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EFFECT OF SPACING ON P AND Zn UPTAKE OF LOCAL T. AMAN RICE VARIETIES IN KHULNA AREA

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Abstract

A field experiment was conducted at the Agronomy field of Khulna University, Khulna during T. Aman season to evaluate the effects of spacing on nutrient content and total uptake of phosphorus and zinc by grain and straw of traditional rice of Khulna region. The experiment was laid out in split-plot design with three replications assigning three varieties viz., Jotai, Bashfulbalam, Ranisalute and three spacings viz., 30 cm x 30 cm, 40 cm x 40 cm and 50 cm x 50 cm. The variety was assigned in main plot and spacing in sub plot. The plot was fertilized with 40-50-35-5 kg of Urea-TSP-MOP and $ZnS0_4$ ha^{-1} respectively. The results indicated that the single effect of variety and spacing on P and Zn content in grain and straw varied significantly while the straw P content was found insignificant. The interaction effect of variety and spacing on P and Zn content was found significant in all the treatments. The highest P and Zn content of grain was found from the variety Ranisalute at 50 cm x 50 cm (V_3S_1) but in straw from Ranisalute x 40 cm×40 cm (V_3S_2) and Bashfulbalam x 30 cm × 30cm (V_2S_1), respectively. The total uptake of P and Zn was found the highest from Jotai variety at 30 cm x 30 cm spacing. From the interaction it showed that the highest P and Zn uptake was found from Jotai x 30 cm × 30 cm (V_1S_1) and the lowest from Ranisalute x 50 cm x 50 cm (V_3S_3). The study indicated that though wider spacings of 40 cm x 40 cm and 50 cm x 50 cm increased the number of tillers $hill^{-1}$ and nutrient uptake but it cannot increase the nutrient uptake and grain yield ha^{-1}. So, 30 cm x 30 cm spacing showed positive relationship on nutrient uptake than 40 cm x 40 cm and 50 cm x 50 cm spacing.

Introduction

Rice is the staple food of Bangladesh. It contributes about 90% of food grains and covers about 80% of total cropped area of the country. It provides about 70% of the calories consumed by 160 million people of Bangladesh (AIS, 2008). In order to increase the yield of rice plants the availability and uptake of proper and judicious use of fertilizers containing major and micronutrient is very important. The practice of intensive cropping with modern varieties causes a marked depletion of inherent nutrient reserve in soils of Bangladesh. Consequently in addition to N, P and K deficiencies, some other nutrient such as Zn, S and B deficiencies are being observed in many parts of the country (Haque and Jahiruddin, 1994).

Fertilizer is the most important input for rice production. For the best yield of rice plant along with nitrogen requirements, phosphorus and zinc is also needed. The application of P and Zn can play important role in grain setting, increased grain yield and nutrient concentration of rice. Phosphorus is important for the growth, reproduction, yield and quality of rice crop. Tillering of rice plant is positively co-related with Phosphorus. It also promotes root development and elongation capability of rice plant (Hossain *et al.*, 2009).

Zinc deficiency has been detected as the third major nutritional problem for Bangladesh soil next to N and P limiting the growth of wetland rice. In some places of Bangladesh yield loss due to Zn deficiency

ranged from 10-18%. Zinc plays an important role in many physiological functions of plants. Planting densities exceed an optimum level competition among plants for macro and micro nutrients becomes severe consequently the plant growth stunted and grain yield decreases. The number of tillers per square meter is increased with the improvement of rice production (Islam, 2001). However, scanty information is available about the effect of spacing on the uptake of nutrients particularly P and Zn on rice. Therefore, the present study was conducted to find out the effect of spacing on the uptake and content of P and Zn of local T. Aman rice varieties of Khulna area.

Materials and Methods

The experiment was conducted in the field of Agro technology Discipline at Khulna University during T. Aman season. The soil was characterized by medium textured silty loam having p^H value 7.5 and organic matter 3.80%. Before raising seeds in the nursery, seeds were water soaked for 24 hours and these were kept in jute bags in dark conditions. After sprouting, the seeds were sown in wet seed bed. Thirty days old seedlings were uprooted carefully from the nursery and transplanted as single seedling $hill^{-1}$ on the well puddled experimental plots. Three popular T. Aman rice varieties viz, jotai (V_1), Bashfulbalam (V_2) and Ranisalute (V_3) were selected for the study. The varieties were planted in three different spacings viz, 30 cm x 30 cm (S_1), 40 cm x 40 cm (S_2), and 50 cm x 50 cm (S_3). The variety was assigned in main plot and spacing in sub plot. The plot size was 4.0 m x 2.5 m. The land was fertilized with 40-50-35-5 kg of urea-TSP-MoP-$ZnSO_4$ ha^{-1} respectively. The full dose of fertilizers and half of urea was applied as basal dose during final land preparation and the remaining half of urea was applied in two splits at active tillering and during panicle initiation stage. Grain yield and straw yield were recorded from whole plot basis leaving boarder lines. Grain yield was adjusted at 14% moisture content.

