Efficacy of New Combination Fungicide against Rice Sheath Blight Caused by *Rhizoctonia solani* (Kuhn)

V. Bhuvaneswari* and S. Krishnam Raju

Department of Plant Pathology, Andhra Pradesh Rice Research Institute & Regional Agricultural Research Station, Maruteru – 534122, West Godavari district, Andhra Pradesh.

Abstract

A new combination fungicide having azoxystrobin 18.2% and difenoconazole 11.4% SC was tested against rice sheath blight disease under field conditions during *kharif* 2010-11 and 2011-12 seasons. The combination fungicide @ 1.25 ml/l and 1.0 ml/l was found effective against sheath blight recording least disease incidence of 9.36% and 16.43% respectively. Similarly, disease severity of 17.19% and 21.37% was recorded as against 72.09% and 78.21% in untreated check. Standard recommended fungicide, hexaconazole 5% EC was also effective showing disease incidence and severity of 23.09% and 31.06% respectively. Azoxystrobin 23 SC alone was also found effective which recorded sheath blight incidence and severity of 27.06% and 32.89%.

Key words: Azoxystrobin 18.2% + difenoconazole 11.4% SC, sheath blight, rice.

Sheath blight of rice caused by *Rhizoctonia solani* Kuhn is a serious threat in rice growing areas. A modest estimation of losses due to sheath blight disease alone in India has been up to 54.3% (Rajan, 1987; Roy, 1993). Sheath blight disease of rice occurs in all rice production areas worldwide (Ou, 1985; Teng *et al.* 1990; Savary *et al.* 2000, 2006). The disease is particularly important in intensive rice production systems (Savary and Mew, 1996). Yield losses of 5-10% have been estimated for tropical lowland rice in Asia (Savary *et al.* 2000). The pathogen has a wide host range and can infect plants belonging to more than 32 plant families and 188 genera (Gangopadyay and Chakrabarti 1982). Chemical control of the sheath blight disease is successfull at field level in majority of the cases (Kandhari *et al.* 2003). Fungicides with multiple effects on the pathogen like sclerotial germination, mycelial growth inhibition and reduction of the disease spread will be most ideal. Most of the fungicides like benomyl, carbendazim, chloroneb, captafol, mancozeb, zineb, edifenphos, iprobenphos, thiophanate, carboxin etc. have been found effective for the control of the disease under field conditions (Dash and Panda, 1984; Kannaiyan and Prasad, 1984; Singh and Sinha, 2004). Out of these benomyl, carbendazim, edifenphos and iprobenphos were the most effective chemicals (Roy, 1993). Several new molecules are available in the market and farmers are going for 3-4 sprays for the control of sheath blight under field conditions. Keeping in view, the present investigation was undertaken to assess the efficacy of two new and four commercially available fungicides at different doses against *R. solani* under field conditions.

*****Corresponding author: bhuvanavk2001@gmail.com

Materials and Methods

Field trials were conducted at Andhra Pradesh Rice Research Institute & Regional Agricultural Research Station, Maruteru during *Kharif* 2010 and 2011 seasons to evaluate the efficacy of a combination fungicide formulation having azoxystrobin 18.2% and difenoconazole 11.4% SC, azoxystrobin 23% SC, difenoconazole 25% EC, kitazin 48% EC and combination product iprodione 25%+ carbendazimm 25% WP. The trials were laid in a randomized block design with 10 treatments and four replications. Popular rice variety, Swarna (MTU-7029) which is highly susceptible to sheath blight disease was grown during *kharif* season of 2010 and 2011. A spacing of 15x15 cm was adopted in a gross plot size of 9.945 sq m. The combination fungicide formulation was evaluated at four different dosages (0.75 ml/l, 1.0 ml/l, 1.25 ml/l and 2.5 ml/l). Standard check fungicide that was proven to be effective against sheath blight disease *viz*., hexaconazole was also included. A check plot was also maintained. A pure culture of a virulent isolate of *Rhizoctonia solani* was multiplied on typha leaf bits (Bhaktavatsalam *et al.* 1978). Inoculation with *R. solani* was carried out at maximum tillering stage during both seasons. The

colonized typha bits were placed between the tillers of rice plant, 5-10 cm above the water level. The data on the disease incidence and subsequent spread were collected from the date of first incidence of the disease till 30 days after final spray. The per cent disease incidence and severity was calculated from the data collected from 25 hills in each replication in each treatment as per the standard evaluation system for rice (IRRI, 1996). The disease incidence and severity data were transformed into arc sine values before statistical analysis. The grain yield was recorded from each gross plot and expressed as kg/ha. The data was subjected to statistical scrutiny and the results are furnished.

