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Efficacy of azoxystrobin 25 SC against rice sheath blight and glume discoloration diseases of rice

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Abstract

Field experiments were conducted at Rice Research Station, Kerala Agricultural University, Moncompu during *Kharif* 2012, *Kharif* 2013 and *Rabi* 2013-14 to evaluate the fungicides against sheath blight and glume discoloration. The six fungicides evaluated were trifloxystrobin25%+tebuconazole 50% 75 WG (Nativo), kresoxim methyl (Ergon 44.3 SC), azoxystrobin 25 SC (Amistar), tricyclazole 75 WP (Beam), carbendazim 50 WP (Bavistin) and propiconazole 25 EC (Tilt). The pooled analysis of three seasons data showed that trifloxystrobin 25%+tebuconazole 50% 75 WG @ 0.4 g/l and azoxystrobin 25 SC @ 1 ml/l were found equally effective against the sheath blight and glume discoloration than other molecules. It was promoted as farm trials at 7 different farmers field during *Rabi* 2014-15, and proved that the azoxystrobin 25 SC @ 1 ml/l and trifloxystrobin 25%+tebuconazole 50% 75 WG @ 0.4 g/l restricted the incidence of sheath blight (18.12 and 21.52 %) and glume discoloration panicles (12.16 and 12.01 %) and spikelets (8.97 and 9.56%) than standard check fungicide carbendazim @ 1g/l (28.26, 12.69 and 9.76 %). Highest yield (6930 kg/ha) was recorded by the azoxystrobin 25 SC followed by trifloxystrobin 25%+tebuconazole 50% 75 WG (6732 Kg/ha) and standard check fungicide (6464 Kg/ha).

Key words: Rice, sheath blight, glume discoloration, fungicide

Introduction

Rice (*Oryza sativa L.*) is the most widely cultivated food crop in the world. It is the staple food grain for the people living in humid and sub-humid regions Asia. Ever growing population in India is further demanding more rice production and productivity. Under field condition, the productivity of rice is affected by many biotic and abiotic factors. Sheath blight of rice (*Rhizoctonia solani* – AGA1-IA) is an important location specific disease in Kuttanad region of Kerala causing 35 to 50 per cent yield loss. The weather and soil conditions such as high relative humidity, temperature and extremely acidic soil pH prevailing during *Rabi* season in Kuttanad region are conducive for the occurrence of sheath blight and glume discoloration diseases. Sheath blight is a destructive disease worldwide that causes significant yield loss and quality degradation (Savary *et al*., 2006). Grain discoloration is caused by complex of fungal species such as *Sarocladium oryzae, Bipolaris oryzae (Cochliobolus miyabeanus), Pyricularia grisea (Magnaporthe grisea) Curvularia lunata, Phoma sp., Microdochium sp., Nigrospora sp., and Fusarium sp.* It is an important constraint for lowland and upland rice production and becoming serious under changing climatic conditions. Of late, the disease was found to be very severe in all over the Kerala causing 5 to 10 per cent yield loss (Surendran *et al*., 2016). If most of the pathogens appear simultaneously, the total devastation of the rice crop may take place. Earlier, it was reported that the grain discoloration pathogens increased due to low soil amendments (Kaur and Padmanadhan, 1974; Datnoff *et al.,* 1991 and Dallagnol *et al.,* 2009). Use of suitable fungicide is the primary one for the effective management of the rice diseases. In the present study, considering the severity of diseases and its economic importance, the field experiments were conducted using different fungicides available in the market for the control of sheath blight and glume discoloration of rice.

