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Management of major diseases of rice using Biogem—a biocontrol agent

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A field trial was conducted at Instructional Farm, BCKV, Kalyani to study the efficacy of Biogem 5% WP (*Pyriformospora indica*)—a biocontrol agent against Blast, Sheath blight and Sheath rot in rice under field condition. Biogem was applied as seed dressing @ 10 g, 5 g and 3 g/kg of seed, soil treatment @ 1.5 kg, 2.5 kg and 3.5 kg/ha 30 days after sowing and in combination of seed treatment and soil treatment. For standard chemical check, Carbendazim was applied as seed treatment @ 2 g/kg of seed and as spraying @ 0.1% 45 days after sowing. The per cent disease index of Blast, Sheath blight and Sheath rot diseases were recorded 30,40,50,60 and 70 days after sowing, 40,55,70 and 85 days after sowing and 45,60 and 75 days after sowing respectively depending upon the onset of disease and yield in ton/ha was recorded after harvesting of the crop. Cost: benefit ratio was also recorded. The results revealed that lowest, Sheath blight and sheath rot in paddy were recorded in treatment where seed treatment with Biogem @ 5 g.kg of seed + soil treatment with Biogem @ 2.5 kg/ha were made which was found comparable with standard chemical check with Carbendazim. Highest yield was also recorded in above treatment. Highest cost: benefit was recorded in treatment where seed treatment with BIOGEM 5% @ 10 g/kg of seed was made.

Key words: Biogem, biocontrol agent, blast, sheath blight, sheath rot, rice

INTRODUCTION

Rice is suffering from number of fungal, bacterial, viral and mycoplasmal diseases. Among them the fungal diseases like blast (*Pyricularia oryzae*), brown spot (*Bipolaris oryzae*), stem rot (*Sclerotium oryzae*), sheath blight (*Rhizoctonia solani*), sheath rot (*Sarocladium oryzae*), bacterial diseases such as bacterial blight (*Xanthomonas oryzae* pv. *oryzae*) and viral diseases such as tungro (rice tungro virus) are most important. Losses due to rice diseases have been estimated to be 10-15% in general (Kandhari, 2005). Individual diseases in certain cases have been reported to cause tremendous losses, even up to 100% (Chakraborty *et al.,* 1998). Rice disease management strategies mainly aim at prevention of outbreak or epidemics through the use of host plant resistance and chemical pesticides. The persistent, injudicious use of chemicals has toxic effects on non-target organisms and can cause undesirable changes in the environment. Most of these chemicals are to expensive for the resource poor farmers of West Bengal whose main cultivable crop is rice, Large scale and long term use of resistant cultivars is likely to result in significant shifts in the virulence characteristics of pathogen, culminating in resistant break down. However, researches during the previous two decades indicate another potential option for rice disease management through the use of biocontrol agents. Several biocontrol agents namely, *Pseudomonas fluroscence, Bacillus subtilis, Trichoderma* spp, have been found effective against major rice diseases caused by fungal pathogens. (*Vasudevan et al.,* 2002). The present investigation has been undertaken to study the effect of BIOGEM 5% (*Pyriformospora indica*) – a new biocontrol agent against sheath blight, blast and sheath rot in rice under field condition.

MATERIALS AND METHODS

The trial was conducted at Instructional Farm, BCKV. All standard and recommended packages of agronomy practices such as tillage, spacing, spacing, manuring, irrigation and insect control for cultivation of the crop was followed. Variety Swarna was used in this experiment. Seed treatment with Biogem was made at the rate of 10 g, 5 g and 3 g per kg of seed and seed treatment with carbendazim was made @ 2 g per kg of seed. Soil treatment with Biogem was made @ 1.5 kg, 2.5 kg and 3.5 kg/has 30 days after sowing. Spraying with carbendazim was made @ 0.1% 45 days after sowing. The data on the severity of diseases were recorded on 30, 40, 50, 60 and 70 days after sowing in case of blast, 40, 55, 70 and 85 days after sowing in case of sheath blight and 30, 45, 60 and 75 days after sowing in case of sheath rot. Five plants were randomly selected from each plot and the leaves were graded on a 0-9 scale where 0 = no symptoms; 1= one per cent or less area affected; 3= 1-10% leaf area affected; 5= 11-20% leaf area affected; 7= 21-50% leaf area affected; 9= above 50% leaf area affected and Per cent Disease Index (PDI) was calculated using the following formula : PDI = Sum of all numerical ratings/Total plants (leaves) observed × Maximum ratings scale × 100.

