

Original Research Article

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## Management of Bakanae Disease of Rice through Combination of *Trichoderma* spp. and Fungicides

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### A B S T R A C T

Bakanae disease is becoming a serious threat to basmati production and had been reported to cause 20-50% loss in total production. Bakanae disease caused by *Fusarium moniliforme* is an emerging and very serious problem of basmati rice. It occurs in both upland and low land rice field. The typical symptoms of the disease are abnormal elongation of seedlings, foot rot and seedling rot of rice. The pathogen survives mainly in seed and in soil also. Therefore seed treatment for the management of seed borne pathogen is most effective method of disease management. Seed treatment with bio-agent for the management of diseases is an eco-friendly method of disease management. Keeping this in view in present investigation different isolates of *Trichoderma* were tested in the management of bakanae disease of basmati rice as seed treatment. *Trichoderma* powder was applied for seed treatment @ 6 g/kg seed alone and in combination with different fungicides 2 g/kg seed. Experiments were conducted in pot condition. The observations were recorded on seed germination, number of tillers and disease incidence after 30 days of seed sowing. Two fungicides (nativo, saaf) and two isolates of *Trichoderma* (S<sub>1</sub>, and S<sub>7</sub>) were tested in pot condition against *Fusarium moniliforme*. Maximum (90%) germination was recorded in case of seed treatment with *Trichoderma*-S<sub>7</sub> followed by 83.33% in *Trichoderma* S<sub>7</sub>+nativo. Minimum (22.85%) disease incidence was recorded in case of the seed treated with *Trichoderma*-S<sub>7</sub>. Maximum disease incidence (76.6%) was recorded in case of control. Among the fungicides and bio-agent, seed treatment with *Trichoderma*-S<sub>7</sub> was most effective for the management of bakanae disease of rice. The selected fungicides and bio-control agents were evaluated as seed and seedling treatment for controlling bakanae disease under field conditions. Among three fungicides evaluated as seed treatment, minimum disease incidence (0.0%) was observed in seed treatment with *Trichoderma*-S<sub>1</sub> followed by seed treatment with *Trichoderma*-S<sub>1</sub>+saaf (0.1%). Maximum disease incidence was observed in the case of control (0.75%) followed by seed treatment with *Trichoderma* (0.49%). Maximum yield (40 q/ ha) was recorded in case of treatment of *Trichoderma*-S<sub>1</sub> which was found most effective for the management of bakanae disease of rice.

### Keywords

Bakanae disease, *Fusarium moniliforme*, Bio-agent, *Trichoderma*, Nativo and Saaf

### Article Info

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## Introduction

Rice is an important cereal crop and growing all over the world. Rice grows in India is primarily divided into basmati rice and Non-Basmati rice. India is the major producer and exporter of basmati rice to the world. Rice production affected by many biotic and abiotic stresses. Among the biotic stress, fungal diseases have important role in reduction the yield of rice. Bakanae (Foot rot) disease is one of them that is emerging as major threat to basmati rice production. Bakanae disease caused by *Fusarium moniliforme* Sheldor [teleomorph: *Gibberella fujikuroi* (Saw.) Wr.] is one of the important disease of rice occurring throughout the rice growing regions of the world (Ram Singh and Sunder, 2012). It is known to cause around 15 per cent loss in Uttar Pradesh and Assam states of India (Pavgi and Singh 1964, Rathaiah *et al.*, 1991). The fungus produces gibberellins and other secondary metabolites such as carotenoids, bikaverin and fusarin, which directly affect the growth of rice, plants (Ilija *et al.*, 2009). The fungus produces giberrellin hormone which causes elongation of plant (Nyvall, 1999). The pathogen is widely distributed through out the world and has wide host range (Kazempour, 2007). *F. moniliforme* is primarily a seed-borne pathogen which infects the seedlings at the time of germination or at an early growth stage (Ou, 1985). Injured roots have been reported to serve as potential entry source of *Fusarium* spp. The disease can occur both at nursery stage and in the main field. Seedlings which survive the attack in nursery may die soon after transplanting. The affected plants appear pale yellow in colour, thin and abnormally long or rarely dwarf. These plants may die prematurely or may develop tall tillers and flower earlier than the healthy plants but the infected plants mostly bear sterile panicles. Highly diseased plants show collar infection and die within 2-6 weeks. There is profuse branching in the roots

and adventitious roots may develop from the lower nodes. A pinkish white cottony growth of the fungal mycelium may be observed at the base of the plant. The fungus produces growth stimulating substances known as gibberellins, which is responsible for excessive elongation of the plants (Malonek *et al.*, 2005). Besides gibberellins, the fungus also produces a phytotoxin, fusaric acid, a nonspecific substance which is toxic to the plants (Desjardins *et al.*, 2000). Seed treatment with fungicide such as thiram has been used for management of bakanae disease (Suzuki *et al.*, 1985). So, there was a dire need of comprehensive studies on the management of this disease. Hence, a study was conducted, using bio-agents and combination of bio-agents and chemical as seed treatments for the management of bakanae disease in basmati rice (var. PB1121).

