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EFFECT OF NUMBER OF SEEDLINGS HILL^{-1} AND ZINC FERTILIZER ON THE PERFORMANCE OF TRANSPLANT *AMAN* (BRRI DHAN39) RICE *(ORYZA SATIVA* L.)

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ABSTRACT

An experiment was conducted at the Agronomy Field Laboratory of Bangladesh Agricultural University, Mymensingh during transplant *aman* season (July to October 2012) to evaluate the effect of number of seedlings hill^{-1} and level of zinc on the yield and yield contributing characters of BRRI dhan39. The experiment consisted of two factors namely, (i) number of seedlings hill^{-1} i.e., 1, 2 and 3 seedlings hill^{-1} and (ii) level of zinc i.e., 0, 5 and 10 kg $ZnSO_4$ ha^{-1}. The experiment was laid out in a randomized complete block design with three replications. Results of the study revealed that plant height, total tillers hill^{-1}, effective tillers hill^{-1}, length of panicle, grains panicle^{-1} and sterile spikelets panicle^{-1} were significantly affected by number of seedlings hill^{-1}. Level of Zn had significant effect on plant height, total tillers hill^{-1} and sterile spikelets panicle^{-1}. Other yield and yield contributing characters including grain yield were remained unaffected by level of Zn. Plant height, total tillers hill^{-1}, effective tillers hill^{-1}, grains panicle^{-1} and sterile spikelets panicle^{-1} were significantly affected by the interaction of number of seedlings hill^{-1} and level of Zn fertilizer although grain yield was not influenced. From the results of the study it may be concluded that BRRI dhan39 rice could be grown in AEZ-9 (Old Brahmaputra Floodplain) with one seedlings or two seedlings hill^{-1} without Zn fertilizer. Moreover, BRRI dhan39 rice could be accommodated in transplant *aman rice*- mustard- *boro* rice cropping pattern since this rice can be harvested in mid or late October.

Key words*: BRRI dhan39, Cropping pattern, Number of seedlings, Zinc fertilizer*

INTRODUCTION

Agriculture in Bangladesh is predominantly rice based and Bangladesh is the fourth rice producing country in the world. In Bangladesh rice occupies 11.35 million hectares of land which is about 79 percent of the cultivated area (BBS, 2010). The population of Bangladesh will increase to 173 million in 2020. According to National Agricultural Commission to feed the increased population by 2020, 47 million tons of rice will be needed to produce. Bangladesh lacks arable land to extend rice production. Besides, rice production is decreasing day by day due to high population pressure, continuing drought and flood in farming areas, and conversion of farmlands to grow cash crops instead of rice. Therefore, it is an urgent need of the time to increase rice yield in Bangladesh. The average yield of rice in Bangladesh is 2.91 t ha^{-1} (BBS, 2010). This yield is much lower than that of other rice growing countries like Japan (6.8 t ha^{-1}), Korea (6.8 t ha^{-1}) and China (6.3 t ha^{-1}) (IRRI, 2005). The reasons for low yield of rice are manifold; some are varietals, others are technological and rests are climatic. Undoubtedly, with the introduction of high yielding varieties the yield of rice has been increased, but the trend of increase is not linear. The yield can be increased by using improved cultural practices like use of quality seed, high yielding varieties, adopting plant protection measures, optimum seedling age, optimum number of seedling hill^{-1}, seedling raising technique, judicious application of fertilizers, etc. Among the improved cultural practices number of seedlings hill^{-1} is an important factor for successful rice production because it influences the tiller formation, solar radiation interception, total sunshine reception, nutrient uptake, rate of photosynthesis and other physiological phenomena and ultimately affects the growth and development of rice plant. In densely populated rice field inter specific competition between the plants is high in which sometimes results in gradual shading and lodging and thus favour increased production of straw instead of grain. It is, therefore, necessary to determine the optimum number of seeding hill^{-1} for higher yield.