Materials and Methods

Field experiments were conducted at Rice Research Station, Moncompu, Alappuzha during *Kharif* 2012, *Kharif* 2013 and *Rabi* 2013-14 under AICRIP programme for evaluating the fungicides against location specific

rice disease management *viz.,* sheath blight and glume discoloration. Three different fungicides *viz*., trifloxystrobin 25% + tebuconazole 50% (Nativo 75 WG) @ 0.4g/l, kresoxim methyl (Ergon 44.3 SC)@ 1.0 ml/l and azoxystrobin 25 SC(Amistar) @ 1ml/l with three standard fungicides were tested against sheath blight and glume discoloration. The standard check fungicides were tricyclazole 75 WP (Beam), carbendazim 50 WP (Bavistin) and propiconazole 25 EC (Tilt). The experiments were laid out in randomized block design with 4 replications in 5x2 m^2 plots using the locally popular susceptible variety, Uma (MO 16). The NPK fertilizers were applied as per the recommendations (90:45:45 kg/ha) of Kerala Agricultural University. The chemicals were applied as foliar spray at the time of appearance of the above diseases under natural conditions. Three sampling units of 1 m^2 area were fixed in each plot at random. A single spray was given at the time of panicle emergence. Observations on sheath blight disease severity were recorded just before the spray and 15-20 days after the spray. Degree of severity was graded based on height of the plant portions affected by the disease and expressed as percentage of the total area as per the SES scale of rice (IRRI, 2013). Glume discoloration was measured based on the percentage of panicles and spikelet's infection at 15 days before harvest. The per cent panicle infection was calculated based on the number of panicles affected from the total number of panicles present in the sampling area. The spikelet infection per cent was recorded by counting the infected grains from each panicle. Grain yield of the each plot was recorded and expressed in Kg/ha at 14 per cent moisture. Data on percentages were transformed and analysis of variance was performed with transformed values. Significance among mean treatments was determined according to Duncan's multiple range tests (Gomez and Gomez, 1984).

The confirmatory farm trials were conducted for testing the effective molecules during *Rabi* 2014-15 at seven locations *viz.*, Kavalam, E-block 24000 kayal, Venattukadu, Peringara, Nedumudy, Veeyapuram and Punnapra area of Kuttanad region. The four treatments were trifloxystrobin 25% + tebuconazole 50% 75 WG @ 0.4g/l, azoxystrobin 25 SC @ 1.0 ml/l, standard Kerala Agricultural University Package of Practice (KAU POP) recommended fungicide, carbendazim 50 WP @ 1.0 g/l and untreated check. The seven locations were considered as replication of the farm trial. The farm trial was laid out in a randomized complete block design (RBD), using MO 16 (Uma) as the test variety in the farmers field. Pregerminated seeds were used for direct sowing with the plot size of 20x10 m^2. Fertilizers were applied @ 90:45:45 NPK Kg/ha as per the KAU POP. The sheath blight severity was recorded at 15-20 days after spray. Grain discoloration observations on panicles and spikelets infection were recorded at 25-30 days after spray or 15 days before harvest. Percentage of panicles and spikelets affected was calculated on 25 plants per sampling unit, by counting the number of infected panicles/spikelets.

Results and Discussion

The results of station trial at Rice Research Station, Moncompu during KHARIF 2012 (Table 1) revealed that the plots treated with fungicide azoxystrobin 25 SC recorded lower sheath blight severity (15.17%). This was followed by tebuconazole 50% +trifloxystrobin 25% 75 WG (16.48%) and check fungicides, tricyclazole 75 WP (18.13 %) and propiconazole 25 EC (19.05%). The maximum yield was obtained from kresoxim methyl 44.3 SC (5820 Kg ha^{-1}) followed by azoxystrobin 25 SC (5780 Kg ha^{-1}) and trifloxystrobin 25%+tebuconazole 50% 75 WG (5630 Kg ha^{-1}). The control plot recorded lowest yield of 4660 Kg ha^{-1}.

During *Kharif* 2013, the systemic fungicide, azoxystrobin 25 SC was found superior in restricting sheath blight disease severity (17.28%) followed by tricyclazole 75WP (18.46%) and carbendazim 50 WP (19.10 %). The systemic standard check fungicide tricyclazole 75 WP was found most effective against sheath blight disease during *Rabi 2013-14* and followed by azoxystrobin 25 SC, carbendazim 50 WP and kresoxim methyl 44.3 SC. There were significant differences in the grain yield among the treatments. The pooled data of station trial results showed that the azoxystrobin 25 SC gave the maximum reduction in disease severity (19.10 %) followed by tricyclazole 75 WP (19.42 %), carbendazim 50 WP (20.11%), kresoxim methyl 44.3 SC (23.31 %) and tebuconazole +trifloxystrobin 75 WG (23.49) (Table 1).

