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Evaluation of bio-efficacy and phyto-toxicity of sprint (Carbendazim 25% + Mancozeb 50% WS) as soil application against disease complex of paddy

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Abstract
Rice is second most important cereal crop of world and the staple food for more than half of the world's population. It provides 20 percent of the world's dietary energy supply followed by Maize and Wheat. Foliar diseases of Rice, mainly Sheath blight caused by *Rhizoctonia solani*, blast incited by *Pyricularia oryzae* and brown leaf spot (*Drechslera oryzae*) are three major devastating diseases in Karnataka during *Kharif* (wet) season. Now these diseases are also appearing in various part of Karnataka during summer season also which was not so common in earlier period which has become a serious problem for successful cultivation of paddy. Therefore, a field experiment was carried out to know the efficacy of carbendazim 25% + mancozeb 50% WS under filed condition against sheet blight, blast and brown leaf spot of rice during 2016 and 2017, at College of Agriculture, Shivamogga. Experimental results revealed that all the treatments significantly reduced the incidence of sheath blight, blast and brown leaf spot where lowest Percent disease index (PDI) was recorded in (Carbendazim 25% + Mancozeb 50% WS) + Urea (312.5 + 625 g a.i./ha) which was on par with Carbendazim 25% + Mancozeb 50% WS + Urea (250 + 500 g a.i./ha) in case of all three diseases under field condition with yield of 39.00 and 38.70 q/ha respectively.

Keywords: Paddy, sheath blight, blast, brown leaf spot and carbendazim 25% + mancozeb 50% WS

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 percent of the world's 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 114Mt of additional milled rice needs to be produced by 2035 with an increase of 26 percent in next 25 years. Worldwide the annual losses due to rice diseases estimated to be 10-15 percent. Depending upon the age of the plant, time of infection and severity, disease cause yield loss to the extent of 5.9 to 69 percent (Venkat Rao *et al.* 1990; Naidu, 1992) [10]. Rice is largely cultivated under submerged condition by transplanting. This method of cultivation requires large quantities of water and is labour intensive. It is estimated that, 5000 L of water is needed to produce 1 kg of rice. About 55 percent of the rice area is under irrigation and accounts for 75 percent of total production. Irrigated lowland is the most important agricultural ecosystem in Asia.

Rice crop is vulnerable to several abiotic and biotic stresses. Of these, outbreaks of insect pests and diseases, soil nutrient status and availability of irrigation water are major limitations to higher productivity. However, Kataki (2001) [2] reported that pests and diseases were foremost problems in rice. Among the all rice diseases, fungal diseases such as blast (*Pyricularia oryzae*), brown leaf spot (*Helminthosporium oryzae*), Sheet blight (*Rhizoctonia solani*), sheath rot (*Sarocladium oryzae*), stem rot (*Sclerotium oryzae*)**,** false smut (*Ustilaginoidia virens*), bacterial diseases such as bacterial leaf blight (*Xanthomonas oryzae* pv. *oryzae*), bacterial leaf streak (*Xanthomonas oryzae* pv. *oryzicola*), viral diseases like Rice grassy stunt (RGSV), Rice ragged stunt (RRSV), Rice yellow mottle (RYMV), Rice tungro disease (RTSV/RTBV) are important (Dahal *et al.* 1995).

Most of the new generation fungicides are highly specific and single site in mode of action. Thus, a fungicide with novel mode of action with combination of other fungicide needs to be identified and evaluated under field conditions for the management of foliar disease. In perusal of available information, an experiment have been formulated with primary objective to

determine the efficacy of different doses of combination of fungicidal formulation of Carbendazim 25% + Mancozeb 50% WS to develop a management module for sheet blight, blast and brown leaf spot of rice.

Material and Methods

The field experiment on bio efficacy and phytotoxicity of Carbendazim 25% + Mancozeb 50% WS against diseases of rice was carried out during *Kharif* 2016 and 2017 at College of Agriculture, Shivamogga, UAHS, Shivamogga. The spray schedule was initiated soon after the disease appearance. The experiment consisted of ten treatments and was laid out with randomized block design (RBD). The treatment fungicides were sprayed to the paddy plot at the beginning of the disease appearance. Spray schedule was repeated at seven days interval. The observations on sheet blight, blast and brown leaf spot were recorded using 0-9 scale at before and after each spray. The observations on the occurrence of the diseases on rice were recorded. The incidence and percent disease index were worked out for the diseases namely sheath blight, blast and brown spot of rice. Five plants were randomly selected from each plot and tagged for future reference. Observations were taken on those plants at 7, 14, 21, 28, 35, 42 and 49 days after application of all treatments of fungicide and statistical calculations were done to compare the results. Average of all spray has been given in this and the data was statistically analyzed after suitable transformations. The recorded grade values were converted into Percent Disease Index (PDI) by using following formula proposed by Wheeler (1969) [13].

