maximum reduction was observed in dry seed treatment with antagonist as well as seed treatment plus soil application. The effect of *T. viride* was more prominent in the seed lot having lower level of loose smut infection. Application of *T. viride* along with half dose of carboxin was however, found as effective as full recommended dose of carboxin (2.5 g/kg of seed). Soaking of seeds in tap water for 24h also reduced the incidence of loose smut by 15.4 per cent.

KEY WORDS: Biocontrol, loose smut, *Trichoderma viride*, *Ustilago segetum* var. *tritici*

Loose smut of wheat, caused by *Ustilago segetum* (Pers) Roussel var. *tritici* Jenson, is one of the important diseases of wheat especially in northern parts of India. Losses average 2-4 per cent and in some areas of the plains they are as high as 5 per cent (Joshi *et al.*, 1985, 1986; Ram and Arora, 1986). However, the incidence of loose smut can be as high as 33 per cent in the hills (Joshi *et al.*, 1986). The disease incidence came down in the late 1960s and early 1970s with the extensive cultivation of resistant cultivar Kalyansona in northern India. With the release of susceptible cultivars, loose smut incidence has again increased (Sood, 1988) and thus causing losses in wheat yields every year, in spite of the fact that its control by seed treatment with carboxin or carbendazim is known since the

1970's. Use of these fungicides is however, not adopted up to the desired extent, mainly due to their high costs and their non-availability to the farmers. *Trichoderma viride* Pers. ex Fr., is well-known potent biocontrol agent for some soil borne plant pathogens (Papavizas, 1995). Its effectiveness against loose smut of wheat has been reported by Agarwal and Nagarajan (1992). The present study was undertaken to explore the possibilities of using *T. viride* alone or with reduced doses of fungicides for the control of loose smut of wheat in the field.

MATERIALS AND METHODS

The experiment was carried out during winter seasons of 1993-94 and 1994-95. The seeds of

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'Sonalika' variety which were inoculated with chlamydospores of *U. segetum* var. *tritici* by using 'Go go method' during previous crop season were used for sowing in the proceeding year. The trials were planted at Karnal, Hisar, New Delhi and Ludhiana centres, during 1993-94 crop season. During 1994-95, the trials were conducted at Karnal, Hisar, New Delhi and Pantnagar. The culture of *T. viride* obtained from IARI was mass multiplied on autoclaved sorghum grains as well as on potato dextrose broth (PDB), after incubating at $25\pm 1^\circ\text{C}$ temperature, for 25 days. The culture filtrate of *T. viride* was obtained after filtering the medium of fungus through Whatman filter paper No. 42 and subsequent centrifugation at 12,000 rpm. Likewise, the uninoculated PDB was also filtered and used as check. The treatments given were as follows :

1993-94 crop season

1. The application of wheat seeds soaked in spore suspension of *T. viride* for over night (12h) and dried under shade. The spore suspension in sterilized water was prepared after shaking the sorghum seeds used for growing of *T. viride* after 25 days of inoculation. The spore concentration was around 35×10^6 /ml.
2. The application of culture of *T. viride* grown on sorghum seeds @ 20 kg/ha in furrows two days before sowing.
3. Combination of treatments 1 & 2.
4. Dry treatment of seeds with carboxin (Vitavax 75 WP @ 2.5 g/kg of seed). Besides these, the infected seeds were also soaked over night in the cell-free culture filtrate of *T. viride* and uninoculated medium at Karnal to observe the effect on loose smut incidence.

1994-95 crop season

After analyzing the results of 1993-94, the treatments were modified as follows:

1. Soaking of seeds in *T. viride* spore suspension for 12 h.
2. Soaking of seeds in *T. viride* spore suspension for 24 h.

3. Soaking of seeds in *T. viride* spore suspension for 12 h + carboxin dry seed treatment @ 1.25 g/kg after air drying of soaked seeds.
4. Soaking of seeds in *T. viride* spore suspension for 24 h + carboxin dry seed treatment @ 1.25 g/kg after air drying of soaked seeds.
5. Carboxin @ 2.5 g/kg of seed as dry seed treatment.

The checks were maintained by soaking of untreated seeds in tap water for over night at room temperature and untreated dry seeds during both the years. The plot size was 1.5 x 1.38m with six rows at the distance of 23cm each. The experiment was conducted in a randomised block design replicated thrice and the crop was raised as per recommended agronomic practices. The records on the smutted and healthy tillers were taken after ear emergence. The per cent smutted tillers were calculated and multilocation data were statistically analysed by taking the means of locations as replications. The data were transformed to arcsine values before subjecting to ANOVA.