Table 1: Influence of different fungicides on sheath blight disease severity

S. No.	Fungicides	Dose/ Liter water	Sheath blight Disease severity (%)			
			Kharif 2012	*Kharif 2013*	*Rabi 13-14*	Mean
1	Trifloxystrobin25%+Tebuconazole 50% 75 WG (Nativo)	0.4g	16.48 (23.89)	29.46 (32.83)	24.52 (29.67)	23.48 (28.79)
2	Kresoxim methyl (Ergon 44.3 SC)	1.0ml	19.44 (26.13)	29.01 (32.65)	21.47 (27.56)	23.30 (28.78)
3	Azoxystrobin 25 SC (Amistar)	1.0ml	15.17 (23.34)	24.50 (29.67)	17.63 (24.80)	19.10 (25.93)
4	Tricyclazole 75 WP (Beam)	0.6g	18.13 (25.33)	25.42 (30.26)	14.71 (22.54)	19.42 (26.04)
5	Carbendazim 50 WP (Bavistin)	1.0g	19.48 (26.13)	25.91 (30.59)	14.95 (22.71)	20.11 (26.47)
6	Propiconazole 25 EC (Tilt)	1.0ml	19.05 (26.21)	30.28 (33.34)	28.92 (32.52)	26.08 (30.69)
7	Control		22.32 (28.18)	45.11 (42.19)	31.76 (34.27)	33.06 (34.88)
	LSD (*P*= 0.05)		**NS**	**3.22**	**3.21**	
	CV (%)		**7.12**	**6.20**	**6.79**	

**Figures given in parentheses are arcsine transformed values*

The fungicide azoxystrobin 25 SC gave maximum yield of 5588 kg/ha and on par with standard fungicide propiconazole 25 EC(5598 kg/ha), kresoxim methyl 44.3 SC (5572 kg/ha), tricyclazole 75 WP (5510 kg/ha) and tebuconazole + trifloxystrobin 75 WG (5468 kg/ha) (Table 2 and Figure1). The present findings are in corroboration with several workers who also reported on the possibility of controlling sheath blight disease by application of fungicides like carbendazim (Bavistin), mancozeb (Dithane M-45) and validamycin A (Dev and Mary 1986).

Table 2: Influence of different fungicides on grain yield

S. No.	Fungicides	Dose/ Liter water	Grain Yield (Kg/ha)			
			Kharif 2012	*Kharif 2013*	*Rabi 13-14*	Mean
1	Trifloxystrobin 25% + tebuconazole 50% 75 WG (Nativo)	0.4g	5630	5461	5913	5668
2	Kresoxim methyl (Ergon 44.3 SC)	1.0ml	5820	5354	5543	5572
3	Azoxystrobin 25 SC (Amistar)	1.0ml	5780	5289	5695	5588
4	Tricyclazole 75 WP (Beam)	0.6g	5440	5655	5435	5510
5	Carbendazim 50 WP (Bavistin)	1.0g	4860	5311	5050	5074
6	Propiconazole 25 EC (Tilt)	1.0ml	5400	5999	5395	5598
7	Control		4660	3806	4445	4304
	LSD (*P*= 0.05)		**NS**	**884.77**	**610.7**	
	CV(%)		**10.57**	**11.30**	**7.67**	

