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# Evaluation of efficiency of bio-control agents against *Rhizoctonia solani* Kuhn, an incitant of sheath blight of rice

**Kishan Kumar Sharma, Vijay Patil, Diksha Nayak and Satyendra Kumar Gupta**

**Abstract**
The six different bio-agents viz., *Trichoderma viride*, *T. harzianum*, *Trichoderma longibrachiatum*, *Pseudomonas fluorescens* I, *Pseudomonas fluorescens* II and *Bacillus subtilis* were evaluated against *Rhizoctonia solani* through dual culture technique. Among six different bio-agents *Trichoderma viride* showed maximum (74.44 %) growth inhibition of the pathogen and appeared to be the most superior in its efficacy over all the antagonists tested. This was followed in sequence by *T. harzianum* (68.14 %), *T. longibrachiatum* (67.41 %), *Pseudomonas fluorescens* I (56.66 %), *Pseudomonas fluorscens* II (55.74 %) and *Bacillus subtilis* (47.77 %) were in decreasing order for per cent growth inhibition of *Rhizoctonia solani*.

**Keywords:** Bio-agents, dual culture technique, *Rhizoctonia solani*

## Introduction
Rice is central to the lives of billions of people around the world. Rice was originally cultivated in tropical Asia, the oldest record dating 5000 years BC, Possibly the oldest domesticated grain (~10,000) years but then extended also to temperate regions [14]. Rice is the most important staple food in Asia. More than 90% of the world's rice is grown and consumed in Asia, where 60% of the world's population lives. Rice accounts for between 35-60% of the caloric intake of three billion Asians [6]. Calories from rice are particularly important in Asia, especially among the poor, where it accounts for 50-80% of daily caloric intake [10]. Asia accounted for 60% of the global population, about 92% of the world's rice production, and 90% of global rice consumption. 85% of the rice that is produced in the world is used for direct human consumption. Rice can also be found in cereals, snack foods, brewed beverages, flour, oil, syrup and religious ceremonies to name a few other uses [10]. Rice is grown under many different conditions and production systems, but submerged in water is the most common method used worldwide. Rice is the only cereal crop that can grow for long periods of time in standing water [4]. The flooded rice paddy is a field of aquatic biodiversity, providing a home for fish, plants, amphibians, reptiles, mollusks, and crustaceans, which many of can be used as a means to incorporate protein into the diets of poor and malnourished people in low and middle income countries that farm rice [9]. The world's estimated rice production is 496.0 million metric tons during 2016 [2]. India is the largest rice growing country accounting for about one third of the world acreage under the crop. In India's annual rice production is 103.6 million tons during 2016 [2]. Rice is grown throughout India in all the states. The major rice growing states of India are West Bengal, Uttar Pradesh, Bihar, Madhya Pradesh, Orissa, Andhra Pradesh, Karnataka and Chhattisgarh [8]. Rice suffers from many diseases caused by fungi, bacteria, viruses, phytoplasma, nematodes and other non-parasitic disorders [10]. Among the fungal diseases, sheath blight is considered as a major threat to rice production because of its wide spread distribution and its destructiveness under favourable conditions [10]. The Commonwealth Mycological Institute has recorded its presence from 85 countries throughout the world [10]. Paddy sheath blight is generally considered as the principal disease of rice and is caused by a fungus belonging to the deuteromycetes *Rhizoctonia solani* (kuhn) [10]. Sheath blight is the most important disease of rice incited by *Rhizoctonia solani* (Kuhn), first reported by Paracer and Chahal, 1963 from Gurdaspur in Punjab. Initial symptoms occur on leaf sheaths near the water line as water-soaked lesions. Secondary infections are caused by hyphae growing upward towards uninfected plant parts, producing additional lesions and sclerotia on leaf sheaths to complete the disease cycle (Brooks, 2007).

## Material and methods

Six known antagonists were tested *in vitro* to evaluate their antagonistic properties against *R. solani* (Table-1) by adopting dual culture method. The test organisms and the pathogen were grown on PDA medium each separately and from 7 days old cultures, 5 mm diameter disc of the test organism (antagonist) and pathogen were taken into consideration. The Petri plates (90 mm) were inoculated aseptically with *R. solani* and test organisms, by placing 5 mm diameter culture blocks at 70 mm apart from each other. Three repetitions of each treatment were kept and the petri plates with only pathogen served as control. All the plates were incubated at temperature (28 ± $2^0$C) and the radial growth of the test organism and pathogen was measured after 7 days. The per cent growth inhibition (PGI) was worked out by using the formula given by Vincent (1947).

$$PGI = \frac{DC - DT}{DC} \times 100$$

Where,
PGI = Per cent growth inhibition
DC = Average diameter of mycelial colony of control set
DT = Average diameter of mycelial colony of treated set

**Table 1:** List of different bio control agents tested against *R. solani in vitro*

| Treatment No. | Details of treatment |
|---|---|
| $T_1$ | *T. viride* (Navsari isolate) |
| $T_2$ | *T. harzianum* (Navsari isolate) |
| $T_3$ | *T. longibrachiatum* (Navsari isolate) |
| $T_4$ | *P. fluorescens* I (Navsari isolate) |
| $T_5$ | *P. fluorescens* II (Waghai isolate) |
| $T_6$ | *B. subtilis* Ell.(Navsari isolate) |
| $T_7$ | Control (Untreated) |

