

Effect of Nutrients Content in Rice as Influenced by Zinc Fertilization

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Abstract: A field experiment was conducted in typical rice growing soil type “Non-calcareous Dark Grey Floodplain” at Bangladesh Agricultural University main Farm. To evaluate the different brands of zinc fertilizer produced and marketed in Bangladesh and their effect on nutrients content in rice (BRRI dhan 32) during the transplanted aman season (July-November). The content of N, S and Ca both in grains and straw did not vary significantly of all the treatments (statistically similar), but the contents of P, K, Na, Mg, Zn, Cu, Fe and Mn in grain and straw varied significantly at $p < 0.05\%$ level of probability due to the application of different brands of zinc fertilizer. The nutrient content in grain was obtained highest N (Zn-7), P (Zn-2), K (Zn-8), Na (Zn-8), Ca (Zn-5), Mg (Zn-1), S (Control) are 1.279, 0.0415, 0.2017, 0.0785, 0.1607, 0.3187, 0.187% respectively and Zn (Zn-2), Cu (Zn-2), Fe (Zn-6), Mn (Zn-2) are 10.77, 8.963, 185.30, 61.33 mg kg⁻¹ respectively. The content founded highest in straw N, K, Na, Ca, S are 0.709, 5.040, 0.0760, 0.3739, 0.208 % respectively and Zn, Cu, Fe, Mn are 56.65, 55.79, 263.7, 548.8 mg kg⁻¹ respectively. It is apparent that Zn-2 induced highest accumulation of P, Zn, Cu and Mn in rice grain whereas in straw; plough branded white zinc fertilizer (Langal marka) induced highest concentration of N, Fe and Mn. The concentration of Zn in both rice grain and straw appeared less in amount in most of the treatments as compared to control except the treatment (Zn-2) in grain, it means the accumulation of Zn by grain and straw is not more dominant.

Key words: Zinc fertilizer, Rice, Performance, Nutrients content

INTRODUCTION

The fertility status of the soil in Bangladesh has gone down due to intensive crop cultivation in respect of macro and micronutrient which are more prominent particularly in rice crop. Because during the last two decades, Bangladesh Agriculture has moved from a low crop intensity and low yielding state to one in which intense cropping and higher yields per unit area are being increasingly sought. Higher crop yields naturally have higher demands of nutrients and more pressure on the soil for available forms of nutrients. As cropping intensity and yield levels go up, the uptake and removal of plant nutrients through harvested crop and other routes from the soil are likely to increase. Since rice is grown in wet condition; diverse soil and climatic situations may cause deficiency of micronutrient and along with some other factors or macronutrients.

Deficiency of zinc and response of rice to zinc under flooded condition have been studied [1]. The available zinc content of several soil samples collected from different districts of Bangladesh varied from extremely deficient to fairly adequate level. It has resulted from continuous exhaustion of soil nutrients without replenishment of fertility through application of adequate amount of proper fertilizers, soil management practices and regular crop rotation. To over come this adverse situation, application of zinc fertilizer has been recommended for rice in Bangladesh [1-2]. Application of zinc in the form of zinc sulphate (ZnSO₄) has been reported to be effective grain yield to a considerable extent. Since the establishment of the deficiency of zinc in Bangladesh, several entrepreneurs have started producing the zinc fertilizer under different trademarks/brands and marketing those throughout the country in different packets and labels. The performance

of those products drew the attention of both public and research works. Present study was therefore, undertaken to emphasize of those zinc fertilizer products produced and marketed in different areas of the country and their response to rice in respect of nutrient content there in.

MATERIALS

A high yielding variety of rice (BRRI Dhan 32) was used as the test crop. The experiment was laid out in a randomized complete block design (RCBD) with three replications consisting 27 individual plots belongs to 10 m² (4m × 2.5m) per unit plot area, the distance between two unit plot was 0.5 m. Locally produced and marketed different brands of zinc fertilizers used which include eight treatments viz: Zn-1, Zn-2, Zn-3, Zn-4, Zn-5, Zn-6, Zn-7 and Zn-8 including one control receiving no Zn fertilizer. The different brands of Zn fertilizer used in the experiment were Zn-1: Farmer brand (krishak marka) white zinc fertilizer, Zn-2: Plough brand (langal marka) white zinc fertilizer, Zn-3: Jamuna brand zinc fertilizer, Zn-4: Rake brand (Moi marka) white zinc fertilizer, Zn-5: Mukta brand

zinc sulphate, Zn-6: Krishan brand (Krishan marka) white zinc fertilizer, Zn-7: Farmer's friend (Krishak bandu) zinc fertilizer, Zn-8: Paired lion (Jora singha) zinc fertilizer which Zn content was 18.4, 19.8, 20.0, 19.8, 9.3, 18.9, 11.0 and 26.0 % respectively.

