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INFLUENCE OF SULPHUR AND ZINC NUTRITION ON INCIDENCE OF DISEASE AND PERFORMANCE OF RICE

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ABSTRACT

To ascertain the influence of sulphur and zinc on disease incidence and their extent and pattern i.e. severity a field experiment was conducted at ICAR Research Complex for Eastern Region Patna, Bihar during *Kharif seasons* of 2008 09 to 2010-11. The experiment was laid down in randomized block design (RBD) keeping three replication to evolve suitable disease management strategy by involving one secondary nutrient sulphur and one micro nutrient zinc under rice – lentil cropping system for Indo - Gangetic plains of Bihar. Total 16 treatment combination (four level of sulphur (0 kg, 20kg, 30kg and 40kg), and zinc (0 kg, 4kg, 5kg and 6 kg) were used to know the their effect on disease development. The incidence of various disease were significantly affected by both the minerals i.e. sulphur and zinc. Significantly decreases in the affected area in plant with respect to most of the disease were recorded with every increase in sulphur dose, whereas reverse response trend was observed in case of zinc application. Plot treated with 40 kg sulphur recoded minimum disease incidence whereas corresponding maximum was observed in case of Zn applied @ 6 kg/ha. The percentage of reduction in agro-morphological traits like plant height, panicle length, number of tiller and seed yield due to incidence of disease was also recorded minimum with 40 kg sulphur application.

Key words: disease incidence, micronutrient, rice, secondary nutrient sulphur and zinc.

Rice (*Oryza sativa* L.), a member of the family poaceae is widely grown in tropical and subtropical regions (Ezuka and Kaku, 2000). It is a dietary staple of more than half of the world and 65% of the Indian population (Liu *et al.*, 2008). Rice production and consumption is concentrated in Asia, where more than 90% of all rice is consumed. In India, of the 44 mha of total rice area, 33% is in rainfed low lands and 15% in uplands (Economic survey 2007). Efficient and balanced nutrient management is one of the important inputs of the rice production that can enhance productivity to a great extent. However excess application of micro nutrients such as zinc could be also increase the incidence of disease (Singh and Kumar, 2009). The rice plant has a wide array of enemies in the field. This includes different diseases and pests which are controlled by using specific strategies. There is need of understanding the relationship between applications of nutrients and incidence and severity of disease in rice crop. The increase in rice production can be achieved by efficient and good agronomical practices (Singh *et al.*, 2012). However poor management of plant nutrients serve as a hurdle in efforts to increase rice production in India. While Indian farmers apply N, P and K fertilizers widely, it is found that application of micronutrient such as sulphur and zinc is not a usual practices. A marked higher incidence of micronutrient deficiency is found in crop due to intensive cropping, loss of fertile top soil and losses of nutrient through leaching. The importance of soil fertility is increasingly recognized in developing countries especially in India, which has a high pressure' of population on the land. Currently the integrated nutrient supply system (INSS) involving the use of inorganic fertilizers, organic manures and bio-fertilisers is gaining and momentum. Even though, INSS is mainly considered for major nutrients *viz.*, N, P and K, its use needs to be extended to important nutrients like S and Zn, since the secondary and micronutrient deficiencies are assuming considerable importance (Singh *et al.*, 2011). The present investigation was undertaken to study the effect of sulphur and Zinc on disease dynamics of transplanted rice. Since disease incidence and severity was said to be associated with the applied quantity of sulphur and or zinc in rice crop. Limited studies have been conducted on this aspect to quantify the role of both the nutrients. The objective of present study was to examine the effect of sulphur and zinc nutrition on performance of rice with reference to growth and development, yield attributes and yield of rice and incidence of disease Blast Pyricularia oryzae, Helminthosporium oryzae, Sheath Blight Rhizoctonia solani, Bunt or kernel smut Tilletia barclayana, Bacterial leaf blight Xanthomonas oryzae pv. oryzae. The yield losses caused by the pathogen ranges from 30-61 per cent depending upon the stages of infection. Sheath blight the fungus affects the crop from tillering to heading stage. The presence of several large lesions on a leaf sheath usually causes death of the whole leaf, and in severe cases all the leaves of a plant

