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Effect of Zinc Sulphate, Salicylic acid and Potassium silicate application on micro nutrient content of brown spot infected rice var. ADT 36

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Abstract: **The Pot culture studies were undertaken to investigate the macro nutrients in rice as influenced by application of Zinc sulphate and foliar application of salicylic acid and Potassium silicate and Brown spot pathogen *Bipolaris oryzae* inoculation. The results revealed that Soil application of Zinc sulphate @ 25 kg/ ha along with foliar application of plant activator Salicylic acid @ 50 ppm on 15 days after transplanting and Foliar spray of silicon based nutrient potassium silicate @ 3 % recorded the minimum disease incidence and maximum biometrics of rice. Also, The results revealed that the treatments treated with the Application of ZS, SA and PS significantly influenced the micro nutrient contents such as Zn, Fe, Mn, Cu and Si in leaf, stem and grain. Generally application of ZS, SA and PS increased the Si, Zn and Cu content in leaf stem and grain. Whereas Fe and Mn content are reduced due to application of ZS, SA and PS in rice leaf stem and grain.**

Keywords: **Zinc sulphate, salicylic acid, Potassium silicate.**

1. INTRODUCTION

Rice, which is being cultivated for several years in our country, it is not just a grain, it is the lifeline and is the second most important crop next to wheat. India is one among the leading producer of rice in Asia (Tony Cisse, 2005). Rice crop has been under cultivation from time immemorial, being grown under varying climatic conditions in different parts of the country. It is widely affected by quite a number of diseases caused by fungi, bacteria, viruses and mycoplasma which results in higher 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 (Current name: *Bipolaris oryzae* (Breda de Haan) Shoemaker) is found to occur in most rice growing areas.

Currently the disease is being managed by application of fungicides. Due to pesticides hazards, pollution effect, fungicide resistant, bio control agent resistant strains, lack of bioprotectant knowledge which required the integrated component approach in Indian farmer's level which will be improve growth and disease suppression.

The micronutrients considered essential for field crops are B, Cu, Fe, Al, Mo, Zn and low conc. of Ni and Co (Fageria *et al.,* 2002). Brown spot might be reduced by balanced fertilization, crop rotation and by the use of high quality planting seed (Rangaswami and Mahadevan, 1999). The incidence of brown spot is closely related with mineral nutrients and careful use of fertilizer can prevent the disease incidence (Gnanamanickam, 2009).

The efficacy of macro - micro nutrients in controlling diseases of cotton (Prasad, 1979), pigeon pea (Sarojini, 1950), rice (Eswaran and Naraynasamy, 2000; Reddy *et al.*, 2000), wheat (Rovira *et al.*, 1983), bengal gram (Balasubramanian and Shanmugam, 1988), cowpea (Kalim *et al.*, 2003), alfalfa (Adhilakshmi *et al.*, 2008), potato (Vishwakarma and Singh, 1984), coconut (Varkey *et al*., 1979), onion (Badawi and Khalaf, 1981), crucifers (Vytskii, 1979), apple (Bartha *et al.*, 1979), peach (Cripps *et al.*, 1983), rose (Sobti *et al.*, 1991), soybean (Sanjana *et al.*, 2005 ; Sanajana and Koti, 2006) are reported.

Bushkora *et al.* (1981) suggested that the use of microelements (boron, copper, zinc and magnesium) reduced the *Erwinia carotovora* (Jones) incidence on potato. Several authors reported on the use of zinc sulphate for managing the plant diseases (Kaur *et al.*, 1986; Reddy *et al.*, 2000; Vengadesh Kumar, 2005). Application of zinc fertilizers to Indian soil increased the resistance to disease, better seed viability and seedling vigour, improved abiotic stress tolerance and higher yield (Cakmak, 2009).

Therefore, with an aim to develop an integrated strategy involving the use of certain macro-micro nutrients, silicon based nutrients and resistance inducing chemicals for the successful sustainable management of rice brown spot. Hence, the present studies were undertaken to investigate the nutrient analysis of macro nutrient content of rice by application of Macro-micro nutrient, Salicylic acid, potassium silicate along with pathogen inoculation.