Experimental Site and Soil: The experiment was carried out in typical rice growing soil type "Non-calcareous Dark Grey Floodplain". The land was medium high and categorized under the Agro Ecological zone (AEZ) "Old Brahmaputra Floodplain" belongs to Sonatola Series. The seeds were sown on seedbed on 7.7.2007; the seedlings were uprooted /transplanted on 6.8.2007 (30 days after sowing). Harvesting time was 22.11. 2007. Physical and chemical characteristic of the pre planting soil are presented in Table 1. Pre-planting soil was collected at the dept of 0-15 cm from the experimental plots prior to addition of fertilizer.

Fertilization and Operation: The nine fertilizer treatments (including control) were randomly distributed at the rate of 10 g plot⁻¹ i.e. 10 kg ha⁻¹. The zinc fertilizer (zinc sulphate) status is presented in Table 2. The standard

Table 1: Physical and chemical properties of pre planting soil of the experimental field

Sand	Silt	Clay	Textural class
A. Physical Properties			
8.84 %	72.00 %	19.61 %	silt loam

Note: Physical properties are measured USDA textural triangle method by NC Brady [20]

B. Chemical properties						
pH	Organic C (%)	Organic matter (%)	Total N (%)	Exchangeable K (mol kg ⁻¹)	Ca (mol kg ⁻¹)	Mg (mol kg ⁻¹)
6.8	0.662	1.14	0.12	1.2825	0.0589	6.1166
P	S	Zn	Cu	Fe	Mn	B
13.0	14.20	2.58	15.45	258.7	39.45	0.987

Note: OC = Organic carbon, OM= Organic matter, Exle: Exchangeable

Table 2: Nutrients content of 8 different produced and marketed Zn fertilizer analyses results

Fertilizer	Zn %	Fe %	Cu (mg kg ⁻¹)	Mn (mg kg ⁻¹)
Zn-1	18.4	0.09	Tr	7.60
Zn-2	19.8	0.34	Tr	15.70
Zn-3	20.0	0.05	Tr	12.10
Zn-4	19.8	0.75	93.00	23.00
Zn-5	9.3	1.21	2.80	157.6
Zn-6	18.9	0.79	Tr	119.5
Zn-7	11.0	0.06	17.5	267.90
Zn-8	26.0	0.45	84.10	248.3

Note: Tr = Trace Zn-1: Farmer brand, Zn-2: Plough brand, Zn-3: Jamuna brand zinc, Zn-4: Rake brand, Zn-5: Mukta brand zinc sulphate, Zn-6: Krishan brand, Zn-7: Farmer's friend, Zn-8: Paired lion brand

level of Zn content [17] is 18-23% where the present status is found within range limit except Zn-5 and Zn-7 and other treatment consist the Zn content is lower limit. NPK and S were applied as basal doses of N = 150 kg N ha⁻¹ from urea, P = 60 kg P₂O₅ ha⁻¹ from TSP, K= 60 kg K₂O ha⁻¹ from MP, S= 60 kg CaSO₄ ha⁻¹ from gypsum. One third dose of N with full dose of P, K, S and Zn were applied broadcast method one day prior to transplanting. Another one third N was applied after 30 days of transplanting and rest at pre booting stage. The intercultural operations (irrigation, weeding, land clearing etc.) and management practices were done to ensure normal growth of the crops but there was no infestation of insect and diseases in the field.

METHODS

The plant materials plot wise randomly were collected at harvest stage from 10 selected hills plot⁻¹. Immediately threshed samples were cleaned, sun dried, oven dried at 70°C over night then dried materials were ground in a grinding machine and preserved in polythene bags for chemical analysis.

