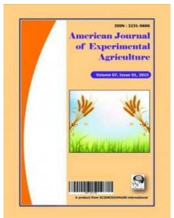

American Journal of Experimental Agriculture
13(5): 1-6, 2016, Article no.AJEA.27992
ISSN: 2231-0606

SCIENCEDOMAIN *international*
www.sciencedomain.org

Evaluation of a New Strobilurin Group of Fungicide for the Management of Blast Disease of Paddy

D. Pramesh[1*], K. Nataraj[2], G. S. Guruprasad[3], K. Mahantashivayogayya[4] and B. G. M. Reddy[5]

[1]Department of Plant Pathology, University of Agricultural Sciences, Raichur, Karnataka, India.
[2]M/s. BASF India Ltd, Navi Mumbai, India.
[3]Department of Agricultural Entomology, University of Agricultural Sciences, Raichur, Karnataka, India.
[4]Department of Genetics and Plant Breeding, University of Agricultural Sciences, Raichur, Karnataka, India.
[5]Department of Agronomy, University of Agricultural Sciences, Raichur, Karnataka, India.

Authors' contributions

This work was carried out in collaboration between all authors. Author DP designed the study, conducted the field experiments, performed the statistical analysis and wrote the first draft of the manuscript. Author KN wrote the protocol and supplied the test fungicides. Authors GSG, KM and BGMR reviewed the experimental design and all drafts of the manuscript. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJEA/2016/27992
Editor(s):
(1) Luis F. Goulao, Tropical Research Institute - IICT, Agri4Safe / BioTrop: Polo Mendes Hand, Agro-Industries and Tropical Agriculture Pavilion (3rd floor) Capped Help, 1349-017 Lisbon, Portugal.
Reviewers:
(1) Manas Kumar Bag, National Rice Research Institute, Cuttack, India.
(2) Hao Wang, China Tobacco Yunnan Industrial Co., Ltd. P.R. China.
Complete Peer review History: http://www.sciencedomain.org/review-history/15825

Original Research Article

Received 28th June 2016
Accepted 8th August 2016
Published 17th August 2016

ABSTRACT

A new strobilurin group of fungicide, pyraclostrobin 100 g/l CS (Seltima 100 g/l CS) was evaluated for its bio-efficacy against rice leaf blast disease under field condition during Kharif 2013 and 2014 at Agricultural research station, Gangavathi, Karnataka, India. The test fungicide, pyraclostrobin 100 g/l CS was found effective against leaf blast disease which recorded least percent disease index (PDI) of 14.20 and 16.48 @ 75 g a.i./h and @ 100 g a.i./h, respectively. Other fungicides such as tricyclazole 75 WP (300 g/h), Carbendazim 50 WP (500g/h) and Isoprothiolane 40 EC (750 ml/h) recorded significantly more PDI than pyraclostrobin 100 g/l CS. Due to difference in the PDI of leaf

**Corresponding author: E-mail: parmi.iari@gmail.com;*

blast disease, different treatments recorded statistically significant yield differences. The highest yield (67.78 q/h) was recorded in the treatment of pyraclostrobin 100 g/l CS @ 75 g a.i./h followed by the same chemical @ 100 g a.i./h (66.87 q/h). Therefore, pyraclostrobin 100 g/l CS (Seltima 100 g/l CS) @ 75-100 g a.i/h can be used for effective management of leaf blast disease.

Keywords: Leaf blast; pyraclostrobin 100 g/l CS; PDI; tricyclazole 75 WP.

1. INTRODUCTION

Rice (*Oryza sativa* L.) is staple food in many countries and food security to millions of population in the world and is one of the major food crops of India. Ever growing population in the world particularly in India is further demanding the enhanced production of rice. Production of rice is affected by many biotic and abiotic factors. Among the different biotic constraints, diseases caused by fungal pathogens such as blast is the most frequent and infectious disease in irrigated rice of both temperate and subtropical areas. Blast pathogen causes damage at all stages of crop growth [1].

Rice blast caused by *Pyricularia oryzae* Cavara [synonym *Pyricularia grisea* Sacc. the anamorph of *Magnaporthe grisea* (Herbert) Yaegashi and Udagawa], is one of the most destructive and wide spread disease of rice [2]. Blast epidemic causes the complete defeat of seedling at the nursery and in field condition and causes up to 80% of total yield reduction [3-6]. Due to non availability of location specific resistant varieties for blast disease, the chemical control is the alternate strategy for the farmers to harvest economic yield. Moreover, poor bio-efficacy of the biocontrol agents under the severe epidemic condition makes the chemical control is an inevitable and ultimate solution for blast disease management. Chemical restraint of the blast diseases is successful at filed level in majority of the cases [7-12]. Fungicidal control is largely practiced for blast disease in many temperate or subtropical rice growing countries, primarily in Japan, China, South Korea, Taiwan and Vietnam [13].