RESULTS AND DISCUSSION

The results on the per cent smutted tillers at multilocation and under different treatments are presented in Tables 1-2. None of the treatment of *T. viride* was found as effective as that of carboxin seed treatment during both the crop seasons and was significantly inferior to treatment of fungicide. The mean reduction in the incidence of loose smut due to treatments of *T. viride* varied from 8.9 to 17.5 per cent. Amongst three methods, the applications of *T. viride* on seed and seed plus soil were most effective. However, the difference in effectiveness of bioagent applied by three methods was statistically non-significant (Table 1). The effect of antagonist was more prominent in the seed lot possessing low level of loose smut infection (11.3 %) than that with higher seed infection (> 30.0 %), as evident from data of Hisar centre where the disease incidence was reduced up to 38.4 per cent in treated seeds by *T. viride* (Table 1). Culture filtrate of *T. viride* also found

Table 1. Effect of biocontrol agent on the loose smut incidence during 1993-94 crop season

Treatment	Dose / Method of application	Per cent smutted tiller				Mean	Control over check (%)
		Karnal	Hisar	New Delhi	Ludhiana		
<i>T. viride</i>	spore treatment	26.5	6.9	31.7	33.2	24.6	17.5
<i>T. viride</i>	soil application	26.0	11.3	34.7	29.6	25.4	14.8
<i>T. viride</i>	seed & soil	26.0	8.5	32.7	31.2	24.6	17.5
Carboxin (Vitavax)	2.5 g /kg of seed	10.0	0.3	0.8	6.2	4.3	85.6
Water soaking	12 h	26.4	10.2	33.2	31.2	25.2	15.4
<i>T. viride</i> culture filtrate	-	30.6	-	-	-	-	-
Potato dextrose media	-	38.7	-	-	-	-	-
Untreated (Check)	-	33.6	11.3	36.1	38.1	29.8	-
CD (P=0.05)		0.1				0.8	

Analysis was done after transformation of data into arcsine values.

effective against loose smut at Karnal centre and reduced the disease significantly (8.9 per cent) over check, thus indicating the role of metabolites of biocontrol agent in control of seedborne infection. Interestingly, soaking of seed in tap water also reduced the loose smut infection by 15.4–23.7 per cent (Tables 1-2). The treatment with *T. viride* and carboxin alone or in combination significantly reduced the loose smut infection during 1994-95 season over untreated check. *Trichoderma viride* when applied in combination with carboxin, even at half of the recommended

dose @ 1.25 g/kg was significantly on par with full dose of carboxin (Table 2). However, *T. viride* alone was significantly inferior to carboxin alone @ 2.5 g/kg and could give only 29.4 per cent control as compared to 94.3 per cent control in the case of carboxin. Earlier also Mathivanan *et al.* (1997) observed better control of damping off and root rot of cotton when *T. viride* was applied as seed treatment with carbendazim followed by soil application. Likewise, Mondal *et al.* (1995) found inhibitory effect of *Trichoderma* spp. against *U. segetum* var. *tritici* *in vitro* with culture

Table 2. Effect of biocontrol agent on the loose smut incidence during 1994-95 crop season

Treatment / Dose & Method of application	Per cent smutted tiller				Mean	Control over check (%)
	Karnal	Hisar	New Delhi	Ludhiana		
<i>T. viride</i> soaking for 12 h (T1)	18.2	20.0	21.1	17.5	19.2	21.6
<i>T. viride</i> soaking for 24 h (T2)	21.2	19.3	13.3	15.4	17.3	29.4
T1 + carboxin @ 1.25 g/kg	1.9	2.6	3.0	0.5	2.0	91.8
T2 + carboxin @ 1.25 g/kg	2.0	1.7	1.8	0.7	1.6	93.5
Carboxin @ 2.5 g/kg	2.6	0.9	1.2	0.8	1.4	94.3
Water soaking 12h	16.4	-	21.0	18.8	18.7	23.7
Untreated (Check)	22.8	26.6	28.0	20.6	24.5	-
CD (P=0.05)					0.21	

Analysis was done after transformation of data into arcsine values.

filtrates and compatibility of bioagents with carboxin @ 200-500ppm levels. The application of *T. viride* on seed and in soil may compete with *U. segetum* var. *tritici* and therefore able to reduce the growth of pathogen and affects its expression at heading stage adversely. The use of *T. viride* may be recommended in reducing the incidence of loose smut of wheat. The application of *T. viride* can reduce the doses of fungicides up to half without affecting its effectiveness. Use of *T. viride* will not only reduce the cost of loose smut control, but also be helpful in reducing the environmental pollution.

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