Exactly 1 g of finely ground grain and straw materials were taken separately into a 250 mL conical flask and 10 mL of di-acid mixture (HNO₃: HClO₄ = 2:1) was added to it. The conical flask with sample was placed on an electric hot plate for heating at 180-200°C until the solid particles disappeared and white fumes were evolved from the flask. Then it was cooled at room temperature, washed with distilled water and filtered into 100 mL volumetric flasks through Whatman No. 42 filter paper making the volume up to the mark with distilled water following wet oxidation method; total nitrogen in rice grain and straw samples was determined by macro Kjeldahl method; available Phosphorous was determined calorimetrically by stannous chloride method [3]. Potassium and sodium content was determined separately with the help of a flame emission spectrophotometer using appropriate potassium filter and sodium filter [4-5]; calcium and magnesium content in rice grain and straw estimated by complexometric method of titration using Na₂EDTA complexing agent following the method by Page *et al.* [6] and sulphur content was determined turbidimetrically following the method [7]; while the concentrations of Zn, Cu, Fe and Mn in grain and straw samples were determined by atomic absorption spectrophotometer according to the method outlined [8] and extracted by 5N HCl.

Statistical Analysis: The analysis of variance for various crop characters including all the data were analyzed statistically and the results were adjudged by the Duncan's Multiple Range Test with the help of a computer package M-STAT program by Dancan, 1951 [19].

RESULT AND DISCUSSION

Results showed that except N, S and Ca the content of all other nutrient element studied (P, K, Na, Mg, Zn, Cu, Fe and Mn) in rice grain (BRRI dhan 32) varied significantly at p <0.05 % level of probability (Table 3). The content of N, S, Ca and Mg did not vary significantly (Table 4) in straw due to the application of different brands of Zn fertilizer but the other nutrients (P, K, Na, Zn, Cu, Fe and Mn) are significant at <0.05% level of probability. It was further observed that the content of all the nutrients elements in rice grain and straw of cv. BRRI dhan 32 was quite different due to the application of different brands of Zn fertilizer.

Nitrogen Content: The content of nitrogen in grain varied from 1.041 (Zn-4) to 1.279 (Zn-6) % were showed in Table 3. The highest N content (1.279 %) in grain was obtained in the treatment Zn-6. The concentration of nitrogen in straw varied from 0.565 to 0.709 % (Table 4) and the highest N content in straw (0.709 %) was observed in the treatment Zn-2. Its concentration in grain was higher than in straw in all the treatments.

Phosphorus Content: The P content in grain samples varied from 0.00766 (Zn-3) to 0.0415 (Zn-2) % by the fertilization of the treatment. The highest P content was recorded (Zn-2) due to the application of fertilizer. Less effect on P concentration in rice grains, through the variation was significantly influenced by the different brands. The accumulation of P in rice straw was less affected by the different brands, the concentration of P was highest in Zn-1 followed by Zn-8 and Zn-7 and it was lowest in Zn-5. Some of the brands induced less accumulation of P in rice straw as compared to control. From these results [9] reported an antagonistic effect of Zn and P fertilizer. Singh *et al.* [10] reported that Zn application increased the P concentration in rice grain and straw. Akhter *et al.* [11] studying the interaction of P and Zn observed that P concentration suppressed the Zn adsorption by rice plant and vice versa in calcareous soil.

Table 3: Effect of different brands of Zn fertilizer on nutrients content in rice grain

	N	P	K	S	Na	Ca	Mg	Zn	Cu	Fe	Mn
Treatments	%							mg kg ⁻¹			
Control	1.120	0.0129 de	0.1733 d	0.187	0.07067 b	0.1067	0.2613 abc	7.750 b	5.333 bc	142.00 c	45.23 bc
Zn-1	1.148	0.0300 b	0.1843 b	0.128	0.01300 f	0.1034	0.3187 a	7.300 b	4.167 d	67.67 f	26.09 g
Zn-2	1.155	0.0415 a	0.2013 a	0.125	0.01667 f	0.0872	0.2547 abc	10.77 a	8.963 a	112.30 d	61.33 a
Zn-3	1.097	0.00766 e	0.1747 d	0.156	0.0625 c	0.09387	0.2067 bc	7.350 b	5.427 b	80.33 e	48.53 b
Zn-4	1.041	0.01550 d	0.1810 bc	0.157	0.0425 e	0.100	0.2447 abc	7.050 b	3.133 e	149.00 b	42.63 cd
Zn-5	1.204	0.01753 cd	0.1727 d	0.135	0.04967 d	0.0617	0.2540 abc	4.067 c	4.460 cd	66.00 f	40.16 d
Zn-6	1.279	0.01167 de	0.1760 cd	0.124	0.04373 e	0.0750	0.1890 c	5.900 bc	4.193 d	185.30 a	34.82 e
Zn-7	1.097	0.01267 de	0.1727 d	0.130	0.06253 c	0.0450	0.2907 ab	5.960 bc	5.453 b	81.29 e	30.65 f
Zn-8	1.069	0.02267 c	0.2017 a	0.129	0.07853 a	0.0814	0.2757 ab	7.900 b	5.743 b	145.0 bc	46.67 b
CV%	13.54	11.61	4.89	22.08	27.49	27.74	13.57	19.18	7.10	0.236	3.47
S _z	0.0887	0.00183	0.00183	0.0180	0.001867	0.01826	0.0182	0.7878	0.2137	1.5550	0.8375

