IJPS INTERNATIONAL JOURNAL OF PLANT SCIENCES
e ISSN-0976-593X Volume **13** | Issue 1 | January, 2018 | 42-46

**DOI: 10.15740/HAS/IJPS/13.1/42-46**
Visit us - *www.researchjournal.co.in*

**RESEARCH ARTICLE**

# Management of sheath blight of rice through integrated application of bio-agents, organic amendments and resistance inducing chemicals

■ **Durga Prasad and Ramji Singh**

## SUMMARY

Eco-friendly approaches have attained importance in modern agriculture to curtail the hazards of extensive use of pesticides for disease control. Present study was undertaken to assess the effect of some different management practices, which relies on less chemical application, on disease severity, per cent disease incidence (PDI) of sheath blight and yield parameters of rice in the field experiment during 2013 and 2014. Among different approaches assessed against sheath blight of rice, pre-transplanting soil application of combination of *Trichoderma harzianum* + *Pseudomonas fluorescens* + farm yard manure followed by foliar spray of zinc sulphate (0.5%) + lime (0.25%) at maximum tillering stage showed maximum reduction in sheath blight severity (50%), per cent disease incidence (55.46%) and higher grain yield (28.55%) over the control. Ten ears and 1000 grain weight showed positive correlation with grain yield. The treatments which consisted pre-transplanting soil application of bio-agents + FYM/ vermi-compost showed greater number of tillers per hill as compared to those treatments where nothing was applied in the soil.

**Key Words :** *Pseudomonas fluorescens*, Resistance inducing chemicals, *Rhizoctonia solani*, Sheath blight, *Trichoderma harzianum*

**How to cite this article :** Prasad, Durga and Singh, Ramji (2018). Management of sheath blight of rice through integrated application of bio-agents, organic amendments and resistance inducing chemicals. *Internat. J. Plant Sci.*, **13** (1): 42-46, **DOI: 10.15740/HAS/IJPS/13.1/42-46**.

**Article chronicle : Received :** 05.09.2017; **Revised :** 13.11.2017; **Accepted :** 27.11.2017

Sheath blight of rice caused by *Rhizoctonia solani* Kuhn [*Thanatephorus cucumeris* (Frank) Donk] is a potential threat to rice cultivation causing extensive damage to the crop in almost all the rice growing tracts of India. Yield losses due to this disease are estimated to be ranging from 1.2-69.0% (Naidu, 1992). The disease is particularly important in intensive rice production systems (Savary and Mew, 1996). The disease is soil borne and the pathogen survives in the form of mycelia or sclerotia for longer period either in soil or in rice stubbles. Use of resistant cultivars has not been successful to control the disease because adequate level of host resistance has not been found (Mew and Rosales, 1986). No commercial varieties in India are resistant to

MEMBERS OF THE RESEARCH FORUM

**Author to be contacted :**
**Durga Prasad,** Department of Plant Pathology, Bihar Agriculture College, Bihar Agricultural University, Sabour (Bihar) India
**Email** : dp.shubh@gmail.com

**Address of the Co-authors:**
**Ramji Singh,** Department of Plant Pathology, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P.) India
**Email** : singh.ramji@gmail.com

the disease (Roy, 1993). Fungicide application is effective, but their use is being discouraged because it is known to cause serious threat to environment, imbalance in the ecosystem and human health hazards. Eco-friendly approaches have attained importance in modern day agriculture to curtail the hazards of extensive use of toxic chemicals for disease control (Homer, 1988). Biological control of *R. solani* could be achieved by either promoting the native antagonists by using organic amendments or other cultural practices or by introducing alien antagonists (Singh *et al.*, 2003). Host nutrition is one of the important factors determining the severity of the disease as well as the effectiveness of bio-control agents (Lucas and Collet, 1988). Adequate information on combined effect of all these agents is not available. So, to evolve a sustainable eco-friendly measure which can control to sheath blight effectively, in the present investigation an attempt has been made to elucidate the influence of integrated application of bio-agents, farm yard manure, vermi-compost and resistance inducing chemicals against sheath blight of rice under field conditions.