may be blighted in this way. Losses up to 6 per cent are noticed in flag leaves stage (Anonymous, 1983) Avoid excess doses of fertilizers. Apply organic amendments. Spray Carbendazim 250 g / ha. False smut affects the early flowering stage of the rice crop when the ovary is destroyed. The second stage of infection occurs when the spikelet nearly reaches maturity. The disease causes chalkiness and can reduce 1,000-grain weight. It also causes a reduction in seed germination of up to 35%. In damp weather, the disease can be severe and losses can reach 25%. In India, a yield loss of 7-75% was observed (*Seth, 1945).* Brown spot is observed during the maximum tillering up to the ripening stages of the crop. Damage is important when infection occurs in the seed, causing the formation of either unfilled grains or spotted or discolored seeds giving rise to infected seedlings. Numerous spots or big spots on a leaf may result in blight, thus killing the whole leaf. Epidemics in India have resulted in 14-41% losses in high yielding varieties. Under favorable environment, yield loss estimates ranging from 16 to 40% in Florida, USA was reported (Webster and Gunnell, 1992). Yield loss due to Bacterial leaf blight disease corresponds to the plant growth stages at which the rice plants were infected. The earlier the disease occurs, the higher the yield loss. Infection at booting stages does not affect yield but results in poor quality and a high proportion of broken kernels.

MATERIAL AND METHODS

Field experiment was conducted at ICAR Research Complex for Eastern Region Patna, Bihar during *Kharif* seasons (2008-11) in randomized block design (RBD) replicated thrice to evolve suitable nutrient management system with respect to one secondary nutrient sulphur and one micro nutrient zinc under rice – lentil cropping system for Indo- Gangetic plains of Bihar. Four level of sulphur S_1(0kg), S_2(20kg), S_3(30kg), and S_4(40kg) and zinc Zn_1(0kg), Zn_2(4kg), Zn_3(5kg), and Zn_4(6kg) respectively, was applied on hectare basis. Both sulphur and zinc applied to rice crop as basal application. Data on disease incidence were also recorded simultaneously to know the effects of tested nutrients on disease dynamics if any. The texture of soil of experimental plot was silty clay loam with mean pH value of 6.8, electrical conductivity 0.16 ds/ m in 1:2 soils: water solution, organic carbon 0.68 per cent, with available nitrogen 244.7 kg/ ha, available phosphorus 28.6 kg/ha, available potash 185.8 kg/ha, sulphur 8.3 kg/ha and zinc 0.8kg/ha. As per the technical programme different sources were used for both the nutrients. All other nutrients especially NPK and agronomic management practice was as per recommended practices. Transplanting was done at 20 cm row to row and 10 cm plant to pant spacing respectively. The size of plots was 10 m X 5 m. Standard package of practice were adopted as in case of rice crops in respect to weed and water management. Incidence of disease was recorded during all the season to know the impact of nutrient management on disease management.

RESULTS AND DISCUSSIONS

Effects of sulphur and zinc on extent and pattern of disease development:

The incidence of various disease infestations are significantly affected by both the factor (Sulphur and zinc). Increasing quantity of sulphur application significantly decreases the plant affected area in respect of most of the disease mention above whereas reverse trends were observed in case of application of zinc (Table 1). Percent plant area damage by sheath blight and brown spot were significantly increase with increasing the level of application of zinc whereas similar results was not observed in case of damage caused by false smut and bacterial leaf blight. Application of Sulphur @ 40kg/had increase significantly the incidence of false smut and brown spot disease as compared to sheath blight and BLB. Reverse type of response was recorded in case of zinc application. Application of 6 kg Zn significantly increased the percent area damage by sheath blight, sheath rot and bacterial leaf blight as compared to false smut (only 1.3 %) and brown spot (2.1%). In case of 20 kg/ha and 30 kg/ha sulphur application, there is no significant differences were observed with respect to incidence of all disease mention above. In case of 5 kg/ha and 6 kg/ha zinc application, infestation of percent plant area by sheath blight and bacterial leaf blight were significantly increased but results was not same for false smut, sheath rot and brown spot. Percent plant area damaged by false smut was at par at application of 20 kg/ha and 40 kg/ha sulphur .(Li *et al.,* 2010).