The per cent disease index was transformed by angular transformation and analyzed statistically. The yield data and germination percentage after treatment before sowing were also analyzed statistically.

RESULTS AND DISCUSSION

Percentage of germination of seeds

Percntage of germination of seeds of rice were recorded maximum up to 81.33 per cent in seeds treated with BIOGEM 5% (W.P.) @ 5 gms/kg followed by control treatment as 81.00% and lowest germination of 79.67% in treatment where spraying with carbendazim @ 0.1% were made. However, no significant differences were observed between treatments as mentioned in Table 1.

Sheath blight disease of rice

The per cent disease index of the disease in different dates of observations (40,55,70 and 85 days after sowing) have been presented in Table 2. It was found that seed treatment with BIOGEM (W.P) @ 5 g/kg of seeds (T_2) + soil treatment with BIOGEM (W.P.) @ 2.5 kg/ha (T_5) recorded lowest disease

Table 1: Evaluation of the effecacy of BIOGEM 5% against Sheath blight, Blast and Sheath rot of rice during 2008

	Treatments	Percentage of germination[1]	Yield in ton/ha[1]	Cost : Benefit ratio
T_1	BIOGEM (W.P) Seed Treatment @ 10 g/kg of seeds	80.67	4.11	1 : 5.17
T_2	BIOGEM (W.P) Seed Treatment @ 5 g/kg of seeds	81.33	2.37	1 : 1.09
T_3	BIOGEM (W.P) Seed Treatment @ 3 g/kg of seeds	80.67	2.22	1 : 0.71
T_4	BIOGEM (W.P) Soil Treatment @ 1.5 kg/ha	80.67	2.48	1 : 0.44
T_5	BIOGEM (W.P) Soil Treatment @ 2.5 kg/ha	80.00	2.67	1 : 0.51
T_6	BIOGEM (W.P) Soil Treatment @ 3.5 kg/ha	80.67	2.59	1 : 0.38
T_7	Seed treatment with carbendazim @ 2 g/kg of seeds	79.67	2.52	1 : 1.37
T_8	BIOGEM (W.P) Seed Treatment @ 5 g/kg of seeds (T_2) + BIOGEM (W.P) Soil Treatment @ 2.5 kg/ha (T_5)	80.67	4.14	1 : 1.52
T_9	Spray with carbendazim @ 0.1%	78.67	2.92	1 : 0.70
T_{10}	Control	81.00	1.97	
SEm		1.55	0.235	
CD (p=0.05)		NS	0.69	
CV%		5.79	25.18	

[1]Average of three replications

Table 2: Evaluation of the efficacy of BIOGEM 5% against Sheath blight, Blast and Sheath rot of rice during 2008.

	Treatments	Sheath blight					
		Per cent disease Index					
		40 days after sowing	55 days after sowing	70 day after sowing	85 days after sowing	Mean	Per cent Disease Control
T_1	BIOGEM (W.P) Seed Treatment @ 10 g/kg of seeds	4.33[1] (10.76)*	1.66 (7.33)	1.66 (7.15)	0.50 (3.26)	2.04 (7.12)	(48.70)
T_2	BIOGEM (W.P) Seed Treatment @ 5 g/kg of seeds	5.00 (12.11)	7.00 (14.22)	2.33 (8.56)	0.66 (3.82)	3.75 (9.68)	(30.26)
T_3	BIOGEM (W.P) Seed Treatment @ 3 g/kg seeds	5.66 (12.78)	7.33 (14.23)	4.66 (11.38)	1.00 (5.74)	4.66 (11.03)	(20.53)
T_4	BIOGEM (W.P) Soil Treatment @ 1.5 kg/ha	4.00 (9.97)	5.66 (12.78)	1.66 (7.15)	2.33 (8.56)	3.41 (9.61)	(30.76)
T_5	BIOGEM (W.P) Soil Treatment @ 2.5 kg/ha	2.66 (8.55)	4.00 (9.97)	1.66 (7.15)	2.00 (6.64)	2.58 (8.08)	(41.79)
T_6	BIOGEM (W.P) Soil Treatment @ 3.5 kg/ha	1.66 (7.15)	2.66 (8.55)	1.00 (5.74)	0.66 (3.82)	1.49 (6.31)	(54.54)
T_7	Seed treatment with carbendazim @ 2 g/kg of seeds	5.66 (11.42)	5.66 (12.78)	2.33 (8.56)	1.66 97.15)	3.83 (9.98)	(28.09)
T_8	BIOGEM (W.P) Seed Treatment @ 5 g/kg of seeds (T_2) + BIOGEM (W.P) Soil Treatment @ 2.5 kg/ha (T_5)	1.00 (5.74)	1.00 (5.74)	0.66 (3.82)	0.33 (1.91)	0.75 (4.30)	(69.02)
T_9	Spray with carbendazim @ 0.1%	5.66 (12.78)	7.00 (14.20)	3.33 (6.14)	0.66 (3.82)	4.16 (9.23)	(33.50)
T_{10}	Control	8.66 (15.65)	12.00 (19.92)	4.00 (9.97)	7.00 (9.97)	7.91 (13.88)	
SEm		(3.613)	(3.328)	(2.761)	(1.98)		
CD (p=0.05)		(NS)	(NS)	(NS)	(NS)		
CV%		(58.54)	(48.15)	(63.27)	(62.71)		