Table 1: Treatment details

T. No.	Treatments	Dosage (g a.i./ha)	Formulation (g/ha)	Method of application
T1	(Carbendazim 25% + Mancozeb 50% WS) + Urea	187.5 + 375	750	Mixture of sprint and urea broadcasting in soil
T2	(Carbendazim 25% + Mancozeb 50% WS) + Urea	250 + 500	1000	
T3	(Carbendazim 25% + Mancozeb 50% WS) + Urea	312.5 + 625	1250	
T4	(Carbendazim 25% + Mancozeb 50% WS) + Sand	187.5 + 375	750	Mixture of sprint and sand broadcasting in soil & Urea broadcasting separately
T5	(Carbendazim 25% + Mancozeb 50% WS) + Sand	250 + 500	1000	
T6	(Carbendazim 25% + Mancozeb 50% WS) + Sand	312.5 + 625	1250	
T7	Carbendazim 50% WP	250	500	Carbendazim as foliar spray and urea as broadcasting in soil
T8	Mancozeb 75% WP	1500	2000	Mancozeb as foliar spray and urea as broadcasting in soil
T9	Carbendazim 12% + Mancozeb 63% WP	90 + 472.5	750	Carbendazim 12% + Mancozeb 63% WP as foliar spray and urea as broadcasting in soil
T10	Untreated Control	-	-	Only urea as broadcasting in soil
T11	Carbendazim 25% + Mancozeb 50% WS	625 + 1250	2500	Application by broadcasting in soil with Urea
T12	Carbendazim 25% + Mancozeb 50% WS	625 + 1250	2500	Application by broadcasting in soil with Sand

Sheath blight

Ten hills/plot are examined and recorded at pretreatment and at 15 and 30 days after treatment to grade the disease incidence as per the scoring scale below

Table 2: Show the description

Grades	Description
0	No infection
1	Vertical spread of the lesions up to 20% of Plant height.
3	Vertical spread of the lesions up to 21-30% of Plant height.
5	Vertical spread of the lesions up to 31-45% of Plant height.
7	Vertical spread of the lesions up to 46-65% of Plant height.
9	Vertical spread of the lesions more than 65% of Plant height.

***Source*:** Standard evaluation system (SES) scale (IRRI, 1996)

Table 3: Blast: *Pyricularia oryzae*

0-9 scale	Disease severity	Host response or reaction
0	No lesion observed	Highly Resistant
1	Small brown specks of pin point size	Resistant
2	Small roundish to slightly elongated, necrotic gray spots, about 1-2 mm in diameter, with a distinct brown margin. Lesions are mostly found on the lower leaves	Moderately Resistant
3	Lesion type same as in 2, but significant number of lesions on the upper leaves	Moderately Resistant
4	Typical susceptible blast lesions, 3 mm or longer infecting less than 4% of leaf area	Moderately Susceptible
5	Typical susceptible blast lesions of 3mm or longer infecting 4-10% of the leaf area	Moderately Susceptible
6	Typical susceptible blast lesions of 3 mm or longer infecting 11-25% of the leaf area	Susceptible
7	Typical susceptible blast lesions of 3 mm or longer infecting 26-50% of the leaf area	Susceptible
8	Typical susceptible blast lesions of 3 mm or longer infecting 51-75% of the leaf area many leaves are dead	Highly Susceptible
9	Typical susceptible blast lesions of 3 mm or longer infecting more than 75% leaf area affected	Highly Susceptible

Table 4: Brown spot: *Drechslera oryzae*

0-9 scale	Disease severity	Host response or reaction
0	Spots are not present.	Highly Resistant
1	Small brown speaks of pin point size on lower leaves.	Resistant
2	Small roundish necrotic brown spots, about 1-2 mm in diameter, with a distinct brown margin. Spots are mostly focused on lower leaves	Moderately Resistant
3	Spot type same as in 2, but significant number of spots on the upper leaves	Moderately Susceptible
4	Typical susceptible brown spot, 3 mm or larger infecting less than 4% of the leaf area	Moderately Susceptible
5	Typical susceptible brown spot, 3 mm or larger infecting 4-10% of the leaf area	Moderately Susceptible
6	Typical susceptible brown spot, 3 mm or larger infecting 11-25% of the leaf area	Susceptible
7	Typical susceptible brown spot, 3 mm or larger infecting 26-50% of the leaf area	Susceptible
8	Typical susceptible brown spot, 3 mm or larger infecting 51-75% of the leaf area	Highly Susceptible

