Management of Rice (*Oryza sativa* L.) Sheath Blight (*Rhizoctonia solani* Kuhn) and Sheath Rot (*Sarocladium oryzae* Sawada) through Seed Bio-Priming

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ABSTRACT

Results obtained in the experiments conducted to find out effect of seed bio-priming on management of sheath blight and sheath rot diseases of rice in field condition revealed that seed bio-primed with *Trichoderma harzianum* applied at imbibition was proved to be an excellent bio-agent to manage sheath blight (*Rhizoctonia solani*) with minimum disease incidence (25.67%) and severity (21.63%) whereas *Pseudomonas fluorescens* applied at imbibition significantly manage sheath rot (*Sarocladium oryzae*) with minimum disease incidence (28.67%) and severity (23.41%). Similarly, significantly higher grain yield (4505 kg ha⁻¹) was recorded in seed bio-primed with *P. fluorescens* applied at imbibition.

Keywords: Rice, Seed bio-priming, Sheath rot, Sheath blight, Disease incidence and Disease severity

Introduction

Rice (*Oryza sativa* L.) is the world's second most important cereal crop grown throughout the world and is a staple food crop of 60 per cent of the world’s population. Rice productivity facing numerous problem, mostly related to the environmental and food safety issues. Diseases are the major constraint in economic crop production as they inflict heavy losses. Seed-borne fungal diseases *viz.* sheath blight and sheath rot are important in reducing the yield and seed quality of rice. The intensive uses of chemical pesticides has been identified contributes to the numerous recent environmental problems. Seed treatment systems that will enhance efficacy of biological agents are needed and “bio-
priming” is one such attempt being made in this direction. Seed bio-priming is treating seed with bio-agents and incubating under warm and moist condition until just prior to radical emergence (Harman and Taylor, 1988).

**Materials and Methods**

The field experiment was laid out during kharif 2017 in Randomized Block Design (RBD) with ten treatments (Table 1) and each treatment replicated thrice using rice cv. GR-11 at Main Rice Research farm, NAU, Navsari on management of rice sheath blight and sheath rot by using seed bio-priming method.

**Bio-priming (applied at imbibition)**

Ten gram of talc formulation of the bio-agents along with 0.1 g gum arabic were used as adhesive was mixed in 25 ml of water. Pre-treated rice seed (surface sterilized with 0.1% HgCl₂ for 2 to 3 min. followed by three washing with water) was soaked in this slurry for 24 hours at room temperature and then dried on blotter paper at room temperature. Seeds without any treatment served as control (Srivastava et al., 2010).

**Bio-priming (after imbibition)**

Seeds of rice were imbibed in aerated water (50 g seed per 500 ml water) for 24 hours and then dried at room temperature. Formulation of the bio-agent in talc along with 0.1 g gum arabic was dusted on seed after seed was imbibed and dried. Seeds without any treatment served as control. The data were recorded as Per cent Disease Incidence (PDI), Per cent Disease Severity (PDS) and grain yield.

### Disease incidence (%)

\[
\text{Disease incidence (\%)} = \frac{\text{Number of diseased plants}}{\text{Total number of plants}} \times 100
\]

### Disease severity (%)

The disease severity was measured by adopting 0-9 scale (Table 2 and 4) using standard evaluation system for rice developed by International Rice Research Institute (IRRI, 2002).

\[
\text{Disease severity (\%)} = \frac{\text{Sum of the individual disease ratings}}{\text{Total number of leaves observed} \times \text{Maximum grade}} \times 100
\]

### Grain yield (kg ha⁻¹)

The grain yield was recorded from net plot area after harvest and converted in to hectare basis and data were statistically analyzed.