In order to conduct chemical analysis during harvest five representative samples of grain and straw from each sub plot were collected. The collected samples were analysed and Phosphorus (P) was determined by Spectrophotometer and Zinc (Zn) by atomic absorption spectrophotometer. The data was analyzed following standard statistical procedures (Gomez and Gomez, 1984) using a computer operated program MSTATC.

Results and Discussion

P Concentration

Phosphorus content in grain differed significantly due to the main effect of variety and spacing but it was found insignificant in straw (Table 1). It was ranged from 0.102% to 0.116% in grain and 0.030% to 0.032% in straw from the effect of varieties and 0.107% to 0.113% in grain and 0.028% to 0.032% in spacings. Among three varieties the maximum P content of grain (0.116%) was found from Ranisalute variety which was followed by Bashfulbalm (0.115%) and Jotai (0.102%). The content of P was found samilar (0.113%) in 50 cm x 50 cm and 30 cm x 30 cm spacing which was followed by 40 cm x 40 cm spacing in straw (0.107%). The grain content of P was higher compared to straw content of that in all treatments which supports the findings of Yoshida (1981) that contents of phosphorus (P) is generally higher in the panicles than in the straw (leaves and culm).

Table 1. Effect of variety and spacing on P and Zn content of grain and straw

Treatments	P (%)		Zn (ppm)	
	Grain	Straw	Grain	Straw
V_1 (Jotai)	0.102	0.032	26.17	37.33
V_2 (Bashfulbalam)	0.115	0.031	36.94	40.17
V_3 (Ranisalute)	0.116	0.030	37.61	34.28

Level of Significance	0.01	NS	0.01	0.01
$LSD_{(0.01)}$	0.06899	-	1.220	2.821
S_1 (30 cm x 30 cm)	0.113	0.032	32.11	39.50
S_2 (40 cm x 40 cm)	0.107	0.032	32.72	37.44
S_3 (50 cm x 50 cm)	0.113	0.028	35.89	34.83
Level of Significance	0.05	NS	0.01	0.01
$LSD_{(0.01)}$	0.06899	-	1.220	2.821
CV (%)	7.00	24.51	1.67	3.47

Interaction effect of variety x spacing was found statistically significant in both grain and straw (Table 2). It was ranged from 0.095% to 0.0128% in grain and 0.025% to 0.037% in straw. The highest grain content (0.128%) was found from V_3S_3 and the lowest (0.095%) from Jotai x 30 cm x 30 cm (V_1S_1). In straw the highest P content (0.037%) was found from Ranisalute x 40 cm x 40 cm (V_3S_2) and the lowest (0.025%) from both Ranisalute x 50 cm x 50 cm (V_3S_3) and Bashfulbalam x 40 cm x 40 cm (V_2S_2).

Zn concentration

Zn concentration in grain and straw was significantly affected by the main effect of variety and spacing. Among three varieties the grain Zn content was found the maximum (37.61 ppm) from jotai which was followed by Bashfulbalam (36.94 ppm) and Ranisalute (26.17 ppm). But in straw Zn content was found the highest (40.17 ppm) from Bashfulbalam and the lowest (34.28 ppm) from Ranisalute. The highest Zn content (35.89 ppm) was found from 50 cm x 50 cm and the lowest (26.17 ppm) from 30 cm x 30 cm spacing. In straw the highest Zn content (37.44 ppm) was found from 40 cm x 40 cm and the lowest (34.83 ppm) from 50 cm x 50 cm spacing (Table 2). Interaction effect of variety x spacing was found statistically significant in both grain and straw Zn content ranged from 24.67 ppm to 41.00 ppm in grain and 32.00 ppm to 43.33 ppm in straw (Table 2). The highest (41.00 ppm) and the lowest (24.67 ppm) Zn content in grain was obtained from Ranisalute x 50 cm x 50 cm (V_3S_3) and Jotai x 30cm x 30cm (V_1S_1), respectively. The straw content of Zn was higher compared to grain content that confirms the findings of Yoshida (1981). The highest (43.33 ppm) and the lowest (32.00 ppm) straw Zn content was obtained from Bashfulbalam x 30 cm x 30 cm (V_2S_1) and Ranisalute x 50 cm x 50 cm (V_3S_3), respectively.