Further, these scales were converted into severity (Percent disease index i.e., PDI) using the formula given below
Source: Standard evaluation system (SES) scale (IRRI, 2002) [3]

Further, these scales were converted into severity (Percent disease index i.e. PDI) using the formula given below

$$PDI = \frac{\text{Sum of numerical values}}{\text{Number of plants observed} \times \text{Maximum grade}} \times 100$$

Results and Discussion

Effect of sprint (Carbendazim 25% + Mancozeb 50% WS) on sheath blight of rice during *Kharif* 2016

The effect of Sprint (Carbendazim 25% + Mancozeb 50% WS) on sheath blight of rice is presented in Table 5. Lowest Mean Percent disease index (PDI) was recorded in (Carbendazim 25% + Mancozeb 50% WS) + Urea (312.5 + 625 g a.i./ha) (0.95) which was on par with Carbendazim 25% + Mancozeb 50% WS + Urea (250 + 500 g a.i./ha) (1.14). Highest percent reduction of disease over control (93.95%) was observed in (Carbendazim 25% + Mancozeb 50% WS) + Urea (312.5 + 625 g a.i./ha) treatment. All the fungicidal treatments recorded significantly good control as compared to control.

Effect of sprint (Carbendazim 25% + Mancozeb 50% WS) on sheath blight of rice during *Kharif* 2017

The effect of Sprint (Carbendazim 25% + Mancozeb 50% WS) on sheath blight of rice is presented in Table 6. Lowest Mean Percent disease index (PDI) was recorded in (Carbendazim 25% + Mancozeb 50% WS) + Urea (312.5 + 625 g a.i./ha) (1.14) which was onpar with Carbendazim 25% + Mancozeb 50% WS + Urea (250 + 500 g a.i./ha) (1.33). Highest percent reduction of disease over control (94.19) was observed in (Carbendazim 25% + Mancozeb 50% WS) + Urea (312.5 + 625 g a.i./ha) treatment. All the fungicidal treatments showed significantly good control as compared to control.

Effect of sprint (Carbendazim 25% + Mancozeb 50% WS) on leaf blast of rice during *Kharif* 2016

The effect of Sprint (Carbendazim 25% + Mancozeb 50% WS) on leaf blast of rice is presented in Table 7. Lowest Mean Percent disease index (PDI) was recorded in (Carbendazim 25% + Mancozeb 50% WS) + Urea (312.5 + 625 g a.i./ha) (0.47) which was on par with Carbendazim 25% + Mancozeb 50% WS + Urea (250 + 500 g a.i./ha) (0.66). Highest percent reduction of disease over control (94.13) was observed in (Carbendazim 25% + Mancozeb 50% WS) + Urea (312.5 + 625 g a.i./ ha) treatment. All the fungicidal treatments showed significantly low PDI as compared to control.

Effect of sprint (Carbendazim 25% + Mancozeb 50% WS) on blast of rice during *Kharif* 2017

The effect of Sprint (Carbendazim 25% + Mancozeb 50% WS) on leaf blast of rice is presented in Table 8. Lowest Mean Percent disease index (PDI) was recorded in (Carbendazim 25% + Mancozeb 50% WS) + Urea (312.5 + 625 g a.i./ha) (0.85) which was onpar with Carbendazim 25% + Mancozeb 50% WS + Urea (250 + 500 g a.i./ha) (1.14). Highest percent reduction of disease over control (92.74) was observed in (Carbendazim 25% + Mancozeb 50% WS) + Urea (312.5 + 625 g a.i./ ha) treatment. All the fungicidal treatments recorded significantly good control as compared to control.

Effect of Sprint (Carbendazim 25% + Mancozeb 50% WS) on brown spot of rice during *Kharif* 2016:

The effect of Sprint (Carbendazim 25% + Mancozeb 50% WS) on brown spot of rice is presented in Table 9. Lowest Mean Percent disease index (PDI) was recorded in (Carbendazim 25% + Mancozeb 50% WS) + Urea (312.5 + 625 g a.i./ha) (0.95) which was onpar with Carbendazim 25% + Mancozeb 50% WS + Urea (250 + 500 g a.i./ha) (1.14). Highest percent reduction of disease over control (93.95) was observed in (Carbendazim 25% + Mancozeb 50% WS) + Urea (312.5 + 625 g a.i./ha) treatment. All the fungicidal treatments recorded significantly good control as compared to control.

