P-ISSN: 2349-8528

E-ISSN: 2321-4902

www.chemijournal.com

IJCS 2020; 8(3): 2759-2762

© 2020 IJCS

Received: 24-03-2020

Accepted: 28-04-2020

Swagatika Mohanty

Department of Plant Pathology,
College of Agriculture, Odisha
University of Agriculture &
Technology, Bhubaneswar,
Odisha, India

SS Mahapatra

Regional Research & Technology
Transfer Station (OUAT),
Ranital, Bhadrak, Odisha, India

A Khandual

Molecular Plant Pathology
laboratory, Crop Protection
Division, ICAR-NRRI, Cuttack,
Odisha, India

KN Koshale

College of Agriculture &
Research Station, Saja, Indira
Gandhi Krishi Vishwavidyalaya,
Raipur, Chhattisgarh, India

AK Mukherjee

Molecular Plant Pathology
laboratory, Crop Protection
Division, ICAR-NRRI, Cuttack,
Odisha, India

Corresponding Author:**AK Mukherjee**

Molecular Plant Pathology
laboratory, Crop Protection
Division, ICAR-NRRI, Cuttack,
Odisha, India

International Journal of Chemical Studies

Impact of fungicides on *Rhizoctonia solani* Kuhn causing sheath blight disease of rice

Swagatika Mohanty, SS Mahapatra, A Khandual, KN Koshale and AK Mukherjee

DOI: <https://doi.org/10.22271/chemi.2020.v8.i3an.9629>

Abstract

Rhizoctonia solani Kuhn, is an important pathogen of rice causing sheath blight disease. The pathogen thrives in soil and is polyphagous in nature. Till date no resistant variety has been registered against the disease which is the main reason of dependence on chemical management of the disease. In the present study six chemicals with different concentrations viz. 50 ppm, 100 ppm and 200 ppm along with control were evaluated *in vitro* against the pathogen. The chemicals were also tested *in vivo* for management of sheath blight. The *in vitro* study was conducted using the 'poisoned food technique' and the *in vivo* study was done in the field condition during kharif season in two subsequent years (2018 and 2019). Spraying of the fungicides was advocated twice after the natural infection i.e. at 45 and 60 days after transplanting. The observations revealed that all the fungicides were capable for significant inhibition of the fungus in '*in vitro*' and the disease in '*in vivo*' conditions.

Keywords: Sheath blight, *Rhizoctonia solani*, fungicides, rice

Introduction

Sheath blight of rice is considered as the second most economically important disease of rice after blast (Manibhusanrao, 1995) [3]. It is mainly aggravated in the field when the crop is in active tillering stage. In Odisha, the crop is mostly affected by the disease during late September to October as the weather is more favourable for spread of the disease. Sheath blight disease is favoured by the high humidity condition, water logging situation near the sheath, close spacing and indiscriminate use of nitrogenous fertilizer (Kagale, 2004) [7]. Monocropping with high yielding varieties for several years is also one of the causes of prevalence of the disease due to genetic homogeneity. No resistant variety till now is registered against the disease. By observing the degree of incidence of the disease in favourable weather conditions, chemical management as the last tool under Integrated Disease Management (IDM) is very essential sometimes as the rate of spread of the disease is very high crossing Economic Threshold Level within a short span of time. Keeping in view the disease severity, a study was undertaken with some commercially available new generation chemicals along with standard chemicals, which were previously reported efficient against the disease, both *in vitro* and *in vivo* to evaluate their efficacy against the disease.

