Effect of Zinc sulphate on Brown spot incidence of rice

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Abstract

The present study was undertaken to investigate the foliar and soil application of Zinc sulphate for the management of brown spot incidence of rice. A field experiment was conducted during Navarai season at the brown spot endemic area *viz*., Puthoor village, Tamil Nadu with ADT 36 as test cultivar. The efficacy of zinc sulphate (2%) as foliar spray was worked out by spraying it once, twice and thrice at different crop growth stages *viz.,* 15, 30 and 45 DAT. Besides as separate trial zinc sulphate was applied as soil application at various dosages *viz*., 5, 10, 15, 20, 25 and 30 Kg/ha just before transplanting the crop. The data indicated that the disease incidence was minimum in plots sprayed thrice with zinc sulphate at 15, 30 and 45 DAT, followed by plots receiving two sprays at 15 DAT and 30 DAT which were statistically at par. Whereas, in soil application the data indicated that the disease incidence was minimum in fields applied with zinc sulphate at 30 kg/ ha followed by fields are applied with zinc sulphate at 25 kg/ha which were statistically at par. In general, $ZnSO_4$ @ two per cent spray and soil application of zinc sulphate at 25 kg/ha markedly reduced the disease incidence and increased the grain yield in separate field conditions.

Key words: brown spot, macro-micro nutrient, foliar spray, soil application

Introduction

Rice (*Oryza sativa* L.) is the second most cultivated crop worldwide and it has been estimated that half the world's population survives wholly or partially on this crop (Van Nguyen and Ferrero, 2006) and rice provides more calories per ha than any other cereal food grains. Rice crop is widely affected by a number of diseases caused by fungi, bacteria, viruses and mycoplasma which results in considerable yield losses (Ou, 1985). Among the various fungal diseases of rice, brown spot or sesame leaf spot incited by *Helminthosporium oryzae* (Breda de Haan) Subram. and Jain (Syn: *Bipolaris oryzae* (Breda de Haan) Shoemaker) is found to occur in most rice growing areas. Normally fungicides are primary means of controlling plant diseases. But the use of chemical fungicides is under special scrutiny for

posing potential environmental threat as the indiscriminate use of chemical fungicides resulted in environmental pollution and ill-health to biotic community as a whole. Even if acceptable fungicides are applied the pathogen often develops resistance and produce new biotypes. The increased consumer preference for healthy agricultural products and environmental risks associated with chemical residues in food are the major driving forces for the search of new safer control methods. The brown spot disease is very common in poorly managed soils and occurs in high proportions under stress conditions due to nutrients and water. Soil and foliar application of sulphur based nutrients has proved to increase resistance against a variety of fungal pathogens on different crops (Wang *et al*., 2003; Klikocka *et al*., 2005). Also, application of zinc fertilizer in Indian soil conditions increased the resistance to diseases, better seed viability and seedling vigour, abiotic stress tolerance and crop yield (Cakmak*,* 2009). Several authors have reported the use of zinc sulphate for the management of rice diseases (Ramabadran and Velazhagan, 1988; Madhiazhagan, 1989; Eswaran and Naraynasamy, 2000; Reddy *et al.,* 2000; Singh *et al.,* 2009). Therefore, the present study was undertaken to investigate the foliar and soil application of Zinc sulphate for the management of brown spot incidence of rice.

Materials and Methods

Field experiments

Separate field studies were conducted to test the efficacy of zinc sulphate (2%) and soil application of zinc sulphate at various rates for assessing their influence on the incidence of brown spot of rice. The brown spot susceptible variety ADT 36 was used for the study. The experiments were conducted in a randomized block design with thee replications for each treatment and a suitable control. Also, the fertilizer application was done following the blanket schedule of 120:38:38 of N: P: K recommended by the State Agricultural department. A plot size of 5X4 m was maintained for each treatment and the crop was raised with the spacing of 12.5 X 10 cm and all the standard agronomic practices as recommended by the State Agricultural Department were followed. The fungicide carbendazim 50 WP @ 0.1 per cent was used for comparison. The rice crop was harvested at maturity, thrashed, winnowed and cleaned plot wise, dried and the yields of grain and straw were recorded. In all the screening field trials the observations on disease incidence was assessed on a randomly selected set of 25 hills per plot at the time of maturity. Also the grain and straw yield of rice was recorded and expressed as t/ha.

Effect of foliar and soil application of zinc sulphate (ZS) on brown spot incidence and yield of rice var. ADT 36

A field experiment was conducted during Navarai season at the brown spot endemic area *viz*., Puthoor village, Tamil Nadu with ADT 36 as test cultivar. The efficacy of zinc sulphate (2%) as foliar spray was worked out by spraying it once, twice and thrice at different crop growth stages *viz.,* 15, 30 and 45 DAT. Besides as separate trial zinc sulphate was applied as soil application at various dosages *viz*., 5, 10, 15, 20, 25 and 30 Kg/ha just before transplanting the crop.

Straw yield

After thrashing and separation of grains, the straw was dried pot wise / plot wise in sun for two days. Later, the straw weight was weighed and computed to t ha^{-1}.

Grain yield

The matured crop was harvested and the grains were hand threshed, winnowed and sun dried sufficiently. The dried grains were weighed plot wise and then converted into per hectare basis and expressed as t ha^{-1}.

Biological yield

The biological yield was calculated by the summation of grain and straw yield and recorded as t ha^{-1}.