Note: In a column figures showing similar letter (s) did not differ significantly according to DMRT. All the data are mean value of three replications with the 27 number of independent samples.

Zn-1: Farmer brand, Zn-2: Plough brand, Zn-3: Jamuna brand zinc, Zn-4: Rake brand, Zn-5: Mukta brand zinc sulphate, Zn-6: Krishan brand, Zn-7: Farmer's friend, Zn-8: Paired lion brand fertilizer

Table 4: Effect of different brands of Zn fertilizer on nutrients content in rice straw

	N	P	K	S	Na	Ca	Mg	Zn	Cu	Fe	Mn
Treatments	%							mg kg ⁻¹			
Control	0.658	0.0455 b	4.217 b	0.080	0.076 a	0.2815	0.482	56.65 a	31.67 c	119.3 bc	404.300 d
Zn-1	0.565	0.0683 a	5.040 a	0.048	0.056 b	0.3739	0.547	44.37 bcd	47.53 b	94.64 c	384.400 d
Zn-2	0.709	0.0493 b	3.967 c	0.088	0.041 c	0.3072	0.574	54.85 ab	22.25 d	236.70 a	548.800 a
Zn-3	0.681	0.0240 c	4.367 b	0.208	0.032 d	0.3205	0.547	40.33 cd	22.77 d	111.00 bc	465.300 bc
Zn-4	0.642	0.0183 d	3.100 d	0.055	0.045 c	0.2937	0.563	38.14 d	23.87 d	140.00 bc	407.300 d
Zn-5	0.588	0.0117 d	3.900 c	0.120	0.041 c	0.3205	0.545	44.90 bcd	21.38 d	106.30 bc	487.900 b
Zn-6	0.583	0.0150 d	4.210 b	0.113	0.061 b	0.2001	0.529	54.55 ab	32.73 c	173.30 b	439.700 bcd
Zn-7	0.663	0.0657 a	3.997 c	0.086	0.041 c	0.2136	0.578	42.58 cd	55.79 a	148.70 bc	283.100 e
Zn-8	0.663	0.0673 a	4.303 b	0.146	0.061 b	0.3205	0.464	51.73 abc	22.38 d	123.30 bc	421.000 cd
CV%	27.25	30.65	2.41	55.21	2.45	23.28	17.92	12.94	4.66	19.02	4.97
S _z	0.1005	0.0018	0.0577	0.0334	0.0018	0.0408	0.0555	3.555	0.8373	15.29	12.25

Note: In a column figures showing similar letter (s) did not differ significantly according to DMRT. All the data are mean value of three replications with the 27 number of independent samples.

Zn-1: Farmer brand, Zn-2: Plough brand, Zn-3: Jamuna brand zinc, Zn-4: Rake brand, Zn-5: Mukta brand zinc sulphate, Zn-6: Krishan brand, Zn-7: Farmer's friend, Zn-8: Paired lion brand fertilizer

Potassium Content: The highest K content (0.2017%) in grains was obtained by the treatment Zn-8 followed by Zn-2 (0.2013 %). Zaman *et al.* [12] in a trial on non calcareous dark grey flood plain soil reported that Zn application decreased K content in rice grain but when applied in calcareous with P it influenced the accumulation of Zn along with P, S and Mn. In this study since we used P with other fertilizer components as basal dose of P = 60 kg P₂O₅ ha⁻¹ from TSP. It is assumed that the same phenomenon might have taken place here also because the pre planting K content was 0.23% but after harvesting soil status of K is decrease.

