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Research Article

Effects of genotypes and methods of micronutrient application on tillering behaviour, growth and yield of aerobic rice

C.J. SRIDHARA, H.E. SHASHIDHAR AND K.T. GURUMURTHY

Abstract : The field experiment on the effect of genotypes and method of micronutrient application on tillering behaviour, growth and yield of aerobic rice was conducted during *Kharif* 2004 and 2005 at College of Agriculture, Navile Farm, Shivamogga. The study consisted of five genotypes *viz*., BI-43, Rasi, BI-27, KRH-2 and H-9 with four method of micronutrient application *viz.,* S_1: Enriched FYM with Zn and Fe, S_2: Seed soaking S_3: Direct seeding S_4: Soil application of Zn and Fe. The results revealed that among the genotypes, BI-43 recorded significantly higher grain yield (49.5 q ha^{-1}) and higher number of tillers (23.5 $plant^{-1}$) as compared to other genotypes. Among the method of micronutrient application, soil application of zinc and iron recorded significantly higher grain yield (49.5 q ha^{-1}) as compared to other methods.

Key Words : Genotypes, Micronutrient, Tillering behavior, Direct seeding, Seed treatment

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INTRODUCTION

Rice (*Oryza sativa* L.) is the most important staple food crop of India. In India, rice is grown in an area of 44.6 m.ha with a production of 109.5 mt and average productivity of 2.62 t per ha. projection of India's rice production target for 2025 AD is 140 mt, which can be achieved only by increasing the rice production by over 2 mt per year in the coming decade and their has to be done against back drop of diminishing natural resource, such as waster and land. Most of the Asian countries facing severe water scarcity, threatenup sustainability of rice production (Belder *et al.,* 2002). Aerobic rice is the best alternative method of rice production under water scared areas with high yielding, good tillering and with better root traits. Rice cropping system has been experiencing decline in productivity (Bhandari *et al.,* 2003) due to high analysis fertilizer and reduced avrge of micro nutrient application which leads to zinc and iron deficiencies (Takkar, 1996). Zinc and iron are most important micronutrients required by the rice. Zinc is a major component and activated of several enzyme involved in metabolic activities such as auxim and protein synthey's, nucleic acid and carbohydrate metabolism (Janakiraman, 2005). Genotypes responds better with different micronutrient application under aerobic situations (Castaneda *et al.,* 2002). Developing good genotypes with good tillering behaviour under different source of micronutrient application is the key factor influencing on growth and yield of aerobic rice. Keeping this in view, the present study on effect of genotypes, micronutrient application, particularly zinc and iron on growth, tillering behaviour and yield of aerobic rice was carried out.

MEMBERS OF RESEARCH FORUM

Author of the Correspondence :
C.J. SRIDHAR, College of Agriculture, Navile Farm, SHIMOGA (KARNATAKA) INDIA

Address of the Coopted Authors :
H.E. SHASHIDHAR AND K.T. GURUMURTHY, College of Agriculture, Navile Farm, SHIMOGA (KARNATAKA) INDIA

EXPERIMENTAL METHODS

Field experiments were carried out for two years (2004 and 2005) during *Kharif* season at College of Agriculture, Navile, Shimoga. The soil of the experimental site was red sandy loam with acidic in nature (pH 6.2), medium in organic carbon (0.43%), high in available phosphorus (194 kg ha^{-1}) and medium in potassium (178 kg ha^{-1}). The experiment was laid out on a randomized black design replicated three times. The treatment compared of combinations of two factors *viz*., genotypes and methods of micronutrient application and replicated three times. These treatments were laid as factorial RCBD. Genotypes consisted of G_1: BI-43, G_2: BI-27, G_3: Rasi and G_4: KRH-2, while methods of micronutrient application consisted of S_1: seed pelleted with enriched FYM, S_2: seed soaking, S_3: direct seeding and S_4: direct seeding with soil application of zinc iron.

Direct seeding was done after preliminarily land preparation without any padding. The field was thurolly prepared by tractor, cultivator and leveler to make fine tilth. Plots was prepared with a dimension of 4.5 x 3mt. Enrichment of farmyard manure was done by mixing 500 ppm of zinc and 1000 ppm of iron in 1 kg organic manure and was used for seed pelleting by using adhesive. Seed soaking was done by soaking seeds in waster for 24 h and then dried under shade for 2-4 hr. For soil applications, 5 g of $FeSO_4$ and 20 g of zinc sulphate was applied for each plot along with FYM and two seeds were sown per spot.

Recommended package of practices were followed for growing the crop. A common fertilizer of 100:50 kg N, P and K ha^{-1} was adopted. The half of the fertilizer dose was applied as based and the remaining quantity was applied as two equal split doses at 30 and 50 day after sowing. The needs were managed by passing wheelhoe two times at 30 and 50 days hand weeding two times at 20 and 40 days. The crop was grown purely on rianfed situations and irrigation was given during dry spells. During the crop growth period the rainfall of 847 mm and 1409 mm was recorded with 67 and 83 rainy days, respectively for 2004 and 2005. Blast and stemborer were the major disease and pest observed during experimentation. Plant protection was taken by the application of bavistin and marcotop at right time. Periodical observation on tillering behaviour *i.e.* primary tillers, secondary tillers, tertiary tillers and total tillers were recorded along with growth and yield parameters. The data obtained were subjected to statistical analysis and were tested at five per cent level of significance to interpret the treatment differences.

