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Antagonistic activity and effect of *Trichoderma* spp. against Sheath Blight of Rice caused by *Rhizoctonia solani*

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Trichoderma spp. is a major disease controlling potential of indigenous strains and bio control agents against many plant pathogens of crop plants. In present study thirty three isolates *of Trichoderma* spp. were collected from SBCL, BTCCARS, Bilaspur which were isolated from soils of rice field. All the thirty three isolates were tested for their antagonistic activity against *Rhizoctonia solani in vitro*. The isolates showed varied level of inhibition and showed maximum percent growth inhibition (66.30%) by the isolates T2 against *Rhizoctonia solani* with minimum mycelial growth (31.00 mm). Different isolates of *Trichoderma* spp. were evaluated against sheath blight of rice *in vivo* and results indicated that T2 was most effective isolate for disease controlling potential with minimum percent disease index (14.67%) compared to other isolates. *Trichoderma* spp. isolates T2 (63.33%) was found to be most effective isolate for percent reduction over control against sheath blight of rice caused by *Rhizoctonia solani* under pot culture.

Keywords : Antagonistic activity, *Rhizoctonia solani, Trichoderma spp.*

INTRODUCTION

One of the world's most significant crops for staple food grains is rice (*Oryza sativa* L.). In the year 2019–20, in Chhattisgarh, rice crop had been cultivated in 3876.13 ha, with a production of 3002 kg ha (Anonymous, 2021).The rice plant is susceptible to a wide range of phytopathogens, among these pathogens, bacterial and fungal pathogens are the primary bottleneck for higher production (Nayak *et al*. 2021). Fungal rice diseases, such as blast caused by *Pyricularia oryzae*, sheath blight caused by *Rhizoctonia solani*, brown spot caused by *Bipolaris oryzae,* and sheath rot caused by *Sarocladium oryzae*, have been recognized as significant culprits in the rice farming system (Prismantoro *et al*. 2024).The pathogen Rhizoctonia solani, which causes rice sheath blight, reduces yield by 10% to 30% and can increase to 50% depending on the severity of sheath blight of rice (Dey *et al*. 2019). Depending on the illness's intensity of disease and the susceptible variety, sheath blight disease can cause yield losses of up to 58% (Chahal *et al*. 2003).

Similarly yield losses of 4–50% have been documented Depending on the crop stage during infection, disease severity and environmental factors, (Kumar *et al*. 2009).

Biological control is mainly used to control harmful organisms in plants through beneficial organisms and their products to control plant diseases and effectively reduce the application of chemical fertilizers and pesticides (Harman *et al*. 2021). The antagonistic action of the genus *Trichoderma* (Hypocreales, Ascomycota) against a number of plant pathogen, including *Rhizoctonia solani*, is well-known (Harman, 2006).Numerous studies have suggested that using *Trichoderma* as a biological control agent could help to reduce the occurrence of sheath blight in rice (Das and Hazarika, 2000; Naik *et al*. 2022).*Trichoderma* species are free-living fungus found in a variety of natural environments, particularly those with

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high levels of organic matter, such as soil and root ecosystems (*Harman et al. 2004*).

MATERIALS AND METHODS

Isolation of pathogen from infected plant samples

Fresh infected samples of rice were brought to the laboratory in paper bags and washed under tap water to remove dust and other inert materials. Small pieces of specimen were then cut, with each piece containing half infected and half healthy portions. These pieces were disinfected with a sodium hypochlorite (0.1%) solution for 1 min followed by washing with sterilized distilled water. The pieces were placed on blotting paper and allow to dry. Once properly dried, the pieces were transferred into culture slants and subsequently transferred into petri dishes containing PDA media. (Neha *et al*. 2016).

Confirmation of pathogenicity test by Koch's postulate

The Koch'S postulate method was used to confirm the pathogenicity test of the *Rhizoctonia solani*. The culture with fungal inoculum contains mycelia and sclerotia were inoculated into the sheath region of 30 days old rice seedlings (variety-Swarna). After the multiplication and expression of the symptoms, the pathogen was re-isolated on the PDA medium from the infected plants showing typical symptoms of sheath blight and microscopic observations were taken to confirm the presence of infected hyphae/ mycelium resembles to the isolate which was isolated from naturally infected rice plant with the sheath blight disease.