Effect of sprint (Carbendazim 25% + Mancozeb 50% WS) on brown spot of rice during *Kharif* 2017

The effect of Sprint (Carbendazim 25% + Mancozeb 50% WS) on brown spot of rice is presented in Table 10. Lowest Mean Percent disease index (PDI) was recorded in (Carbendazim 25% + Mancozeb 50% WS) + Urea (312.5 + 625 g a.i./ha) (1.33) which was on par with Carbendazim 25% + Mancozeb 50% WS + Urea (250 + 500 g a.i./ha) (1.71). Highest percent reduction of disease over control (91.92) was observed in (Carbendazim 25% + Mancozeb 50% WS) + Urea (312.5 + 625 g a.i./ha) treatment. All the fungicidal treatments recorded significantly good control as compared to control.

Effect of sprint (Carbendazim 25% + Mancozeb 50% WS) on yield parameters of rice during *Kharif* 2016 & *Kharif* 2017

The effect of Sprint (Carbendazim 25% + Mancozeb 50% WS) on yield of rice is presented in Table 11a & 11b. (Carbendazim 25% + Mancozeb 50% WS) + Urea (312.5 + 625 g a.i./ha) with highest Plant height (cm), Number of

productive tillers, Straw & grain yield recorded (81.0, 11.07, 32.80 & 39.0 /ha during 2016 respectively) which was on par with Carbendazim 25% + Mancozeb 50% WS + Urea (250 + 500 g a.i./ha) with Plant height (cm), Number of productive tillers, Straw & grain yield recorded (80.0, 10.80, 32.33 & 38.70/ha during 2016 respectively). Similarly, (Carbendazim 25% + Mancozeb 50% WS) + Urea (312.5 + 625 g a.i./ha) with highest Plant height (cm), Number of productive tillers, Straw & grain yield recorded (84.33, 11.33, 32.60 & 38.67 /ha during 2017 respectively) which was on par with Carbendazim 25% + Mancozeb 50% WS + Urea (250 + 500 g a.i./ha) with Plant height (cm), Number of productive tillers, Straw & grain yield recorded (83.33, 11.07, 32.53 & 38.20 /ha during 2017 respectively). Highest percent increase in yield over control (42.7 & 48.70 during 2016 & 2017 respectively) was observed in (Carbendazim 25% + Mancozeb 50% WS) + Urea (312.5 + 625 g a.i./ ha) treatment. All the fungicidal treatments showed significantly higher yield as compared to control.

Phytotoxic effect of sprint (Carbendazim 25% + Mancozeb 50% WS) on rice during *Kharif* 2016 & *Kharif* 2017

The phytotoxic effect of different treatments of Sprint (Carbendazim 25% + Mancozeb 50% WS) on rice plant was recorded by following 1-10 grade scale and results are presented in Table 12. No symptoms of Chlorosis, Necrosis, Wilting, Scorching, Hyponasty and Epinasty injury were observed on rice plant during the season.

Sprint is a fungicide that contains both contact as well as systemic action having both curative and preventive activity, by virtue of its systemic nature, chemical penetrates and move into plant system and it helps to distribution on the surface, consequently, showing better disease control (Vyas, 1993) [11] and it also expected to protect emerging younger leaves from the initial infection. Efficacy of carbendazim + mancozeb, carbendazim against blast has also been reported by Ram Singh *et al.* 2004 and 2010 [6]; Srinivas Prasad *et al*. 2011 [9]; Upamanyu and Rana, 2012 [14]; Singh, 2000 [8]; Mathivanan and Prabhavati, 2007 [4]; Sachin and Sandeep, 2016 [7] and Waghe *et al*. 2014. Mixture partner mancozeb is a contact action and preventive fungicide with multisite mode of action. It remains on the seed surface treated in treated seeds. It is fungitoxic when exposed to air, converted in to isothicyanate, which inactivates the sulphahydral group of enzyme in fungi, causing disturbance in fungal enzyme functioning. Other mixture partner carbendazim is systemic in action acts as preventive and curative. It acts by disrupting the spindle formation during cell division in fungi.

Table 5: Effect of sprint (Carbendazim 25% + Mancozeb 50% WS) at different doses against sheath blight in rice (2016)