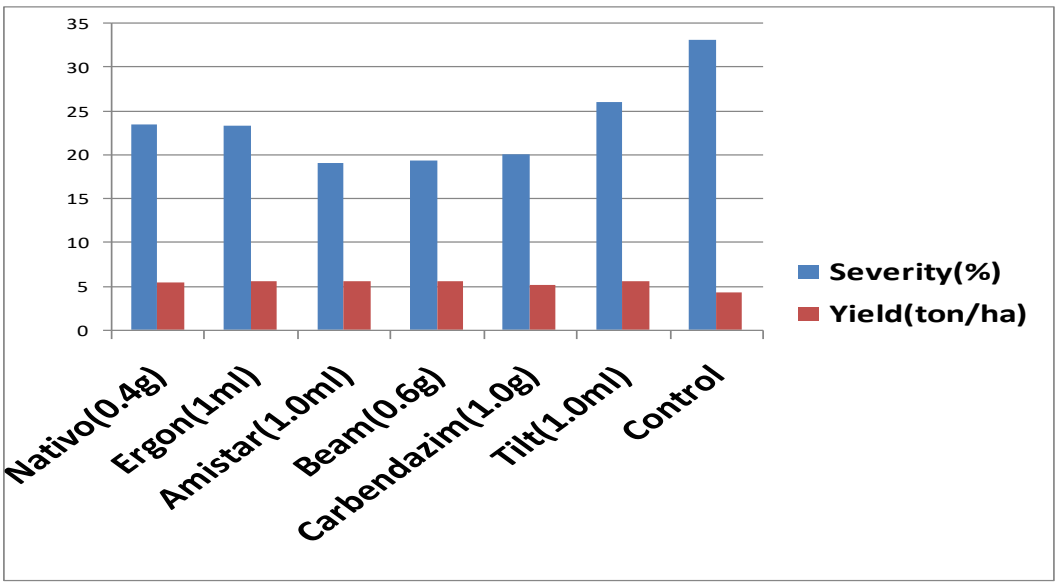

Figure 1: Effectiveness of different fungicides on sheath blight disease severity and grain yield

Grain discoloration

The data on grain discoloration, panicles and spikelets infection indicated that standard fungicide carbendazim 50 WP reduced disease effectively (1.96 and 1.01 %) when compared with fungicides *viz.*, azoxystrobin 25 SC (2.00 and 1.12 %), trifloxystrobin 25% + tebuconazole 50% 75 WG (2.22 and 1.15 %) and kresoxim methyl 44.3 SC (2.19 and 1.16 %) during *Kharif 2012*. During *Kharif 2013*, carbendazim @ 1g/l was found to be effective in limiting the glume discoloration and the maximum yield was obtained from carbendazim 50 WP treated plot (2645 kg ha^{-1}) followed by kresoxim methyl 44.3 SC (2623 kg ha^{-1}) and azoxystrobin 25 SC 2430 kg ha^{-1}. Out of six commercially available fungicides tested, the standard check fungicide carbendazim 50 WP was found superior against the glume discoloration followed by azoxystrobin 25 SC and trifloxystrobin 25%+tebuconazole 50% 75 WG during *Rabi* 2013-14. The highest yield was recorded in the trifloxystrobin 25%+ tebuconazole 50% 75 WG (5913 kg ha^{-1}) treated plot followed by azoxystrobin 25 SC(5695 kg ha^{-1}). The pooled data of three season station trials showed that the standard check fungicide carbendazim 50 WP was very effective in restricting glume discolored panicle and spikelets incidence followed by azoxystrobin 25 SC and trifloxystrobin 25%+tebuconazole 50% 75 WG. The analysis of pooled data on panicle percentage affected showed that carbendazim 50 WP (3.09 %) and azoxystrobin 25 SC (3.26 %) were found equally effective than other fungicides (Table 3).