Effects of sulphur and zinc on rice performance:

The plant height of rice is significantly affected by both the nutrients (sulphur and zinc). Application of sulphur @ 20kg/ha produced significantly taller plants (124.6 cm) over no application of sulphnr (S_1). Application of sulphur @ 30kg/ha showed superiority (126.5cm) over S_1 and S_2 treatments but produces at par with highest level of sulphur application i.e. 40 kg/ ha. Similar type of response was also noticed in case of zinc application. Application of Zn @ 5kg/ ha recorded significantly higher plant height (129.4cm) over no application of Zn, however it produces at par with Zn applied @4kg/ ha (Zn_4 treatment). Maximum plant height 129.4 cm was

Table 1. Effect of sulphur and zinc nutrition on disease infestation in rice

Treatments	False Smut (% Infected Florets)	Sheath Bligh (% Plant Area Damage)	Sheath Rot (% Affected Tiller)	Brown Spot (% Leaf Area Damage)	BLB (% Leaf Area Damage)
S_1 (0kg)	1.4	7.1	7.1	2.7	9.5
S_2 (20kg)	1.3	6.5	6.5	2.1	8.4
S_3 (30kg)	1.2	5.7	5.7	2.0	7.2
S_4 (40kg)	0.9	3.5	5.1	1.8	6.1
Zn_1 (0kg)	1.0	5.2	7.2	1.7	6.8
Zn_2 (4kg)	1.2	6.7	7.8	1.9	7.3
Zn_3 (5kg)	1.2	7.9	8.1	2.0	8.2
Zn_4 (6kg)	1.3	11.2	8.2	2.1	9.6
CD (p = 0.05)	0.2	1.1	1.2	0.1	1.4

Table 2. Effect of sulphur and zinc nutrition on growth yield attributes and yields of rice

Treatments	Plant height(cm)	LAI	Panicle / M^2	Grains/ panicle	Biomass (t/ha)	Grain (t/ha)	HI (%)	1000 seed (g)
S_1 (0kg)	121.5	6.35	271.4	191.8	17.23	7.23	0.41	15.9
S_2 (20kg)	124.6	7.12	287.9	199.5	17.57	7.25	0.42	16.0
S_3 (30kg)	126.3	7.51	303.6	204.9	17.71	7.44	0.42	15.9
S_4 (40kg)	128.4	7.84	300.1	205.6	18.32	7.51	0.41	16.0
Zn_1 (0kg)	122.7	6.64	274.0	193.1	17.12	7.19	0.42	15.9
Zn_2 (4kg)	126.2	7.25	291.4	202.03	17.85	7.32	0.41	16.0
Zn_3 (5kg)	128.3	7.73	307.9	205.59	17.74	7.45	0.42	16.0
Zn_4 (6kg)	129.4	8.15	311.4	207.7	18.12	7.61	0.42	16.1
CD (p = 0.05)	2.1	0.63	15.6	9.08	0.31	0.12	NS	NS