Treatments	Dosage (g a.i./ha)	Percent disease index of sheath blight								Mean	% Reduction in disease over control
		Incidence before spraying	7 DAA	14 DAA	21 DAA	28 DAA	35 DAA	42 DAA	49 DAA		
(Carbendazim 25% + Mancozeb 50% WS) + Urea	187.5+375	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.34 (3.83)	4.00 (7.95)	9.34 (12.42)	2.09	86.7
(Carbendazim 25% + Mancozeb 50% WS) + Urea	250+500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.00 (5.74)	6.00 (9.89)	1.14	92.75
(Carbendazim 25% + Mancozeb 50% WS) + Urea	312.5+625	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.34 (3.83)	5.34 (9.36)	0.95	93.95
(Carbendazim 25% + Mancozeb 50% WS) + Sand	187.5+375	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.00 (4.63)	6.00 (9.89)	13.34 (14.9)	3.04	80.64
(Carbendazim 25% + Mancozeb 50% WS) + Sand	250+500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.34 (3.83)	3.34 (7.34)	8.00 (9.89)	1.81	88.46
(Carbendazim 25% + Mancozeb 50% WS) + Sand	312.5+625	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.67 (1.92)	2.00 (4.63)	6.00 (11.48)	1.23	92.17
Carbendazim 50% WP	250	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.67 (1.92)	2.67 (6.54)	9.34 (12.36)	18.00 (17.41)	4.38	72.11
Mancozeb 75% WP	1500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.34 (3.83)	5.34 (9.09)	13.34 (14.9)	22.67 (19.65)	6.09	61.23
Carbendazim 12% + Mancozeb 63% WP	90+472.5	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.67 (1.92)	2.67 (6.54)	8.00 (11.48)	1.62	27.81
Untreated Control	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.34 (3.83)	6.00 (9.89)	20.00 (18.38)	36.67 (25.31)	46.00 (28.63)	15.71	-
S.Em(±)		NS	NS	NS	0.6	0.84	1.04	0.71	0.31	-	-
CD (p = 0.05)		NS	NS	NS	1.79	2.51	3.09	2.13	0.92	-	-

*Data presented in parentheses are angular transformed values; DAA = Days after application

Table 6: Effect of sprint (Carbendazim 25% + Mancozeb 50% WS) at different doses against sheath blight in rice (2017)

Treatments	Dosage (g a.i./ha)	Percent disease index of sheath blight								Mean	% Reduction in disease over control
		Incidence before spraying	7 DAA	14 DAA	21 DAA	28 DAA	35 DAA	42 DAA	49 DAA		
(Carbendazim 25% + Mancozeb 50% WS) + Urea	187.5+375	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	3.34 (7.34)	6.67 (10.41)	16.67 (16.76)	3.81	80.58
(Carbendazim 25% + Mancozeb 50% WS) + Urea	250+500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.67 (6.54)	6.67 (10.50)	1.33	93.22
(Carbendazim 25% + Mancozeb 50% WS) + Urea	312.5+625	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.00 (5.74)	6.00 (9.89)	1.14	94.19

(Carbendazim 25% + Mancozeb 50% WS) + Sand	187.5+375	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	4.00 (7.95)	8.67 (11.9)	21.34 (19.04)	4.85	75.28
(Carbendazim 25% + Mancozeb 50% WS) + Sand	250+500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.67 (6.54)	5.34 (9.27)	8.00 (13.30)	2.28	88.38
(Carbendazim 25% + Mancozeb 50% WS) + Sand	312.5+625	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.34 (3.83)	4.00 (7.95)	6.00 (12.42)	1.62	91.74
Carbendazim 50% WP	250	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.34 (3.83)	6.00 (9.89)	13.34 (14.9)	26.67 (21.38)	6.76	65.55
Mancozeb 75% WP	1500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	3.34 (7.34)	9.34 (12.36)	20.00 (18.43)	34.67 (24.58)	9.62	50.97
Carbendazim 12% + Mancozeb 63% WP	90+472.5	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.67 (6.54)	6.67 (10.41)	12.67 (14.57)	3.14	84.00
Untreated Control	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.67 (6.54)	7.34 (11.02)	24.67 (20.50)	45.34 (28.39)	57.34 (32.36)	19.62	-
S.Em (±)		NS	NS	NS	0.25	0.62	0.67	0.63	0.48	-	-
CD (p = 0.05)		NS	NS	NS	0.74	1.85	1.99	1.88	1.42	-	-

*Data presented in parentheses are angular transformed values; DAA = Days after application

Table 7: Effect of sprint (Carbendazim 25% + Mancozeb 50% WS) at different doses against leaf blast in rice (2016)