2. MATERIALS AND METHODS

Crop, Variety and Source

Crop : Rice (*Oryza sativa* L.)

Variety : ADT 36

Source : Tamil Nadu Rice Research Institute (TRRI),
Aduthurai, Tamil Nadu.

-Pot culture studies

The pot culture studies was conducted to test the efficacy of certain macro-micro nutrients, silicon based nutrients and certain resistance inducing chemicals for assessing their influence on the incidence of brown spot of rice with various treatment and combinations. The brown spot susceptible variety ADT 36 grown in rectangular pots of size, 30x45 cm was used for the study. The plants were given artificial inoculation by spraying the spore suspensions with adequate spore load (50,000 spores/ml) at 15 DAT in the evening hours. The crop was maintained in a poly house with frequent spraying of water to provide adequate moisture and relative humidity to enable successful infection by the pathogen. The experiments were conducted in a randomized block design with three replications for each treatment and a suitable control. The fungicide carbendazim 50 WP @ 0.1 per cent was used for comparison and the standard agronomic practices as recommended by the State Agricultural Department were followed.

The effective treatments observed in different experiments conducted under pot and field conditions were pooled together and a new schedule of treatments in combination was evolved for the effective management of brown spot disease of rice. Also, zinc sulphate @ 25 Kg/ha was applied as basal application to the entire treatments (ZSS) except control and comparison. The treatment details are given below;

Treatment schedule

T_1 – ZSS + ZSF_1 + ZSF_2

T_2 – ZSS + SA_1 + SA_2

T_3 – ZSS + PS_1 + PS_2

T_4 – ZSS + ZSF_1 + SA_2

T_5 – ZSS + SA_1 + ZSF_2

T_6 – ZSS + SA_1 + PS_2

T_7 – ZSS + PS_1 + SA_2

T_8 – ZSS + PS_1 + ZSF_2

T_9 – ZSS + ZSF_1 + PS_2

T_{10} – Carbendazim 50 WP @ 0.1 per cent as foliar spray (comparison)

T_{11} – Control

$ZnSO_4$ @ 25 Kg/ha was applied as basal application to the entire treatments (ZSS) except control and comparison. The treatment details are given below;

T_1 – ZSS + Two sprays of zinc sulphate @ 3 % on 15 and 30 DAT

T_2 - ZSS + Two sprays with salicylic acid @ 50 ppm on 15 and 30 DAT.

T_3 - ZSS + Two sprays with potassium silicate @ 3 % on 15 and 30 DAT.

T_4 - ZSS + First spray with zinc sulphate @ 3 % on 15 DAT + second spray with salicylic acid @ 50 ppm on 30 DAT.

T_5 - ZSS + Second spray with zinc sulphate @ 3 % on 30 DAT

T_6 - ZSS + First spray with salicylic acid @ 50 ppm on 15 DAT + second spray with potassium silicate @ 3 % on 30 DAT

T_7 - ZSS + First spray with potassium silicate @ 3 % on 15 DAT + second spray with salicylic acid @ 50 ppm on 30 DAT

T_8 - ZSS +First spray with potassium silicate @ 3 % on 15 DAT + second spray with zinc sulphate @ 3 % on 30 DAT

T_9 - ZSS + First spray with zinc sulphate @ 3 % on 15 DAT + second spray with potassium silicate @ 3 % on 30 DAT

T_{10} – Carbendazim (0.1 %) – Comparison

T_{11} - Un treated control.

Effect of ZS, SA, PS on the macro nutrient contents in rice

Triacid extract

One g. of powdered leaf, stem and grain samples were wet digested using 10 ml of triacid mixture containing concentrated HNO_3, H_2SO_4 and 60 per cent $HClO_4$ in the ratio of 5:1:2. The clear digest was made up to 100 ml with water (Yoshida *et al.*, 1972). The above extract was used for the individual elemental analysis following standard procedures.