Pathogen was confirmed as *Rhizoctonia solani* and proved its pathogenicity (Moni *et al*. 2016).

Bio-control agents (Trichoderma spp)

Fresh cultures of different isolates of *Trichoderma* spp. were procured from State Bio Control Laboratory (SBCL) BTC College of Agriculture and Research Station, IGKV, Bilaspur (C.G.) and used under the present the investigation. Potato Dextrose Agar (PDA) medium was used for the multiplication of isolates of *Trichoderma* spp.

Maintenance of pure cultures of microorganisms under laboratory condition.

Pure cultures of *Rhizoctonia solani* and isolates of *Trichoderma* spp. were maintained on PDA slants and petri dishes under laboratory conditions, wrapped with aluminium foil and kept in the refrigerator at 4 °C for further use.

Antagonistic activity of indigenous strains of Trichoderma spp. against Rhizoctonia solani under in vitro condition

Dual culture

The antagonistic activity of *Trichoderma spp*. strains against *R. solani in vitro* was evaluated using the dual culture technique (Bell *et al*. 1982). Mycelial discs (7 mm) from different strains of *Trichoderma* spp. and pathogens i.e. *Rhizoctonia solani* from five days old culture were mounted opposite to each other at an equal distance from the periphery and incubated at 25±2 ^{0}C. The radial mycelial growth (mm) of the pathogen was measured after 24 hours of incubation and continued till 96 hrs at an interval of 24 hrs. The percentage inhibition of mycelial growth was calculated using the formula (Nirmalkar *et al*. 2017; Chaudhary *et al*., 2020)

$$I = \frac{C - T}{C} X 100$$

Where, I - per cent inhibition of mycelial growth,
C- mycelial growth of pathogen in control.

T- mycelial growth of pathogen in dual culture.

In vivo studies

The field experiment was conducted during Kharif season of 2023 to study of different Trichoderma spp. for the control of sheath blight of rice. The experiment was laid out in complete randomized design (CRD) with the pot size of 28 cm. x 28 cm. Each treatment was replicated thrice.

Preparation of inoculum

Typha grass, or cattail (*Typha angustifolia*), is used as a substrate for multiplying *Rhizoctonia solani*, a fungal pathogen that causes sheath blight

in rice and other crops. The typha method, where *R.* solani is grown on pieces of typha grass, is a common inoculation method compared to agar blocks. The typha method allows for rapid mass multiplication of the fungus. Typha leaf bit method was first used by Bhaktavatsalam *et al*. (1978) for mass multiplication of Sheath blight causing fungus (Tejaswini *et al*., 2016). *R.solani* was multiplied on Typha grass on a large scale in the plant pathology laboratory. The grasses were cut into small pieces, filled in polythene bags and placed in an autoclave for 15 minutes at 121.6°C for sterilization. Sterilized polythene bags were inoculated with mycelial discs (7 mm) of five days old culture of *R. solani* and incubated for 7 days in the BOD incubator at 28±2°C (Thakur *et al*. 2022). Two bits per hill were used for artificial inoculation. The bits were inserted in between the tillers at the base of the plant and tied with thread so as to come in contact with the neighbouring tillers.

Preparation of liquid formulations of different isolates of Trichoderma spp.

Ten mycelial discs (7 mm) of different isolates of *Trichoderma* spp. from the culture grown in petri dishes were inoculated on conical flasks of 250 ml capacity having 200 ml of sterilized potato - dextrose broth and incubated for 15 days in the BOD incubator at 28±2°C. Spore biomass of each isolate of *Trichoderma* spp. was collected along with broth and homogenized in mixer. Homogenized semi liquid spore biomass then further diluted in sterilized distilled water @ 100 g / l water and thus liquid formulations of 10 per cent concentration was prepared having CFUs of 2.5 x 10^{10} (Thakur *et al*. 2022). Liquid formulation (10 %) of each Trichoderma isolate was used as foliar spray @ 10 ml/ l water.