Table 3: Influence of different fungicides on glume discoloration panicles

S. No.	Fungicides	Dose/ Liter water	Panicle affected (%)			
			Kharif 2012	*Kharif 2013*	*Rabi 13-14*	Mean
1	Trifloxystrobin 25% + tebuconazole 50% 75 WG (Nativo)	0.4g	2.22	5.14	6.07	4.47
2	Kresoxim methyl (Ergon 44.3 SC)	1.0ml	2.19	5.19	7.36	4.91
3	Azoxystrobin 25 SC (Amistar)	1.0ml	2.00	5.14	2.63	3.25
4	Tricyclazole 75 WP (Beam)	0.6g	2.37	5.24	5.60	4.40
5	Carbendazim 50 WP (Bavistin)	1.0g	1.96	4.95	2.37	3.09
6	Propiconazole 25 EC (Tilt)	1.0ml	2.19	5.13	5.45	4.25
7	Control		2.90	7.94	8.92	6.58
	LSD (*P*= 0.05)		**NS**	**0.34**	**0.04**	
	CV (%)		**16.52**	**9.78**	**1.23**	

**Figures given in parentheses are square root transformed values*

The data on spikelets affected indicated that carbendazim 50 WP (2.36 %), trifloxystrobin 25% + tebuconazole 50% 75 WG (2.43 %) and azoxystrobin 25 SC (2.44 %), were significantly superior to all other fungicides tried (Table 4).

Table 4: Influence of different fungicides on glume discoloration spikelets

S. No.	Fungicides	Dose/ Liter water	Spikelets affected (%)			
			Kharif 2012	*Kharif 2013*	*Rabi 13-14*	Mean
1	Trifloxystrobin25% + tebuconazole 50% 75 WG (Nativo)	0.4g	1.15	2.35	3.80	2.43
2	Kresoxim methyl (Ergon 44.3 SC)	1.0ml	1.16	2.41	4.26	2.61
3	Azoxystrobin 25 SC (Amistar)	1.0ml	1.12	2.23	3.98	2.44
4	Tricyclazole 75 WP (Beam)	0.6g	1.20	2.22	4.01	2.47
5	Carbendazim 50 WP (Bavistin)	1.0g	1.01	2.40	3.68	2.36
6	Propiconazole 25 EC (Tilt)	1.0ml	1.30	2.48	3.74	2.50
7	Control		1.82	2.48	4.66	2.98
	LSD (*P*= 0.05)		**0.07**	**NS**	**0.01**	
	CV (%)		**4.73**	**4.16**	**0.48**	

**Figures given in parentheses are square root transformed values*

Table 5: Influence of different fungicides on grain yield (Kg/ha)

S. No.	Fungicides	Dose/ Liter water	Grain Yield (Kg/ha)			
			Kharif 2012	*Kharif 2013*	*Rabi 13-14*	Mean
1	Trifloxystrobin25%+tebuconazole 50% 75 WG (Nativo)	0.4g	5890	1978	5913	4594
2	Kresoxim methyl (Ergon 44.3 SC)	1.0ml	4710	2623	5543	4292
3	Azoxystrobin 25 SC (Amistar)	1.0ml	5610	2430	5695	4578
4	Tricyclazole 75 WP (Beam)	0.6g	5570	1892	5435	4299
5	Carbendazim 50 WP (Bavistin)	1.0g	5810	2645	5050	4502
6	Propiconazole 25 EC (Tilt)	1.0ml	5050	2288	5395	4244
7	Control		4320	1657	4445	3474
	LSD (*P*= 0.05)		**942.47**	**594.78**	**262.05**	
	CV (%)		**12.02**	**18.07**	**15.17**	

The maximum yield was obtained from trifloxystrobin 25% + tebuconazole 50% 75 WG (4593 kg ha^{-1}) treated plot followed by azoxystrobin 25 SC (4578 kg ha^{-1}). The control plot recorded with lowest yield of 3474 kg ha^{-1}(Table 5 and Figure 2). Several workers have reported on the scope for controlling grain discoloration disease by application of fungicides like edifenphos and copper oxychloride (Govindarajan and Kannaiyan,1982), propiconazole (Lore *et al.*, 2007) and captan 70% + hexaconazole 5% (Kumar and Kumar, 2011).