Materials and Method

In vitro Study of Chemicals against *Rhizoctonia solani*

An *in vitro* study was conducted by taking six chemicals along with control (untreated) viz. (Tebuconazole 50% + Trifloxystrobin 25%) 75 WG, Propiconazole 25% EC, Azoxystrobin 25% SC, Validamycin 3L, Carbendazim 50% WP, Hexaconazole 5% SC in different concentrations of 50 ppm, 100 ppm and 200 ppm using the 'poisoned food technique' (Nene & Thapliyal, 1982) [6]. The media used for the purpose was potato dextrose agar. After calculation, the desired amount of chemicals were weighed and mixed with the calculated amount of the molten media to get the desired concentration. First 1% tween 20 was added to the emulsified chemicals for their thorough mixing and then poured into the molten media. The poisoned media with different concentrations were poured in 90 mm petri dishes. 5 mm mycelial discs were cut from the edges of 5 days old fresh culture plates of *Rhizoctonia solani* and inoculated at the centre of the plate.

Each treatment was replicated thrice and the design of the experiment was Completely Randomized Design (CRD). The whole process was carried out in aseptic condition by taking utmost care. The plates were incubated at $27 \pm 1^\circ\text{C}$ for 24 hours and observations were taken at regular interval. The untreated plate with the fungus was maintained along with

treated plates as control. The final observations were taken when the control plate attained its maximum mycelial growth and the treated plates were compared with the control plate to evaluate the inhibition of radial growth by the following formula (Vincent, 1927) ^[17].

$$\text{Percent Radial growth inhibition (I)} = \frac{\text{Radial growth in control (C)} - \text{Radial growth in treatment (T)}}{\text{Radial growth in control (C)}} \times 100$$

Table 1: Chemical details used for bioassay against *Rhizoctonia solani*

Sl. No.	Chemical with Formulation	Dose (Per litre of water)	Chemical group
1	(Tebuconazole 50%+Trifloxystrobin 25%) 75 WG	0.4g	Strobilurin + Triazole
2	Propiconazole 25% EC	1ml	Triazole
3	Hexaconazole 5% SC	2ml	Strobilurin
4	Carbendazim 50% WP	1.5ml	Aminoglycoside antibiotics
5	Validamycin 3%L	1ml	Benzimidazole
6	Azoxystrobin 25% SC	1ml	Triazole

Bio-Efficacy Study of Chemicals against *Rhizoctonia solani* under Field Condition

After observing efficacy of the chemicals against the pathogen *in vitro*, a field experiment was conducted in the Regional Research and Technology Transfer Station (OUAT), Ranital, Bhadrak for two consecutive years *i.e.* 2018 kharif and 2019 kharif to study the efficacy of the chemicals in field condition. The design of the experiment was Randomized Block Design (RBD) with seven treatments along with the control having three replications for each treatment. The rice variety 'Swarna (MTU 7029)' was taken as it is susceptible to sheath blight disease. The plot size was (6X3) m². Standard agronomic practices with judicious fertilizer application were followed in the experiment. The crop was allowed to have natural incidence of the sheath blight infection. The chemicals were sprayed twice in respective plots at 15 days interval at active tillering stage (45 DAP) and at 60 DAP. The control plot was sprayed with only water. The data on disease incidence were recorded 10 days after spray by Standard Evaluation System (SES) of IRRI, 2002.

Rice sheath blight grade chart (IRRI, 2002)

0 No infection observed

1 Lesion limited to lower 20 per cent of the height of the plant

3 Lesion limited to 21-30 per cent of the height of the plant

5 Lesion limited to 31-45 per cent of the height of the plant

7 Lesion limited to 46-65 per cent of the height of the plant

9 Lesion more than 65 per cent of the height of the plant

Per cent Disease Index (PDI) and Grain Yield (kg/ha) were the parameters taken in to consideration for data analysis.

$$\text{Per cent Disease Index (PDI)} = \frac{\text{Sum of numerical rating}}{\text{Number of observations} \times \text{Maximum Scale}} \times 100$$

Statistical Analysis

The observations recorded in the various experiments of the study were statistically analysed by OPSTAT agriculture data analysis tool, CCSHAU, Hissar.