[1]Average of three replications
* Figures in parentheses are the angular transformed values

and caused maximum control of disease over control. The highest sheath blight was recoded in control treatment although the treatment differences were not significant in all the dates of observations.

Blast disease of rice

The per cent disease index was recorded in five different dates of observations (30 40, 50, 60 and 70 days after sowing) revealed that lowest disease was recorded in treatment T_8 where seed treatment with BIOGEM (W.P) @ 5 g/kg of seeds (T_2) + soil treatment with BIOGEM (W.P.) @ 2.5 kg/ha (T_5) were made in all the dates of observations and it was statistically at par with all the treatments except in treatments T_4 (soil treatment with BIOGEM (W.P.) @ 1.5 kg/ha). T_5 (soil treatment with BIOGEM (W.P.) @ 2.5 kg/ha) and control treatment at 30 days after sowing, in treatments T_3 (seed treatment with BIOGEM @ 3 g/kg of seeds) and control treatment at 40 days after sowing in treatments T_4 (soil treatment with BIOGEM (W.P.) @ 1.5 kg/ha), T_5 (soil treatment with BIOGEM (W.P.) @ 2.5 kg/ha). T_6 (soil treatment with BIOGEM (W.P) @ 3.5 kg/ha), T_7 (seed treatment with carbendazim @ 2 g/kg of seeds) and control treatment at 50 days after sowing, in treatments T_3 (seed treatment with BIOGEM @ 3 g/kg of seeds), T_4 (soil treatment with BIOGEM (W.P.) @ 1.5 kg/ha), T_5 (soil treatment with BIOGEM (W.P.) @ 2.5 kg/ha), T_7 (seed treatment with carbendazim @ 2 g/kg of seeds) and control

Table 3: Evaluation of the efficacy of BIOGEM 5% against Sheath blight, Blast and Sheath rot of rice during 2008.