Treatments	Dosage (g a.i./ha)	Percent disease index of blast								Mean	% Reduction in disease over control
		Incidence before spraying	7 DAA	14 DAA	21 DAA	28 DAA	35 DAA	42 DAA	49 DAA		
(Carbendazim 25% + Mancozeb 50% WS) + Urea	187.5+375	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.67 (1.92)	4.67 (8.75)	10.00 (12.88)	2.19	72.63
(Carbendazim 25% + Mancozeb 50% WS) + Urea	250+500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.34 (3.83)	3.34 (6.04)	0.66	91.75
(Carbendazim 25% + Mancozeb 50% WS) + Urea	312.5+625	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.67 (1.92)	2.67 (6.54)	0.47	94.13
(Carbendazim 25% + Mancozeb 50% WS) + Sand	187.5+375	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.34 (3.83)	5.34 (9.36)	11.34 (13.69)	2.57	67.88
(Carbendazim 25% + Mancozeb 50% WS) + Sand	250+500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.34 (3.83)	2.67 (6.54)	7.34 (11.02)	1.62	79.75
(Carbendazim 25% + Mancozeb 50% WS) + Sand	312.5+625	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.00 (5.74)	5.34 (9.36)	1.04	87.00
Carbendazim 50% WP	250	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.00 (5.74)	6.67 (10.35)	15.34 (15.99)	3.43	57.13
Mancozeb 75% WP	1500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.67 (6.54)	9.34 (12.42)	20.00 (18.43)	4.57	42.88
Carbendazim 12% + Mancozeb 63% WP	90+472.5	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.67 (1.92)	3.34 (7.16)	7.34 (10.87)	1.62	79.75
Untreated Control	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.34 (3.83)	6.00 (9.89)	18.00 (17.39)	30.67 (22.97)	8.00	-
S.Em (±)		NS	NS	NS	NS	0.6	1.09	0.81	0.99	-	-
CD (p = 0.05)		NS	NS	NS	NS	1.79	3.25	2.41	2.94	-	-

*Data presented in parentheses are angular transformed values; DAA = Days after application

Table 8: Effect of sprint (Carbendazim 25% + Mancozeb 50% WS) at different doses against leaf blast in rice (2017)

Treatments	Dosage (g a.i./ha)	Percent disease index of blast								Mean	% Reduction in disease over control
		Incidence before spraying	7 DAA	14 DAA	21 DAA	28 DAA	35 DAA	42 DAA	49 DAA		
(Carbendazim 25% + Mancozeb 50% WS) + Urea	187.5+375	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	3.34 (7.34)	7.34 (10.96)	16.67 (16.74)	3.9	66.70
(Carbendazim 25% + Mancozeb 50% WS) + Urea	250+500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.00 (5.74)	6.00 (9.89)	1.14	90.26
(Carbendazim 25% + Mancozeb 50% WS) + Urea	312.5+625	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.34 (3.83)	4.67 (8.75)	0.85	92.74
(Carbendazim 25% + Mancozeb 50% WS) + Sand	187.5+375	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	4.00 (8.14)	10.67 (13.3)	18.00 (17.45)	4.66	60.20
(Carbendazim 25% + Mancozeb 50% WS) + Sand	250+500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.00 (5.74)	4.67 (8.47)	10.67 (13.3)	2.47	78.91
(Carbendazim 25% + Mancozeb 50% WS) + Sand	312.5+625	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	3.34 (7.34)	8.67 (11.94)	1.71	85.40
Carbendazim 50% WP	250	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	3.34 (7.34)	14.67 (15.68)	24.67 (20.54)	6.09	47.99
Mancozeb 75% WP	1500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	4.67 (8.57)	18.00 (17.45)	31.34 (23.31)	7.71	34.16

Carbendazim 12% + Mancozeb 63% WP	90+472.5	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.67 (6.54)	6.67 (10.5)	13.34 (14.9)	3.24	72.33
Untreated Control	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.00 (2.00)	7.34 (11.02)	25.34 (20.83)	47.34 (29.08)	11.71	-
S.Em (±)		NS	NS	NS	NS	0.25	0.53	0.65	0.53	-	-
CD (p = 0.05)		NS	NS	NS	NS	0.74	1.59	1.96	1.59	-	-

*Data presented in parentheses are angular transformed values; DAA = Days after application

Table 9: Effect of sprint (Carbendazim 25% + Mancozeb 50% WS) at different doses against brown spot in rice (2016)