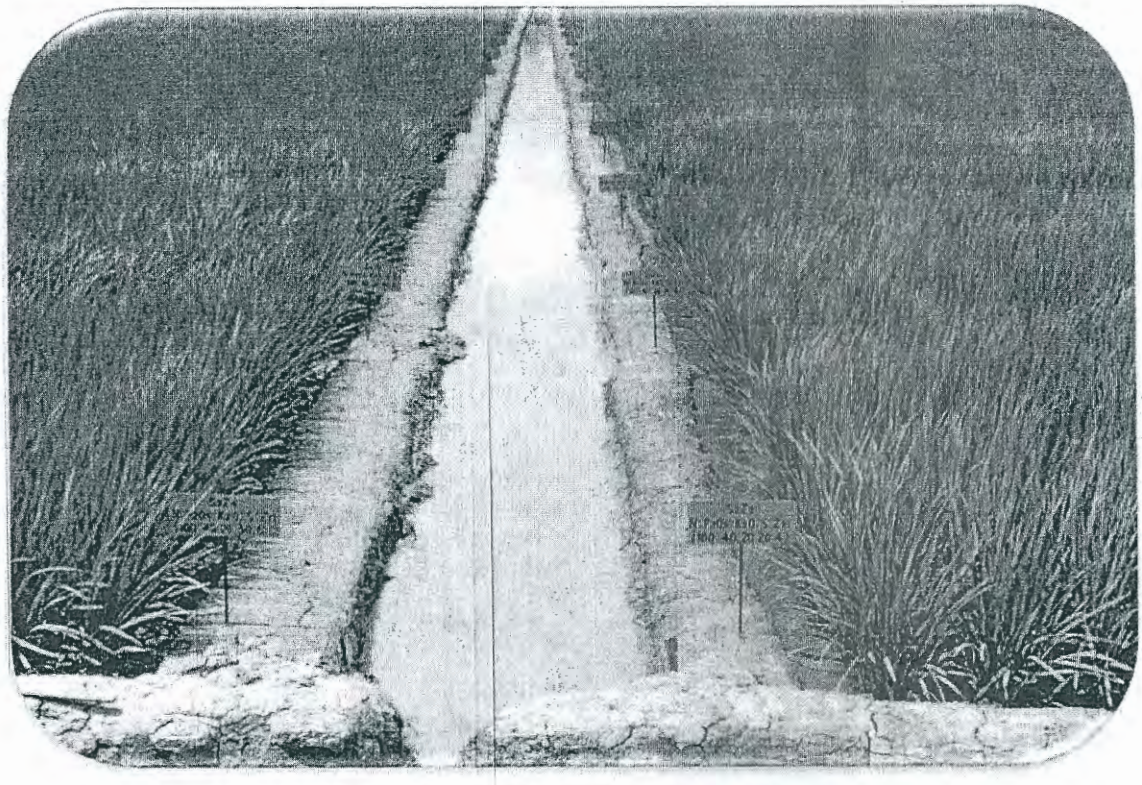

Figure1: Field view of rice crop at active tillering stage

recorded with application Zn_4, whereas corresponding minimum plant height (121.5 cm) was recorded with no application of Zn. (Table 2). Sulphur application influences leaf area index (LAI) significantly. It was recorded that application of sulphur @ 20 kg/ha produced significantly higher LAI (7.12) over no application and at par with other tested levels of sulphur (Table 1). Response of graded doses of applied zinc on LAI was also noticed. In case of zinc application highest LAI (8.15) was obtained with zinc @ 6 kg/ha and minimum (6.45) with no application of sulphur (S_1). Results showed that the treatment (Zn_3) consisting of zinc @5kg/ha produced significantly higher LAI (7.73) over no application of zinc and @4kg/ha, however it produced at par with zinc applied @6kg/ha. Yield attributes were also influenced significantly with graded doses of sulphur and zinc. Number of panicle per square meter, which contributes to the economic yield, significantly influenced with both the nutrients. Maximum (311.4) and minimum (271.4) panicle/M^2 was recorded with the application of Zn @6kgand with no application of sulphur (Table 1). Number of grains per panicle was also influenced significantly with both the tested nutrients. Maximum (207.7) and minimum (191.8) grains per panicle, was recorded with Zn_4 and S_1 treatments respectively (Table 1). Total above ground biomass (t/ha) production was also varied due to graded application of sulphur and zinc. It was noticed that maximum (18.32) and minimum (17.12) above ground biomass was recorded with Zn_4 and S_1 treatment. Grain yield of rice was also affected significantly with the levels of both the factors/nutrients (S and Zn). Maximum (7.57 t/ha) and minimum (7.20 t/ha) grain yield was obtained with 6 and 0 kg/ha In case of sulphur, application, @ 20 kg/ha produced rice grain 7.45 t/ha significantly over control (S_1) however it produced at par with other tested levels of i.e. S_3 and S_4. In case of zinc, application of zinc @6kg/ha produced significantly higher grain yield over no zinc application but produces at par with other tested levels of zinc. Harvest index (HI) was not influenced significantly by any of tested factor, it might be due to characters highly influence with its genetic makeup, though the harvest index (HI) ranged in between 0.41 to 0.42. Similar trend was also recorded in case of 1000 - grain weight and its range in between 15.9 to 16.1 g (Ali, *et al.*, 2012 and Singh *et al.*, 2011).

Conclusion

Application of sulphur and zinc in exact / appropriate combination will not only improve quantity of produce but it also improve its quality due to less incidence of disease and consequently minimum utilization of pesticide, which is not only minimized cost of production but also minimized the soil contamination with all these health hazardous chemical substance, having very slow pace in bio degradation.

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