

Original Research Article

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## Antagonistic Potential of *Trichoderma harzianum* against *Rhizoctonia solani* Causing Banded Leaf and Sheath Blight of Maize

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### ABSTRACT

The basic aim of the investigation was to screen the potential of *Trichoderma harzianum* for bio suppression of *Rhizoctonia solani* f. sp. *sasaki*, the causal agent of banded leaf and sheath blight of maize which is one of the most destructive diseases of Bihar. The disease severity ranging from 30.30 to 80.46 per cent and gaining the economic importance now a day. Maize (*Zea mays* L.) is one of the most important cereal crops in the world agricultural economy as food, feed and industrial products. It is a miracle C4 crop and has a very high yield potential. There is no other cereal, which has such an immense potentiality and thus is rightly called queen of cereals. In India, maize is grown in almost all the states. It is fourth in area next to rice, wheat, and sorghum, but third in production. It is not only utilized for direct human consumption but also for livestock and poultry feed. *Trichoderma harzianum* was evaluated for its antagonistic potential against *Rhizoctonia solani* f. sp. *sasaki* *in vitro* condition by employing dual culture technique. The outcome of testing revealed that in dual culture, after 72 hours of incubation, *Trichoderma* started to overgrew the pathogen colony and in 144 hours *Trichoderma* fully covered (100 %) the pathogen colony and totally inhibited sclerotial formation. The mechanism of antagonism was hyphal coiling and penetration of the hyphae of *Trichoderma* in the hyphae of host fungus.

#### Keywords

*Trichoderma harzianum*,  
*Rhizoctonia solani*  
and Antagonism.

#### Article Info

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### Introduction

The increasing awareness to pesticides related hazards had led to adoption of alternative methods for disease management which is eco-friendly and in this context biological control is a good option. Biological control of plant diseases maintain the biological balance within the soil ecosystem and offers a powerful means to improve the soil health and increase the productivity of plant by suppression and destruction of pathogen inoculum. It is an important approach for plant disease management under changing

habitat and commercialization of agriculture. In recent years attempts were also made to use consortium of bio control organism to get persistent control of plant pathogens. Antagonistic fungi especially *Trichoderma* species have been widely used against number of phytopathogens particularly soil borne fungi such as *Rhizoctonia* species which causes soil borne diseases to a wide range of crops. Banded Leaf and Sheath Blight (BLSB) of maize is one of the destructive diseases of maize caused by

*Rhizoctonia solani* f. sp. *sasakii* (Kuhn). *Rhizoctonia solani* is wide spread in tropical and subtropical region of the world and once established in the field the fungus often remains indefinitely. Sclerotia of *R. solani* are known to survive several years in the soil. In this disease, crop rotation and tillage practices have little effect on the disease severity. Integrated Pest Management (IPM) strategy for its management is crucial. Biological control appears to be the best solution for long term sustainability and effective management for this soil borne pathogen. Knowing these factors the present investigation was done to assess the potential of *Trichoderma harzianum* against *Rhizoctonia solani* f. sp. *sasakii* *in vitro*.

## Materials and Methods

### Isolation and purification of phytopathogen and bioagent

*Rhizoctonia solani* was isolated from the diseased maize leaf infected with banded leaf and sheath blight collected from the experimental farm of Tirhut College of Agriculture, Dholi, Muzaffarpur and bioagent *Trichoderma harzianum* from soil was isolated and purified by serial dilution plate method (Warcup, 1950, 1960) by using peptone dextrose rose bengal agar medium and potato dextrose agar medium.

### Antagonism

The antagonistic activity of *Trichoderma harzianum* against *Rhizoctonia solani* f. sp. *sasakii*, the incitant of Banded leaf and sheath blight disease of maize was studied by dual culture technique (Morton and Stroube, 1955). They were cultured on PDA plates for 72 hours. A 5 mm disc of *Trichoderma* was inoculated on the Potato Dextrose Agar medium on one side of petriplate aseptically and 5 mm disc of *R. solani* was inoculated at

the opposite side in the same plate in such a way that the discs were 4 cm apart from each other. The plates were then incubated at 28°C for 6 days. Antagonisms were apparent when sporulating *Trichoderma* started over growing on the pathogen colony which was noted at 24 hours interval. Based on observation percentage inhibition was calculated by following formula.

$$\text{Percentage Inhibition (PI)} = \frac{C-T}{C} \times 100$$

Where,

C = Radial growth of pathogen in control plate.