Treatments	Dosage (g a.i./ha)	Percent disease index of brown spot								Mean	% Reduction in disease over control
		Incidence before spraying	7 DAA	14 DAA	21 DAA	28 DAA	35 DAA	42 DAA	49 DAA		
(Carbendazim 25% + Mancozeb 50% WS) + Urea	187.5+375	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.34 (3.83)	4.00 (7.95)	9.34 (12.42)	2.09	86.70
(Carbendazim 25% + Mancozeb 50% WS) + Urea	250+500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.00 (5.74)	6.00 (9.89)	1.14	92.74
(Carbendazim 25% + Mancozeb 50% WS) + Urea	312.5+625	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.34 (3.83)	5.34 (9.36)	0.95	93.95
(Carbendazim 25% + Mancozeb 50% WS) + Sand	187.5+375	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.00 (4.63)	6.00 (9.89)	13.34 (14.9)	3.04	80.65
(Carbendazim 25% + Mancozeb 50% WS) + Sand	250+500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.34 (3.83)	3.34 (7.34)	8.00 (9.89)	1.81	88.48
(Carbendazim 25% + Mancozeb 50% WS) + Sand	312.5+625	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.67 (1.92)	2.00 (4.63)	6.00 (11.48)	1.23	92.17
Carbendazim 50% WP	250	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.67 (1.92)	2.67 (6.54)	9.34 (12.36)	18.00 (17.41)	4.38	72.12
Mancozeb 75% WP	1500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.34 (3.83)	5.34 (9.09)	13.34 (14.9)	22.67 (19.65)	6.09	61.23
\Carbendazim 12% + Mancozeb 63% WP	90+472.5	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.67 (1.92)	2.67 (6.54)	8.00 (11.48)	1.62	89.69
Untreated Control	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.34 (3.83)	6.00 (9.89)	20.00 (18.38)	36.67 (25.31)	46.00 (28.63)	15.71	-
S.Em (±)		NS	NS	NS	0.6	0.84	1.04	0.71	0.31	-	-
CD (p = 0.05)		NS	NS	NS	1.79	2.51	3.09	2.13	0.92	-	-

*Data presented in parentheses are angular transformed values; DAA = Days after application

Table 10: Effect of sprint (Carbendazim 25% + Mancozeb 50% WS) at different doses against brown spot in rice (2017)

Treatments	Dosage (g a.i./ha)	Percent disease index of brown spot								Mean	% Reduction in disease over control
		Incidence before spraying	7 DAA	14 DAA	21 DAA	28 DAA	35 DAA	42 DAA	49 DAA		
(Carbendazim 25% + Mancozeb 50% WS) + Urea	187.5+375	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	4.67 (8.75)	18.00 (17.45)	26.67 (21.42)	7.04	57.26
(Carbendazim 25% + Mancozeb 50% WS) + Urea	250+500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.67 (6.54)	4.00 (7.95)	5.34 (9.27)	1.71	89.62
(Carbendazim 25% + Mancozeb 50% WS) + Urea	312.5+625	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.00 (4.63)	3.34 (7.16)	4.00 (7.95)	1.33	91.92
(Carbendazim 25% + Mancozeb 50% WS) + Sand	187.5+375	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	6.00 (9.89)	22.00 (19.36)	29.34 (22.51)	8.19	50.27
(Carbendazim 25% + Mancozeb 50% WS) + Sand	250+500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.67 (6.54)	11.34 (13.76)	18.00 (17.45)	4.57	72.25
(Carbendazim 25% + Mancozeb 50% WS) + Sand	312.5+625	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.00 (5.74)	8.67 (12.00)	16.67 (16.78)	3.9	76.32
Carbendazim 50% WP	250	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.67 (1.92)	10.00 (12.88)	28.67 (22.25)	38.00 (25.84)	11.04	32.97
Mancozeb 75% WP	1500	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.67 (6.54)	14.00 (15.32)	33.34 (24.07)	46.67 (28.88)	13.81	16.15
Carbendazim 12% + Mancozeb 63% WP	90+472.5	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	3.34 (7.34)	14.00 (15.32)	22.67 (19.67)	5.71	65.33
Untreated Control	-	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	1.34 (3.83)	4.67 (8.75)	18.67 (17.76)	41.34 (27.03)	50.67 (30.22)	16.47	-
S.Em (±)		NS	NS	NS	0.6	0.62	0.88	0.65	0.59	-	-
CD (p = 0.05)		NS	NS	NS	1.79	1.87	2.63	1.93	1.76	-	-

*Data presented in parentheses are angular transformed values; DAA = Days after application

Table 11a: Effect of sprint (Carbendazim 25% + Mancozeb 50% WS) on grain yield of rice during *Kharif* 2016