Historically, copper and mercury based fungicides were in use against blast, but were found not suitable because of phytotoxicity and mammalian toxicity. Present day products are mainly systemic with a residual action of 15 days at least. The modern fungicides used for blast of rice management are Isoprothiolane, Probenazole, Pyroquilon, Tricyclazole and most of the other fungicides like Benomyl, Carbendazim, Chloroneb, Captafol, Mancozeb, Zineb, Edifenphos, Iprobenphos, Thiophanate, Carboxin, Kitazin, Flutolanil, etc. are found to be effective to some extent for blast disease management under filed conditions [14-19]. Fungicides have been used successfully to control blast, but their efficacy could vary with dose and geographical region. Although, all the above mentioned fungicides are effective against blast disease, it has been advised to rotate the fungicides to overcome the development of fungicide resistance in targeted fungal population [20]. Due to continuous development of fungicide tolerance in fungal population, it is inevitable to search for a new group of fungicide with different mode of action so that new information on diverse fungicides with different modes of action can be offered to farmers. Strobilurins (also known as β-methoxyacrylates) or QoI (Quinone outside Inhibitors) fungicides, originally derived from a wild mushroom (*Strobilurus tenacellus*) were introduced for plant disease management in late 1990s [21,22]. Strobilurins, are now the second largest group of fungicides, widely used on cereals [23]. The strobilurin fungicides includes Azoxystrobin, Fluoxastrobin, Kresoxim-methyl, Metominostrobin, Picoxystrobin, Pyraclostrobin and Trifloxystrobin which act against electron transport chain in fungal mitochondrial synthesis in *cytochrome bc1*, are highly effective, and are suitable for a wide range of crops including rice [23].

In this view, present study was undertaken to appraise the field efficacy of pyraclostrobin 100 g/l CS (commercially available as Seltima 100 g/l CS), a strobilurin group of fungicide at different doses against blast disease of paddy under field conditions.

2. MATERIALS AND METHODS

A Field trial was conducted at the experimental fields of All India Co-ordinated Rice Improvement Programme, Agricultural Research Station, Gangavathi, Karnataka (5.4319° N, 76.5315° E) during two consecutive *Kharif* seasons of 2013 and 2014. A popular rice variety BPT5204 which is susceptible to blast disease was sown in the month of July and planted in August (in both

Kharif seasons). The healthy seeds were incubated in the gunny bags after soaking over night for sprouting before sowing in the nursery. The land was prepared by puddling method by applying one ploughing followed by two ploughing after one week. The experiment was laid out in a randomized complete block design (RCBD) with a plot size of 5 x 4 m each for every treatment. Seedlings of 30 days old were planted in trial plots at 20X10 cm spacing. All standard agronomic practices were followed except using higher nitrogenous (200 kg/ha) and lower pottasic (50 kg/ha) fertilizer dose than the normal dose (N_2:P_2O_5:K_2O::150:75:75).

The RCBD experiment comprises seven treatments with three replications each. The fungicide, pyraclostrobin 100 g/l CS (commercially available as Seltima 100 g/l CS) was tested at different doses (62.5-100 g a.i/h) along with Tricyclazole 75 WP (300 g/h), Carbendazim 50% WP (500g/h) and Isoprothiolane 40% EC (750 ml/h). Bio-efficacy was evaluated by spraying all the test chemicals thrice at 10 days interval starting from the initiation of the disease.

Observations were recorded for disease severity in each treatment after each spray as per the standard method. The disease was measured on leaves using the disease rating scale of 0-9 developed by International Rice Research Institute (IRRI. 1996) for leaf blast disease. Further, the scored data was converted into per cent disease index (PDI) using formula given below. The data on the yield were recorded by marking 3 x 2 m section within each plot using a wire frame as described by [24] and tillers within the frame were cut and harvested in order to determine the yield.