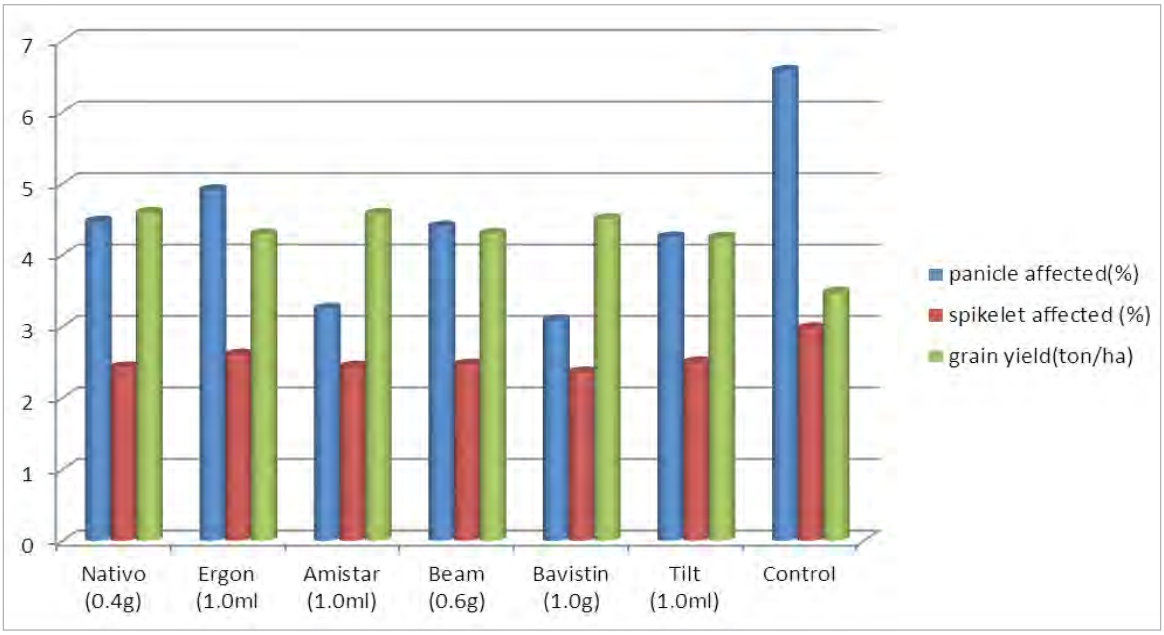

Figure 2: Effectiveness of fungicides on glume discoloration

Farmers field trials

The farm trial results showed that the azoxystrobin 25 SC @ 1 ml/l gave the minimum of sheath blight (18.12%), glume discoloration panicles (12.16%) and spikelets (8.97 %) incidence, followed by combination molecule of trifloxystrobin 25% + tebuconazole 50% 75 WG @ 0.4 g/lit (21.52, 12.01 and 9.56 %, respectively) (Table 6, 7 and 8). Similar results were reported by Surendran *et al*.**,** (2019) who reported that the application of trifloxystrobin 25% + tebuconazole 50% WG effectively controlled the sheath blight disease.

Table 6: Efficacy of trifloxystrobin 25 % + tebuconazole 50 % 75 WG and azoxystrobin 25 SC on sheath blight severity in rice

S. No.	Fungicides	Rate g/l	Locations							Mean (%)
			1	2	3	4	5	6	7	
1	Trifloxystrobin 25 % + tebuconazole 50 % 75 WG	0.4 g	24.35	18.24	19.55	17.66	18.15	24.95	27.76	21.52
2	Azoxystrobin 25 SC	1.0 ml	19.09	14.06	15.68	15.00	15.89	24.58	22.54	18.12
3	Carbendazim 50 WP	1.0 g	42.30	26.64	20.44	32.90	25.84	22.71	26.99	28.26
4	Control		29.40	28.39	36.03	32.58	33.02	35.24	31.24	32.27
	LSD (*P*= 0.05)		**5.34**							
	CV(%)		**10.28**							