Inoculation of rice plants

Thirty- days old rice seedlings were transplanted in the pots (40 cm in diameter) @ 4-5 seedlings/ pot. At maximum tillering stage, plants were inoculated with 2-3 Typha pieces colonized with *R. solani* mycelium and sclerotia at the foot of tillers (a cluster of tillers). 85 and 90 percent humidity level and favourable temperature (25 ^{0}C - 28 ^{0}C) were maintained by the sprinkling of clean water as well as irrigating the pots for the optimum growth of the pathogen and development of symptoms of sheath blight disease. After the development of initial symptoms of sheath blight, liquid formulation of all isolates of *Trichoderma* spp. was sprayed uniformly, covering all areas above ground. Four sprays of different treatments were applied at an interval of five days **(**Fig.1**).**

Treatments Details are as follows :

Treatments	Formulation %	Doses ml/lwater
Trichoderma harzianum T_1	10%	10
Trichoderma harzianum T_2	10%	10
Trichoderma harzianum T_3	10%	10
Trichoderma harzianum T_4	10%	10
Trichoderma harzianum T_5	10%	10
Trichoderma harzianum T_6	10%	10
Trichoderma harzianum T_7	10%	10
Trichoderma harzianum T_8	10%	10
Trichoderma harzianum T_9	10%	10
Trichoderma harzianum T_{10}	10%	10
Trichoderma harzianum T_{11}	10%	10
Trichoderma harzianum T_{12}	10%	10
Trichoderma harzianum T_{13}	10%	10
Trichoderma harzianum T_{14}	10%	10
Trichoderma harzianum T_{15}	10%	10
Trichoderma harzianum T_{16}	10%	10
Trichoderma harzianum T_{17}	10%	10
Trichoderma asperellum T_{18}	10%	10
Trichoderma harzianum T_{19}	10%	10
Trichoderma harzianum T_{20}	10%	10
Trichoderma harzianum T_{21}	10%	10
Trichoderma harzianum T_{22}	10%	10
Trichoderma harzianum T_{23}	10%	10
Trichoderma harzianum T_{24}	10%	10
Trichoderma harzianum T_{25}	10%	10
Trichoderma harzianum T_{26}	10%	10
Trichoderma harzianum T_{27}	10%	10
Trichoderma harzianum T_{28}	10%	10
Trichoderma harzianum T_{29}	10%	10
Trichoderma harzianum T_{30}	10%	10
Trichoderma harzianum T_{31}	10%	10
Trichoderma harzianum T_{32}	10%	10
Hexaconazole 5%SC	5%	2.0
Azoxystrobin + Difenoconazole	18.2%	1.5
Untreated control		

Visual scoring of sheath blight incidence rating scale given by International Rice Research Institute (IRRI, 1996).

Scale	Symptoms
0	No infection
1	Vertical spread of the lesions up to 20% of plant height
3	Vertical spread of the lesions up to 21-30% of plant height
5	Vertical spread of the lesions up to 31-45% of plant height
7	Vertical spread of the lesions up to 46-65% of plant height
9	Vertical spread of the lesions up to 66-100% of plant height

Per cent Disease Index (PDI) was calculated by using the formulas given below :

$$PDI = \frac{\text{Sum of individual rating}}{\text{Total number of plant observed x Maximum grade value}} \times 100$$

RESULTS AND DISCUSSION

Using the dual culture method, all isolates of *Trichoderma harzianum* and *Trichoderma asperellum* were evaluated for their antagonistic activity against *Rhizoctonia solani*.Data presented in table 1 representing the radial mycelial growth (mm) after 24 hrs of incubation indicated that the most of the isolates of *Trichoderma harzianum* and *Trichoderma asperellum* (15.50 mm – 18.00 mm) were found effective and showing significant higher antagonistic activity against *Rhizoctonia solani* over control (20.00 mm).

Data on radial mycelial growth (mm) recorded after 48 hrs of incubation indicated that all isolates of *Trichoderma harzianum* and *Trichoderma asperellum* were significantly effective (29.33 mm – 32.50 mm) in arresting the mycelial growth of *R.solani* over control (40.00 mm). However, isolates i.e. T12 (29.33 mm) and T21 (29.33 mm) were found to be the most effective and showing significant higher antagonistic over control (40.00 mm) closely followed by T7, T8, T22, T25, T10, T13, T16, T20, T24, T27, T33, T14, T23, T26, T28, T26,T28, T32, T2, T6, T11, T29, T31, T5, T15, T17, T19, T30 and T18 (29.67 mm - 31.67 mm).