PDI = [(Sum of the scores x 100)/ (Number of Observation X Highest Number in Rating Scale)]

3. RESULTS AND DISCUSSION

Disease ratings based on 0-9 SES scale were converted into PDI values. PDI values from two *Kharif* seasons were pooled to get the average PDI (Table 1). The pooled data indicated that the test fungicide pyraclostrobin 100 g/l CS was found to be highly effective in reducing the leaf blast severity at its 75-100 g a.i/h compare to others treatments (Table 1). Although, remaining fungicides recorded higher PDI than the pyraclostrobin 100 g/l CS its 75-100 g a.i/h, but recorded significantly lower PDI compared the untreated control. At final observation (10 days after 3rd spray), lowest PDI (14.20) was recorded with pyraclostrobin 100 g/l CS @ 100 g/h dose which is statistically on par with same chemical at 75 g a.i./h.

In this experiment, the test chemical pyraclostrobin 100 g/l CS @ 75-100g a.i./h has reduced blast PDI significantly compare to the widely used fungicide 'Tricyclazole 75WP' @ 300 g/h (PDI 29.56) in India. This could be due to repeated use of tricyclazole 75 WP for blast disease management in the country from many years which may have lead to the development of resistant fungal population and hence, reduced the bio-efficacy under field condition. This observation is in agreement with the previous report where authors have recommended the rotation of different groups of fungicide for managing the development of fungicide resistance population [20].

Test chemical pyraclostrobin 100 g/l CS @ 62.5 g a.i./h recorded statistically on par PDI (27.37) as that of Tricyclazole 75 WP (300 g/h). Highest PDI was recorded in unsprayed control (47.24) followed by isoprothiolane 40% EC @ 750 ml/h (PDI 39.51). Effectiveness of strobilurin fungicides in reducing the blast disease compare to other fungicides has also been reported previously [25]. Various experimental reports confirmed that strobilurin compounds found to be effective in controlling other rice diseases like grain discoloration, sheath rot and brown spot, Sheath blight [10,26,27]. In a recent report it was evident that not only fungal diseases, viral disease like *Tobacco Mosaic Virus* infection is also restricted in tobacco plant pre-treated with pyraclostrobin [28]. Effect of Trifloxystrobin 25%+Tebuconazole 50% 75WG, a strobilurin derived combi product in controlling the leaf blast disease of paddy under field condition [29].

In the present study, significant increase in the grain yield was also observed in the plots treated with test chemical pyraclostrobin 100 g/l CS @ 75-100 g a.i./h (66.87-67.78 q/h) compare to the other fungicidal treatments which recorded the yield in the range of 53.05-60.65 q/h. The lowest yield was recorded in the unsprayed control plots (45.3 q/h) (Table 2). Our results are in conformity with previous reports that the fungicides application increases the yield of rice [10,11,23,29,30,31,32].

Table 1. Effect of pyraclostrobin 100 g/l CS (Seltima 100 g/l CS) on blast disease of rice

Sl. no.	Treatment	Dose a.i. (/ha)	Leaf blast PDI									
			Initial score	10 days after 1st spray			10 days after 2nd spray			Terminal score (10 days after 3rd spray)		
				2013	2014	Pooled mean	2013	2014	Pooled mean	2013	2014	Pooled mean
1	Pyraclostrobin 100 g/l CS	62.5 g	6.75 (15.06)	24.36 (29.55)	20.58 (26.97)	22.47 (28.30)	26.88 (31.20)	23.68 (29.15)	25.28 (30.19)	27.92 (31.88)	26.82 (31.20)	27.37 (31.56)
2	Pyraclostrobin 100 g/l CS	75 g	7.25 (15.64)	14.64 (22.48)	12.65 (20.84)	13.64 (21.64)	15.47 (23.15)	17.75 (24.91)	16.62 (24.06)	16.88 (24.25)	16.08 (23.60)	16.48 (23.95)
3	Pyraclostrobin 100 g/l CS	100 g	5.5 (13.56)	11.58 (19.85)	13.38 (21.44)	12.48 (20.66)	12.44 (20.66)	14.74 (22.58)	13.59 (21.64)	15.35 (22.98)	13.05 (21.13)	14.20 (22.14)
4	Tricyclazole 75% WP	225 g	6.25 (14.82)	24.85 (29.9)	20.15 (26.67)	22.55 (28.35)	24.98 (29.98)	26.77 (31.15)	25.88 (30.53)	29.88 (33.13)	29.24 (32.74)	29.56 (32.93)
5	Carbendazim 50% WP	250 g	7.32 (15.68)	29.64 (32.98)	26.84 (31.20)	28.24 (32.14)	35.54 (36.60)	31.24 (34.00)	33.29 (35.24)	38.47 (38.35)	36.07 (36.88)	37.27 (37.62)
6	Isoprothiolane 40% EC	300 ml	7.40 (15.79)	23.18 (28.77)	27.58 31.67)	25.38 (30.26)	36.45 (37.14)	34.05 (35.68)	35.25 (36.42)	40.56 (39.55)	38.46 (38.33)	39.51 (38.94)
7	Control	-	6.11 (14.30)	37.66 (37.84)	35.56 (36.60)	36.60 (37.23)	45.61 (42.48)	43.21 (41.09)	44.41 (41.78)	47.84 (43.78)	46.64 (43.08)	47.24 (43.35)
CD at 5% level			**NS**	**3.4**	**3.54**	**3.80**	**3.6**	**2.6**	**4.1**	**4.18**	**3.82**	**3.62**
Coefficient of variance			**--**	**10.46**	**11.9**	**12.83**	**14.55**	**13.8**	**11.54**	**10.35**	**15.65**	**13.56**