EXPERIMENTAL RESULTS AND ANALYSIS

Seed treatments are one of the important factors contributing to grain yield in aerobic rice. Method of micronutrient application has significant influence on growth and yield of rice.

Effect of micronutrient application on growth of aerobic rice:

Significantly higher grain yield (54.6 q ha^{-1}) was

Table 1 : Effect of genotypes and methods of micro nutrient application on tillering behaviour growth and yield in aerobic rice (pooled data for 2004 and 2005)

Genotypes	30 DAS			60 DAS				90 DAS			
	Primary	Sec.	Total	Primary	Sec.	Tertiary	Total	Primary	Sec.	Tertiary	Total
G_1: BI-43	2.0	6.5	8.5	2.9	10.9	3.1	17.0	2.1	19.4	2.0	23.5
G_2: BI-27	1.4	1.7	3.1	1.7	3.4	1.2	6.4	1.2	9.9	2.0	13.2
G_3: Rasi	2.0	5.6	7.6	3.0	9.5	2.2	14.8	2.3	17.2	2.1	21.7
G_4: KRH-2	1.5	3.0	4.5	2.0	4.2	2.5	8.8	1.5	11.5	2.4	15.5
S.E. ±	0.1	0.2	0.2	0.2	0.4	0.3	0.3	0.2	0.4	0.2	0.3
C.D. (P=0.05)	0.3	0.5	0.6	0.5	1.0	NS	0.9	0.5	1.0	NS	0.9
Micronutrient applications (S)											
S_1	1.7	4.6	6.4	2.5	7.5	2.4	12.5	2.0	14.8	2.2	19.1
S_2	1.5	3.9	5.5	2.1	6.0	2.5	10.6	1.5	13.6	2.5	17.6
S_3	1.5	3.3	4.9	1.8	5.7	2.0	9.6	1.4	13.0	2.2	16.2
S_4	2.0	4.9	7.0	3.1	8.7	2.2	14.1	2.2	16.6	2.0	21.0
S.E. ±	0.1	0.2	0.2	0.2	0.4	0.3	0.3	0.2	0.4	0.2	0.3
C.D. (P=0.05)	0.3	0.5	0.5	0.5	1.0	NS	0.9	0.5	1.1	NS	0.9
Interaction (G x S)											
S.E. ±	0.1	0.2	0.2	0.2	0.4	0.4	0.4	0.2	0.4	0.2	0.4
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS=Non-significant

Table 2 : Tillering behaviour and yield as influenced by genotypes and method of micronutrient application aerobic rice (mean data for two years)

Genotypes (G)	Weeks after sowing								
	4	5	6	7	8	9	10	11	12
G_1	2.4	8.5	9.3	9.5	12.7	17.0	22.3	20.3	20.0
G_2	2.5	3.6	4.3	4.5	5.0	7.0	10.9	13.0	11.5
G_3	3.0	7.4	7.5	8.6	14.0	16.7	22.0	20.0	19.4
G_4	3.6	4.5	4.8	6.4	7.5	9.0	13.3	15.4	13.7
S.E. $\pm$	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
C.D. (P=0.05)	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.5	0.5
Micronutrient methods (S)									
S_1	3.5	6.0	6.7	8.0	10.6	13.0	17.3	17.4	15.8
S_2	2.3	5.2	5.3	6.5	9.0	11.2	15.8	16.4	14.9
S_3	1.7	4.9	5.3	6.6	8.5	10.5	15.6	15.5	14.7
S_4	4.0	7.5	7.7	8.0	11.2	15.0	19.7	19.5	19.2
S.E. $\pm$	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
C.D. (P=0.05)	0.5	0.5	0.5	0.6	0.5	0.6	0.6	0.6	0.5
Interaction (G x S)									
S.E. $\pm$	0.2	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.2
C.D. (P=0.05)	NS	0.6	0.8	0.6	0.8	0.6	0.8	0.6	0.5

NS=Non-significant

recorded with soil application of zinc and iron compared to seed pelleting with enriched FYM (49.5 q ha^{-1}), seed soaking (47.2 q ha^{-1}) and direct seeding (44.6 q ha^{-1}) (Table 3). The reduction in yield over soil application was 6.0, 9.1 and 13.0 per cent in seed pelleting, seed soaking and direct seeding, respectively. Good response of rice to zinc sulphate and iron sulphate application was observed at different places upto 25 kg ha^{-1} (Tripathi and Tripathi, 2004). Higher grain yield in soil application of zinc and iron was mainly due to higher leaf area (1335.3 cm^2 $plant^{-1}$), higher dry matter