Rice is generally grown on soils where Fe and Mn concentrations increase manifold due to submerged and reduced conditions while their high amounts disturb the balance of other micronutrients in the soil as well as within the plants (Ganwar and Mann, 1972; Chaudhry *et al*., 1977). High level of Zn and Fe in the growth medium may impede Mn uptake by plants while Fe deficiencies are evolved by excess of nutrients such as Cu, Mn and Zn (Tisdale *et al*., 1985). A favorable balance of macro and micronutrients is required for optimum crop production but nutrient imbalances can occur due to non-judicious and liberal use of major and low level of micronutrients in soil. Increase in paddy yield with Zn has been reported in literature (Takkar and Singh, 1978: Kausar *et al*., 2001). On the other hand, excess application of any fertilizer including Zn is harmful for soil. It is therefore, needed to determine the actual requirement of zinc for the production of BRRI dhan39 rice in *aman* season. The present research work was therefore, undertaken to find out the optimum number of seedlings hill^{-1} and application of zinc for the production of BRRI dhan39 rice grown in *aman* season.

MATERIALS AND METHODS

The study was carried out at Mymensing during the period from July to October 2012 with a view to find out the effect of number of seedlings hill^{-1} and zinc fertilization on the yield of transplant *aman* rice namely BRRI dhan39. The treatments consisted of

three levels of number of seedlings hill^{-1} viz., one, two and three seedlings hill^{-1} and three levels of $ZnSO_4$ viz., 0, 5 and 10 kg $ZnSO_4$ ha^{-1}. The experimental site belongs to the Old Brahmaputra Floodplain (AEZ-9). The experimental field was medium high. The experiment was laid out in a randomized complete block design with three replications. Rice variety BRRI dhan39 was used as planting material. Sprouted seeds were sown on well-prepared nursery bed on 30 June 2012. Weeds were removed and irrigation was given in the seedling nursery as and when necessary. In the experiment, each unit plot was uniformly fertilized with urea, TSP, MP, and gypsum at the rate of 130, 55, 85 and 60 kg ha^{-1} as source of N, P_2O_5, K_2O and S, respectively, as per BRRI recommendation (BRRI, 2011). Fifteen-day-old seedlings were uprooted on 15 July 2012 and transplanted in the unit plot as per experimental treatment. The zinc sulphate as a source of zinc was also applied as per experimental treatment. Except urea all the fertilizers were applied as basal dose. Urea was top dressed in two equal splits at 20 and 40 days after transplanting. Weeding, watering and other intercultural operations were done as and when necessary. No remarkable disease and insect infestation were observed in the experimental plots and hence, no plant protection measure was taken. The crop was harvested at full maturity on 24 October 2012. Maturity of crops was determined when some 90% of the grains became golden yellow in colour. The grains were cleaned and sun dried to moisture content 14%. Straws were also sun dried properly and brought to moisture content 14%. Finally grain and straw yields plot^{-1} were recorded and converted to t ha^{-1}. Data were collected on plant height, total tillers hill^{-1}, effective tillers hill^{-1}, length of panicle, grains panicle^{-1}, 1000-grain weight, grain yield, straw yield and harvest index. The collected data were compiled and tabulated in proper form and were subjected to statistical analysis. Analysis of variance (ANOVA) was done following the computer package MSTAT-C. The mean differences were adjudged by Duncan's Multiple New Range Test (DMRT) (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effect of number of seedlings hill^{-1}

Number of seedlings hill^{-1} had significant influence on plant height, total tillers hill^{-1}, effective tillers hill^{-1}, length of panicle and grains panicle^{-1} whereas 1000-grain weight, grain and straw yields and harvest index were not significantly influenced by number of seedlings hill^{-1} (Table 1). From the results of the study it is observed that one seedling hill^{-1} produced the tallest plant (106.9 cm) which was statistically identical (106.7 cm) with that of three seedlings hill^{-1}. The shortest plant (103.2 cm) was obtained from two seedlings hill^{-1}. The highest number of total tiller hill^{-1} (13.18) and effective tillers hill^{-1} (8.27) was observed from transplanting three seedlings hill^{-1}. This might be due to more number of seedlings transplanted per hill produced more number of tillers and effective tillers hill^{-1}. The longest panicle (26.75 cm) was obtained from one seedlings hill^{-1} which was statistically similar with that of three seedlings hill^{-1}. The highest number of grains panicle^{-1} (152.6) was obtained from two seedlings hill^{-1} which was at par (152.4) with three seedlings hill^{-1}. The highest number of sterile spikelets panicle (26.93) was obtained from one seedling hill^{-1} which was at par with three seedlings hill^{-1} (26.93). Although grain yield, straw yield and harvest index of BRRI dhan39 was not significantly affected by the number of seedlings hill^{-1} but numerically the highest grain and straw yields were obtained from two seedlings hill^{-1} and numerically the highest harvest index was recorded from one seedlings hill^{-1}. From the results it is observed that number of seedlings had no significant effect on grain yield. These results corroborate the findings of Islam *et al.* (2002) and Alam *et al*. (2012).