## Results and discussion

In this study, six known antagonists were evaluated *in vitro* for their antagonistic effect against *R. solani* by dual culture method. The results presented in Table (2) and depicted in ce (1) and figure (1) revealed that, all the antagonists screened against *R. solani* were significantly superior in their efficacy over the control. Out of these, the least growth of the pathogen was recorded in the treatment of *Trichoderma viride* (Navsari Isolate) (23.00 mm) where the antagonists over grew the small colony of the pathogen restricting the further growth. This was significantly superior in its efficacy against the pathogen over rest of the antagonists tested. Next best antagonists in order of merit was *Trichoderma harzianum* (Navsari Isolate) (28.67 mm), which was followed by *Trichoderma longibrachiatum* (Navsari isolate) (29.33 mm). Whereas, *Pseudomonas fluorescens* I (Navsari Isolate), *Pseudomonas fluorescence* II (Waghai Isolate) and *Bacillus subtilis* (Navsari Isolate) were least effective with (39.0 mm), (39.83 mm) and (47 mm) colony diameter of pathogen respectively.

*Trichoderma viride* showed maximum (74.44 %) growth inhibition of the pathogen and appeared to be the most superior in its efficacy over all the antagonists tested. This was followed in sequence by *T. harzianum* (68.14 %), *T. longibrachiatum* (67.41 %), *Pseudomonas fluorescens* I (56.66 %), *Pseudomonas fluorscens* II (55.74 %) and *Bacillus subtilis* (47.77 %) were in decreasing order for per cent growth inhibition of *Rhizoctonia solani*.

It is very clear from this study that all the local strains (Navsari isolates) of *Trichoderma* evaluated by dual culture method, were very effective against *Rhizoctonia solani*. Whereas, bacterial bio-agents such as *Pseudomonas fluorscens* I (Navsari isolate), *Pseudomonas fluorscens* II (Waghai Isolate) and *Bacillus subtilis* (Navsari isolate) also showed consistent antagonistic activity.

This suggests biological control of sheath blight of rice using *T. viride, T. harzianum and T. longibrachiatum* (Navsari isolates) and *Pseudomonas fluorscens* I (Navsari isolate), *Pseudomonas fluorscens* II (Waghai Isolate) will be very useful in tribal area to mitigate this serious problem.

Our results are in hormony with earlier worker Srinivas *et al*., (2014) found that *Trichoderma viride* was capable of checking the growth of *R. solani in vitro* significantly.

Seema *et al*., (2011) reported highest growth inhibition of (70%) of *R. solani* by *Trichoderma viride* which was followed by *Trichoderma harzianum* (67 %).

In the present study all the species of Trichoderma tested showed more hyphal inhibition compared to bacterial antagonists. This might be due to the production of antibiotics, which are detrimental to the growth of *R.solani*. (Karthikeyan and Gnanamanickam, 2008) and also may be due to higher competitive ability of Trichoderma spp.

**Table 2:** Effect of antagonists against the pathogen *in vitro*

| S. No. | Name of antagonists | Isolate | Average diameter of pathogen colony (mm) | (%) Growth inhibition |
|---|---|---|---|---|
| 1. | *Trichoderma viride* | Navsari isolate | 4.89* (23.00)** | 74.44 |
| 2. | *Trichoderma harzianum* | Navsari isolate | 5.44 (28.67) | 68.14 |
| 3. | *Trichoderma longibrachiatum* | Navsari isolate | 5.50 (29.33) | 67.41 |
| 4. | *Pseudomonas fluorescens* I | Navsari isolate | 6.32 (39.00) | 56.66 |
| 5. | *Pseudomonas fluorescens* II | Waghai isolate | 6.38 (39.83) | 55.74 |
| 6. | *Bacillus subtilis* | Navsari isolate | 6.92 (47.00) | 47.77 |
| 7. | Control (Untreated) | ---- | 9.48 (90.00) | ----- |
| | S.Em± | | 1.18 | |
| | C.D. at 5 % | | 0.40 | |
| | C.V. % | | 3.58 | |