**Results and Discussion**

The data presented in Table 3 and Fig. 1 and 2 revealed that all the treatments significantly reduced the sheath blight and sheath rot incidence and severity as compared to control. Among all the treatments, *T. harzianum* applied at imbibition was found significantly superior with minimum sheath blight incidence (25.67%) and severity (21.63%) which was found statistically at par with *T. viride* applied at imbibition (26.33%) and (22.37%), *P. fluorescens* applied at imbibition
(27.00%) and (23.11%) and *T. viride* applied after imbibition (28.00%) and (24.30%). The next best treatment in order of merit was *B. subtilis* applied at imbibition (34.33%) and (29.33%) followed by *P. fluorescens* applied after imbibition (35.00%) and (31.85%), *T. harzianum* applied after imbibition (35.67%) and (32.59%), *B. subtilis* applied after imbibition (36.00%) and (32.89%) and primed seeds with hydration (37.33%) and (33.93%). The maximum disease incidence (38.00%) and severity (34.22%) was observed in control.

Whereas, minimum sheath rot incidence (28.67%) and severity (23.41%) was recorded in *P. fluorescens* applied at imbibition it was found statistically at par with *T. harzianum* applied at imbibition (29.33%) and (25.04%), *T. viride* applied at imbibition (30.00%) and (26.07%) and *P. fluorescens* applied after imbibition (31.33%) and (28.30%). The next best treatment in order of merit was *B. subtilis* applied at imbibition (35.67%) and (30.67%) followed by *T. harzianum* applied after imbibition (36.67%) and (31.11%), *T. viride* applied after imbibition (37.00%) and (32.00%), *B. subtilis* applied after imbibition (37.33%) and (34.81%) and primed seeds with hydration (40.33%) and (36.30%). The maximum disease incidence (41.67%) and severity (37.48%) was observed in control.

The results of grain yield presented in Table 3 and Fig. 2 revealed that significantly highest grain yield (4505 kg ha\(^{-1}\)) was harvested in plot treated with *P. fluorescens* applied at imbibition which was found statistically at par with *T. harzianum* applied at imbibition (4412 kg ha\(^{-1}\)), *T. viride* applied at imbibition (4282 kg ha\(^{-1}\)) and *B. subtilis* applied at imbibition (3984 kg ha\(^{-1}\)).

### Table 1. Treatment details for seed bio-priming

| Tr. No. | Treatment                                       |
|---------|-------------------------------------------------|
| T1      | Bio-priming (*T. viride* applied at imbibition) |
| T2      | Bio-priming (*T. viride* applied after imbibition) |
| T3      | Bio-priming (*T. harzianum* applied at imbibition) |
| T4      | Bio-priming (*T. harzianum* applied after imbibition) |
| T5      | Bio-priming (*P. fluorescens* applied at imbibition) |
| T6      | Bio-priming (*P. fluorescens* applied after imbibition) |
| T7      | Bio-priming (*B. subtilis* applied at imbibition) |
| T8      | Bio-priming (*B. subtilis* applied after imbibition) |
| T9      | Hydrompriming (Water only)                      |
| T10     | Control (Without any treatment)                 |

### Table 2. Disease severity scale for sheath blight (IRRI, 2002)

| Scale | Description                                           |
|-------|-------------------------------------------------------|
| 0     | No infection                                         |
| 1     | 1 to 20 per cent area of leaves/plant part infected   |
| 3     | 21 to 30 per cent area of leaves/plant part infected  |
| 5     | 31 to 45 per cent area of leaves/plant part infected  |
| 7     | 46 to 65 per cent area of leaves/plant part infected  |
| 9     | 66 to 100 per cent area of leaves/plant part infected |
Table 3: Effect of seed bio-priming on incidence of rice diseases and yield

