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Bio-efficacy and phytotoxicity evaluation of Carbendazim 50% WP as dry seed treatment against sheath blight of Rice

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ABSTRACT
Rice (Oryza sativa L.) is an important target to provide stable food and food security to millions population of the world and is one of the main foodstuffs in Asia. Rice affected by quite a lot of diseases among them Sheath blight, caused by Rhizoctonia solani Kunh., is a soil borne disease of rice occurs in all rice production regions of the world. In the present study aimed to test the efficacy of Carbendazim 50 % WP for the control of rice sheath blight disease. Two field trials were conducted in the rice variety BPT-5204 at Morepalayam village, Namakkal district during the year 2017-2018.The results of the present study revealed that the first season trail, generally all the treatments showed highest germination percentage except control .The data presented in Table 1 shows that the fungicide formulations were applied as seed treatment @ 2.0 and 3.0 g / kg of seed could reduce the progress of sheath blight disease by 8.11 and 7.98 per cent, respectively when compared to untreated control (28.05 PDI). The market sample Carbendazim 50% WP @ 2g/kg of seed recorded 8.16 PDI which was on par with Carbendazim 50 % WP test molecule @2 g/kg of seed with 8.11 PDI. Carbendazim 50%WP @ 3g/kg of seed recorded significantly highest grain yield of 8.12 t/ha which was on par with Carbendazim 50%WP @ 2 g/kg of seed (8.08 t/ha). The market sample Carbendazim 50 % WP @ 2g/kg of seed (8.04 t/ha) has shown on par result with test molecule of Carbendazim 50%WP@ 2g/kg of seed (8.08 t/ha). Similar trend in efficacy was observed with regard to per cent disease index and grain yield on second season trial by different treatments. Further, Carbendazim 50%WP @ 2 and 4g/kg of seed tested for its phytotoxicity studies did not shows any phytotoxic symptoms like leaf injury, wilting, vein clearing, necrosis, epinasty and hyponasty from 15, 20, 25 and 30 days after sowing on rice plants.
Keywords: *Oryza sativa,* phytotoxicity evaluation, Carbendazim

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INTRODUCTION

Rice (*Oryza sativa* L.) is second most important cereal and the staple food for more than half of the world's population. It provides 20% of the worlds dietary energy supply followed by Maize and Wheat. The production of rice to be achieved by 2020 is 128 Mt to feed the growing population in India. To meet the global demand, it is estimated that about 114 Mt of additional milled rice needs to be produced by 2035 with an increase of 26% in next 25 years. Rice is grown in an area of 431.94 lakhs ha with an annual production of 110.15 million ton [1].

Under field condition, the productivity of rice is affected by many biotic and abiotic factors. Among the different biotic constraints, sheath blight is more frequent and ferocious disease in irrigated rice of both temperate and subtropical areas and which cause damage at all stages of crop growth. Sheath blight, caused by *Rhizoctonia solani* Kunh., is an important destructive disease of rice occurs in all rice growing areas of the world. In India, yield losses due to the sheath blight disease was estimated up to 54.3% [11;13]. The disease is particularly important in intensive rice production systems due to excess use of nitrogenous fertilizers. Yield losses of 5-10% have been estimated for tropical lowland rice varieties such as PSBRc4, C4-137, IRW, IR74 and IR72 in Asia [12].

The fungus *Rhizoctonia solani* produced usually long cells of septate mycelium which are hyaline within young, yellowish brown. It produced large number of globose sclerotia which initially turn white, late turn brown to purplish brown. Sclerotia as a major source of primary inoculum. Wide host range of the pathogen *Rhizoctonia solani* makes management of the disease a different taste. Breeding for resistance through effective method has not succeeded due to lack of suitable clones. So far complete resistance source has not been found against this fungus, mainly because resistance is governed by quantitative trait loci (QTL), i.e.controlled by polygenes. Hence, fungicide based management of sheath blight diseases is successful at filed level in majority of the cases [4;10;7]. For sheath blight, most of the fungicides like benomyl, carbendazim, chloroneb, captafol, mancozeb, zineb, edifenphos, iprobenphos, thiophanate, carboxin, *etc*. have been found effective under field conditions [6; 14]. Recently, many combination fungicides such as Trifloxystrobin 25% + Tebuconazole 50% 75WG, Azoxystrobin 18.2% + Difenoconazole 11.4% SC, Kasugamycin 5% + Copper Oxychloride 45% WP and Kresoxim methyl 40% + Hexaconazole 8% WG have been shown to control the blast and sheath blight disease under field condition [3; 7]. Fungicides have been used successfully to control sheath blight but, 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. In the present study was undertaken to test the field efficacy of Carbendazim 50%WP as dry seed treatment on rice seed germination and sheath blight disease of paddy under field conditions.