T = Radial growth of pathogen in dual culture.

### Mycoparasitism

The slides were prepared from intermingling zone of dual culture in 0.1 per cent cotton blue. Detailed study was done to observe hyphal interaction i.e., coiling, penetration. Photomicrographs were taken for mode of parasitism at high power of magnification.

## Results and Discussion

### Symptoms of disease

Banded leaf and sheath blight (BSLB) disease of maize is caused by *Rhizoctonia solani* f. sp. *sasakii* (Kuhn.) is the most devastating disease of maize. It has now become a wide spread disease and had been reported to cause (31.9 %) reduction in grain yield in maize cultivar with disease severity level up to 87.3 per cent (Lal *et al.*, 1980). In India, the annual loss of maize production due to BLSB had been estimated upto 13.2 per cent (Payak and Sharma, 1985). Characteristics symptoms

include concentric bands on infected leaves and sheath that are discoloured, brown, tan or grey in colour. Typically disease develops on the first and second leaf sheath above the ground and eventually spread to the ears causing ear rot which is characterized by light brown cottony mycelium on the ear and the presence of small round black sclerotia and its cobs dry prematurely.

**Characters of *Rhizoctonia solani* f. sp. *sasakii* and *Trichoderma harzianum***

The identity of pathogen was established on the basis of cultural and morphological characters. The colony of *Rhizoctonia solani* was fast growing on PDA. It produces white to deep brown mycelium and dark brown irregular sclerotia. Mycelium was septate, multinucleate abundantly branching rather stout mycelium. Hyphae were 4-15 m wide and tended to branch at right angle. A septum near each branch with a slight constriction at the point of branching was observed and Colonies of *Trichoderma harzianum* grow rapidly and mature in 5days. On PDA colonies are wooly and become compact. Hyphae are septate, hyaline and conodiophores are hyaline and branched. Phialides are flask shaped and inflated at the base. Conidia are mostly green in colour. The symptoms and morphological characters

observed in the present investigation had also been recorded and described by several workers (Singh and Sharma 1976; Maiti 1978).

**Antagonism**

After 24 hours of incubation clear radial growth of *R. solani* and *T. harzianum* was observed with 20 and 35 mm diameter respectively whereas diameter of *Rhizoctonia* in control was 34 mm. Examination of the extent of fungal growth in dual culture revealed that the first apparent contact between hyphae of both fungi had occurred after 48 hours of inoculation at that time hyphae of *Rhizoctonia* was grown up to 35 mm diameter. Various other workers also reported similar observation (Elad *et al.*, 1982; Pan and Jash 2009). After 72 hours of incubation, *Trichoderma* started to overgrew the pathogen colony and in 144 hours *Trichoderma* fully covered (100 %) the pathogen colony and totally inhibited sclerotial formation. This can be easily cleared by (Table 1). In microscopic view, mode of antagonism observed was coiling and penetration (Plate 1). The process of coiling initiated first, thereafter simultaneously the mycoparasite penetrates the host. Similar process of coiling and penetration was also observed by Agarwal and Kotasthane (2010).