## MATERIAL AND METHODS

The experiment was conducted using a highly susceptible rice variety *i.e.* Pusa Basmati-1. In total there were 8 treatments (Table 1) which were replicated thrice under Randomized Block Design. To ensure heavy inoculum pressure in experimental field, the mass culture of *Rhizoctonia solani* was prepared using autoclaved sorghum grains and uniformly broadcasted in the field, prior to transplanting. The chemical borax (20%B) @ 0.2 %, $ZnSO_4$ (21% Zn) @ 0.5% + lime @ 0.25% and validamycin @0.25%, were applied at maximum tillering stage (MTS) and boot leaf stage (BLS) as spray application, while *Trichoderma harzianum* ($10^6$ CFU/ g), *Pseudomonas fluorescens* ($10^5$ CFU/g), farm yard manure (FYM) @ 15 tonnes/ha and vermi-compost @ 6 tonnes/ha; were applied to field soil prior to transplanting

Experimentation was done under field conditions during *Kharif*, 2013 and 2014 at Mandan Bharti Agriculture College (MBAC), Saharsa. The bio-agents mentioned in the treatments were mixed thoroughly in FYM and or vermi compost @ 0.2% and spread as a layer (6" thick) under shade. It was covered with rice straw. Water was sprayed on the top to make the FYM moist. It was incubated for 15 days. The incubated and air-dried mixture of bio-agents + FYM/ vermi compost now became saturated with very high population of bio-agents and used directly for the soil application.

The experimental field was ploughed twice and soil was brought to a fine tilth. Plots of size 3x2m were prepared. On completion of field preparation and leveling, the mixtures of bio-agents + FYM/ vermi compost were applied to each plot as per treatment dosages determined. Two weeks after amending plots with mixture of bio-agent + organics, 25 days old Pusa Basmati-1 seedlings were transplanted in the plots at a spacing 20x15cm. Each plot also received NPK @ 80:40:20 kg/ha. The crop was sown in the month of July and harvested in the month of November in both the years. Controlled irrigation was given uniformly throughout the cropping season. Plots were given irrigation at an interval of 20 days. Resistance inducing chemicals *i.e.* $ZnSO_4$, borax and validamycin 3L (Sheathmar) were sprayed in respective plots either once or twice at respective stages of crop *i.e.* maximum tillering and boot leaf stages.

The disease severity was recorded with the help of randomly selected five hills in a plot. The selected hills were tagged for identification. These tagged hills were taken for recording observations on disease severity with the help of 0 to 9 rating scale of standard evaluation system (SES) for rice (IRRI, 2002).

The per cent disease incidence was calculated as per following equation-

$$\text{\% disease incidence} = \frac{\text{Number of sheath blight infected plants}}{\text{Total number of plants}} \times 100$$

The per cent disease index (PDI) was calculated as per following formula-

$$\text{PDI} = \frac{\text{Sum of all numerical rating}}{\text{Total number of rating} \times \text{Maximum grade}} \times 100$$

On the basis of above observations the per cent disease control (PDC) was calculated according to following equation-

$$\text{PDC} = \frac{\text{PDI in control - PDI in treated}}{\text{PDI in control}} \times 100$$

The crop was harvested in second week of November and threshed manually. The thousand grain weight and ten ears weight were recorded from individual plot and randomly selected grains and ears. Per cent yield increase was calculated by the following formula-

$$\text{\% yield increase} = \frac{\text{Yield under protected - Yield under unprotected}}{\text{Yield under protected}} \times 100$$

The data (disease incidence, disease severity, number of tillers per hill, ten ears weight, yield and 1000 grain weight) recorded during present investigations (Table 1 and 2) were statistically analyzed and calculations were made after applying the test of significance for the treatment means. The data taken into percentage were first transformed into angular values and then analyzed for test of significance with the help of computer.

## RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

### Effect of integrated treatments on per cent disease severity and incidence :

During both the crop season it was observed that all treatments (Table 1) showed significant reduction in disease severity and disease incidence over the untreated control. Among the various approaches assessed against sheath blight, the treatment $T_7$ (Two foliar sprays of Validamycin 3L at maximum tillering and boot leaf stages) resulted in maximum reduction of sheath blight with 39.26% severity and 18.50% incidence which was at par with $T_5$ (Soil application of Th + Pf + FYM followed by foliar spray of $ZnSO_4$ + Lime at MTS,) which also resulted in quite low level of disease severity (48.15%) and incidence (23.83%) which was significantly quite lower than other treatments. Treatments $T_1$ where *Trichoderma harzianum* (Th) and *Pseudomonas fluorescens* (Pf) was applied to field soil along with FYM, $T_2$ where Th and Pf was applied to field soil along with vermi compost and $T_6$ where Th and Pf was applied to field soil along with FYM followed by application of borax at MTS were also satisfactorily effective in reducing the incidence and severity of sheath blight but were comparatively of lower level than $T_5$ and $T_7$. The average disease severity and incidence observed in untreated control ($T_8$) during the both year were 96.30% and 53.50%, respectively.