The disease was first noticed in the experimental plots at maximum tillering stage during both seasons. Three fungicidal sprays were given with 15 days interval starting from the appearance of initial disease symptoms. A spray fluid of 500 l/ha was used to ensure thorough coverage of the plants. Symptoms of phytotoxicity, if any, were also recorded at 5 and 10 days after the imposition of the treatments.

Results and Discussion

The pooled data for both the years presented in Table 1 indicated that the test combination fungicide (azoxystrobin 18.2% + difenoconazole 11.4% SC) was found highly effective against rice sheath blight disease at all the four concentrations tested when compared to the untreated control, wherein the disease incidence and severity was at the maximum (72.09% and 78.21%). There was significant difference among the treatments with respect to sheath blight incidence. Lowest disease incidence was recorded with Azoxystrobin18.2% + difenoconazole 11.4% SC @ 1.25 ml (9.36%) followed by 1.0 ml/l (16.43%) and significantly different from the standard recommended fungicide, hexaconazole 5% EC @ 2.0 ml/l (23.09%). Azoxystrobin18.2% + difenoconazole 11.4% SC @ 2.5 ml/l (22.00%), difenoconazole 25% EC @ 0.5 ml/l (24.48%) and azoxystrobin 23% SC @ 1.0 ml/l (27.06%) were also recorded significantly lower sheath blight incidence when compared to untreated control where the disease incidence was 72.09%. Iprodione + carbendazin 50% WP and Kitazin 48% EC were also recorded significantly lower disease incidence which recorded 57.33% and 61.29% disease respectively.

With respect to sheath blight severity, all the four concentrations of test fungicide were significantly different from the untreated check in which the severity was 78.21 per cent. Lowest disease severity was recorded in the test fungicide, Azoxystrobin 18.2% + difenoconazole 11.4% SC when sprayed @ 1.25 ml (17.19%) closely followed by 1.0 ml (21.37%) and 2.5 ml/l (27.64%) of the test fungicide and are at par with the recommended fungicide (31.06%). Azoxystrobin 23% SC @ 1.0 ml/l, Azoxystrobin 18.2% + difenoconazole 11.4% SC @ 0.75 ml/l and Difenoconazole 25% EC @ 0.5 ml/l also gave significantly low disease severity of 32.89, 33.28 and 36.14 per cent, respectively. No phytotoxic symptoms were observed in any of the treatment plots throughout the study.

All the fungicidal treatments were significantly different from the check plot with respect to grain yield. Highest grain yield was obtained in azoxystrobin 18.2% + difenoconazole 11.4% SC @ 1.25 ml (6908kg/ha) followed by azoxystrobin 18.2% + difenoconazole 11.4% SC @ 2.5 ml (6537 kg/ha) and 1.0 ml/l (6534 kg/ha), respectively and at par with standard recommended fungicide hexaconazole @ 2.0 ml/l (6661kg/ha).

Although, biological control of sheath blight has received more attention recently, control strategies of this devastating disease on rice still has been centered around the use of chemicals. In the present studies new fungicide molecules have been used to contain sheath blight of rice. In the present studies, a new combination fungicide azoxystrobin 18.2% + difenoconazole 11.4% SC @ 1.25 and 1.0 ml/l was the most effective with the least disease incidence and severity of 9.36, 16.43 and 17.19, 21.37 per cent, respectively. The other test concentrations of azoxystrobin 18.2% + difenoconazole 11.4% SC also recorded significantly low disease over control. Efficacy of propiconazole + difenconazole 30 EC followed by contaf (hexaconazole) was found very effective by other workers in reducing the disease (Surulirajan and Khandari, 2003; Suryadai and Kadir, 1989). Singh and Sinha (2004) reported that contaf was effective for decreasing the disease severity, increasing the grain yield and 1000 grain weight as 23.5%, 60.9%, 34.2 g/plant and 29.3g respectively as against 74.7%, 95.6%, 24.4g/plant and 25.5 in control. Thangasamy and Rangaswamy (1989) studied the efficacy of carbendazim and mancozeb in the control of this