** Figures in the parentheses represent arcsine transformed values*

Table 2. Effect of pyraclostrobin 100 g/l CS (Seltima 100 g/l CS) on paddy grain yield

Sl. no.	Treatment	Dose a.i. (/ha)	Dose formulation (/ha)	Yield (q/h)		
				Kharif 2013	Kharif 2014	Pooled
1	Pyraclostrobin 100 g/l CS (Seltima 100 g/l CS)	62.5 g	625 ml	62.50	58.80	60.65
2	Pyraclostrobin 100 g/l CS (Seltima 100 g/l CS)	75 g	750 ml	70.20	65.35	67.78
3	Pyraclostrobin 100 g/l CS (Seltima 100 g/l CS)	100 g	1000 ml	69.50	64.23	66.87
4	Tricyclazole 75% WP	225 g	300 g	63.60	56.80	60.2
5	Carbendazim 50% WP	250 g	500 g	58.10	51.15	54.63
6	Isoprothiolane 40% EC	300 ml	750 ml	57.50	48.60	53.05
7	Control	-	-	49.25	41.35	45.3
CD at 5% level				**4.93**	**3.60**	**4.24**
Coefficient of variance				**10.52**	**11.35**	**11.1**

4. CONCLUSION

Present investigation provides the field efficacy of a strobilurin fungicide Pyraclostrobin 100 g/l CS @ 75-100 g a.i./h for managing the blast disease of paddy.

ACKNOWLEDGEMENTS

Authors are thankful to Director of Research, University of agricultural sciences, Raichur, Karnataka, India for providing necessary research facilities. Authors are also grateful to *M/s.* BASF India Ltd, Navi Mumbai, India for providing test fungicides and financial support.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Bonman JM, Estrada BA, Kim CK, Ra DS, Lee EJ. Assessment of blast disease and yield loss in susceptible and partially resistant rice cultivars in two irrigated low land environments. Plant Dis. 1991;75: 462-466.
2. Jia Y, Me Adams SA, Bryan GT, Hershay HP, Valent B. Direct interaction of resistance genes products confers rice blast resistance. Embo. J. 2000;19:4004-4014.
3. Chaudhary B, Karki BP, Lal KK. Neck blast resistant lines of radha-17 isolated. Int. Rice Res. Notes. 1994;19:11.
4. Teng PS, Klein-Gebbinck H, Pinnschmidt H. An analysis of the blast pathosystem to guide modeling and forecasting. In: Blast Modeling and Forecasting, IRRI, Manila, Philippines. 1991;1-30.
5. Chaudhary B. Effect of blast disease on rice yield. Nepal Agri. Res. J. 1999;3:8-13.
6. Koutroubas SD, Katsantonis D, Ntanos DA, Lupotto E. Blast disease influence on agronomic and quality traits of rice varieties under Mediterranean conditions. Turkish J. Agri. Forestry. 2009;33:487-494.
7. Venkata Rao G, Muralidharan K. Fungicides and control of leaf blast in dry nursery. Indian Phytopathology. 1983;36: 355.
8. Varie M, Maiti D, Shukla VD. Efficacy of combination of fungicide formulations on management of rice-blast (*Pyricularia oryzae*) in rainfed upland. Indian J. Agri. Sci. 1993;63:386-389.
9. Kandhari J, Gupta RL. Efficacy of fungicides and resistance inducing chemicals against sheath blight of rice. J. Mycological Res. 2003;41:67-69.
10. Bhuvaneswari V, Raju KS. Efficacy of new combination fungicide against rice sheath blight caused by *Rhizoctonia solani* (Kuhn). J. Rice Res. 2012;5(1&2).
11. Naik GR, Naik GB, Naik BT, Naik KR. Fungicidal management of leaf blast disease in rice. Global Journal Bio-Science & Biotechnology. 2012;1(1):18-21.
12. Kumar PMK, Sidde Gowda DK, Rishikant M, Kiran Kumar N, Pandurange Gowda, KT, Vishwanath K. Impact of fungicides on rice production in India. In: Fungicides – Showcases of Integrated Plant Disease Management from Around the World (Open Access Chapter). 2013;77-98.
13. Kumar PMK, Veerabhadraswamy AL. Appraise a combination of fungicides against blast and sheath blight diseases of paddy (*Oryza sativa* L.). J. Exper. Biol. Agricultural Sci. 2014;2:49-57.
14. Filippi MC, Prabhu AS. Integrated effect of host plant resistance and fungicidal seed treatment on rice blast control in Brazil. Plant Dise. 1997;81:351-355.
15. Varma AS, Menon MR. Fungicidal trial on the control of sheath blight of rice. Madras Agricultural J. 1977;64:416-417.
16. Araki F. Monocot (Flutolanil), a new systemic fungicide. Japan Pesticide Information. 1985;47:23-25.
17. Dash SC, Panda S. Chemical control of rice sheath blight disease. Indian Phytopathol. 1984;37:79-82.
18. Kannaiyan S, Prasad NN. Effect of foliar spray of certain fungicides on the control of sheath blight of rice. Madras Agricultural J. 1984;71:111-114.
19. Singh R, Sinha AP. Comparative efficacy of local bioagents, commercial bioformulation and fungicide for the management of sheath blight of rice under glass house conditions. Indian Phytopathol. 2004;57:494-496.
20. Tangdiabang J, Pakki S. Penyakit blast (*Pyricularia grisea*) dan strategi pengendaliannya pada tanaman padi. Pusat Penelitian Tanaman Pangan Departmen Pertanian. 2006;7:241-245.