The disease incidence was assessed by adopting 0-9 scale according to "Phytopathometry" by Mayee and Datar (1986) and the per cent disease incidence /index was calculated based on the formula suggested by Vidhyasekaran *et al.* (1989).

DISEASE SEVERITY	DESCRIPTION OF DISEASE INDEX
0	No lesions
1	Affected leaf area less than 1 %
3	1-10 % affected leaf area
5	11-25 % affected leaf area
7	26 -50 % affected leaf area
9	> 50 % leaf area affected

$$\textbf{Per cent Disease Index} = \frac{\text{Total ratings}}{\text{Total number of leaves graded} \times \text{Maximum grade in the score chart.}} \times 100$$

Results and Discussion

The data indicated that the disease incidence was minimum (13.20 %) in plots sprayed thrice with zinc sulphate at 15, 30 and 45 DAT, followed by plots receiving two sprays at 15 DAT and 30 DAT (13.69 %) which were statistically at par (Table 1). The grain yield and straw yield were also higher in plots sprayed thrice (15, 30 and 45 DAT) followed by plots receiving two sprays at 15 and 30 DAT. Among the various treatments the plots receiving single spray (T_3) was the least effective. The control plots recorded 32.58 per cent disease incidence, 3.73 t/ha of grain yield and 5.54 t/ha of straw yield.

The data indicated that the disease incidence was minimum in fields applied with zinc sulphate at 30 kg/ ha followed by fields are applied with zinc sulphate at 25 kg/ha which were statistically at par (Table 2). The results showed that zinc sulphate @ 30 kg/ha field recorded 17.09 per cent disease incidence, 5.13 t/ha of grain yield and 7.31 t/ha of straw yield. It was followed by zinc sulphate @ 25 kg/ha which recorded 17.16 per cent disease incidence, 5.10 t/ha grain yield and 7.26 t/ha straw yield. The treatment applied with Zinc sulphate @ 10 kg/ha was the least effective (21.43 %).

Use of zinc sulphate for management of rice diseases has been reported by several authors (Kaur *et al.,* 1986; Ramabadran and Velazhagan, 1988; Eswaran and Narayanasamy, 2000; Reddy *et al.,* 2000). The development of resistance due to $ZnSO_4$ spray on different crops was reported by earlier workers against bengal gram leaf blight (Balasubramanian and Shanmugam, 1988), tomato wilt (Vidhyasekaran, 1988) and rice brown leaf spot (Madhiazhagan, 1989). In the light of the above, the present observations made on the $ZnSO_4$ spray treatment were found confirmed.

In the present study, the $ZnSO_4$ spray not only checked the disease incidence, but also significantly influenced the grain yield. The mechanisms leading to these nutrient induced changes in disease development are complex and multifarious and include effects of mineral nutrients directly on the pathogen, on plant growth and development and on plant resistance mechanisms. Micronutrients Zn and Mn can affect the plant biochemistry and physiology, which can influence the resistance or tolerance mechanisms of plants to pathogens (Simoglou and Dordas, 2006).

Application of zinc fertilizers in Indian soil conditions increased the resistance to plant disease, better seed viability and seedling vigour, improved abiotic stress tolerance and

higher yield (Cakmak, 2009). Soil application of zinc sulphate @ 40 kg/ha can increase the yield of rice in alkali soil (Singh *et al.,* 1987). Also, soil application of sulphur was proved to increase resistance against a variety of fungal pathogens on different crops (Schnug *et al*., 1995; Bourbos *et al*., 2000; Wang *et al*., 2003; Klikocka *et al*., 2005). Thus, the sulphur component present in $ZnSO_4$ could have exerted a synergism with zinc and resulted in maximum disease suppression.

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Table 1. Effect of spraying Zinc sulphate (2%) at different crop growth stages on brown spot incidence and yield of rice var. ADT 36 (Field experiment – Navarai season)

Treatment	Stages of spraying	Disease incidence (%)	Grain yield (t/ha)	Straw yield (t / ha)	Biological Yield
T_1	15 DAT	18.92	4.38	6.72	11.10
T_2	30 DAT	21.05	4.22	6.49	10.71
T_3	45 DAT	22.60	4.10	6.36	10.46
T_4	$T_1 + T_2$	13.69	4.79	7.10	11.89
T_5	$T_1 + T_3$	14.92	4.57	7.02	11.59
T_6	$T_2 + T_3$	15.50	4.50	6.93	11.43
T_7	$T_1 + T_2 + T_3$	13.20	4.94	7.16	12.10
T_8	Carbendazim 0.1 %	11.43	4.42	6.12	10.54
T_9	Control	32.58	3.73	5.54	09.27
	C.D. (p=0.05)	4.25	0.09	0.14	0.11

Table 2. Effect of soil application of Zinc sulphate at various dosages on the management of brown spot of rice (Field experiment – Navarai season)

Treatment	Dosage of $ZnSo_4$ (kg / ha of soil)	Disease incidence (%)	Grain yield (t/ha)	Straw yield (t / ha)	Biological Yield
T_1	10	21.43	4.59	6.71	11.3
T_2	15	20.67	4.74	6.86	11.6
T_3	20	19.62	4.91	7.11	12.02
T_4	25	17.16	5.10	7.26	12.36
T_5	30	17.09	5.13	7.31	12.44
T_6	Carbendazim 0.1 %	14.26	4.48	6.50	10.98
T_7	Control	39.31	4.03	5.74	09.77
	C.D. (p=0.05)	3.64	0.17	0.12	0.15