Data on radial mycelial growth (mm) recorded after 72 hrs of incubation indicated that all isolates were found significantly effective against the mycelial growth of R. solani (33.17 mm – 39.67 mm) over control (70.00 mm). However, some of the isolates i.e. T15 (33.17 mm), T1 (34.00mm), T6 (34.00 mm),T2 (34.33 mm), T5 (34.33mm),T8 (34.33 mm), T7 (34.67mm) and T18 (34.67 mm) were found highly effective and showing significant higher antagonistic activity over control (70.00 mm).

Similarly, data on radial mycelial growth (mm) recorded after 96 hrs of incubation indicated that isolates i.e. T2 (31.00 mm), T5 (31.67 mm), T24 (32.00 mm), T29 (32.67 mm), T30 (32.67 mm), T17 (33.00 mm), T10 (33.67 mm), T8 (33.67 mm)

Fig. 1 : Growth of *Rhizoctonia solani* in PDA, artificial inoculation with *R.solani* and symptoms of sheath blight (Left, middle and right, respectively)

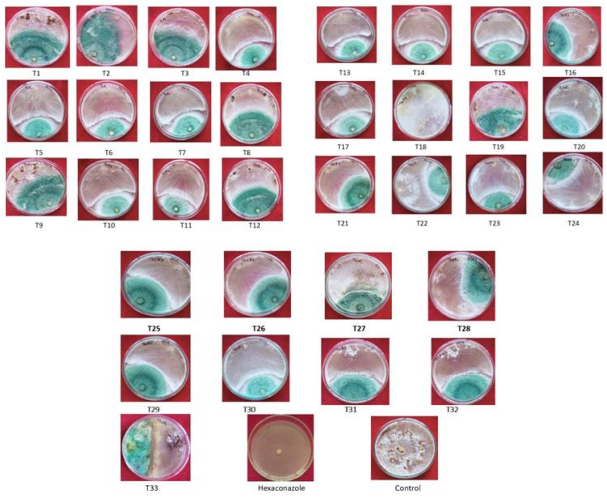

Fig. 2 : Antogonistic reaction of different isolates of Trichoderma against *Rhizoctonia solani in vitro*

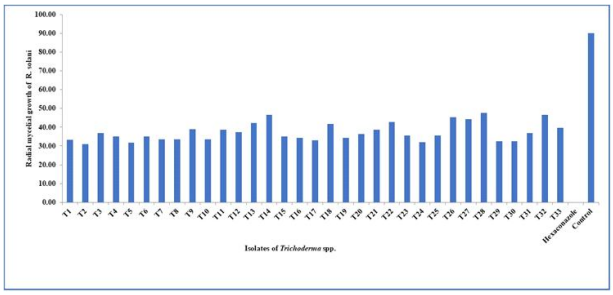

Fig. 3 : Antagonistic activity of different isolates of Trichoderma against *Rhizoctonia solani in vitro* after 96 h. of growth in Petri dishes

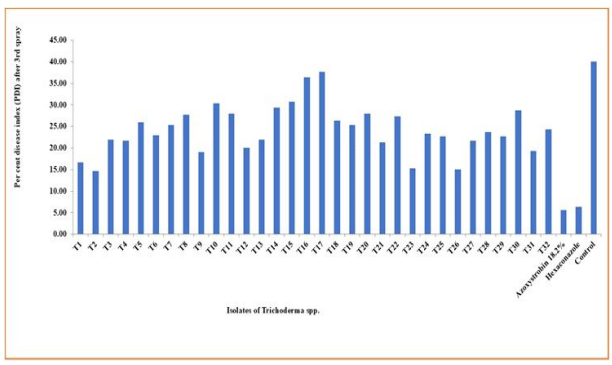

Fig. 4: Effect of isolates of *Trichoderma* spp. as foliar spray on sheath blight disease of rice caused by *Rhizoctonia solani*

and T7 (33.67 mm), were found highly effective and showed higher antagonistic activity against radial mycelial of *Rhizoctonia solani* over control (90.00 mm) (Figs. 2 and 3)