disease by applying them at different stages of crop growth like panicle initiation (65 days of sowing) or 80 days of sowing and found them effective in controlling the disease development. Earlier researchers have also reported the effectiveness of thiafluzamide and hexaconazole in suppressing the disease (Sunder *et al.* 2003). Krishnam Raju *et al.* (2008) reported the efficacy of hexaconazole 5 EC @ 2.0 ml/l, propiconazole 25 EC @ 1.0 ml/l and tebuconazole 25 EC @ 1.5 g/l against sheath blight of rice. Azoxystrobin belongs to group strobilurins or QoI fungicides which have a common mode of action to interfere with respiration and energy production in the fungal cell by blocking electron transfer at the site of quinol oxidation (the Qo site) in the cytochrome bc1 complex, thereby preventing ATP formation. Azoxystrobins move trans-laminarly and systemically through the vascular system of the plant. Some strobilurin fungicides show growth-promoting effects on treated plants, apparently by delaying leaf senescence and having water-conserving effects. Strobilurins are effective against most fungal diseases of most crops. The study revealed that Amistar Top 32.5 SC was found effective against sheath blight of rice when sprayed at effective concentration of 1.25 ml/l.

References

Bhaktavatsalam, G., Satyanarayana, K., Reddy, A.P.K. and John, V.T. 1978. Evaluation for sheath blight resistance in rice. *International Rice Research Newsletter* 3: 9-10.

Dash, S.C. and Panda, S. 1984. Chemical control of rice sheath blight disease. *Indian Phytopathology* 37: 79-82.

Gangopadyay, S. and Chakrabarti, N.K. 1982. Sheath blight on rice. *Review of Plant Pathololgy* 61: 451-460.

IRRI 1996. Standard Evaluation System for rice. INGER Genetic Resource Centre, 4th Edn. July, 1996.

Kandhari, J., Gupta, R.L. and Kandhari, J. 2003. Efficacy of fungicides and resistance inducing chemicals against sheath blight of rice. *Journal of Mycological Research* 41: 67-69.

Kannaiyan, S. and Prasad, N.N. 1984. Effect of foliar spray of certain fungicides on the control of sheath blight of rice. *Madras Agricultural Journal* 71: 111-114.

Krishnam Raju, S., Vijay Krishna Kumar, K. and Ramabhadra Raju, M. 2008. Efficacy of tebuconazole against *Rhizoctonia solani*, causal agent of rice sheath blight. *Indian Journal of Plant Protection* 36 (1): 98-101.

Ou, S.H. 1985. Rice Diseases, 2nd edn. Commonwealth Mycological Institute, Surrey.

Rajan, C.P.D. 1987. Estimation of yield losses due to sheath blight of rice. *Indian Phytopathology* 40: 174-177.

Roy, A.K. 1993. Sheath blight of rice in India. *Indian Phytopathology*. 46: 97-205.

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.

Savary, S., Willocquet, L., Elazegui, F.A., Castilla, N. and Teng, P.S. 2000. Rice pest constraints in tropical Asia: quantification and yield loss due to rice pests in a range of production situations. *Plant Disease* 84: 357-369.

Savary, S., Teng, P.S., Willocquet, L. and Nutter, F.W. Jr. 2006. Quantification and modeling of crop losses: a review of purposes. *Annual Review of Phytopathology* 44: 89-112.

Singh. Rajbir. and Sinha, A.P. 2004. Comparative efficacy of local bioagents, commercial bioformulation and fungicide for the management of sheath blight of rice under glass house conditions. *Indian Phytopathology*. 57: 494-496.

Sunder, S., Singh, R. and Dodan, D.S. 2003. Standardization of inoculation methods and management of sheath blight of rice. *Indian Journal of Plant Pathology* 21: 92-96.