Treatments	Dosage (g a.i./ha)	Biometrics of paddy			Kharif 2016	
		Plant height (cm)	No. of productive tillers	Straw yield Q/ha	Grain yield (q/ha)	% Increase in yield over control
(Carbendazim 25% + Mancozeb 50% WS) + Urea	187.5 + 375	74.67	9.17	31.00	34.53	26.34
(Carbendazim 25% + Mancozeb 50% WS) + Urea	250 + 500	80.00	10.80	32.33	38.70	41.60
(Carbendazim 25% + Mancozeb 50% WS) + Urea	312.5 + 625	81.00	11.07	32.80	39.00	42.70
(Carbendazim 25% + Mancozeb 50% WS) + Sand	187.5 + 375	72.33	9.07	30.93	33.07	21.00
(Carbendazim 25% + Mancozeb 50% WS) + Sand	250 + 500	78.00	10.53	31.47	37.67	37.83
(Carbendazim 25% + Mancozeb 50% WS) + Sand	312.5 + 625	80.33	10.87	32.40	38.00	39.04
Carbendazim 50% WP	250	76.00	9.33	30.73	33.33	21.95
Mancozeb 75% WP	1500	75.67	9.27	30.67	32.33	18.29
Carbendazim 12% + Mancozeb 63% WP	90 + 472.5	78.00	10.07	32.00	34.67	26.85
Untreated Control	-	68.67	8.07	25.60	27.33	-
S.Em (±)		0.94	0.22	0.72	1.35	-
CD (p = 0.05)		2.80	0.67	2.14	4.02	-

Table 11b: Effect of sprint (Carbendazim 25% + Mancozeb 50% WS) on grain yield of rice during *Kharif* 2017

Treatments	Dosage (g a.i./ha)	Biometrics of paddy			Kharif 2017	
		Plant height (cm)	No. of productive tillers	Straw yield (q/ha)	Grain yield (q/ha)	% Increase in yield over control
(Carbendazim 25% + Mancozeb 50% WS) + Urea	187.5 + 375	78.00	9.50	30.33	34.13	31.26
(Carbendazim 25% + Mancozeb 50% WS) + Urea	250 + 500	83.33	11.07	32.53	38.20	46.90
(Carbendazim 25% + Mancozeb 50% WS) + Urea	312.5 + 625	84.33	11.33	32.60	38.67	48.70
(Carbendazim 25% + Mancozeb 50% WS) + Sand	187.5 + 375	76.33	9.40	30.27	33.00	26.92
(Carbendazim 25% + Mancozeb 50% WS) + Sand	250 + 500	82.67	10.87	31.87	37.67	44.88
(Carbendazim 25% + Mancozeb 50% WS) + Sand	312.5 + 625	83.67	11.07	32.93	39.33	51.26
Carbendazim 50% WP	250	77.33	9.27	29.20	32.33	24.34
Mancozeb 75% WP	1500	76.00	8.93	28.93	31.00	19.23
Carbendazim 12% + Mancozeb 63% WP	90 + 472.5	80.00	10.93	30.87	33.67	29.50
Untreated Control	-	68.67	8.20	24.73	26.00	-
S.Em (±)		1.00	0.16	0.44	1.17	-
CD (p = 0.05)		2.13	0.5	1.33	3.48	-

Table 12: Phytotoxicity of sprint (Carbendazim 25% + Mancozeb 50% WS) on rice during *Kharif*, 2016 and 2017

Treatment		Dose	Formulation	Phytotoxicity parameters observed (Mean observations recorded after 0, 1, 3, 5, 7, 10 and 15 days of each spray)						
		g a.i. /ha	(g /ha)	Scorching	Chlorosis	Wilting	Yellowing	Necrosis	Epinasty	Hyponasty
T2	(Carbendazim 25% + Mancozeb 50% WS) + Urea	312.5 + 625	1250	0	0	0	0	0	0	0
T5	(Carbendazim 25% + Mancozeb 50% WS) + Sand	312.5 + 625	1250	0	0	0	0	0	0	0
T11	(Carbendazim 25% + Mancozeb 50% WS) + Urea	625 + 1250	2500	0	0	0	0	0	0	0
T12	(Carbendazim 25% + Mancozeb 50% WS) + Sand	625 + 1250	2500	0	0	0	0	0	0	0
T10	Untreated control	-	-	0	0	0	0	0	0	0

*Based on 1-10 scale: 1 = 0-10%, 2 = 11-20%, 3 = 21-30%, 4 = 31-40%, 5 = 41-50%, 6 = 51-60%, 7 = 61-70%, 8 = 71-80%, 9 = 81-90%, and 10 = 91-100%

Conclusion

The two years experiment was conducted to find out the effect of Sprint (Carbendazim 25% + Mancozeb 50% WS) on three major diseases of rice and based findings of investigation, it is evident that soil application of Carbendazim 25% + Mancozeb 50% WS + Urea (312.5 + 625 g a.i./ha) has recorded lowest Percent disease index (PDI) in which was on par with Carbendazim 25% + Mancozeb 50% WS + Urea (250 + 500 g a.i./ha which were found statistically significant in reducing the disease occurrence and resulted in maximization of yield through reduction in soil inoculum build up, disease progress and further secondary spread of the diseases.

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