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Integrated Management of Grain Discolouration Disease in Paddy

Y. S. Balgude and A. P. Gaikwad

Agricultural Research Station, Lonavala, Tal. Maval, Dist. Pune, Pin - 410 401 (MS), India
Email: apgaikwad@rediffmail.com, ars_lonawala@rediffmail.com

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Abstract

In a field experiment on integrated management of grain discolouration, three years pooled results revealed that the lowest seed discolouration (22.11 %) with highest per cent disease reduction (58.02) and highest grain yield (31.14 q/ha) with 126.66 per cent increase over control was recorded in the treatment combination of seed treatment (ST) with benomyl (0.3%) followed by *Pseudomonas fluorescens* (0.5%) + soil application of rice husk ash at sowing on raised beds (1 kg m^{-2}) and soil application of rice straw @ 2 tones ha^{-1} at transplanting with three sprays of propiconazole (0.10%) starting first spray at disease appearance, second at panicle emergence and third at grain filling stages. This was followed by ST + cultural practices with sprays of carbendazim (0.10%), bitertanol (0.25%) and tricyclazole (0.10 %) where 49.16, 55.49 and 47.89 per cent decrease in grain discolouration was noticed with 113.32, 99.47 and 88.12 per cent increase in grain yield, respectively.

Key words: IDM, paddy, grain discolouration

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. In Maharashtra the productivity of rice is low (1.8 t/ha) as compared to national average (2.41 t/ha) (Anonymous, 2014). Among the several diseases infecting rice, grain discoloration, caused by a 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. 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 all over Maharashtra causing 20 to 40 per cent yield loss. If most of the pathogens appear simultaneously, the total devastation of crop may take place. Control of the disease by use of fungicides only is not effective to manage the disease is not up to the expected level.

Earlier, It is reported that the grain discolouration pathogens due to increased resistance (Kaur and Padmanadhan, 1974; Datnoff *et al.*, 1991 and Dallagnol *et al*., 2009). Amendment of soils known to be low in plant-available silicon with calcium silicate slag was found beneficial. In addition, application of the plant growth promoting rhizobacterium *Pseudomonas fluorescens* asseedtreatment, broadcasting, and foliar spray was effective against six-important diseases (bacterial leaf blight, blast, brown spot, narrow brown spot, sheath blight and dirty panicle caused by *Xanthomonas oryzae* pv. *oryzae*, pathogens including *C. Pyriculariagrisea*, *Helminthosporium oryzae*, *Cercospora oryzae*, *Rhizoctonia solani*; and complex *oryzae*, *Curvularia lunata*, *Helminthosporium oryzae*, *Fusarium semitectum*, *Alternaria padwickii*, and *Sarocladium oryzae* respectively) and increased yield with 52.1 per cent in rice (Prathuangwong *et al.,* 2012).

Hence, looking to the severity of disease, its economic importance and need of the rice growers, it was very necessary to manage this disease by integration of all available disease management practices. Therefore, the field trials were conducted by integration of cultural, biological and chemical methods for management of grain discolouration of rice.

Materials and Methods

A field experiment was conducted at Agricultural Research Station, Lonavala, Pune (MS) during three consecutive *kharif* seasons (2009-12). The experimental design was a split-plot with three replications. Main plot treatments consisted of seed treatment (ST) with benomyl (0.3%) followed by *Pseudomonas fluorescens* (0.5%) + cultural practices (CP) *viz*., soil application of rice husk ash (RHA) at sowing on raised beds (1 kg m^{-2}) + soil application of rice straw (RS) @ 2 tones ha^{-1} at transplanting. The subplot treatments included application of eight fungicides *viz.*,carbendazim (0.1%), propiconazole (0.1%), bitertanol (0.25%), tricyclazole (0.1%), iprobenphos (0.25%), Kasugamycin (0.25%), alternate sprays with mancozeb (0.25%) followed by benomyl (0.1%) and copper oxychloride (0.25%) including absolute control.

Subplots (3.0 × 1.95 m) of each of the treatment consisted

of 13 rows of 3.0 m long at 0.20 m distance with 0.15m plant to plant spacing. The fungicide and bioagent treated seeds of EK 70, a highly susceptible variety of rice, were sown on the raised beds mixed with the rice husk ash during the last week of June while, the transplanting of seedlings was carried out in the last week of July. The rice straw was added before transplanting in the puddled field. The crop was fertilized with 50N:50P:50K as basal dose and top dressed with 50 N one month after transplanting. The first spray of fungicides was taken immediately after appearance any pathogen (*i.e. Pyricularia grisea*) responsible for grain discolouration disease. While, the second and third sprays were taken at panicle emergence and grain filling (milk) stages, respectively. The observations for incidence of grain discolouration were recorded as per SES scale (Anonymous, 2002) and for grain yield (kg/net plot) at maturity stage.

Results and discussion

Grain discolouration. The pooled data recorded during the years 2009, 2010 and 2011 (Table 1) indicated that the differences due to main, sub-plot and interaction effects were statistically significant except interactions during the individual years. The ST + CP had recoded significantly lowest incidence of grain discolouration (30.39 %) with 42.30 per cent disease control as compared to no ST and CP where, the incidence was 40.88 per cent. Lawrence *et al.*(2001) reported that silicon was effective against several important diseases of rice including grain discoloration and thus suggested that silicon could be employed in integrated disease management systems for reducing fungicide use and enhancing host plant resistance for the control of important rice diseases.