The results of the experiment have been quite in accordance with earlier findings that integration of organic amendments with fungal antagonists (*Trichoderma harzianum*) against sheath blight has a synergistic effect on the effectivity of *Trichoderma harzianum*. Maximum reduction in disease severity (48.07%) and incidence (32.78%) were recorded due to application of FYM + *Trichoderma harzianum* (Khan and Sinha, 2006). The field trial with cv. IR-50 revealed that sheath blight was controlled by validamycin 3L @ 0.3% and carbendazim @ 0.1% (Devi and Mary, 1986). Validamycin has curative and protective effects against sheath blight of rice (Devi *et al.*, 1987). Soil types, pH, nutritional levels and organic amendments influence the efficacy of *Trichoderma harzianum* for managing sheath blight of rice (Ashraf and Sinha, 2005). The foliar application of Cu and B was found to reduce fungal disease infestation in MR219 rice cultivar and subsequently increase rice yield (Liew *et al.*, 2012). Application of recommended dose of macronutrients (N, P and K) and micronutrients (Zn, S and Fe) increased incubation period and quantity of phenols with decreased level of sheath blight (Prasad *et al.*, 2010). Silicon, copper and zinc applications have been found effective in reducing sheath blight disease severity and increasing rice yield (Khaing *et al.*, 2014).

### Effect of integrated treatments on yield parameters:

*Tillers per hill :*

Average number of tillers per hill recorded in treatments where combination of bio-agents + FYM/ vermi-compost was applied in the soil prior to transplanting was significantly higher than the number tillers in those treatments where bio-agents + organics (Table 2) were not applied. As per results of *Kharif* 2013 and 2014, the highest average number of tillers (13.83) per hill was obtained in treatment $T_2$. It was at par with average number of tillers per hill observed in treatments $T_1$ (13.40), $T_5$ (13.40) and $T_6$ (13.32). The average number of tillers per hill obtained in treatments without combination of bio-agents + organics were 11 ($T_3$), 10.95 ($T_4$), 10.97 ($T_7$) and 11.30 ($T_8$).

*Ten ears weight :*

As per average of both the crop seasons, highest weight (38.33g) of ten ears was obtained in crop sprayed with validamycin at MTS and BLS ($T_7$) which was significantly higher than weight of ten ears recorded in other treatments. Second highest weight (36.33g) of ten ears was obtained in $T_5$; it was at par with 35.50g noticed in $T_2$ and significantly higher than other treatments except $T_7$. The ten ears weight obtained in untreated control was 33.50g.

*Grain yield :*

Among various eco-friendly approaches assessed against sheath blight, the treatment $T_7$ resulted in highest yield (34.12 q/ha with 31.67% increase in yield.) followed by $T_5$ which also resulted in quite high level of yield (32.63 q/ha) with 28.55% increase in yield over control. It was significantly higher than grain yield obtained in other treatments. The lowest increase of 9.21% was obtained in treatment $T_4$ in which two foliar sprays of borax @ 0.2% was done at MTS and BLS. The grain yield found in untreated control was 23.31q/ha only.

*1000 grain weight :*

As per average of both the crop seasons, it was observed that the highest weight (25.40g) of one thousand grains was obtained in the crop where combination of bio-agent + FYM was applied in soil prior to transplanting followed by spray of combination of zinc sulphate + lime at MTS ($T_5$). It was significantly superior to other treatments but at par with 25.22 g weight of 1000 grains obtained in treatment $T_7$ in which validamycin was sprayed at MTS and BLS. The weight of 1000 grains in untreated control was 23.14g.

The findings of present investigation are quite in conformity with the reports of earlier workers. Soil application of *Trichoderma harzianum* and soil amendment with FYM 1% + saw dust @ 1% showed the maximum reduction in sheath blight severity, per cent disease incidence and higher grain yield over the control (Surulirajan and Kandhari, 2005). Application of

**Table 1: Effect of integrated application of bio-agents, organics and resistance inducing chemicals on sheath blight of rice**