Macro - Micro nutrient	References
Calcium and Magnesium	Cheng and Bray, 1951
Fe, Mn, Zn and Cu	Yoshida *et al.*, 1972
Crude silica	Yoshida *et. al.*, 1972

Effect of ZS, SA, PS and *H.oryzae* inoculation on micro nutrient content of rice var. ADT 36

Micro nutrients

Application of ZS, SA and PS significantly influenced the micro nutrient contents such as Zn, Fe, Mn, Cu and Si in leaf, stem and grain. Generally application of ZS, SA and PS increased the Si, Zn and Cu content in leaf stem and grain (Table 1 and Fig. 1, 2 and 3). Whereas Fe and Mn content are reduced due to application of ZS, SA and PS in rice leaf stem and grain.

Interaction effect of SA and PS might have increased the Ca and Mg content in the leaves of ADT 36 (Table 1). The results of the present investigations corroborate the finding of Bockhaven *et al.* (2011) who reported that application of various levels of silicate salts increased the micronutrient content significantly over control and reduced the incidence of brown spot. Also, Aref (2011) reported that foliar spray of zinc increased the content of copper and manganese in maize leaf.

Application of ZS, SA and PS significantly influenced the micro nutrient contents such as Zn, Fe, Mn, Cu and Si in leaf, stem and grain (Fig. 1, 2 and 3). Direct application of micronutrients at critical growth stages increased the micronutrient absorption in the grain (Kalyan Singh *et al.*, 2003). The supply of silicon could have also altered the content of K, Mg, S, Zn, Ca and Si in rice as observed by Moraes *et al.* (2009) in bean leaves. In the present study the maximum content of Fe was observed in control in all plant parts. This is due to the reason that normally zinc fertilizers reduce the content of Fe.

The results of the present investigations corroborate the finding of Aref (2011) who reported that there was antagonistic effect between the Fe and Zn. Manganese content was found decreased with the application of ZS, SA and PS and their combinations. Zinc uptake can be inhibited by a high Fe content of plants indicating the importance of interrelationships among nutrient contents in crop plants (Bergman, 1992). Copper content also increased with the application of ZS, SA and PS and their combinations. Among the plant parts, grain contained the minimum content of copper than stem and leaf. The increased content of Zn and Cu found might be due to the increased growth and its effect on increased nutrient absorption and accumulation whereas the reduction in the conc. of Fe and Mn might be due to the reduced absorption.

The combination treatment consisting of ZSS, SA_1 and PS_2 (T_6) increases the micro nutrient content of Ca, Mg and other micro nutrients activity when compared to control and fungicide treatments.

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APPENDICES-A

Table 1: Effect of ZS, SA and PS application on macro nutrients (NPK) content of brown spot infected rice var. ADT 36

T.No	Treatments	Nitrogen (%)			Phosphorus (%)			Potassium (%)		
		Leaf	Stem	Grain	Leaf	Stem	Grain	Leaf	Stem	Grain
1	ZSS + ZSF_1 + ZSF_2	0.25	0.27	0.92	0.23	0.21	0.32	1.32	3.18	0.61
2	ZSS + SA_1 + SA_2	0.24	0.31	0.93	0.24	0.20	0.35	1.25	3.09	0.59
3	ZSS + PS_1 + PS_2	0.22	0.30	0.91	0.20	0.23	0.27	1.30	3.01	0.62
4	ZSS + ZSF_1 + SA_2	0.26	0.26	0.92	0.21	0.24	0.32	1.29	3.22	0.60
5	ZSS + SA_1 + ZSF_2	0.20	0.26	0.91	0.22	0.24	0.34	1.38	3.24	0.58
6	ZSS + SA_1 + PS_2	0.24	0.29	0.94	0.24	0.25	0.35	1.46	3.35	0.67
7	ZSS + PS_1 + SA_2	0.22	0.29	0.91	0.24	0.23	0.34	1.42	3.17	0.62
8	ZSS + PS_1 + ZSF_2	0.24	0.28	0.92	0.20	0.23	0.31	1.27	3.29	0.58
9	ZSS + ZSF_1 + PS_2	0.25	0.27	0.92	0.21	0.22	0.26	1.25	3.25	0.60
10	Carbendazim	0.24	0.26	0.90	0.19	0.21	0.27	1.25	3.08	0.57
11	Control	0.23	0.25	0.90	0.18	0.19	0.25	1.15	3.02	0.53

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