Phosphorus uptake

The interaction effect of variety x spacing on P uptake was shown in figure 1, 3 and 5. It was observed that variety Jotai uptake the highest P than Bashfulbalam and Ranisalute (Fig. 1, 3 and 5). The spacing 30 cm x 30 cm uptake the highest P than 40 cm x 40 cm and 50 cm x 50 cm. Though wider spacing enhanced nutrient uptake but the highest grain yield was obtained from 30 cm x 30 cm spacing as a result the total uptake of P was obtained from 30 cm x 30 cm spacing. Actually wider spacing promoted more tillering than lower spacing but tiller number per square meter is important for total uptake of nutrient than tillers $hill^{-1}$ (Islam, 2001). The interaction of Jotai x 30 cm x 30 cm (V_1S_1) uptake the highest P (4.85 kg ha^{-1}) and the lowest (3.0 kg ha^{-1}) was found from Ranisalute x 50 cm x 50 cm (V_3S_3) interactions.

Table 2. Effect of variety x spacing interaction on P and Zn content of grain and straw

Interaction (Variety x Spacing)	P (%)		Zn (ppm)	
	Grain	*Straw*	*Grain*	*Straw*
V_1S_1	0.108	0.32	24.67	42.17
V_1S_2	0.102	0.35	26.83	35.17
V_1S_3	0.950	0.28	27.00	34.67
V_2S_1	0.115	0.35	36.83	43.33
V_2S_2	0.115	0.25	34.33	39.33
V_2S_3	0.115	0.32	39.67	37.83
V_3S_1	0.115	0.28	34.83	33.00

V_3S_2	0.103	0.37	37.00	37.83
V_3S_3	0.128	0.25	41.00	32.00
$LSD_{(0.01)}$	0.07	NS	1.22	2.82
CV (%)	7.00	24.51	1.67	3.47

V_1 = Jotai, V_2=Bashfulbalam, V_3=Ranisalute
S_1 = 30cm x 30cm, S_2=40cm x 40cm, S_3=50cm x 50cm

Zinc Uptake

The interaction effect of variety x spacing on Zn uptake was shown in figure 2, 4 and 6. It was observed that variety Jotai uptake the highest Zn than Bashfulbalam and Ranisalute (Fig. 2, 4 and 6). The spacing 30 cm x 30 cm uptake the highest Zn than 40 cm x 40 cm and 50 cm x 50 cm. Though wider spacing enhanced nutrient uptake but the highest yield was obtained from 30 cm x 30 cm spacing. The interaction of Jotai x 30 cm x 30 cm (V_1S_1) uptake the highest Zn (0.273 kg ha^{-1}) and the lowest (0.156 kg ha^{-1}) was found from Ranisalute x 50 cm x 50 cm (V_3S_3).