Surulirajan, M. and Kandhari Janki. 2003. Screening of *Trichoderma viride* and fungicides against *Rhizoctonia solani*. *Annals of Plant Protection Science* 11: 382-384.

Suryadai, Y. and Kadir, T. S. 1989. Field evaluation of fungicides to control rice sheath blight. *International Rice Research Newsletter*.14: 35.

Teng, P. S., Torries, C. Q., Nuque, F. L. and Calvero, S.B. 1990. Current Knowledge on crop losses in tropical rice. In: IRRI (ed) Crop loss assessment in rice. International Rice Research Institute, Los Banos, pp 39-54.

Thangasamy, T.A. and Rangaswamy, M. 1989. Fungicides timings to control rice sheath blight (ShB). *International Rice Research Newsletter* 14: 24.

Table 1. Efficacy of Azoxystrobin 18.2% + Difenoconazole 11.4% SC in the management of rice sheath blight disease

Treatments	Dose/l	*Disease Incidence (%)			Disease Severity (%)			Yield (Kg/ha)		
		2010	2011	Pooled	2010	2011	Pooled	2010	2011	Pooled
Azoxystrobin 18.2% + difenoconazole 11.4% SC (Amistar top 32.5% SC)	0.75 ml	56.13 (48.70)	9.86 (18.14)	32.99 (34.89)	43.64 (41.31)	22.91 (28.48)	33.28 (35.09)	4480	7964	6222
Azoxystrobin 18.2% + difenoconazole 11.4% SC	1.0 ml	23.91 (28.86)	8.96 (17.33)	16.43 (23.71)	23.88 (28.55)	18.87 (25.41)	21.37 (27.30)	5036	8032	6534
Azoxystrobin 18.2% + difenoconazole 11.4% SC	1.25 ml	11.07 (19.36)	7.64 (15.00)	9.36 (17.55)	15.07 (22.79)	19.32 (25.38)	17.19 (24.20)	5764	8052	6908
Azoxystrobin 18.2% + difenoconazole 11.4% SC	2.5 ml	39.65 (38.85)	4.34 (11.94)	22.0 (27.71)	39.15 (38.54)	16.13 (23.58)	27.64 (31.45)	4852	8223	6537
Azoxystrobin 23% SC (Amistar 25% SC)	1.0 ml	44.56 (41.85)	9.56 (17.88)	27.06 (31.32)	44.46 (41.81)	21.32 (26.71)	32.89 (34.90)	4051	7986	6019
Difenoconazole 25% EC (Score 25% EC)	0.5 ml	28.62 (31.73)	20.35 (26.71)	24.48 (29.35)	29.67 (32.73)	42.61 (40.69)	36.14 (36.84)	4465	6742	5604
Kitazin 48% EC (Kitazin 48% EC)	2.0 ml	96.06 (82.03)	26.51 (30.95)	61.29 (51.54)	90.69 (72.74)	51.52 (45.87)	71.11 (57.50)	3705	6606	5156
Iprodione 25% + carbendazim 25% WP (Quintal)	1.0 g	86.50 (71.57)	28.16 (31.80)	57.33 (49.26)	85.16 (68.79)	45.81 (42.58)	65.49 (54.07)	3693	6481	5087
Hexaconazole 5% EC (Contaf 5% EC)	2.0 ml	28.97 (32.50)	17.21 (24.33)	23.09 (28.67)	39.02 (38.62)	23.10 (28.69)	31.06 (33.85)	6023	7298	6661
Control (Untreated)	--	98.25 (84.74)	45.93 (42.63)	72.09 (58.16)	92.71 (75.02)	63.72 (52.97)	78.21 (62.20)	3088	5505	4297
	CV	15.15	17.62	9.80	15.64	13.36	9.62	14.83	8.81	7.90
	SEm+/-	3.64	2.09	1.73	3.60	2.27	1.91	334.87	321.07	233.28
	CD(P=0.05)	10.55	6.05	5.01	10.46	6.60	5.54	971.79	931.73	676.98

*Mean of four replications. Figures in the parentheses are arc sine transformed values.