Table 1: Influence of seed treatment, cultural practices and fungicides on management of grain discolouration of paddy (Three years pooled results)

Sr. No.	Fungicides	Conc. (%)	Per cent seed discolouration*			Reduction over control (%)		
			M1	M2	Mean	M1	M2	Mean
1	**Carbendazim**	0.1	26.78	37.44	32.11	49.16	28.91	39.03
			30.43	**36.86**	**33.65**			
2	**Propiconazole**	0.1	22.11	31.00	26.56	58.02	41.14	49.58
			27.80	**33.40**	**30.60**			
3	**Bitertanol**	0.25	23.44	34.00	28.72	55.49	35.45	45.47
			28.85	**35.28**	**32.07**			
4	**Tricyclazole**	0.1	27.44	39.44	33.44	47.89	25.11	36.50
			31.12	**37.70**	**34.41**			
5	**Iprobenphos**	0.25	36.56	46.00	41.28	30.60	12.66	21.63
			36.48	**41.93**	**39.21**			
6	**Kasugamycin**	0.25	30.78	41.00	35.89	41.56	22.16	31.86
			33.15	**38.63**	**35.89**			
7	**Alternate sprays**	-	34.22	45.44	39.83	35.03	13.72	24.37
			35.45	**41.39**	**38.42**			
8	**Control**	-	41.78	52.67	47.22	20.68	0.01	10.34
			39.52	**45.59**	**42.56**			
	Mean		30.39	40.88		42.30	22.39	
			33.20	**39.64**				

Source S.E. ±	S. D. Incidence	C.D. (5%)
Main plots	0.37	2.24
Sub plots	0.53	1.07
Main X Sub plots	0.76	1.51

Note: *The figures in the bold faces are arcsine values,

M1: Seed treatment and cultural practices,
M2: No seed treatment and cultural practices

Fungicide propiconazole 25 EC (0.1%) recorded significantly lower incidence (26.56 %) and thereby

highest grain discolouration reduction of 49.58 per cent. The next fungicides in order of efficacy were bitertanol (0.25%) and carbendazim (0.10%) those showed 28.72 and 32.11 per cent disease incidence with 45.47 and 39.03 per cent reduction over control, respectively. Sumangala *et al.* (2008) also noticed effectiveness of propiconazole against grain discoloration (*Curvularia lunata*) of rice.

Seed discolouration was lowest (22.11 %) with highest disease reduction of 58.02 per cent over control in the treatment combination of ST + CP with sprays of propiconazole (0.10%). This was followed by ST + CP with sprays of bitertanol (0.25%), carbendazim (0.10%) and tricyclazole (0.10 %) where 55.49, 49.16 and 47.89 per cent decrease in grain discolouration was noticed, respectively. These results are in agreement with the observations of Raja and Saravanan (1993) who developed an integrated diseases management module in paddy consisting of seed treatment with carbendazim (2 g/kg) and *Pseudomonas fluorescens* (10g/kg seed) and sprays with fungicide carbendazim (0.05%) or tricyclazole (0.8%).

Grain yield. Three years pooled observations presented in Table 2 illustrate that ST + CP yielded significantly higher grain yield (25.29 q/ha) with 84.05 per cent enhancement as compared to without ST + CP (21.48 q/ha). Similarly, significantly higher grain yield (29.15 q/ha) with 112.13 per cent increase was noticed in sprays with propiconazole (0.1%). It was followed by carbendazim (0.1%) and bitertanol (0.25%) those had 27.35 and 25.40 q grain yields/ha thus, 99.08 and 84.88 per cent increase in yield over control, respectively. The treatment combination of ST + CP with sprays of propiconazole (0.10%) yielded significantly highest grain yield (31.14 q/ha) thereby, substantial increase in the yield (126.66 %) over control. However, it was at par with seed ST + CP with sprays of carbendazim (0.10%) wherein, 29.31 q grain yield/ha was obtained with 113.32 per cent increase in grain yield. This was followed by ST + CP with sprays of bitertanol (0.25%) that yielded 27.41 q grain yield/ha enhancing it by 99.47 per cent.

Table 2: Influence of integrated management of grain discolouration disease on grain yield of paddy (Three years pooled results)

Sr. No.	Fungicides	Conc. (%)	Grain Yield (Q/ha)			Increase over control (%)		
			M1	M2	Mean	M1	M2	Mean
1	**Carbendazim**	0.1	29.31	25.40	27.35	113.32	84.84	99.08
2	**Propiconazole**	0.1	31.14	27.15	29.15	126.66	97.60	112.13
3	**Bitertanol**	0.25	27.41	23.40	25.40	99.47	70.28	84.88
4	**Tricyclazole**	0.1	25.85	22.25	24.05	88.12	61.94	75.03
5	**Iprobenphos**	0.25	22.39	19.00	20.69	62.95	38.26	50.60
6	**Kasugamycin**	0.25	24.43	21.18	22.80	77.78	54.15	65.96
7	**Alternate sprays**	-	23.06	19.75	21.40	67.81	43.71	55.76
8	**Control**	-	18.72	13.74	16.23	36.28	0.00	18.14
	Mean		25.288	21.481		84.049	56.346	
	Source		**S.E. ±**	**C.D. (5%)**				
	Main plots		0.24	1.44				
	Sub plots		0.35	1.02				
	Main X Sub plots		0.5	1.45				

Note: The figures in the bold faces are arcsine values,
M1: Seed treatment and cultural practices,
M2: No seed treatment and cultural practices

Conclusion

The seed treatment with benomyl (0.3%) and *Pseudomonas fluorescens* (0.5%) to rice seeds along with soil application of rice husk ash (RHA) at sowing on raised beds @ 1 kg m^{-2}+ soil application of rice straw (RS) @ 2 tones ha^{-1} at transplanting followed by three sprays of propiconazole (0.1%) or carbendazim (0.1 %) at 15 days interval starting first spray at disease appearance, second at panicle emergence and third at grain filling stages are recommended as an integrated disease management (IDM) module for effective management of grain discolouration disease and increasing the grain yield of paddy.

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