Effect of zinc fertilizer

Zinc fertilizer did not show any significant influence on the most of the yield and yield contributing characters except total tillers hill^{-1} of BRRI dhan39. The highest number of total tillers hill^{-1} (12.84) was recorded with the application of 10 kg $ZnSO_4$ ha^{-1} which was statistically identical (12.11) with that of 0 kg $ZnSO_4$. Numerically the highest number of effective tillers hill^{-1} (8.11), longest panicle ((26.53 cm) and the highest number of grains panicle^{-1} (153.6) was recorded with the application of 0 kg $ZnSO_4$ ha^{-1}. Although the grain yield was not affected by the application of $ZnSO_4$, numerically the highest grain yield (5.13 t ha^{-1}) was obtained from without the application of any $ZnSO_4$. Numerically the highest harvest index was recorded from the application of 0 kg $ZnSO_4$ ha^{-1} and lowest from 10 kg $ZnSO_4$ ha^{-1}.

Therefore, from the results of the study it might be concluded that in AEZ-9 BRRI dhan39 rice could be cultivated without application of any zinc fertilizer. Because, without significant increase in yield it will not be wise to use excess Zn or any other chemical fertilizer which will increase the cost of production as well as harmful for soil characteristics. BRRI (2011)

also recommended no zinc fertilizer for the cultivation of BRRI dhan39.

Effect of interaction

Interaction effect of number of seedlings hill^{-1} exerted significant influence on plant height, total tillers hill^{-1}, effective tillers hill^{-1}, grains panicle^{-1} and sterile spikelets panicle^{-1}. The tallest plant (108.7 cm) was observed from the interaction of three seedlings hill^{-1} × 10 kg $ZnSO_4$ ha^{-1} which was statically at par with other interactions except two seedlings hill^{-1} × 5 kg $ZnSO_4$ ha^{-1}. The treatment combination of two seedlings hill^{-1} × 5 kg $ZnSO_4$ ha^{-1} produced the shortest plant (102.0cm). The highest number of total tillers hill^{-1} (15.67) was obtained from the interaction of three seedlings hill^{-1} × 10 kg $ZnSO_4$ ha^{-1} and the lowest number total tillers hill^{-1} (10.33) was obtained from one seedling hill^{-1} × 5 kg $ZnSO_4$ ha^{-1} which was statistically identical with that of all other interactions. The highest number of effective tillers hill^{-1} (9.67) was recorded from the interaction of three seedlings hill^{-1} × 5 kg $ZnSO_4$ ha^{-1} which was statistically at par (8.67) with two seedlings hill^{-1} × 5 kg $ZnSO_4$ ha^{-1} and one seedling hill^{-1} × 0 kg $ZnSO_4$ ha^{-1}. The interaction between three seedlings hill^{-1} × 10 kg $ZnSO_4$ ha^{-1} produced the highest number of grains panicle^{-1} (173.3) which was statistically similar with that of two seedlings hill^{-1} × 5 kg $ZnSO_4$ ha^{-1} (162.3), three seedlings hill^{-1} × 5 kg $ZnSO_4$ ha^{-1} (161.o7), three seedlings hill^{-1} × 5 kg $ZnSO_4$ ha^{-1} (155.00) and one seedling hill^{-1} × 5 kg $ZnSO_4$ ha^{-1} (152.67). The highest number of sterile spikelets panicle^{-1} (34.0) was produced from the interaction effect of three seedlings hill^{-1} × 0 kg $ZnSO_4$ ha^{-1} which was statistically at par with other interactions except two seedlings hill^{-1} × 0 kg $ZnSO_4$ ha^{-1} and three seedlings hill^{-1} × 10 kg $ZnSO_4$ ha^{-1}. Interaction effect of number of seedlings hill^{-1} and application zinc fertilizer did not exert any significant influence on 1000-grain weight. The grain weight is a genetic factor; therefore, this was not influenced by the interaction effect of number of seedlings hill^{-1} and application of $ZnSO_4$. Numerically the highest grain yield (5.25 t ha^{-1}) was recorded from the interaction of two seedlings hill^{-1} × 5 kg $ZnSO_4$ ha^{-1} and the second highest grain yield (5.00 t ha^{-1}) was obtained from the interaction of one seedling hill^{-1} × 0 kg $ZnSO_4$ ha^{-1} and two seedlings hill^{-1} × 5 kg $ZnSO_4$ ha^{-1}. Numerically the highest straw yield (6.13 t ha^{-1}) and the highest harvest index (48.09%) were obtained from the interaction of two seedlings hill^{-1} × 5 kg $ZnSO_4$ ha^{-1} and two seedlings hill^{-1} × 0 kg $ZnSO_4$ ha^{-1}, respectively. Based on the results of the study it may be concluded that BRRI dhan39 rice could be grown in AEZ 9 (Old Brahmaputra Floodplain) with one seedlings or two seedlings hill^{-1} without Zn fertilizer. Moreover, BRRI dhan39 rice could be accommodated in transplant *aman rice*- mustard- *boro* rice cropping pattern since this rice can be harvested in mid or late October.