MATERIAL AND METHODS

The experiment was laid out in Randomized Block Design (RBD) at the farmer's fields of morepalayam village, Namakkal districts during 2017-2018. A popular rice variety BPT5204 which is susceptible to sheath blight disease was used for the study. Seeds were sown in the month of July and planted in August. Before sowing, healthy seeds were water soaked overnight and incubated in the gunny bags for better sprouting 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 RBD with a plot size of 5 × 5 m each for all treatments. Seedlings of 30 days old were planted in trail plots at 20 ×20 cm spacing. The crop was supplied fertilizers as per recommendations mentioned in Package of Practices for field crops. The RBD experiment comprises of six treatments and four replications. The treatment details are listed below.

S.No.	Treatment	Formulation dose (gm/kg of seed)	Method of Application
T_1	Carbendazim 50 % WP	1	1 litre/10 kg of seed as wet slurry treatment
T_2	Carbendazim 50 % WP	2	1 litre/10 kg of seed as wet slurry treatment
T_3	Carbendazim 50 % WP	3	1 litre/10 kg of seed as wet slurry treatment
T_4	Carbendazim 50 % WP (market sample)	2	1 litre/10 kg of seed as wet slurry treatment
T_5	Carbendazim 50 % WP (only for phytotoxicity)	4	1 litre/10 kg of seed as wet slurry treatment
T_6	Control	-	-

Bio-efficacy was evaluated by spraying all the test chemicals twice at 15 days interval starting from the initiation of the disease.

Disease Assessment and Statistical Analysis

Fourteen days after the fungicide application disease assessment was carried out. The disease was measured using the disease rating scale of 0-9 developed by International Rice Research Institute (IRRI, 1996) for sheath blight disease. The details are given below.

Grade	Symptoms
0	No incidence
1	Less than 1% sheath area affected
3	1-5% sheath area affected
5	6-25% sheath area affected
7	26-50% sheath area affected
9	51-100% sheath area affected

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 [5] and tillers within the frame were cut and harvested in order to determine the yield. Data from 2017 and 2018 seasons were pooled to get the average PDI and yield values. Subsequently, the data on disease severity and yield parameters were subjected to appropriate statistical analysis.

RESULTS AND DISCUSSION

Efficacy of Carbendazim 50%WP on rice seed germination, sheath blight and grain yield on rice (%)

Field experiment revealed that generally all the treatments showed highest germination percentage except control **.**The data presented in Table 1 shows that the fungicide formulations were applied as seed treatment @ 2.0 and 3.0 g / kg of seed could reduce the progress of sheath blight disease by 8.11 and 7.98 per cent, respectively when compared to untreated control (28.05 PDI). With regard to the grain yield, the market sample Carbendazim 50% WP @ 2g/kg of seed recorded 8.16 PDI which was on par with Carbendazim 50 % WP test molecule @2 g/kg of seed with 8.11 PDI. Carbendazim 50%WP @ 3g/kg of seed recorded significantly highest grain yield of 8.12 t/ha which was on par with Carbendazim 50%WP @ 2 g/kg of seed (8.08 t/ha). The market sample Carbendazim 50 % WP @ 2g/kg of seed (8.04 t/ha) has shown on par result with test molecule of Carbendazim 50%WP@ 2g/kg of seed (8.08 t/ha). However, control recorded the lowest grain yield (4.23 t/ha) (Table 1).