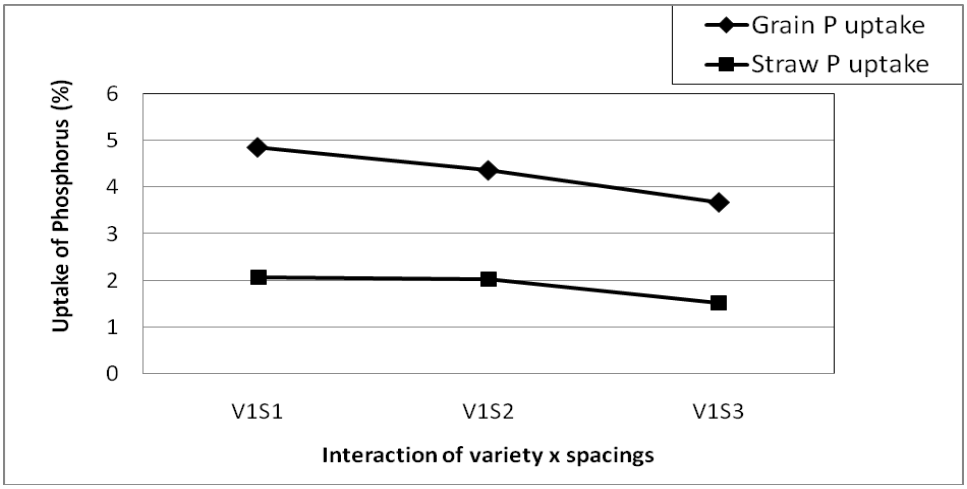

Fig. 1. Phosphorus uptake by Jotai variety in three spacings

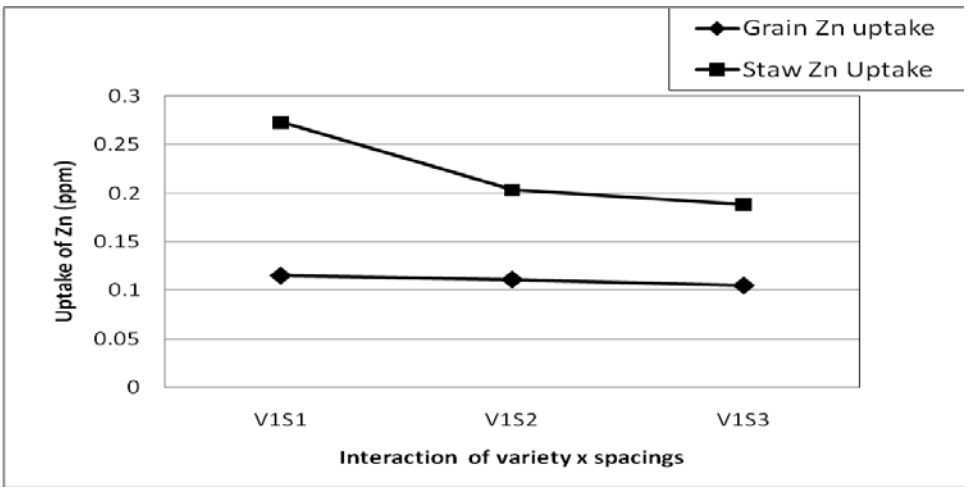

Fig. 2. Zinc uptake by Jotai variety in three spacings

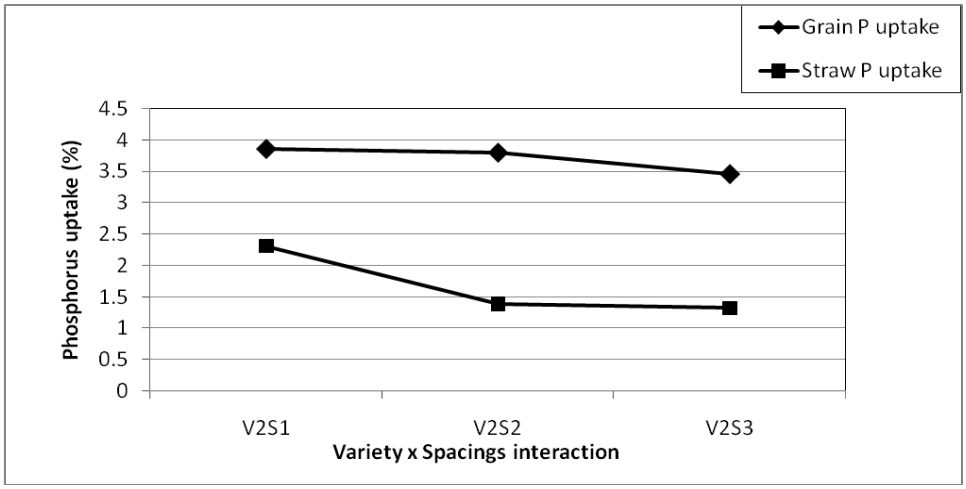

Fig. 3. Phosphorus uptake by Bashfulbalam variety in three spacing

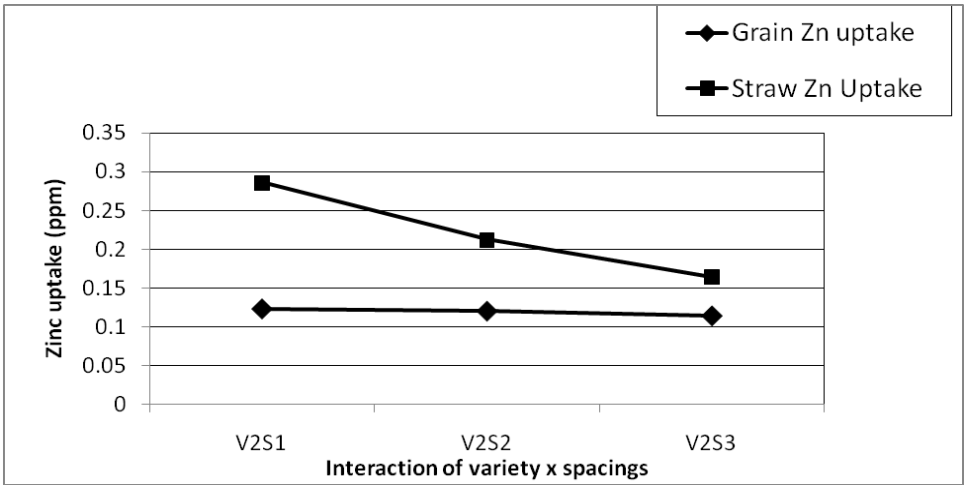

Fig. 4. Zinc uptake by Bashfulbalam variety in three spacing

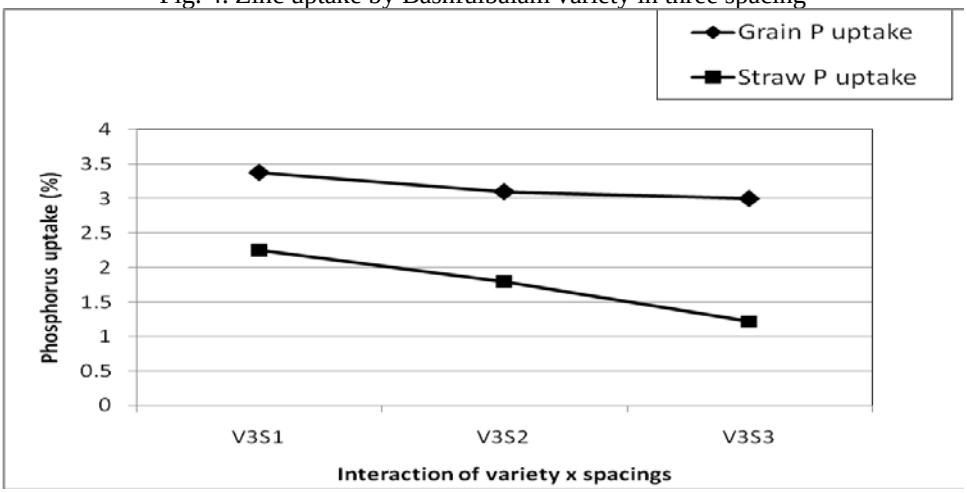

Fig. 5. Phosphorus uptake by Ranisalute variety in three spacing

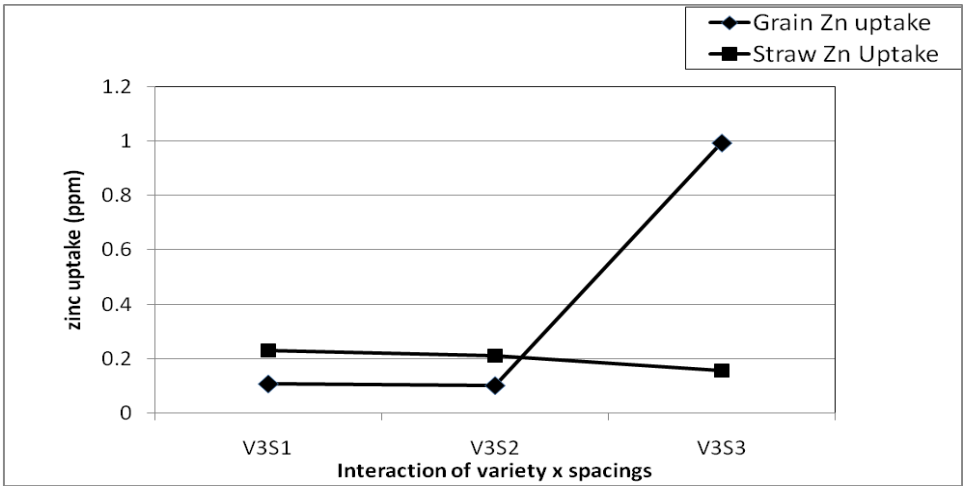

Fig. 6. Zinc uptake by Ranisalute variety in three spacing

Nutrient status of soil

Nutrient status of the experimental soil before planting and after harvest was shown in Table 3. Before planting the nutrient N, P, K, Zn and S content of soil was 0.207%, 7.15 ppm, 0.36 meq. 100 g^{-1} soil, 0.46 ppm and 129.53 ppm, respectively. After harvest the N, P, K, Zn and S content of soil were 0.250%, 4.17 ppm, 0.27 m.eq/100 g soil, 0.883 ppm and 218.38 ppm, respectively. Recovery of P and Zn was obtained from basal application of 50 kg P_2O_5 ha^{-1} and 30 kg $ZnSO_4$ ha^{-1}. In the experimental plot the deficiency of P and Zn was present before planting and different level of P and Zn fertilizer was not applied in the treatment that's why apparent recovery of these two nutrients was smaller than field experiments. The results indicated that added elements (P and Zn) might have residual effect on the succeeding crop (Jahiruddin *et al*., 1994).