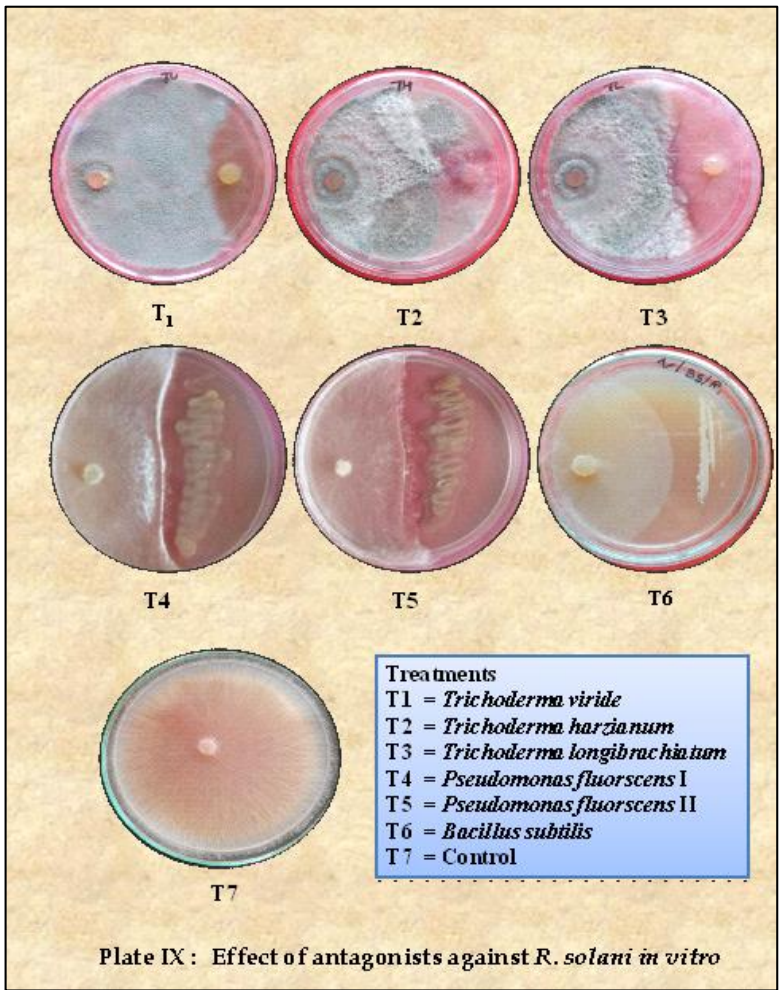
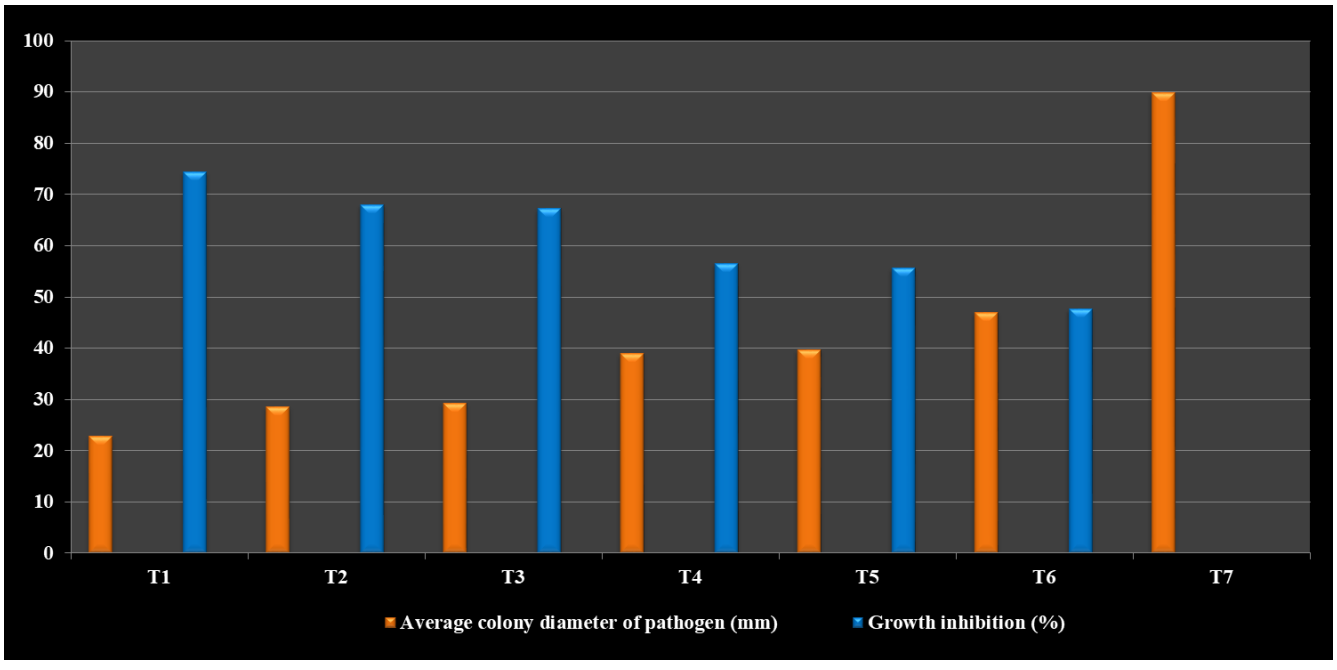



**Plate 1:** Effect of antagonists against the pathogen *in vitro*




**Treatments**

**T1 = *Trichoderma viride* T2= *Trichoderma harzianum* T3= *Trichoderma longibrachiatum* T4= *Pseudomonas fluorescens* I**
**T5 = *Pseudomonas fluorscens* II T6= *Bacillus subtilis* T7= Control**

**Fig 1:** Effect of antagonists against *R. solani in vitro*

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