	Treatments	Blast						
		Per cent disease Index						
		30 days after sowing	40 days after sowing	50 day after sowing	60 days after sowing	70 days after sowing	Mean	Per cent Disease Control
T_1	BIOGEM (W.P) Seed Treatment @ 10 g/kg of seeds	3.48[1] (9.42)*	6.93 (14.52)	1.16 (6.17)	1.00 (4.62)	0.33 (1.91)	2.58 (7.33)	(61.96)
T_2	BIOGEM (W.P) Seed Treatment @ 5 g/kg of seeds	3.66 (9.24)	10.16 (18.59)	3.00 (9.72)	4.00 (10.71)	0.66 (3.82)	4.29 (10.42)	(45.92)
T_3	BIOGEM (W.P) Seed Treatment @ 3 g/kg seeds	6.00 (12.81)	12.50 (20.64)	0.83 (5.17)	5.50 (12.22)	1.00 (4.62)	5.17 (11.09)	(42.45)
T_4	BIOGEM (W.P) Soil Treatment @ 1.5 kg/ha	12.83 (20.77)	10.00 (18.37)	7.00 (14.48)	6.00 (13.58)	3.33 (9.96)	7.83 (15.43)	(19.92)
T_5	BIOGEM (W.P) Soil Treatment @ 2.5 kg/ha	12.50 (20.52)	8.00 (14.98)	6.66 (14.3)	4.33 (11.51)	1.66 (7.33)	6.63 (13.73)	(28.75)
T_6	BIOGEM (W.P) Soil Treatment @ 3.5 kg/ha	4.16 (11.14)	2.66 (8.55)	4.66 (12.16)	0.83 (5.17)	1.00 (5.74)	2.66 (8.55)	(55.63)
T_7	Seed treatment with carbendazim @ 2 g/kg of seeds	1.10 (5.96)	1.60 (6.94)	7.00 (14.94)	5.33 (13.10)	1.66 (7.15)	3.34 (9.62)	(50.08)
T_8	BIOGEM (W.P) Seed Treatment @ 5 g/kg of seeds (T_2) + BIOGEM (W.P) Soil Treatment @ 2.5 kg/ha (T_5)	0.81 (5.15)	1.93 (8.05)	0.85 (5.17)	0.40 (4.62)	0.66 (3.82)	0.93 (5.36)	(72.18)
T_9	Spray with carbendazim @ 0.1%	3.28 (9.75)	7.00 (14.20)	1.60 (10.71)	1.50 (6.77)	1.33 (6.53)	2.94 (9.59)	(50.23)
T_{10}	Control	6.50 (13.69)	26.66 (30.00)	14.33 (22.10)	7.66 (15.61)	6.66 (14.93)	12.36 (19.27)	
SEm		(3.164)	(3.480)	(1.90)	(2.307)	(1.707)		
CD (p=0.05)		(9.399)	(10.34)	(5.644)	(6.853)	(5.071)		
CV%		(46.25)	(38.94)	(28.64)	(40.81)	(44.95)		

[1]Average of three replications

* Figures in parentheses are the angular transformed values

treatment at 60 days after sowing and in treatments T_4 (soil treatment with BIOGEM (W.P.) @ 1.5 kg/ha), T_5 (soil treatment with BIOGEM (W.P) @ 2.5 kg/ha), T_6 (soil treatment with BIOGEM (W.P) @ 3.5 kg/ha), T_7 (seed treatment with carbendazim @ 2 g/kg of seeds) and control treatment at 70 days after sowing. Highest disease was recorded in control treatment (Table 3).

Sheath rot of rice

The results (Table 4) recorded in three different dates of observations (45, 60 and 75 days after sowing) showed that no disease was recorded in treatments T_1 (seed treatment with BIOGEM (W.P) @ 10 g/kg seed), T_2 (seed treatment with BIOGEM (W.P) @ 5 g/kg of seed), T_4 (soil treatment with BIOGEM (W.P) @ 1.5 kg/ha), T_7 (seed treatment with carbendazim @ 2 g/kg of seeds), T_8 (seed treatment with BIOGEM (W.P) @ 5 g/kg of seed + soil treatment with BIOGEM (W.P) @ 2.5 kg/ha) and T_9 (spraying with carbendazim @ 0.1%) at 45 days after sowing and highest disease was recorded in control treatment. At 60 days after sowing no disease was recorded in treatments T_1 (seed treatment with BIOGEM (W.P.) @ 10 g/kg of seeds), T_7 (seed treatment with carbendazim @ 2 g/kg of seeds) and T_8 (seed treatment with BIOGEM (W.P) @ 5 g/kg of

Table 4: Evaluation of the efficacy of BIOGEM 5% against Sheath blight, Blast and Sheath rot of rice during 2008.