| Treatments | Average disease incidence (%) | | | | Average disease severity (%) | | | |
|---|---|---|---|---|---|---|---|---|
| | 2013 | 2014 | Pooled | % reduction over control ($T_8$) | 2013 | 2014 | Pooled | % reduction over control ($T_8$) |
| $T_1$-Soil application of Th + Ps + FYM | 37.67 (37.80)* | 40.33 (39.39) | 39.00 (38.59) | 27.10 | 70.37 (57.18) | 73.33 (58.96) | 71.85 (58.07) | 25.39 |
| $T_2$-Soil application of Th + Pf + Vermicompost | 38.33 (38.22) | 41.33 (39.96) | 39.83 (39.08) | 25.55 | 68.89 (56.13) | 71.85 (58.25) | 70.37 (57.19) | 26.93 |
| $T_3$-Two foliar sprays of $ZnSO_4$ + Lime at MTS and BLS | 40.33 (39.41) | 41.67 (40.19) | 41.00 (39.80) | 23.36 | 91.11 (73.02) | 86.66 (69.06) | 88.89 (71.04) | 7.69 |
| $T_4$-Two foliar sprays of Borax at MTS and BLS | 41.33 (40.00) | 42.33 (40.52) | 41.83 (40.25) | 21.81 | 92.59 (77.63) | 92.59 (77.08) | 92.59 (77.36) | 3.85 |
| $T_5$-Soil application of Th + Pf + FYM followed by foliar spray of $ZnSO_4$ + Lime at MTS | 22.67 (28.36) | 25.00 (29.89) | 23.83 (29.12) | 55.46 | 46.67 (43.05) | 49.63 (44.74) | 48.15 (43.89) | 50.00 |
| $T_6$-Soil application of Th + Pf + FYM followed by foliar spray of Borax at MTS | 37.33 (37.65) | 39.33 (38.80) | 38.33 (38.22) | 28.36 | 71.85 (58.06) | 74.81 (60.78) | 73.33 (59.42) | 23.85 |
| $T_7$-Treated control (Two foliar sprays of Validamycin 3L at MTS and BLS) | 17.33 (24.51) | 19.67 (26.18) | 18.50 (25.34) | 65.42 | 37.78 (37.64) | 40.74 (39.57) | 39.26 (38.60) | 59.23 |
| $T_8$-Untreated control (water spray) | 52.33 (46.38) | 54.67 (47.68) | 53.50 (47.03) | 0.00 | 97.08 (81.89) | 95.56 (80.16) | 96.30 (81.03) | 0.00 |
| C.D. (P=0.05) | 5.76 | 6.12 | 4.27 | — | 12.09 | 12.68 | 9.01 | — |

*Figures given in parentheses are angular transformed values

**Table 2: Effect of integrated application of bio-agents, organics and resistance inducing chemicals on rice yield parameters (tillers per hill, ten ears weight, grain yield and 1000 grain weight)**

| Treatments | No. of tillers per hill | | | Ten ears weight (g) | | | Yield q/ha | | | | 1000 grain wt (g) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2013 | 2014 | Pooled | 2013 | 2014 | Pooled | 2013 | 2014 | Pooled | % Increase over control | 2013 | 2014 | Pooled |
| $T_1$ | 12.87 | 13.93 | 13.40 | 34.67 | 35.00 | 34.83 | 28.15 | 28.08 | 28.12 | 17.10 | 24.37 | 24.33 | 24.35 |
| $T_2$ | 13.60 | 14.07 | 13.83 | 35.33 | 35.67 | 35.50 | 28.33 | 28.25 | 28.29 | 17.61 | 24.40 | 24.43 | 24.42 |
| $T_3$ | 11.00 | 11.00 | 11.00 | 35.00 | 35.00 | 35.00 | 25.90 | 25.98 | 25.94 | 10.14 | 23.80 | 23.47 | 23.63 |
| $T_4$ | 10.73 | 11.17 | 10.95 | 34.33 | 34.00 | 34.17 | 25.75 | 25.60 | 25.68 | 9.21 | 23.63 | 23.70 | 23.67 |
| $T_5$ | 12.93 | 13.87 | 13.40 | 36.00 | 36.67 | 36.33 | 32.93 | 32.31 | 32.63 | 28.55 | 25.67 | 25.14 | 25.40 |
| $T_6$ | 12.87 | 13.77 | 13.32 | 34.67 | 35.00 | 34.83 | 28.32 | 28.45 | 28.39 | 17.88 | 24.37 | 24.23 | 24.30 |
| $T_7$ | 10.93 | 11.00 | 10.97 | 38.00 | 38.67 | 38.33 | 34.28 | 33.94 | 34.12 | 31.67 | 25.37 | 25.07 | 25.22 |
| $T_8$ | 11.13 | 11.47 | 11.30 | 33.33 | 33.67 | 33.50 | 23.56 | 23.05 | 23.31 | 0.00 | 23.23 | 23.05 | 23.14 |
| C.D. (P=0.05) | 1.68 | 1.96 | 1.13 | 1.92 | 1.85 | 1.15 | 3.59 | 3.52 | 2.87 | — | 0.95 | 0.82 | 0.55 |

*Trichoderma harzianum* and *Pseudomonas fluorescens* as soil application for managing rice sheath blight, and all the methods of application significantly reduced disease severity and incidence as compared to control and significantly increased grain yield/plant and 1000-grain weight as compared to check (Singh and Sinha, 2005). Imbalanced zinc application increase the proneness in plants for stresses (Advanced Nutrients, 2007). Integration of organic amendments and fungal antagonists (Th) has synergistic effect on the effectivity of *Trichoderma harzianum* (Khan and Sinha, 2006). Validamycin effectively control the sheath blight (Osada, 1993). Soil application of Pf + FYM reduced the sheath blight significantly (Biswas and Datta, 2013).