Data presented in Table. 1 representing the radial mycelial growth (mm) after 24, 48 , 72 and 96 hrs of incubation indicated that there was substantial decrease in the growth of *R. solani* from 48 hrs to 96 hrs of incubation brought by some of the isolates i.e. T2 (34.33 mm - 31.00 mm), T5 (34.33 mm - 31.67 mm), T24 (37.67 mm - 32.00 mm), T29 (39.00 mm - 32.67 mm), T30 (38.00 mm - 32.67 mm), T17 (39.00 mm - 33.00 mm), T7 (34.67 - 33.67 mm), T8 (34.33 mm - 33.67 mm), T10 (36.00 mm - 33.67 mm), T19 (36.83 mm - 34.33 mm) and T16 (35.17 mm - 34.33 mm), which indicate that these isolates were not only grew with higher growth rate to arrest the mycelial growth of *R. solani* but also over grew on the mycelial growth indicating their hyperparasitic or mycoparasitic activities (Babu and Kumar, 2008). Variability in antagonistic potential among the different strains of *Trichoderma harzianum and T. asperellum* against the mycelial growth of *R. solani* may be due to variation in growth rate, different levels of mycoparasitism and production of antifungal compounds by the *Trichoderma* isolates. Variability in antagonistic potential among the different strains of *Trichoderma* against different pathogen have been reported (Kavita *et al*. 2025). Jambhulkar *et al*. (2024) reported the antagonistic effect of isolates of *Trichoderma* spp. against three soilborne plant pathogenic fungi: *Sclerotium rolfsii, Rhizoctonia solani,* and *Fusarium verticillioides* in plate culture assays. One of the most potent strains was *T. afroharzianum* BThr29 having a maximum in vitro inhibition of *S.rolfsii* (76.6%), *R. solani* (84.8%), and *F. verticillioides* (85.7%). Shalini and Kotasthane (2007) reported that Trichoderma isolates coiled around the hyphae *of R. solani* and formed appresoria and hook-like structures. Inter-fungal interaction, which was observed by an electron microscope, showed hyperparasitic action of *T. virens* against *R.solani* involved the formation of the knob-like structure followed by the growth of *Trichoderma* hyphae inside host mycelia, coiling, lysed cell wall, and swelling of mycelial tips (Alfi *et al*. 2020).

Management of Sheath blight of rice

The pot experiment was conducted in Kharif season using complete randomized design for the management of sheath blight of rice.

Data presented in Table 2 indicates that all isolates of *Trichoderma harzianum* and *Trichoderma asperellum* were found significantly effective (PDI-14.67- 37.67) in suppressing the sheath blight severity over control (PDI- 40.00). Amongst the different isolates of *Trichoderma spp*., isolates i.e. T2 (PDI-14.67), T26 (PDI-15.00), T23 (PDI-15.33) and T1 (PDI-16.67) were found significantly more effective in controlling sheath blight disease over untreated control (PDI-40.00) and statistically at par with each other. Other isolates i.e. T9 (PDI-19.00), T31 (PDI-19.33), T12 (PDI-20.00), T21 (PDI-21.33), T4 (PDI-21.67), T27 (PDI-21.67), T3 (PDI-22.00), T13 (PDI-22.00), T25, T29 (PDI-22.67), T6 (PDI-23.00), T24 (PDI-23.33),T28 (PDI-23.67), T32 (PDI-24.33), T7 (PDI-25.33) and T19 (PDI-25.33)were also found significantly effective. Whereas, lowest per cent disease index (PDI) was observed in Hexaconazole 5% SC (PDI- 5.67%) which was at par with Azoxystrobin 18.2%+ Difenoconazole (PDI-6.33%).