Results and Discussion

The present *in vitro* study on the chemicals showed that all the chemicals significantly reduced the mycelial growth at all the concentrations. The inhibitory effect of all test chemicals increased with the increase of concentrations. The combination

of (Tebuconazole 50% + Trifloxystrobin 25%) 75 WG and Hexaconazole 5% SC gave the highest mycelial growth inhibition (100%) at 200 ppm concentration followed by Propiconazole 25% EC (93.10%), Azoxystrobin 25% EC (90.60%), Carbendazim 50% WP (87.60%) and Validamycin 3L (81.40%), respectively. The inhibition by (Tebuconazole 50% + Trifloxystrobin 25%) 75 WG in this finding corroborates with the result of Sriraj *et al.* (2014) who had reported 100% mycelial growth inhibition by (Tebuconazole 50% + Trifloxystrobin 25%) 75 WG at 10 ppm but contradicts to his finding that Carbendazim 50% WP was equally effective at the same concentration as the present result showed Carbendazim at 200 ppm could reduce the radial growth by 87.60%. Rini Pal (2016) ^[16] reported (Tebuconazole 50% + Trifloxystrobin 25%) 75 WG as most effective against the fungus *in vitro* at 200 ppm. The lowest radial growth inhibition was observed in case of Validamycin 3% L (37.50%) at 50 ppm followed by Carbendazim 50% WP (53.70%). The effect of Validamycin 3%L is in contrast to the finding of Kumar *et al.* (2012) who reported two sprayings of Validamycin 3%L was effective against the fungus with less disease severity of 25.33%. Nagaraju (2013) found significant reduction of mycelial growth by Propiconazole 25% EC, Hexaconazole 5% SC at 500 ppm which is similar to the present finding. After successful *in vitro* screening, the field experiment was conducted (2018 kharif and 2019 kharif) to evaluate the efficacy of the chemicals against the disease in natural condition. The data on sheath blight incidence and grain yield are presented in table 2. Grain yield increased with decrease in the disease incidence. The pooled analysis result of two years showed that two sprayings of combination fungicide (Tebuconazole 50% + Trifloxystrobin 25%) 75WG @ 0.04% at 15 days interval was found most effective in reducing percent disease index (PDI) up to 37.74% over control of sheath blight with increase in the grain yield up to 65.14% over control. This result is corroborated with the finding of Pramesh *et al.* (2016) ^[13], Kumar *et al.* (2018) ^[9] and Persaud *et al.* (2019). Persaud *et al.* (2019) ^[14] reported the combination of strobilurin and azole compounds in (Tebuconazole 50% + Trifloxystrobin 25%) 75 WG could affect the quinines and sterol biosynthesis in the fungal pathogen. The effect of Hexaconazole 5% SC and Propiconazole 25% EC was also found significant with least PDI 28.99% and 26.81% with an increase in yield by 27.29% and 22.19% over control, respectively. Kumar *et al.* (2014) ^[10] and Chandra *et al.* (2016)

[2] reported Propiconazole 25% EC at 1ml/l as most efficient with disease severity of 7.77% and 7.50% with gain yield of 3486.04 kg/ha, 3985 kg/ha, respectively. Likewise Swamy *et al.* (2009), Bhuvanewari and Raju (2012) reported Hexaconazole at 2ml/l to be limiting the disease severity within 25% and 31.06% with gain yield of 5087 kg/ha and 6661 kg/ha, respectively. The promising effect of Hexaconazole 5% SC and Propiconazole 25% EC also corroborates with the finding of Nagaraju (2013). This was followed by Carbendazim 50% WP with PDI 31.84% and Validamycin 3L with PDI 32.24% with grain yield of 47.77 q/ha and 44.97 q/ha, respectively and were found to be at par with each other. The finding was supported

with the work of Nagaraju *et al.* (2017) [5] who found the effect of Carbendazim 50% WP and Validamycin 3%L to be at par in their performance with PDI of 24.80% & 21.60% with higher grain yield of 69.21% and 73.83%, respectively in field trial but contrast to the finding of Prakash (2015) i.e. Carbendazim 50% WP is most effective against the disease with low PDI of 24.81%. The effect of Azoxystrobin 25% SC on the fungus was not that promising (with PDI 24.98 and grain yield 45.75 q/ha) in the finding of Bag *et al.* (2016). The report revealed that Azoxystrobin 25% SC @1 ml/l effectively controlled the disease (with the lowest disease severity 16.4%) and improved grain yield 5225 kg/ha.