The present study revealed that integrated application of bio-agents (Th + Pf) + FYM + resistance inducing chemical (zinc sulphate) effectively minimized the sheath blight of rice without damaging the environment and creating imbalance in the ecosystem and human health hazards. It was found significantly superior to other approaches and at par with chemical (validamycin) control of sheath blight.

## REFERENCES


Ashraf, A.K. and Sinha, A.P. (2005). Influence of soil and nutritional factors on the effectivity of *Trichoderma harzianum* against sheath blight of rice. *Indian Phytopath.,* **58** : 276-281

Biswas, S. and Datta, M. (2013). Evaluation of biological control agents against sheath blight of rice in Tripura. *Indian Phytopath.,* **66** : 77-80.

Devi, R.R., Paul, T.S. and Gokulapalan, C. (1987). Efficacy of different fungicides in the control of sheath blight of rice. *Indian J. Pl. Protec.,* **15** : 69-70.

Devi, V.P.S. and Mary, C.A. (1986). Sheath blight control. *Int. Rice Res Newsl.,* **11**: 22

Homer, D.W. (1988). *Trichoderma* as a biocontrol agent. In: *Biocontrol of plant diseases* Vol. 1. CRC Press, Inc. Florida, USA, pp 71-82

IRRI (2002). Standard evaluation system for rice. Philippines: International Rice Research Institute, Manila, Philippines

Khan, A.A. and Sinha, A.P. (2006). Integration of fungal antagonists and organic amendments for the control of rice sheath blight. *Indian Phytopath.,* **59**:363-365.

Khaing, E.E., Ahmad, Z.A.M., Yun, W.M. and Ismail, M.R. (2014). Effects of silicon, copper and zinc applications on sheath blight disease severity on rice. *World J. Agric. Res.,* **2**: 309-314.

Lucas, P. and Collet, J.M. (1988). Influence de la fertilisation azotée sur la receptivityédun sol au piétin-échaudage, le développement de la maladie au champ et les populations de Pseudomonas fluorescents. *Bulletin-OEPP,* **18** (1) : 103-109.

Liew, Y.A., Husni, M.H.A., Zainal, A.M.A. and Ashikin, N. (2012). Effects of foliar applied copper and boron on fungal diseases and rice yield on cultivar MR219. *Pertanika J. Trop. Agric. Sci.,* **35**: 339-349.

Mew, T. W. and Rosales, A. M. (1986). Bacterization of rice plants for control of sheath blight caused by *Rhizoctonia solani*. *Phytopathol.,* **76** : 1260-1264.

Naidu, V. D. (1992). Influence of sheath blight of rice on grain and straw yield in some popular local varieties. *J. Res. Publ.,* **10** : 78-80.

Osada, S. (1993). Effect of several fungicides on the seasonal occurrence of rice sheath spot caused by *R. oryzae.* Ryker and Gooch. *Annual Report of the Society of Plant Protection of North Japan,* **44** : 11-13.

Prasad, D., Singh, R. and Singh, A. (2010). Management of sheath blight of rice with integrated nutrients. *Indian Phytopath.,* **63** : 11–15.

Roy, A.K. (1993). Sheath blight of rice in India. *Indian Phytopath.,* **46** : 197-205.

Savary, S. and Mew, T.W. (1996). Analyzing crop losses due to *Rhizoctonia solani*: rice sheath blight, a case study. In: Sneh B, Javaji-Hare S, Neate S, Dijst G (Eds) *Rhizoctonia* species: *taxonomy, molecular biology, ecology, pathology and disease control*, Kluwer, Dordrecht, pp. 237-244.

Singh, R. and Sinha, A.P. (2005). Influence of application methods of *Pseudomonas fluorescens* for managing rice sheath blight. *Indian Phytopath.,* **58**: 474-476.

Singh, S.K., Shukla, V., Singh, H.P. and Sinha, A.P. (2003). Current status and impact of sheath blight in rice (*Oryzae sativa* L.). *Agric. Rev.,* **25** : 289-297.


## WEBLIOGRAPHY


Advanced Nutrients (2007). At info@advancednutrients.com