Results from (Table 2 and Fig. 4) on the per cent reduction in sheath blight severity over control indicated that all isolates of *Trichoderma harzianum* and *Trichoderma asperellum* were found significantly effective in controlling the sheath blight disease of rice over control and showing varying degree of per cent disease control ranging from 8.13 % to 63.33 %. However, *Trichoderma* isolates i.e. T2 (63.33%), T26 (62.50%), T23 (61.67%), T1 (58.33%), T9 (52.50%) and T31 (51.67%) were found highly effective along with Azoxystrobin 18.2% + Difenoconazole (85.83%) and Hexaconazole 5% SC (84.17%) in controlling the sheath blight of rice followed by isolates i.e. T21 (46.67%), T4 (45.83%), T27 (45.83%), T3 (45.00%), T13 (45.00%), T6 (42.50%), T28 (40.83%) and T29 (43.33%), T25 (43.33%) and T24 (41.67%). Moreover, *Trichoderma* isolates i.e. T32 (39.17), T7 (36.67), T19 (36.67), T5 (35.00), T18 (34.17), T8 (30.83), T11 (30.00), T20 (30.00) and T22 (31.67) were also found significantly effective in reducing per cent severity of sheath blight of rice

Fig. 5: Effect of isolates of *Trichoderma* spp against sheath blight disease of rice (pot experiment)

(Fig.5). Khan and Sinha (2007) also reported that all *Trichoderma* spp. isolates were effective against *R. solani* and reducing disease severity and incidence of rice sheath blight by 38.8% and 24.6%, respectively. Isolates i.e. T2 (63.33%), T26 (62.50%), T23 (61.67%), T1 (58.33%),T9 (52.50%) and T12 (48.33%) were found to be significantly more effective in controlling the sheath blight of rice under *in vivo* condition and were also significant in inhibiting the mycelial growth of *R. solani* (58.89% – 66.30%) under *in vitro* condition except T31 which was effective in controlling the sheath blight of rice (51.67%) but comparatively less effective in inhibiting the mycelial growth of *R.solani* (49.63%).Similarly, some of the isolates i.e. which were found highly significant in checking the mycelial growth of *R. solani in vitro* did not perform well in controlling the sheath blight of rice. The results of present study are in accordance with the findings of several workers who reported the biocontrol and growth enhancement potential of Trichoderma spp. against Sheath blight of rice causing *R. solani* (Chaudhary *et al*., 2020; Shahram *et al*., 2025).

Different level of disease controlling potential recorded in different strains of *Trichoderma harzianum* and *Trichoderma asperellum* may be due to influence of meteorological factors and host response during the interaction between *Trichoderma* isolates and *Rhizoctonia solani* under the process of pathogenesis. *Trichoderma* secretes enzymes like chitinolytic enzymes, glucanases, cellulases, and proteases to manage plant diseases. *Trichoderma* can effectively control soil-borne pathogens like *Pythium* sp., *R.solani*, and *Sclerotium rolfsii* through various mechanisms, including antibiosis, mycoparasitism, defense response induction and growth promotion (Sharma and Sain, 2004; Sala *et al*. 2007; Mishra and Khan, 2015). Mirsam *et al*. (2023) reported that the different isolates of *T. asperellum* showed the antagonistic mechanism in inhibiting the *R. solani* growth through the action of parasitism.The *T.asperellum* isolates tested on corn seedlings showed a significantly high difference from the control treatment on the observational variables of maximum growth potential (MGP), growth rate

Table 1: Antagonistic activity of different isolates of *Trichoderma* spp. against mycelial growth (mm) of *Rhizoctonia solani* using dual culture technique.