Results in Table 4 also show that the K concentration in rice straw was significantly at p < 0.05 % level of probability influenced by the treatments. The highest K content (5.040 %) was recorded due to Zn-1 and it was lowest (3.100 %) in the treatment Zn-4. From Table 4, it appeared that except Zn-1 and Zn-3, all other brands either reduced or leaching, accumulated and maintained the same K status in rice straw by comparing to the pre-planting soil status belongs to K content. It can further be noticed (Tables 3 and 4) that percent K content in straw is quite higher than that of rice grains. It seemed imperative that the source Zn (zinc fertilizer) affects the K content in rice grain and straw.

Sodium Content: The maximum Na concentration (0.0785 %) in rice grain was recorded in Zn-8 which was significantly ($p < 0.05\%$) different from that of all other treatments including Control, Zn-3 (statistically similar to Zn-7 or Zn-5 or Zn-3), Zn-4 (similar to Zn-6). The lowest Na content (0.0130%) was observed in Zn-1 similar to Zn-2 (Table 3).

The highest concentration of Na (0.0760 %) in straw was found in control which was statistically different from the rest of the treatments along with Zn-1 (statistically similar to Zn-6 or Zn-8), Zn-2 (statistically similar to Zn-4 or Zn-5 or Zn-7) and Zn-3. From the results (Tables 3 and 4) it is evident that the different brands of Zn fertilizer available in the local markets have other differently on the sodium content in rice grains and straw. In almost all the cases from the control compare to the all other treatment (except Zn-8 in grain) Zn application reduces the concentration of Na in both grain and straw. From the presented data of the table we stated that only Zn-8 is highest consists of Na content but all other is lower content of Na from control.

Tisdale *et al.* [13] stated that sodium concentrations as little as 1 to 2 % in sensitive (sensitive: 0.75-1.0 mg/L, moderately sensitive: 1.0-2.0 mg/L) crops (eg. pepper, maize, peas, lentil, mung, cowpea etc.) lowers the yield. They also reported that high sodium (Tolerant: 4.0-6.0 mg/l and Very Tolerant: 6.0-15.0 mg/l) levels in plants are often accompanied by low potassium. The approximate levels of exchangeable sodium percentage (ESP) corresponding to the three categories of tolerance are: sensitive less than 15 ESP; semi-tolerant 15-40 ESP; tolerant more than 40 ESP. Particular care in assessment of a potential toxicity due to SAR or sodium is needed with high SAR water because apparent toxic effects of sodium may be due to or complicated by poor water infiltration. Many crops do show sodium toxicity [18]. By this literature it is clear that our present research is similar phenomenon that if sodium accumulation is increased then K accumulation would be decreased.

Calcium Content: The highest Ca concentration in grains (0.1607 %) was obtained in control treatment and in straw that was with Zn-1 treatment (0.3739 %). The treatment of Zn fertilization in rice is not effective to accumulate the Ca by grain and straw. The lowest Ca in grain and straw were 0.045 and 0.200 % in Zn 7 and Zn-6 respectively. Tisdale *et al.* [13] stated that Calcium is abundant in leaves and has a role in shoot, panicle length, spikelet etc. elongation. There is often a poor supply in fruits and storage organs (statement of Tisdale works).

From results of Ca in grain and straw samples the statements is clear that Ca content in rice grain and straw may indeed be negligible because Ca was lower belonging the treatment of Zn-1 to Zn-8.

Magnesium Content: The highest Mg concentration (0.3187 %) was found in Zn-1 treatment and is statistically identical at $p < 0.05\%$ to all other treatments except Zn-3 and Zn-6. In straw Mg did not differ significantly due to the treatments of Zn fertilization (Table-4). But there is highest amount Mg (0.578%) in the treatment (Zn-7) and lowest (0.464%) in Zn-8 which was inferior to the control (0.482%).

Since magnesium is a mobile element which is readily translocated from older to younger parts of the plant and is involved in various physiological and biochemical function. It is a constituent of chlorophyll [13] and its accumulation in small amounts in grains and straw of rice. We obtained such type of result in the present study is therefore obvious the same phenomena occurs in this experiment. It is concluded further that the application of Zn fertilizer had small (2.241 kg ha^{-1} uptake) influence on Mg content in rice grains and straw.

Sulphur Content: Data were presented in Table 3 where S content in rice grain ranged from 0.124 (Zn-6) to 0.187 % (control). From the presented data (Table 4) the highest (0.208 %) being in Zn-3 treatment and the lowest S in straw was 0.048 % (Zn-1). The data of grain and straw had no statistical variation.