Table 1: Efficacy of Carbendazim 50%WP against rice seed germination and sheath blight on rice: I Season (July-October 2017)

S.No	Treatments (g/lit)	Seed germination (%)	Sheath blight (PDI)*				yield (t/ha)*
			30 DAT	45 DAT	60 DAT	% control over untreated check	
T_1	Carbendazim 50 % WP @1g/kg of seed	82.82 (65.51)	4.13 (11.72)	7.04 (15.38)	8.57 (17.02)	69.44	6.90 (3.95)
T_2	Carbendazim 50 % WP@2g/kg of seed	85.71 (67.78)	4.14 (11.73)	6.74 15.04()	8.11 (16.54)	71.08	8.08 (4.63)
T_3	Carbendazim 50 % WP@3g/kg of seed	85.91 (67.95)	4.12 (11.71)	6.60 (14.88)	7.98 (16.40)	70.42	8.12 (4.65)
T_4	Carbendazim 50 % WP @2g/kg of seed (market sample)	85.78 (67.84)	4.17 (11.78)	6.78 (15.09)	8.16 (16.59)	70.90	8.04 (4.61)
T_5	Untreated Check	66.20	4.07	16.94	28.05	-	4.23
	SED	0.03	0.01	0.01	0.02	-	0.02
	CD (p=0.05)	0.07	0.02	0.04	0.05	-	0.04

Mean of three replications

Values in each column followed by the same letter are not significantly different according to the DMRT method (p = 0.05)

Table 2: Efficacy of Carbendazim 50%WP against rice seed germination and sheath blight on rice: II Season (July-November 2018)

S.No	Treatments (g/lit)	Seed germination (%)	Sheath blight (PDI)*				yield (t/ha)*
			30 DAT	45 DAT	60 DAT	% control over untreated check	
T_1	Carbendazim 50 % WP @1g/kg of seed	82.76 (65.47)	3.60 (10.93)	6.40 (14.65)	8.04 (16.47)	71.84	5.42 (3.10)
T_2	Carbendazim 50 % WP@2g/kg of seed	85.68 (67.76)	3.56 (10.87)	6.12 (14.32)	7.56 (15.95)	73.52	6.66 (3.81)
T_3	Carbendazim 50 % WP@3g/kg of seed	85.82 (67.88)	3.62 (10.96)	6.02 (14.20)	7.40 (15.78)	74.08	6.70 (3.84)
T_4	Carbendazim 50 % WP @2g/kg of seed (market sample)	85.60 (67.69)	3.60 (10.93)	6.10 (14.29)	7.52 (15.91)	73.66	6.62 (3.79)
T_5	Untreated Check	65.42 (53.98)	3.58 (10.90)	17.22 (24.51)	28.56 (32.30)	-	3.52 (2.01)
	SED	0.09	0.03	0.13	0.19	-	0.22
	CD (p=0.05)	0.20	0.07	0.28	0.4	-	0.45

Mean of three replications
Values in each column followed by the same letter are not significantly different according to the DMRT method (p = 0.05)

Similarly, [1] reported the fungicides viz, carbendazim Flo2, fenpropimorph 750 EC, fludoxanil 2.5 SC, hexaconazole 250 SC, iprodione 50 WP, pencycuron 250 Flo, propiconazole 250 EC and tolclofos- methyl 500 Flo as effective against sheath blight under *in vitro* and *in vivo* conditions. [4] Who reported better efficacy of azoxystrobin 18.2% + difenoconazole 11.4% SC in managing sheath blight and enhancing grain yield of rice. The tested fungicide i.e.Hexaconazole 5 SC (Contaf) treatment found highly effective in reducing the disease severity of sheath blight 11.11% and46.50% decrease of the disease over control this was at par with Captan70% + Hexaconazole5% WB [8]. Azoxystrobin 18.2% + difenoconazole 11.4% SC, which proved less toxic to *R. solani in vitro*, was the best treatment with 66.27% disease control followed by thifluzamide 23.9% SC, pencycuron 22.9%SC, and validamycin 3% L [9].

Phytotoxic effect of Carbendazim 50%WP on rice

Carbendazim 50%WP @ 2 and 4g/kg of seed tested for its phytotoxicity studies did not shows any phytotoxic symptoms like leaf injury, wilting, vein clearing, necrosis, epinasty and hyponasty from 15, 20, 25 and 30 days after sowing on rice plants (data not shown).

CONCLUSION

Based on two season field trails it is concluded that Carbendazim 50%WP @ 2g/kg of seed has showed increased germination percentage and proved superior control against sheath blight disease caused by *Rhizoctonia solani* in rice along with significant increase in grain yield. Hence, Carbendazim 50%WP @ 2g/kg of seed may be recommended for the management of sheath blight in rice.

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