Treatments	Radial mycelial growth (mm) of *Rhizoctonia solani* incubation period			
	24 hours	48 hours	72 hours	96 hours
Trichoderma harzianumT_1	17.83	32.50	34.00	33.33
Trichoderma harzianumT_2	17.33	30.83	34.33	31.00
Trichoderma harzianumT_3	16.33	32.33	36.00	37.00
Trichoderma harzianumT_4	16.00	30.50	36.50	35.00
Trichoderma harzianumT_5	18.00	31.33	34.33	31.67
Trichoderma harzianumT_6	17.67	31.00	34.00	35.00
Trichoderma harzianumT_7	17.33	29.67	34.67	33.67
TrichodermaharzianumT_8	16.33	29.67	34.33	33.67
TrichodermaharzianumT_9	16.33	32.33	39.17	39.00
TrichodermaharzianumT_{10}	15.50	30.33	36.00	33.67
Trichoderma harzianumT_{11}	17.00	31.00	39.00	38.67
Trichoderma harzianumT_{12}	17.50	29.33	38.00	37.33
Trichoderma harzianumT_{13}	17.00	30.33	39.00	42.33
Trichoderma harzianumT_{14}	18.00	30.67	35.33	46.67
Trichoderma harzianumT_{15}	17.50	31.33	33.17	35.00
Trichoderma harzianumT_{16}	17.50	30.33	35.17	34.33
Trichoderma harzianumT_{17}	17.33	31.33	39.00	33.00
Trichoderma asperellumT_{18}	17.50	31.67	34.67	41.67
Trichoderma harzianumT_{19}	18.00	31.33	36.83	34.33
Trichoderma harzianumT_{20}	17.17	30.33	34.83	36.33
Trichoderma harzianumT_{21}	17.67	29.33	39.00	38.67
Trichoderma harzianumT_{22}	17.50	30.00	36.33	42.67
TrichodermaharzianumT_{23}	16.50	30.67	35.00	35.67
Trichoderma harzianumT_{24}	17.33	30.33	37.67	32.00
TrichodermaharzianumT_{25}	17.67	30.00	38.00	35.67
Trichoderma harzianumT_{26}	17.00	30.67	39.17	45.33
TrichodermaharzianumT_{27}	17.83	30.33	39.00	44.33
Trichoderma harzianumT_{28}	17.67	30.67	39.00	47.67
Trichoderma harzianumT_{29}	18.00	31.00	39.00	32.67
Trichoderma harzianumT_{30}	17.00	31.33	38.00	32.67
Trichoderma harzianumT_{31}	17.67	31.00	38.33	37.00
Trichoderma harzianumT_{32}	18.00	30.67	38.33	46.67
Trichoderma asperellumT_{33}	17.50	30.33	39.67	39.67
Hexaconazole 5% SC 100ppm	0.00	0.00	0.00	0.00
Control	20.00	40.00	70.00	90.00
S. Em.	1.690	1.450	1.670	1.430
CD (0.05)	2.845	2.441	2.812	2.408
CV	3.12	3.46	2.79	2.32

S.Em.- Standard error of mean
CD- Critical difference
CV- Coefficent of variation

(GtR), growth simultaneity (GS), vigor index (VI), germination rate (GR), and median germination time (T50). However, *T. asperellum* isolate CHM01 showed better potential than other isolates in inhibiting the growth of *R. solani*in vitro on PDA medium with a parasitism mechanism and enhancing the growth of corn seedlings.

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Table 2: Effect of isolates of *Trichoderma* spp. as foliar spray for the management of sheath blight of rice caused by *Rhizoctonia solani* under artificial inoculated condition