Table 1. Effect of number of seedlings hill^{-1} on the yield and yield attributes of BRRI dhan39 grown in *aman* season

Number of seedlings hill^{-1}	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Length of panicle (cm)	Grains panicle^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
1 seedling hill^{-1}	106.9a	11.51ab	7.16b	26.75a	133.6b	25.60	4.61	5.28	46.66
2 seedlings hill^{-1}	103.2b	11.22b	7.89ab	25.48b	152.6a	25.63	5.00	5.88	45.96
3 seedlings hill^{-1}	106.7a	13.18a	8.27a	26.67a	152.4a	25.57	4.64	5.72	44.79
Level of sig.	0.05	0.05	0.05	0.05	0.01	NS	NS	NS	NS
CV (%)	2.90	14.64	13.63	3.63	10.66	1.76	19.36	13.56	15.33

** In a column figures having common letter(s) do not differ significantly as per DMRT. NS = Not significant*

Table 2. Effect of Zinc fertilization on the yield and yield attributes of BRRI dhan39 grown in *aman* season

Zinc fertilization	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Length of panicle (cm)	Grains panicle^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
0 kg $ZnSO_4$	106.0	12.11ab*	8.11	26.53	153.6	25.60	5.13	5.72	47.28
5 kg $ZnSO_4$	104.8	10.96b	7.16	26.02	138.7	35.63	4.53	5.43	45.48
10 kg $ZnSO_4$	106.1	12.84a	8.04	26.35	146.3	25.57	4.58	5.72	44.47
Level of sig.	NS	0.05	NS	NS	NS	NS	NS	NS	NS
CV (%)	2.90	14.64	13.63	3.63	10.66	1.76	19.36	13.56	15.33

** In a column figures having common letter(s) do not differ significantly as per DMRT. NS = Not significant*

Table 3. Interaction effect of seedling number and zinc fertilization on the yield and yield attributes of BRRI dhan39 grown in *aman* season