Table 3. Some important properties of the experimental soils

Parameters	Before planting	After harvest
Texture	Silty Loam	Silty Loam
P^H	7.5	7.6
E.C	7.77 ds m^{-1}	8.87ds m^{-1}
Organic matter	3.80%	5.17%
Total N	0.207%	0.25%
Exchangeable K	0.36 meq. 100 g^{-1} soil	0.27 meq. 100 g^{-1} soil
Exchangeable Ca	27.50 meq. 100 g^{-1} soil	38.17 meq. 100 g^{-1} soil
Exchangeable Mg	5.75 meq. 100 g^{-1} soil	7.78 meq. 100 g^{-1} soil
Available P	7.15 ppm	4.17 ppm
Total Zn	0.46 ppm	0.883 ppm
Available S	129.53 ppm	218.38 ppm

Conclusion

The overall results of the present study showed that the single and interaction effect of variety and spacing showed significant influence on phosphorus and zinc content in grain and straw but the straw phosphorus content was insignificant from the single effect of variety and spacing. The uptake of phosphorus and zinc was found the highest in closer spacing than wider spacing. The number of tillers square meter^{-1} was more in closer spacing 30 cm x 30 cm than wider spacing 40 cm x 40 cm and 50 cm x 50 cm. So, it can be the concluded that the uptake of nutrient depends on number of tillers square meter^{-1} than number of tillers hill^{-1}.

References

AIS (Agricultural Information Service). 2008. Krishi Dairy. Agric. Int. Ser. Dhaka. pp.20-22.