**Table.1** Antagonistic activity of *Trichoderma harzianum* against *Rhizoctonia solani* f. sp. *sasakii*

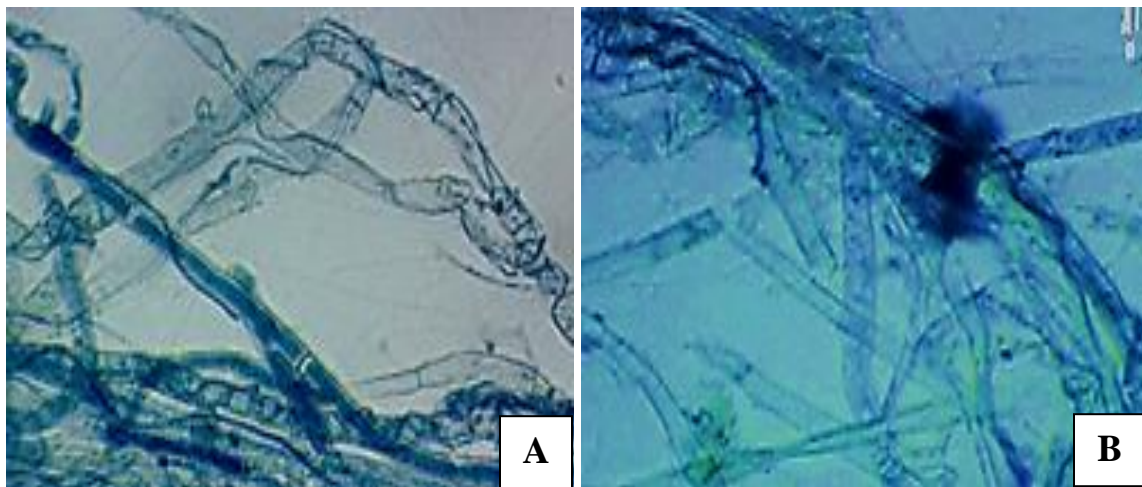
Hours	Colony dia. (mm) in dual culture		Colony dia. (mm) of <i>R. solani</i> in monoculture	Inhibition of mycelial growth of <i>R. solani</i> (%)	Overgrowth of <i>T. harzianum</i> on colony of <i>R. solani</i> (%)
	<i>T. harzianum</i>	<i>R. solani</i>			
24	35	20	34	-	-
48	55	35	65	-	-
72	60	35	75	53.73 (47.12)**	14.40(22.25)**
96	70	35	90	61.47 (51.65)	43.24 (41.16)
120	85	35	90	61.47 (51.65)	86.35 (87.90)
144	90	35	90	61.47 (51.65)	100 (90)
SEM	0.31	0.17	0.17	0.18	1.33
CD at 5%	1.01	0.53	0.53	0.61	4.35
CV	0.92	0.91	0.40	0.64	4.21

\*\* Values in parentheses are Arcsin  $\sqrt{\text{Percentage transformation}}$

**Table.2** Showing sclerotia formation during successive growth stages of *R. solani* in mono and dual culture with *T. harzianum*

Hours	No. of sclerotia	
	In monoculture Aggregation of mycelium	In dual culture Aggregation of mycelium
72		
96	22	No sclerotia formation
120	40	No sclerotia formation
144	55	No sclerotia formation
168	68	No sclerotia formation
SEM	0.5	-
CD at 5%	1.8	-
CV	2.1	-

**Fig.1** Mode of antagonism between *T. harzianum* and *R. solani* f. sp. *sasakii*



**(A) Coiling and (B) Penetration**

In monoculture aggregation of mycelium occurred in *Rhizoctonia solani* after 72 hours of incubation. After 96 hours 22 sclerotia were formed and after 120, 144, 168 hours 40, 55 and 68 sclerotia were formed but in dual culture with *Trichoderma* aggregation of mycelium occurred after 72 hours but sclerotia formation in dual culture was completely inhibited. (Table 2) *T. harzianum* completely overgrew the hyphal colony of *R. solani* f. sp. *Sasakii* (Fig. 1).

In the present investigation *Trichoderma harzianum* in dual culture inhibited mycelial growth of *R. solani* up to 61 per cent which corroborates with the findings of Mello and

Faull, 2000; Agarwal and Kotasthane, 2007; 2010. Sclerotia formation was totally inhibited in dual culture in the present investigation. Successful biological control of *R. solani* by infesting field with culture of *T. harzianum* had been reported by (Back man *et al.*, 1975).

Further investigation with the potential isolate of *Trichoderma* may help to explore it for control of *R. solani* and diseases caused by it.

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