Number of seedlings hill^{-1} × zinc fertilization	Plant height (cm)	Total tillers hill^{-1} (no.)	Effective tillers hill^{-1} (no.)	Length of panicle (cm)	Grains panicle^{-1} (no.)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
S_1Zn_0	107.3ab*	12.33b	8.00abc	26.63	152.6ab	25.53	5.00	5.83	46.17
S_1Zn_1	107.5ab	10.33b	6.33c	26.33	137.6bcd	25.90	4.17	4.50	48.09
	106.1ab	11.88b	7.13bc	27.28	110.6d	25.37	4.67	5.50	45.92
	104.2ab	12.00b	8.67ab	26.03	140.6bc	25.83	5.25	5.50	48.84
S_1Zn_2	102.0b	10.67b	7.67bc	25.40	162.3ab	25.20	5.00	6.13	44.92
S_2Zn_0	103.7ab	11.00b	7.33bc	25.00	155.0ab	25.87	4.75	6.00	44.19
S_3Zn_0	106.6ab	12.00b	7.67bc	26.93	123.0cd	25.07	5.17	5.83	47.00
S_3Zn_1	105.0ab	11.88b	7.47bc	26.31	161.0ab	25.73	4.41	5.67	43.75
S_3Zn_2	108.7a	15.67a	9.67a	26.78	173.3a	25.90	4.33	5.67	43.30
Level of sig.	0.05	0.05	0.05	NS	0.01	NS	NS	NS	NS
CV (%)	2.90	14.64	13.63	3.63	10.66	1.76	19.36	13.56	15.33

** In a column figures having common letter(s) do not differ significantly as per DMRT.*
NS = Not significant; S_1 = One seedling hill^{-1}, S_2 = Two seedlings hill^{-1}, S_3 = Three seedling hill^{-1}
Zn_0 = 0 kg $ZnSO_4$ ha^{-1}, Zn_1 = 5 kg $ZnSO_4$ ha^{-1}, Zn_2 = 10 kg $ZnSO_4$ ha^{-1}

REFERENCES

Alam MS, Baki MA, Sultana MS, Ali KJ and Islam MS. 2012. Effect of variety, spacing and number of seedlings per hill on the yield potentials of transplant *aman* rice. Intl .J. Agron. Agril. Res. 2(12): 10-15.

BBS (Bangladesh Bureau of Statistics). 2010. Yearbook of Agricultural Statistics of Bangladesh. Bangladesh Bureau of Statistics. Statistics Division, Ministry of Planning. Government of the People's Republic of Bangladesh. pp. 47-49, 113, 122.

BRRI (Bangladesh Rice Research Institute). 2011. *Adhunik Dhaner Chash* (in Bengali). BRRI, Joydebpur, Gazipur. p. 28.

Chaudhry FM, Alarn SM, Rashid A and Latif A. 1977. Mechanism of differential susceptibility to two rice varieties to zinc deficiency. Plant and Soil 46: 865-879.

Ganwar MS and Mann LI. 1972. Zinc nutrition of rice in relation to iron and manganese uptake under different water regimes. Indian J. Agric. Sci. 42: 1052-1035.

Gomez KA and Gomez AA. 1984. Statistical Procedures for Agricultural Research. John Willey and Sons. New York, Chickester, Brisbane, Toronto, Singapore. pp. 84-107.

IRRI (International Rice Research Institute). 2005. Rice Production and Market: Trend and Outlook. *In*: IFA Regional Conference for Asia and the Pacific. Hossain, M. (ed.). Singapore, 6-8 December 2005. Intl. Rice Res. Inst. Los Banos, The Philippines.

Islam MR, Salam MA, Hannan MAand Sarkar MAR. 2002. Effect of hill density and number of seedlings hill^{-1} on the yield and yield components of fine rice cv. Kalizira. Bangladesh J. Agril. Sci. 29(2): 325-328.

Kausar MA, Ali S and Iqbal MI. 2001. Zinc nutrition of three rice varieties in alkaline calcareous soils. Pak. 1. Soil Sci. 20: 9-14.

Takkar PN and Singh T. 1978. Zinc nutrition of rice as influenced by rates of gypsum and Zn fertilization of alkali soils. Agron. J. 70: 447-450.

Tisdale SL, Nelson WL and Beaton JD. 1985. Soil Fertility and Fertilizers. 4th Ed. The MacMillan Co. Collic-MacMillan Uo., London. Pp. 370-374.