Zaman *et al.* [12] in a filed trial on Non calcareous Dark Grey Flood Plain Soils reported that remarkable effect of Zn application. The S content in rice grain was decreased by Zn application though not significant. In our presented data there might be putted a statement that our results did not show significant effect because they had no statistical difference among the treatments. But from the table it was showed that concentration of S was higher in straw than that of grain.

Zinc Content: The highest Zn concentration in grain (10.77 mg kg^{-1}) was found in Zn-2 which was statistically different from all other treatments. The different brands of Zn treatments except (Zn-2) had little or negative response as regards to Zn content in grain compared to the control. Sakal *et al.* [14] reported that application of Zn fertilizer increased the Zn content in rice grain. The concentration of Zn in straw was highest (56.65 mg kg^{-1})

in control which was statistically similar to Zn-2 (54.85 %), Zn-8 (51.73 %) and Zn-6 (54.55 %). Zn content in straw was found much superior to that in grains of rice. Singh [15] showed that Zn application significantly increased Zn concentration in various plant parts.

Copper Content: The highest Cu concentration in rice grain (8.963 mg kg^{-1}) was found in Zn-2 followed by Zn-8 (7.743 mg kg^{-1}). The content of Cu due to Zn-7 (5.453 mg kg^{-1}), Zn-3 (5.427 mg kg^{-1}) and control (5.33 mg kg^{-1}) was almost identical. The Cu concentration in straw was also significantly different among the treatments. The maximum Cu concentration (55.79 mg kg^{-1}) was found in Zn-7 and it was lowest in Zn-5 (21.38 mg kg^{-1}). The results indicate that the concentration of Cu in straw was higher as compared to that of grains of BRRI Dhan 32.

Iron Content: In grain the highest Fe concentration ($185.30 \text{ mg kg}^{-1}$) was found in Zn-6 followed by Zn-4 (149 mg kg^{-1}), Zn-8 (145 mg kg^{-1}) and control (142 mg kg^{-1}). The lowest (66.0 mg kg^{-1}) Fe was obtained in Zn-5 which is similar to Zn-1. The highest Fe (236.7 mg kg^{-1}) in straw was found in Zn-2 and it was lowest in Zn-1 (94.64 mg kg^{-1}). It is concluded from the data (Tables 3 and 4) that concentration of Zn in rice grain and straw were as different in different branded treatments. It is difficult to predict if it was due to particular brand of Zn fertilizer. The variation in Fe in grain due to the application of different brands of Zn fertilizer did not maintain the same sequence but they are statistically significant.

Manganese Content: The highest Mn concentration in rice grains (61.33 mg kg^{-1}) was found in Zn-2 followed by Zn-3, Zn-8 and control and it was lowest (26.09 mg kg^{-1}) in Zn-1. The Mn concentration in straw ranged from 283.1 to 548.8 mg kg^{-1} (Table 4). The highest Mn concentration was found in Zn-2 treatment. Among the eight different brands of Zn fertilizer, 50 % were statistically identical with the control because the treatment that is control was statistically similar to Zn-1, Zn-4, Zn-6 and Zn-8 and the result 487.9 mg kg^{-1} (Zn-5) was also statistical similar to Zn-3, Zn-6. So the different Zn treatments had no effective response, in respect of Mn conc. in rice straw [16]. It had seen (Tables 3 and 4) that different brands of Zn fertilizer had acted differently on the content of Mn in rice grains and straw. The amount of Mn in rice grain was much higher than that in rice straw according to the experimental data.

CONCLUSION

The content of nutrients N, S and Ca in rice grains and straw were not statistical significant for the Zn fertilizer treatment. The content of nutrients (P, K, Na, Mg, Zn, Cu, Fe and Mn) in plants samples as influenced by different brands of Zn fertilizer produced and marketed in Bangladesh was studied significantly. It is apparent that Zn-2 induced highest accumulation of P, Zn, Cu and Mn in rice grain whereas in straw this brand induced highest concentration of N, Fe and Mn. The concentration of Zn in both rice grain and straw appeared less in amount in most of the treatments as compared to control except that grain due to Zn-2. The supplied Zn fertilizer contained Zn % from 9.3 to 26 but it should be ensured to the farmers that supplied Zn fertilizer to be maintained appropriate standard. This poses big questions about the purity of the brands of Zn fertilizer produced and marketed locally in Bangladesh.

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