| Tr. No. | Treatment                                      | Disease incidence (%) | Disease severity (%) | Grain Yield (kg ha⁻¹) |
|---------|-----------------------------------------------|-----------------------|----------------------|-----------------------|
|         |                                               | Sheath blight         | Sheath rot           | Sheath blight         | Sheath rot           |
| T₁      | *T. viride* applied at imbibition             | 30.77* (26.33)**      | 33.18 (30.00)        | 28.21 (22.37)         | 30.69 (26.07)        | 4282                  |
| T₂      | *T. viride* applied after imbibition          | 31.93 (28.00)         | 37.45 (37.00)        | 29.50 (24.30)         | 34.42 (32.00)        | 3580                  |
| T₃      | *T. harzianum* applied at imbibition          | 30.39 (25.67)         | 32.75 (29.33)        | 27.68 (21.63)         | 30.02 (25.04)        | 4412                  |
| T₄      | *T. harzianum* applied after imbibition       | 36.64 (35.67)         | 37.25 (36.67)        | 34.79 (32.59)         | 33.85 (31.11)        | 3423                  |
| T₅      | *P. fluorescens* applied at imbibition        | 31.27 (27.00)         | 32.35 (28.67)        | 28.72 (23.11)         | 28.93 (23.41)        | 4505                  |
| T₆      | *P. fluorescens* applied after imbibition     | 36.23 (35.00)         | 34.01 (31.33)        | 34.33 (31.85)         | 32.03 (28.30)        | 3717                  |
| T₇      | *B. subtilis* applied at imbibition           | 35.85 (34.33)         | 36.63 (35.67)        | 32.78 (29.33)         | 33.61 (30.67)        | 3984                  |
| T₈      | *B. subtilis* applied after imbibition        | 36.85 (36.00)         | 37.64 (37.33)        | 34.97 (32.89)         | 36.15 (34.81)        | 3316                  |
| T₉      | Hydropriming (Water only)                    | 37.64 (37.33)         | 39.40 (40.33)        | 35.60 (33.93)         | 37.01 (36.30)        | 3222                  |
| T₁₀     | Control (Without any treatment)              | 38.02 (38.00)         | 40.19 (41.67)        | 35.77 (34.22)         | 37.72 (37.48)        | 3067                  |

*S.E.m±   | C.D. at 5%                                    | 1.71                  | 1.39                  | 1.34                  | 1.51                  | 202.12                 |
| C.V. (%) |                                             | 8.58                  | 6.66                  | 7.17                  | 7.84                  | 9.33                   |

*Figure outside parenthesis are arc sine transformed value **Figures in parentheses are original value
**Fig. 1** Effect of seed bio-priming on incidence of sheath blight and sheath rot

| Treatments                                      | Sheath blight | Sheath rot |
|-------------------------------------------------|---------------|------------|
| $T_1 = T. viride$ applied at imbibition          | 26.33         | 30.00      |
| $T_2 = T. viride$ applied after imbibition       | 28.00         | 37.00      |
| $T_3 = T. harzianum$ applied at imbibition       | 25.67         | 29.33      |
| $T_4 = T. harzianum$ applied after imbibition    | 35.67         | 36.07      |
| $T_5 = P. fluorescens$ applied at imbibition     | 27.00         | 28.67      |
| $T_6 = P. fluorescens$ applied after imbibition  | 35.00         | 31.33      |
| $T_7 = B. subtilis$ applied at imbibition        | 34.33         | 35.67      |
| $T_8 = B. subtilis$ applied after imbibition     | 36.00         | 37.33      |
| $T_9 = \text{Hydropriming}$                      | 37.33         | 40.33      |
| $T_{10} = \text{Control}$                       | 38.00         | 41.67      |
Fig. 2. Effect of seed bio-priming on severity of sheath blight, sheath rot and yield of rice.