BRRI (Bangladesh Rice Research Institute). 1989. Annual Internal Review for 1989. Bangladesh Rice Res. Inst. Gazipur-1701. pp.169-171.

Gomez, K. A. and A. A. Gomez. 1984. Statistical procedures for Agricultural Research. Intl. Rice Res. Inst. Los Banos, Laguna, Philippines. pp.97-116.

Haque, M. S. and M. Jahirruddin. 1994. Effect of single and multiple application of sulphur and zinc in a continuous rice cropping pattern. Indian J. Agric. Res. 28(1): 9-14.

Hossain, M. B., M. Jahiruddin, M. R. H. Loppert, G. M. Panaullah, M. R. Islam and J. M. Duxbury. 2009. The effects of iron plaque and phosphorus on yield and arsenic accumulation in rice. J. Plant Soil. 317: 167-176.

Islam, M. 2001. Enhancement of and yield of Boro rice through modification of SRI (System of Rice Intensification) technique in terms of fertilizer management, spacing and seedling age. M. Sc. Thesis, Dept. of Agronomy. BAU, Mymensingh.

Jahiruddin, M., M. N. Islam, M. A. Hashem and M. R. Islam. 1994. Influence of Sulphur, Zinc and Boron on yield and nutrient uptake of BR2 rice. Progress. Agric. 59(1): 61-67.

Rahman, K. M. M., M. A. K. Chowdhury, F. Sharmeen, A. Sarkar, M. A. Hye and G. C. Biswas. 2011. Effect of zinc and phosphorus on yield of *Oryza sativa* (cv.BR-11). Bangladesh Res. Pub. J. 4 (5): 351-358.

Yoshida, S. 1981. Fundamentals of Rice Crop Science. The Intl. Rice Res. Inst. Los Banos, Laguna, Philippines.