## Materials and Methods

### Mass multiplication and preparation of *Trichoderma* spp.

The bio-control agent *Trichoderma* isolates ( $S_1$  &  $S_7$ ) were collected from Nematology Lab, Department of Plant Pathology Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut U.P. Wheat grains were used for mass culture of *Trichoderma*. Wheat grains were soaked in water for 12 hours and then spreaded on paper to remove the extra water. Dextrose was added in wheat seeds @ 2 gm/kg seed and then 250 gm of wheat grains were taken in each 500 ml conical flasks. Flasks with wheat grains were plugged with nonabsorbent cotton and wrapped with aluminum foil and sterilized in autoclave at 121°C temperature at 15 lbs pressure/inch for 15 minutes. The sterilized wheat grains were inoculated by taking 5 mm diameter PDA disc from the periphery of actively growing 5 days old culture of *Trichoderma* isolates. All the inoculated

conical flasks were incubated in incubator at  $26\pm2^{\circ}\text{C}$  temperature. These inoculated flasks were allowed to grow *Trichoderma* with periodic shaking of the flasks, so that the surface of all wheat seeds colonized with growth of *Trichoderma* properly. After proper growth of *Trichoderma* on the surface of wheat grain in conical flask (when colour of fungal growth become fully green) whole grains were taken out from flask, and spreaded in neat and clean plastic trays, clumps of grains were broken, then after fungal growth covered grain were shade air dried, after proper drying grains were converted in fine powder with the help of mixer grinder and pestle mortar. This fine powder was used for seed treatment for conducting trials. At the time of seed treatment this powder @ 6 gram/kg seed was applied for seed treatment.

### Pot experiment

A pot experiment was conducted to see the Effect of application of *Trichoderma* isolates alone and in combination of fungicides on the management of bakanae disease of basmati rice. In this experiment first seed were inoculated with pathogen inoculums by soaking the seeds overnight in pathogen culture suspension. Followed by these seeds were treated with bio-agents and chemicals as per plan. Ten seeds were sown in the each earthen pot. The each treatment was replicated three times, control pots were maintained without seed treatment with bio-agent but these seeds were inoculated with pathogen. The observations were recorded on seed germination, no. of tillers and disease incidence after 30 days of sowing. Data on number of bakanae infected plants were recorded at 30 days after sowing.

### Field experiment

A field Trail was conducted at CRC to see the performance of *Trichoderma* isolates alone

and in combination of fungicides in the management of bakanae disease of rice. In this experiment two isolates of *Trichoderma* (S<sub>1</sub>& S<sub>7</sub>) and three different fungicides (saaf, nativo and bavistin) were taken in different combinations for the seed treatment. *Trichoderma* @ 6 gm/ kg of seed and chemicals @ 2 gm/kg of seed were applied for seed treatment. Observations on bakanae disease incidence at 30 days after transplanting and yield/plot were recorded. The present disease incidence was calculated according to the following formula given by (Teng and james, 2001; Zainudin *et al.*, 2008)

Percent disease incidence

$$\frac{\text{Total number of infected plant}}{\text{Total plant examined}} \times 100$$

### Results and Discussion

In pot condition, maximum (90%) germination was recorded in case of *Trichoderma*-S<sub>7</sub> followed by 83.33% in *Trichoderma*-S<sub>7</sub>+Nativo. While (76.6 %) germination was recorded in case of seed treatment with *Trichoderma*-S<sub>7</sub>+Saaf. Maximum 9 tillers/plant were recorded in seed treatment with *Trichoderma*-S<sub>7</sub> followed by 7.33 tillers/plant recorded in case of seed treated with *Trichoderma*-S<sub>1</sub>+Nativo, *Trichoderma*-S<sub>7</sub>+Nativo and *Trichoderma*-S<sub>7</sub>+Saaf respectively. In case of control 5.33 tillers/plants were recorded. Minimum (22.85%) disease incidence was recorded in case of seed treated with *Trichoderma*-S<sub>7</sub> followed by 35.30, 37.52 and 38.33% disease incidence was recorded in case of seed treated with *Trichoderma*-S<sub>1</sub>+Nativo, Nativo alone and *Trichoderma* S<sub>7</sub>+Nativo respectively. Maximum 76.6% disease incidence was recorded in case of control.