Treatments	PDI before spray	PDI 5th days after Ist spray	PDI 5th days after IInd spray	PDI 5th days after IIIrd spray	% reduction in PDI after IIIrd spray
Trichoderma harzianum T_1	11.11 (19.30)	27.00 (31.30)	26.00 (30.65)	16.67 (24.09)	58.33 (49.80)
Trichoderma harzianum T_2	12.96 (21.08)	31.52 (34.15)	29.00 (32.58)	14.67 (22.51)	63.33 (52.74)
Trichoderma harzianum T_3	12.04 (20.27)	24.67 (29.78)	23.67 (29.10)	22.00 (27.96)	45.00 (42.12)
Trichoderma harzianum T_4	12.04 (20.27)	21.07 (27.32)	20.00 (26.55)	21.67 (27.73)	45.83 (42.61)
Trichoderma harzianum T_5	16.67 (21.29)	32.33 (34.65)	30.67 (33.62)	26.00 (30.65)	35.00 (36.24)
Trichoderma harzianum T_6	13.89 (21.49)	28.52 (32.27)	24.33 (29.54)	23.00 (28.63)	42.50 (40.65)
Trichoderma harzianum T_7	12.04 (21.34)	27.19 (31.42)	25.00 (29.97)	25.33 (30.22)	36.67 (37.26)
Trichodermaharzianum T_8	14.81 (21.08)	29.85 (33.11)	29.33 (32.77)	27.67 (31.73)	30.83 (33.68)
Trichodermaharzianum T_9	16.67 (21.41)	21.48 (27.60)	21.33 (27.47)	19.00 (25.84)	52.50 (46.43)
Trichodermaharzianum T_{10}	16.67 (20.74)	35.00 (36.27)	31.33 (34.03)	30.33 (33.41)	24.17 (29.36)
Trichoderma harzianum T_{11}	18.52 (20.71)	30.67 (33.62)	30.00 (33.20)	28.00 (31.94)	30.00 (33.16)
Trichoderma harzianum T_{12}	10.19 (20.74)	24.07 (29.37)	20.00 (26.55)	20.00 (27.00)	48.33 (44.03)
Trichoderma harzianum T_{13}	13.89 (21.88)	22.14 (28.24)	22.00 (27.96)	22.00 (27.96)	45.00 (42.12)
Trichoderma harzianum T_{14}	13.89 (21.88)	29.70 (33.02)	29.00 (32.57)	29.33 (32.79)	26.67 (31.07)
Trichoderma harzianum T_{15}	13.89 (21.49)	31.33 (34.04)	30.00 (33.20)	30.67 (33.61)	23.33 (28.67)
Trichoderma harzianum T_{16}	13.89 (21.88)	33.33 (35.26)	35.67 (36.66)	36.33 (37.07)	9.17 (17.35)
Trichoderma harzianum T_{17}	16.67 (21.75)	34.33 (35.87)	36.00 (36.85)	37.67 (37.85)	8.33 (16.51)
Trichoderma asperellum T_{18}	15.74 (21.11)	27.19 (31.42)	26.00 (30.66)	26.33 (30.86)	34.17 (35.73)
Trichoderma harzianum T_{19}	13.89 (21.88)	27.60 (31.69)	26.67 (31.07)	25.33 (30.19)	36.67 (37.20)
Trichoderma harzianum T_{20}	16.67 (20.54)	28.19 (32.07)	27.00 (31.29)	28.00 (31.94)	30.00 (33.16)
Trichoderma harzianum T_{21}	15.74 (21.29)	22.81 (28.53)	22.00 (27.97)	21.33 (27.47)	46.67 (43.08)
Trichoderma harzianum T_{22}	13.89 (20.84)	28.78 (32.44)	27.33 (31.52)	27.33 (31.51)	31.67 (34.18)
Trichodermaharzianum T_{23}	13.89 (21.88)	17.56 (24.77)	16.33 (23.82)	15.33 (23.04)	61.67 (51.76)
Trichoderma harzianum T_{24}	13.89 (21.88)	23.33 (28.88)	22.67 (28.41)	23.33 (28.87)	41.67 (40.18)
Trichodermaharzianum T_{25}	16.67 (20.57)	23.07 (28.71)	22.67 (28.43)	22.67 (28.43)	43.33 (41.16)

Trichoderma harzianumT_{26}	13.89 (21.88)	17.22 (24.52)	16.00 (23.55)	15.00 (22.78)	62.50 (52.25)
TrichodermaharzianumT_{27}	13.89 (21.88)	23.07 (28.71)	22.67 (28.39)	21.67 (27.73)	45.83 (42.61)
Trichoderma harzianumT_{28}	13.89 (21.88)	23.41 (28.93)	23.00 (28.64)	23.67 (29.11)	40.83 (39.72)
Trichoderma harzianumT_{29}	15.74 (20.74)	22.18 (28.53)	22.33 (28.19)	22.67 (28.43)	43.33 (41.17)
Trichoderma harzianumT_{30}	11.11 (20.80)	28.59 (32.32)	29.67 (32.99)	28.67 (32.37)	28.33 (32.14)
Trichoderma harzianumT_{31}	16.67 (21.24)	22.89 (28.58)	19.33 (26.01)	19.33 (26.08)	51.67 (45.96)
Trichoderma harzianumT_{32}	16.67 (21.23)	26.33 (30.87)	25.67 (30.42)	24.33 (29.56)	39.17 (38.74)
Azoxystrobin 18.2%+ Difenoconazole 11.4%	16.67 (21.49)	18.50 (25.47)	13.33 (21.41)	6.33 (14.30)	84.17 (66.95)
Untreated control	19.44 (21.41)	35.00 (36.27)	38.00 (38.06)	40.00 (39.23)	0.00 (0.28)
S.Em.	NS	1.585	1.460	1.324	2.915
CD (0.05)	NS	2.67	2.46	2.23	4.91
CV	NS	5.42	5.07	4.77	7.73

DECLARATION

Conflict of Interest. Authors declare no conflict of interest.

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