**Treatments**

- **T<sub>1</sub>** = *T. viride* applied at imbibition
- **T<sub>2</sub>** = *T. viride* applied after imbibition
- **T<sub>3</sub>** = *T. harzianum* applied at imbibition
- **T<sub>4</sub>** = *T. harzianum* applied after imbibition
- **T<sub>5</sub>** = *P. fluorescens* applied at imbibition
- **T<sub>6</sub>** = *P. fluorescens* applied after imbibition
- **T<sub>7</sub>** = *B. subtilis* applied at imbibition
- **T<sub>8</sub>** = *B. subtilis* applied after imbibition
- **T<sub>9</sub>** = Hydropriming
- **T<sub>10</sub>** = Control
Table.3 Disease severity scale for sheath rot (IRRI, 2002)

| Scale | Description |
|-------|-------------|
| 0     | No lesion/ spot on flag leaf sheath. |
| 1     | Spots visible on the tillers upon very careful examination (less than 1 per cent flag leaf sheath area covered). |
| 3     | Spots visible on the tillers upon careful examination (1 to 5 per cent flag leaf sheath area covered). |
| 5     | Spots easily visible on the tillers (6 to 25 per cent flag leaf sheath area covered). |
| 7     | Spots present on almost whole the tillers parts (26 to 50 per cent flag leaf sheath area covered). |
| 9     | Spots very common on whole the tillers parts (51 to 100 per cent flag leaf sheath area covered) death of plants common, reduced severe yield loss. |

The next best treatment in order of merit was *P. fluorescens* applied after imbibition (3717 kg ha\(^{-1}\)), *T. viride* applied after imbibition (3580 kg ha\(^{-1}\)), *T. harzianum* applied after imbibition (3423 kg ha\(^{-1}\)), *B. subtilis* applied after imbibition (3316 kg ha\(^{-1}\)) and seeds primed with hydration (3222 kg ha\(^{-1}\)). The lowest grain yield (3067 kg ha\(^{-1}\)) was observed in control.

Table.4 Disease severity scale for sheath blight (IRRI, 2002)

| Scale | Description |
|-------|-------------|
| 0     | No lesion/ spot on flag leaf sheath. |
| 1     | Spots visible on the tillers upon very careful examination (less than 1 per cent flag leaf sheath area covered). |
| 3     | Spots visible on the tillers upon careful examination (1 to 5 per cent flag leaf sheath area covered). |
| 5     | Spots easily visible on the tillers (6 to 25 per cent flag leaf sheath area covered). |
| 7     | Spots present on almost whole the tillers parts (26 to 50 per cent flag leaf sheath area covered). |
| 9     | Spots very common on whole the tillers parts (51 to 100 per cent flag leaf sheath area covered) death of plants common, reduced severe yield loss. |

The results obtained in present study were found in harmony with the findings of earlier workers, Gopalakrishnan and Valluvaparidasan (2006) observed that *P. fluorescens* showed the lowest per cent of sheath rot incidence and severity and Mougy and Kader (2008) noticed that seed bio-priming with *T. harzianum* gave the lowest per cent sheath blight incidence and severity. These results were also in agreement with those of other workers, Jain and Lore (2014) and Suman et al. (2017).

The present study concludes that out of ten treatments tested against sheath blight and sheath rot of rice through seed bio-priming. The minimum sheath blight incidence (25.67%) and severity (21.63%) was found in *T. harzianum* applied at imbibition it was found statistically at par with *T. viride* applied at imbibition, *P. fluorescens* applied at imbibition and *T. viride* applied after imbibition whereas minimum sheath rot incidence (28.67%) and severity (23.41%) was found in *P. fluorescens* applied at imbibition it was found statistically at par with *T. harzianum* applied at imbibition, *T. viride* applied at imbibition and *P. fluorescens* applied after imbibition.

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**How to cite this article:**

Shekhada, M.R., V.A. Patil, A.S. Savaliya and Sangani, M.D. 2018. Management of Rice (*Oryza sativa* L.) Sheath Blight (*Rhizoctonia solani* Kuhn) and Sheath Rot (*Sarocladium oryzae* Sawada) through Seed Bio-Priming. *Int.J.Curr.Microbiol.App.Sci.* 7(08): 2787-2794. doi: [https://doi.org/10.20546/ijcmas.2018.708.293](https://doi.org/10.20546/ijcmas.2018.708.293)