**Figures given in parentheses are arcsine transformed values*

Table 7: Effect of trifloxystrobin 25% + tebuconazole 50 % 75 WG and azoxystrobin 25 SC on glume discoloration of panicles

S. No.	Fungicides	Rate g/l	Locations							Mean (%)
			1	2	3	4	5	6	7	
1	Trifloxystrobin 25 % +tebuconazole 50 % 75 WG	0.4g	13.18	11.97	7.49	13.31	14.06	11.97	12.11	12.01
2	Azoxystrobin 25 SC	1.0ml	10.63	12.11	11.24	13.31	16.64	9.97	11.24	12.16
3	Carbendazim 50 WP	1.0g	10.94	12.79	12.38	14.89	12.52	12.79	12.52	12.69
4	Control		13.44	15.68	15.23	14.77	14.06	14.42	14.65	14.61
	LSD (*P*= 0.05)		**1.75**							
	CV(%)		**6.35**							

**Figures given in parentheses are square root transformed values*

Table 8: Efficiency of trifloxystrobin 25 % + tebuconazole 50 % 75 WG and azoxystrobin 25 SC on glume discoloration of spikelets

S. No.	Fungicides	Rate g/l	Locations							Mean (%)
			1	2	3	4	5	6	7	
1	Trifloxystrobin 25 % +tebuconazole 50 % 75 WG	0.4g	7.92	9.97	9.80	9.80	9.80	9.80	9.80	9.56
2	Azoxystrobin 25 SC	1.0ml	7.49	9.46	9.10	9.10	8.91	9.28	9.46	8.97
3	Carbendazim 50 WP	1.0g	7.71	10.30	10.47	9.46	9.63	10.30	10.47	9.76
4	Control		8.13	11.24	11.24	11.39	11.97	11.54	11.54	11.01
	LSD (*P*= 0.05)		**0.43**							
	CV (%)		**1.84**							

**Figures given in parentheses are square root transformed values*

The grain yield data indicated that the highest yield (6930 kg/ha) was recorded by the treatment azoxystrobin 25 SC (Table 9) and on par with combination fungicide trifloxystrobin 25% + tebuconazole 50% 75 WG (6732 kg/ha) and standard check carbendazim 50 WP (6464 kg/ha). The lowest yield was recorded in the untreated control plot (3679 kg ha^{-1}). Surendran et al., (2016) proved that the contact and systemic action fungicide carbendazim 12 %+mancozeb 63 % was promising molecule against glume discoloration when compared with individual molecule. Hossain et al., (2011) reported that the systemic fungicides azoxystrobin and propiconazole were found to be effective against rice glume discoloration and increase the yield. The present study also proved the effectiveness of azoxystrobin 25 SC and trifloxystrobin 25%+tebuconazole 50% 75 WG were best molecules for the sheath blight and grain discoloration than other systemic fungicides.

Table 9: Influence of trifloxystrobin 25 %+tebuconazole 50 % 75 WG and azoxystrobin 25 SC on grain yield

S. No.	Fungicides	Rate g/l	Locations							Mean (%)
			1	2	3	4	5	6	7	
1	Trifloxystrobin 25 % +tebuconazole 50 % 75 WG	0.4g	7250	4000	5500	3500	8125	10000	8750	6732
2	Azoxystrobin 25 SC	1.0ml	8125	8250	7250	6125	6188	6325	6250	6930
3	Carbendazim 50 WP	1.0g	4750	8000	7250	8000	3000	6250	8000	6464
4	Control		4750	4000	3500	4000	3250	3250	3000	3679
	LSD @5% (*P*= 0.05)		**2053**							
	CV(%)		**30.72**							

Conclusion

Systemic fungicide azoxystrobin 25 SC @ 1 ml/l was found most effective against the sheath blight and glume discoloration and trifloxystrobin 25% + tebuconazole 50% 75 WG @ 0.4 g/l treatment was on par. The strobilurin fungicide azoxystrobin 25 SC @ 1 ml/l can be recommended for the management of sheath blight and grain discoloration and improve the quality of seeds in Kuttanad region.

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