In the field condition, minimum disease incidence (0.0%) was observed in seed

treatment with *Trichoderma-S<sub>1</sub>* followed by seed treatment with *Trichoderma-S<sub>1</sub>+saaf* (0.1%) and in treatment *Trichoderma-S<sub>7</sub>* and *Trichoderma-S<sub>7</sub>+saaf* it was 0.2%. Maximum disease incidence (0.75%) was recorded in case of control followed by in *Trichoderma-S<sub>7</sub>+nativo* (0.49 %). Maximum yield (40 q/ ha)

was recorded in case of treatment with *Trichoderma-S<sub>7</sub>*. In field condition seed treatment with *Trichoderma-S<sub>7</sub>* was found most effective for the management of bakanae disease of rice (Fig. 1 and 2; Table 1 and 2).

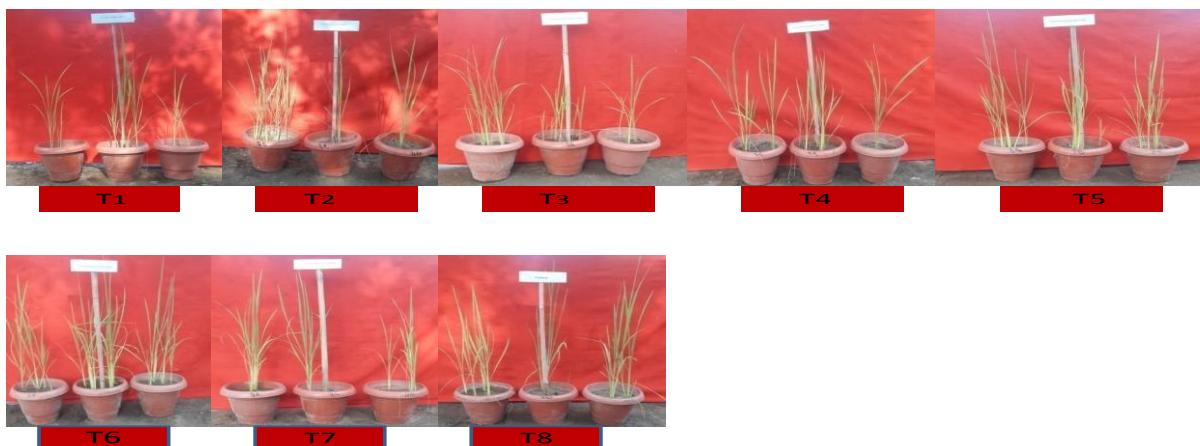
**Table.1** Management of bakanae disease of rice in pot condition

Treatment	Treatments	% seeds germination	Healthy plants at 30 days	Infected Plants at 30 days	Total no of Tillers per plant	Disease incidence (%) at 30 days
<b>T<sub>1</sub></b>	Seed treatment with <i>Trichoderma-S<sub>1</sub></i>	73.20	5.3	2.00	6.67	54.05
<b>T<sub>2</sub></b>	Seed treatment with <i>Trichoderma-S<sub>7</sub></i>	90.00	7.0	1.60	9.00	22.85
<b>T<sub>3</sub></b>	Seed treatment with <i>Trichoderma-S<sub>1</sub>+ nativo</i>	86.60	6.6	2.33	7.30	35.30
<b>T<sub>4</sub></b>	Seed treatment with <i>Trichoderma-S<sub>7</sub> + nativo</i>	83.30	6.0	2.30	7.30	38.33
<b>T<sub>5</sub></b>	Seed treatment with <i>Trichoderma-S<sub>7</sub> + saaf</i>	76.60	4.0	2.30	7.30	57.50
<b>T<sub>6</sub></b>	Seed treatment with <i>Trichoderma-S<sub>1</sub> + saaf</i>	66.00	5.3	3.00	6.00	56.60
<b>T<sub>7</sub></b>	Seed treatment with <i>nativo</i> only	53.00	5.3	2.00	6.67	37.52
<b>T<sub>8</sub></b>	Control	50.00	3.0	2.30	5.33	76.60
<b>C.D at 5%</b>		1.886	1.817	N.S	N.S	N.S