21. Anke T, Oberwinkler F, Steglich W, Schramm G. The strobilurins, new antifungal antibiotics from the basidiomycete *Strobilurus tenacellus* (Pers. Ex Fr.) Sing. J. Antibiotics. 1977;30: 806-810.
22. Balba H. Review of strobilurin fungicide chemicals. J. Enviro. Sci. & Health, Part B: Pesticides, Food Contaminants, and Agricultural Wastes. 2007;42:441-451.
23. Bag MK, Yadav M, Mukherjee AK. Bioefficacy of strobilurin based fungicides against rice sheath blight disease. Transcriptomics. 2016;4:128.
24. Seebold KW, Datnof JLE, Correa –Victoria FJ, Kucharek TA, Suyder GH. Effects of silicon and fungicides on the control of leaf and neck blast in Upland rice. Plant Dis. 2004;88:253-258.
25. Debashis D, Supradip S, Prasad RD, Kumar BM. Effect of different active fungicides molecules on the management of rice blast disease. International Journal of Agriculture, Environment and Biotechnology. 2012;5:247-251.
26. Bag MK, Saha S. Fungitoxic effect of nativo 75 WG (trifloxystrobin 25%+tebuconazole 50%) on grain discoloration (GD) disease of rice in West Bengal. Pestol. 2009;33:47-49.
27. Biswas A, Bag MK. Strobilurins in management of sheath blight disease of rice: A review. Pestology. 2010;34:23-26.
28. Herms S, Seehaus K, Koehle H, Conrath U. A strobilurin fungicide enhances the resistance of tobacco against tobacco mosaic virus and pseudomonas syringae pv tabaci. Plant Physiology. 2002;130: 120-127.
29. Usman GM, Waqas W, Sahi ST, Saleemil-Yasin. Influence of various fungicides on the management of rice blast disease. Mycopathol. 2009;7:29-34.
30. Sood GK, Kapoor AS. Efficacy of new fungicides in the management of rice blast. Plant Disease Research. 1997;12: 140-142.
31. Tirmali AM, Latake SB, Bendr NJ. Evaluation of new fungicides for control of blast disease of rice. J. Maharashtra Agricultural University. 2001;26:197-198.
32. Prabhu AS, Filippi MC, Zimmermann FJP. Cultivar response to fungicide application in relation to rice blast control, productivity and sustainability. Pesq. Agropec. Bras. Brasilia. 2003;38:11-17.

Peer-review history:
The peer review history for this paper can be accessed here:
http://sciencedomain.org/review-history/15825