Table 2: *In vitro* efficacy of new chemicals on the mycelial growth of *Rhizoctonia solani*

Sl. No.	Chemical	50 ppm		100 ppm		200 ppm	
		Radial Growth (mm) *	% inhibition Over Control *	Radial Growth (mm) *	% inhibition Over Control *	Radial Growth (mm) *	% inhibition Over Control *
1	(Tebuconazole 50%+Trifloxystrobin 25%) 75 WG	19.26	78.60 (62.49)	9.24	89.73 (71.39)	0.00	100.00 (90.00)
2	Propiconazole 25% EC	34.36	61.30 (51.53)	15.66	82.60 (65.38)	16.74	93.10 (64.50)
3	Hexaconazole 5% SC	32.10	64.33 (53.34)	13.59	84.90 (67.20)	0.00	100.00 (90.00)
4	Carbendazim 50% WP	41.67	53.70 (47.13)	23.13	74.30 (59.55)	11.16	87.60 (69.55)
5	Validamycin 3L	56.25	37.50 (37.76)	30.75	65.83 (54.25)	6.21	81.40 (74.83)
6	Azoxystrobin 25% SC	41.13	54.03 (47.32)	19.23	78.63 (62.49)	8.46	90.60 (72.25)
7	Control(C)	90.00	0.00 (0.00)	90.00	0.00 (0.00)	90	0.00 (0.00)
	SEm (±)		0.77		1.05		1.13
	CD (0.05)		2.36		3.23		3.48

Figures in parentheses represent corresponding transformed values

* Average of three replications

Table 3: Efficacy of chemicals against sheath blight disease and yield of rice

Sl. No.	Chemical	Dose (Per litre of water)	Per cent Disease Index (%)			% reduction over control	Grain Yield (g / ha)			% Increase in grain yield over control
			2018 Kharif *	2019 Kharif *	Pooled		2018 Kharif *	2019 Kharif *	Pooled	
1	(Tebuconazole 50%+Trifloxystrobin 25%) 75 WG	0.4g	17.83 (24.98)	18.23 (25.27)	25.13	37.74	61.60	61.20	61.40	65.14
2	Propiconazole 25% EC	1ml	24.13 (29.42)	24.50 (29.66)	29.54	26.81	50.50	50.13	50.32	35.34
3	Hexaconazole 5% SC	2ml	22.30 (28.17)	23.73 (29.14)	28.66	28.99	55.37	54.77	55.07	48.12
4	Carbendazim 50% WP	1.5ml	28.20 (29.42)	27.50 (31.62)	31.84	21.11	47.90	47.63	47.77	28.48
5	Validamycin 3%L	1ml	27.20 (31.43)	29.73 (33.04)	32.24	20.12	44.03	45.90	44.97	20.95
6	Azoxystrobin 25% SC	1ml	25.37 (30.24)	25.47 (30.32)	30.28	24.98	46.20	45.30	45.75	23.05
7	Control(C)		42.33 (40.79)	41.20 (39.93)	40.36		36.83	37.53	37.18	
	SEm (±)		0.53	0.57	0.54		1.21	1.82	1.54	
	CD (0.05)		1.67	1.80	1.56		0.39	0.58	0.65	