Table 3 : Growth and yield parameter as influenced by genotypes and methods of micronutrients application in aerobic rice (pooled data for 2 years)

Genotypes (G)	Leaf area (90 DAS) (cm^2 $plant^{-1}$)	TDM (90 DAS) (g. $plant^{-1}$)	No. of panicles $plant^{-1}$	No. of grains $panicles^{-1}$	Panicles weight (g)	Panicle length (cm)	Test weight	Grain yield (q ha^{-1})
G_1	1363.3	62.7	17.5	158.2	3.0	21.9	24.4	49.5
G_2	1164.9	53.6	10.9	137.3	2.1	17.1	22.0	40.2
G_3	1282.7	61.4	15.9	156.6	2.8	21.5	24.0	42.2
G_4	1271.2	58.4	13.7	154.2	2.7	19.9	22.4	41.5
S.E. $\pm$	10.7	0.7	0.3	0.7	0.04	0.2	0.2	0.8
C.D. (P=0.05)	30.8	2.1	0.8	2.1	0.13	0.5	0.5	2.3
Micronutrient methods (S)								
S_1	1306.9	60.0	14.8	155.6	2.6	19.9	23.3	49.5
S_2	1232.6	57.1	13.1	149.1	2.6	19.9	23.0	47.2
S_3	1207.3	55.8	12.5	143.0	2.5	19.6	22.6	44.6
S_4	1335.3	63.2	17.5	158.6	2.8	20.9	23.9	54.6
S.E. $\pm$	10.7	0.7	0.3	0.7	0.04	0.2	0.2	0.6
C.D. (P=0.05)	30.8	2.1	0.8	2.1	0.13	0.5	0.5	1.7
Interaction (G x S)								
S.E. $\pm$	12.3	0.8	0.3	0.8	0.05	0.2	0.2	0.9
C.D. (P=0.05)	35.1	NS	NS	NS	0.10	NS	NS	NS

NS=Non-significant

accumulates (63.2 g plant^{-1}), higher number of panicles (17.5 plant^{-1}), number of grains panicle (158.6 plant^{-1}), higher panicle length (20.9 cm), panicle weight (2.8 g) and more test weight (23.9 g) as compared to other treatment (Table 3). Tillering behaviour at 90 DAS clearly indicated more number of primary (2.2), secondary (16.6) and tertiary tillers (2.0) in soil application of zinc and iron and other micronutrient application methods (Table 1). Early tillering was observed in soil application of zinc and iron (4.0) at 4 weeks after sowing and contuined upto 10 weeks (19.7) after sowing and starts declining later, whereas in to other micronutrient application methods tillering still continued leading to late tillering, resulting in lower yield. Higher yield could be attributed to overall experiment in crop growth and increased supply of nutrients and photosynthates (Vasudeva and Ananthanarayana, 2001). It was quite interested to note that soil application of zinc and iron increased number of tillers by 23.3 per cent over control (direct seeding). Grain yield entirely depends on total dry matter accumulation. Significantly higher dry matter accumulation (63.2g) was noticed in soil application of zinc and iron. Higher dry matter accumulation was mainly due to micro photo synthete leaf surface area (1335.3 cm^2). Improvement in the yield and yield components of zinc with soil application of zinc and iron was ascribed to its involvement in metallo-enzyme system regulatory function and in growth promoting auxic production (Murayana, 1964).

Effect of genotypes and method of micronutrient application on yield of aerobic rice:

Among the micronutrient deficiencies in rice, iron deficiency is the second most. Common trace element disorder after rice under aerobic situations and more so in drop at prone areas. Soil application of iron in the form of ferrous sulphate increased the rice yield. Among the various treatments, direct seeding (control) resulted lower yield, whereas seed soaking with water improved grain yield (3.9%) but soil application of ferrous sulphate at 5 kg ha^{-1} significantly increased the grain yield over control. The increased grain yield was due to more number of panicles (17.5) and more panicle weight (2.8g) (Table 3). In addition, iron application helps in better utilization of nitrogen which helped in increased sink size (Sarangi and Sharma, 2004). Soil application micronutrient was superior to all other treatments in increasing the yield. Among the genotypes, BI-43 recorded significantly higher grain yield (49.5 q ha^{-1}) compared to other genotypes. Higher grain yield in BI-43 was due to higher number of Panicles(17.5 per plant),number of grains(158.2 per plant), panicle weight (3.0g),panicle length (21.9cm) and higher test weight (24.4 g).

Effect of genotypes and method of micronutrient application on tillering behaviour:

Tillering behaviour study also indicated that BI-43 early tillering (from 5th week) extends upto 10th week (22.3) compared to other genotypes (Table 2). BI-43 recorded significantly more number of primary (2.1), secondary (19.4), tertiary (2.0) and total tillers (23.5 compared to other genotypes (Table 1). The study clearly revealed that BI-43 is a early tillering bearing more number of effective tillers in turn lead to high yield.

Conclusion:

From this study it is concluded that BI-43 along with the soil application of zinc and iron was the better adoption practice to increased yield in aerobic rice.

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