**Table.2** Management of bakanae disease of basmati rice in field condition

Treatment	Treatments	Healthy plant	Infected plant	Disease incidence (%)	Yield/ plot (Kg)	Yield q/ha
<b>T<sub>1</sub></b>	Seed Treatment with <i>Trichoderma -S<sub>1</sub></i>	540	0.0	0.00	4.5	37.50
<b>T<sub>2</sub></b>	Seed Treatment with <i>Trichoderma-S<sub>7</sub></i>	537	1.0	0.20	3.5	29.16
<b>T<sub>3</sub></b>	Seed Treatment with <i>Trichoderma-S<sub>1</sub>+ saaf</i>	538	0.6	0.10	3.5	29.16
<b>T<sub>4</sub></b>	Seed Treatment with <i>Trichoderma-S<sub>7</sub>+saaf</i>	537	1.3	0.20	2.5	20.83
<b>T<sub>5</sub></b>	Seed Treatment with <i>Trichoderma-S<sub>1</sub>+nativo</i>	528	1.3	0.25	4.2	35.00
<b>T<sub>6</sub></b>	Seed Treatment with <i>Trichoderma-S<sub>7</sub>+nativo</i>	534	2.6	0.49	3.7	30.83
<b>T<sub>7</sub></b>	Seed Treatment with <i>Trichoderma-S<sub>1</sub>+bavisten</i>	533	2.0	0.37	4.8	40.00
<b>T<sub>8</sub></b>	Seed Treatment with <i>Trichoderma-S<sub>7</sub>+bavistin</i>	532	2.0	0.37	4.0	33.33
<b>T<sub>9</sub></b>	Control	536	4.0	0.75	3.7	30.83
<b>C.D at 5%</b>		<b>1.307</b>	<b>2.128</b>	-	-	-

**Fig.1** Effect of different treatments on management of bakanae disease



**Fig.2** View of the field experiment (plots wise)



As the disease has been reported mainly seed borne in nature (Webster and Gunnell, 1992), therefore seed treatment may be an effective way for the management of pathogen of the bakanae disease. Seed treatment with chemical had been found effective by different worker in the management of this disease. Bagga and Sharma (2006) evaluated different fungicides as seed treatment for controlling bakanae

disease in basmati rice. They reported that seed treatment with bavistin at the rate of 0.1% for 6 h was effective in reducing the disease incidence. They also reported that during seed treatment fungicide efficacy increased as the duration of the treatment increased from 2-6 hours. During their study Bhalli *et al.*, (2001) found Derosal fungicide (Carbendazim) most effective against

*Fusarium moniliforme* causing bakanae disease of rice. There are several reports where *Trichoderma* has been found effective bioagent for the management of *Fusarium* spp. The isolates S-1 & S-7 of *Trichoderma* selected in this study for seed treatment were also found quite effective in previous *in vitro* studies. For reducing the doze of chemical pesticides in the management of this disease and for getting sustainable management these isolates were tried for seed treatment alone and in combination of fungicides. Similar to this study, biobased options had been tried by different workers and some level of success has been obtained for the management of this disease. *Fusarium moniliforme* causing foot rot/bakanae disease of rice was controlled biologically using fermented products of composts and vermicompost by (Manandhar and Yami 2008).

*Trichoderma* species as potential bio-agents for the management of several plant diseases has been reported by several workers.

The biocontrol potential of *Trichoderma* spp. against phytopathogenic *Fusarium* spp. was reported by Calistru *et al.*, (1997). *Trichoderma* species are commonly used for effective management of fungal pathogen in various fruit crops (Svetlana *et al.*, 2010). Dehkai *et al.*, (2004) reported that *T. harzianum*, *T. virens* were found most effective bio-agents to reduce the bakanae disease of rice. Bhramaramba, *et al.*, (2013) reported that twenty eight *Trichoderma* isolates were collected from the major rice growing areas of Nalgonda, Krishna and Khammam districts of Andhra Pradesh belonged to seventeen species. These isolates were found effective *in vitro* against the *Fusarium fujikuroi* to reduce growth of pathogen. Application of *Trichoderma* in combination with fungicide as seed treatment may have a synergistic effect on management of bakanae disease. In early stage of seed

germination chemical provide the protection to the seedling and later on *Trichoderma* proliferate in the rhizosphere and provides the protection to the plant from pathogen.

On the bases of the results of present investigations it can be concluded that application of *Trichoderma* as seed treatment alone and in combination of fungicides may be recommended for the management of bakanae disease in rice.

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