Treatments		Sheath rot				
		Per cent disease Index				
		45 days after sowing	60 days after sowing	75 day after sowing	Mean	Per cent Disease Control
T_1	BIOGEM (W.P) Seed Treatment @ 10 g/kg of seeds	0.00 (0.00)	0.00 (0.00)	1.00[1] (3.32)*	(94.15)	(94.15)
T_2	BIOGEM (W.P) Seed Treatment @ 5 g/kg of seeds	0.00 (0.00)	3.00 (8.05)	5.00 (10.54)	(67.36)	(67.36)
T_3	BIOGEM (W.P) Seed Treatment @ 3 g/kg seeds	2.00 (6.22)	5.00 (19.14)	7.00 (15.27)	(46.18)	(46.18)
T_4	BIOGEM (W.P) Soil Treatment @ 1.5 kg/ha	0.00 (0.00)	3.00 (8.05)	5.00 (10.08)	(68.16)	(68.16)
T_5	BIOGEM (W.P) Soil Treatment @ 2.5 kg/ha	4.33 (9.46)	5.00 (10.54)	8.00 (13.41)	(41.27)	(41.27)
T_6	BIOGEM (W.P) Soil Treatment @ 3.5 kg/ha	1.00 (3.32)	1.00 (3.51)	4.00 (9.14)	(71.95)	(71.95)
T_7	Seed treatment with carbendazim @ 2 g/kg of seeds	0.00 (0.00)	0.00 (0.00)	1.00 (3.32)	(94.15)	(94.15)
T_8	BIOGEM (W.P) Seed Treatment @ 5 g/kg of seeds (T_2) + BIOGEM (W.P) Soil Treatment @ 2.5 kg/ha (T_5)	0.00 (0.00)	0.00 (0.00)	1.00 (3.32)	(94.15)	(94.15)
T_9	Spray with carbendazim @ 0.1%	0.00 (0.00)	4.00 (11.37)	10.00 (18.24)	(47.97)	(47.97)
T_{10}	Control	6.00 (13.77)	10.00 (18.24)	18.00 (24.90)		
SEm		(2.434)	(3.075)	(4.454)		
CD (p=0.05)		(7.230)	(9.135)	(13.232)		
CV%		(128.94)	(73.97)	(69.20)		

[1]Average of three replications
* Figures in parentheses are the angular transformed values

seed + soil treatment with BIOGEM (W.P) @ 2.5 kg/ha) and highest disease was recorded in control treatment. At 75 days after sowing, lowest disease was recorded in treatment T_8 (seed treatment with BIOGEM (W.P) @ 5 g/kg of seed + soil treatment with BIOGEM (W.P) @ 2.5 kg/ha) where seed treatment with BIOGEM (W.P) @ 5 g/kg of seeds (T_2) + soil treatment with BIOGEM (W.P) @ 2.5 /ha and it was statistically at par with all the treatments except control treatment where highest disease was recorded.

Yield

Highest yield up to 4.14 ton/ha) was found in treatment T_8 where BIOGEM (W.P) @ 5 g/kg of seeds (T_2) + soil treatment with BIOGEM 5% (W.P) @ 2.5 kg/ha (T_5) and it was statistically at par with treatment T_1 where seed treatment with BIOGEM @ 10 g/kg of seed was made. The lowest yield was recorded in control treatment (T_{10}) and it was statistically inferior to other treatments (Table 1).

Cost : Benefit ratio

Highest cost : benefit was recorded in treatment where seed treatment with BIOGEM 5% @ 10 g/kg of seed was made and lowest cost : benefit ratio was recorded in treatment where soil treatment with BIOGEM 5% (W.P) @ 3.5 kg/ha was made (Table 1).

The results thus obtained revealed that percentage of germination of seeds of rice were recorded maximum in seeds treated with BIOGEM 5% (W.P) @ 5 g/kg of seeds. Lowest disease incidence of blast, sheath blight and sheath rot in rice and maximum control of disease over control were recorded in T_8 where seed treatment with BIOGEM 5% (W.P) @ 5 g/kg of seeds (T_2) + soil treatment with BIOGEM (W.P) @ 2.5 kg/ha (T_5) were made. Maximum yield were also recorded in above treatment. However, seed treatment with BIOGEM 5% (W.P.) recorded lowest cost : benefit ratio. BIOGEM 5% (W.P) is a product of *Pyriformospora indica* which induce resistance to fungal diseases (Waller *et al., 2005).* Here also *Pyriformospora indica* induces resistance against major diseases of rice when seed treatment and soil treatment were made.

Form the results it can be concluded that for the control of major diseases of rice BIOGEM 5% (W.P) (*pyriformospora indica.*) as seed treatment @ 5 g/kg of seed + soil treatment with BIOGEM (W.P) @ 2.5 kg/ha may be recommended for triala on farmer's field in different locations before giving recommendation to the farmer.

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