Figures in parentheses represent corresponding transformed values

* Average of three replications

References

- Bhuvanewari V, Raju S K. Efficacy of new combination fungicide against rice sheath blight caused by *Rhizoctonia solani* (Kuhn). Journal of Rice Research. 2012; 5(1):57-61
- Chandra S, Kumar P, Kumar S. Field evaluation of fungicides and botanicals against sheath blight, *Rhizoctonia solani* in rice (*Oryza sativa* L.), An Asian Journal of Soil Science. 2016; 11(1):95-97.
- Manibhushanrao K. Sheath blight disease of rice. Daya Publishing House, Delhi, 1995, 101.
- Narayan Swamy, Sannaulla Syed, Kumar Dinesh M. Screening of new fungicides against rice sheath blight disease. Karnataka Journal of Agricultural Science. 2009; 22(2):448-449.
- Nagaraju, Perumandla, Manjunath Krishnappa Naik. "Evaluation of fungicides, botanicals and bio-agents against sheath blight of rice caused by *Rhizoctonia solani* Kühn under irrigated eco-system. International Journal of Plant Protection. 2017; 10:247-251.
- Nene YL, Thapliyal PN. Fungicides in plant disease control, Oxford and IBH Publishing House, New Delhi, 1982, 163
- Kagale S, Marimuthu T, Thayumanavan B, Nandakumar R, Samiyappan R. Antimicrobial activity and induction of systemic resistance in rice by leaf extract of *Datura metel* against *Rhizoctonia solani* and *Xanthomonas oryzae* pv. *Oryzae*, Physiological and Molecular Plant Pathology. 2004; 65(2):91-100.
- Kumar MK, Sidde DK, Gowda K, Koti, Vishwanath. A New Carboxynilide Group Fungicide against Paddy Sheath Blight. Research Journal of Agricultural Sciences. 2012; 3:500-505.

9. Kumar S, Kumari S, Rai SN, Sinha A. A New Combination Fungicide for the Management of Sheath Blight, Neck Blast, Brown Spot, False Smut and Grain Discolouration Diseases of Paddy on Farmers Field. *Current Journal of Applied Science and Technology*. 2018; 31(3):1-9. <https://doi.org/10.9734/CJAST/2018/45898>
10. Kumar MR, Prasanna, Veerabhadraswamy AL. Appraise a combination of fungicides against blast and sheath blight diseases of paddy (*Oryza sativa* L.). *Journal of Experimental Biology and Agricultural Sciences*. 2014; 2(1):50-57.
11. Kumar Prasanna MK, Gowda SDK, Gowda PKT, Vishwanath K. New carboxynilide group fungicide against paddy sheath blight. *Research journal of Agricultural Sciences*. 2012; 3(2):500-505.
12. Prasad, Nirmal, Singh, Nohar, Avinash P, Tiwari *et al*. Efficacy of new fungicides against sheath blight disease management of rice caused by *Rhizoctonia solani* under field condition. *International Journal of Chemical Studies*. 2020; 8:216-220. 10.22271/chemi.2020.v8.i3c.9228.
13. Pramesh D, Maruti KM, Mallikarjun GS, Guruprasad GS, Mahantashivayogayya, Reddy BGM, Gowdar SB, Chethana BS. Bio-efficacy of a combination fungicide against blast and sheath blight disease of paddy, *Journal of Experimental agriculture International*. 2016; 14(4):1-8.
14. Persaud R, Khan A, Isaac WA, Ganpat W. Palnt extracts, bioagents and new generation fungicides in the control of rice sheath blight in Guyana. *Crop Protection*. 2019; 119:30-37.
15. Prakash G, Pandian RTP, Rajashekara H, Sharma P, Singh UD. Assessment of efficacy of pesticides applied singly and in combination on rice sheath blight disease development. *Indian Phytopathology*. 2015; 68(3):248-253.
16. Pal R. PhD thesis on Studies on occurrence and severity of rice sheath blight in western Odisha and its management. Department of Plant Protection, Visva-Bharati, Sriniketan, West Bengal, 2016.
17. Vincent JM. Determination of per cent inhibition *in vitro*. *Nature*. 1927; 159:850.