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RESPONSE OF MAIZE VARIETIES TO ZINC FERTILIZATION

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Abstract

Eight maize varieties viz. four composites (Mohor, Barnali, Khoibhutta, and BARI Maize-6) and four hybrids (BARI Hybrid Maize-1, BARI Hybrid Maize-3, BARI Hybrid Maize Top 1 & Pacific 984), were tested for their response to zinc fertilization (0 and 3 kg Zn/ha) at the Regional Agricultural Research Station (RARS), Jessore (AEZ-11, High Ganges River Floodplain) during 2002-2005. The varieties were not equally responsive to Zn addition. Except BARI Hybrid Maize-3, all other hybrids showed higher response to Zn compared to composite varieties. Among the hybrids, the Pacific 984 had the highest response followed by BARI Hybrid Maize-1 and BARI Hybrid Maize Top 1, the later two showed identical response. Comparing the composite varieties, their response can be ranked as Barnali ≈ Mohor > Khoibhutta > BARI Maize-6. The result suggests that BARI Hybrid Maize-3 and BARI Maize-6 were the most Zn inresponsive (Zn efficient) varieties. Further it appeared that Pacific 984 gave the highest seed yield, 10.46 t/ha due to Zn application. So, the farmers can grow this variety with an application of Zn @ 3 kg/ha in the deficient soil. The results also indicate that the farmers can cultivate BARI Hybrid Maize-3 in the moderately zinc deficient soils with a minimum dose (1 to 2 kg/ha) of Zn fertilization.

Keywords: Maize varieties, zinc fertilization.

Introduction

Zinc deficiency is the most widespread micronutrient deficiency in the world (Fageria *et al.*, 2002). Sommer and Lipman (1926) were the first to prove the essentiality of Zn as a nutrient requirement for higher plants. Plants emerged from seeds with low concentration of Zn could be highly sensitive to biotic and abiotic stress (Obata *et al.*, 1999). Zinc enriched seeds can perform better with respect to seed germination, seedling health, crop growth, and finally yield advantage (Cakmak *et al.*, 1996). Sakai *et al.* (1997) reported that the continuous rice-wheat system with increasing NPK fertilizer applications is the cause of depleting the soil available micronutrients reserve, particularly available Zn, leading to decline in crop productivity. In Bangladesh, Zn deficiency has occurred mainly due to continuous mining of this nutrient from soil and to increase cropping intensity (180% at present, BBS, 2009). This element is less available for plant uptake in high pH soils (e.g. calcareous soils) mainly due to their retention by soils and soil constituents (Hossain, 2007).

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The maize (corn) cultivation in our country is increasing because of high yield potential as well as its high market demand for poultry feed. The average yield of the crop stands at 6.18 t/ha (BBS, 2009), which is very low compared to the yield of many maize growing countries of the world. There are several reasons that can explain this yield variation, which cover biotic and abiotic factors. Among the biotic and abiotic factors, unavailability of high yielding varieties and nutriment deficiency (Carsky and Reid, 1990; Zuo *et al*., 1995) are responsible for lower productivity of maize. Maize is recognized as highly sensitive to Zn deficiency. The variety which is not responsive to applied Zn in the Zn deficient soil but capable to produce optimum yield, that variety is called Zn efficient variety. It is known as an indicator plant for evaluation of Zn deficiency of a soil. Plants absorb Zn in the form of Zn^{2+}. The functional role of Zn includes auxins metabolism, nitrogen metabolism, influence on the activities of enzymes, cytochrome c synthesis and stabilization of ribosomal fractions and protection of cells against oxidative stress (Tisdale *et al.*, 1997; Obata *et al*., 1999). Poor growth, interveinal chlorosis and necrosis of lower leaves are the common symptoms of Zn deficiency in field crops. In a study with 49 maize cultivars in Africa Oikeh *et al*. (2003) observed that kernel Zn levels of different varieties varied from 16.5 to 24.6 mg/kg. Jessore region is an extensively maize growing area and the soil of this area is calcareous in nature. So, maize varieties may differ in their sensitivity to Zn deficiency. Keeping the above points in view, the present study was undertaken to evaluate the response of different varieties of maize to Zn fertilization.

Materials and Method

Maize varieties may differ in their sensitivity to zinc deficiency. With this idea in view, eight maize varieties, of which four composites (Mohor, Barnali, Khoibhutta, and BARI Maize-6) and four hybrids (BARI Hybrid Maize-1, BARI Hybrid Maize-3, BARI Hybrid Maize top-1, and Pacific 984), were evaluated on their agronomic response to added Zn, except Pacific 984. All these varieties have been developed by the Bangladesh Agricultural Research Institute (BARI). The variety Pacific 984 is of Thailand origin. The field trial was conducted at the Regional Agricultural Research Station (RARS), Jessore, Bangladesh for consecutive 3 years from 2003-2004 to 2005-2006. The land belongs to High Ganges River Floodplain in the agroecological zone, (AEZ 11) and Gopalpur soil series (Soil taxonomy: Aquic Eutrochrepts). The soil had high pH value (8.2) with low Zn content (0.58 mg/kg). The critical level of DTPA extractable Zn for maize in calcareous soils, as determined by Lindsay and Norvell (1978), is 0.78 mg/kg. The other soil properties were 1.44% organic matter, 7.32 mg/kg Olsen-P, 0.29 c mol/kg exchangeable K, 20 c mol/kg Ca, 1.25 c mol/kg Mg, 7.51 mg/kg C_aC1_{2}-S and 0.21 mg/kg Ca (H_2PO_4)-B. Soil pH was determined by glass electrode pH meter (1:2.5 soil-water ratio) and organic matter by wet oxidation method (Nelson and Sommers, 1982). The K, Ca, and Mg contents of soil were determined by IM NH_40Ac (pH 7.0) extraction method. The experiment was laid out in a randomized complete block design with three replications, each plot size being 5m x 4.5m. Zinc was applied at 3 kg/ha, where other one was control. This layout was kept undisturbed for the second and third year of the study. Zinc was applied as ZnO (78% Zn). Every year, 260 kg N, 63 kg P, 80 kg K, 47 kg S, and 1 kg B/ha were applied for high yield on the basis of soil nutrient status. The source of nutrients were urea, triple super phosphate (TSP), muriate of potash (MoP), gypsum, and boric acid for N, P, K, S, and B, respectively. Intercultural operations viz. weeding, irrigation, and insecticide spray were done as and when required. Every year, the maize varieties were sown in the first week of November and harvested in the first week of April. At maturity, data on yield components were recorded from 10 randomly selected plants from each plot. Yield data were recorded from whole plot and were expressed as t/ha on 12% moisture level. The data were statistically analyzed following the principle of *F*-statistics and the mean values were separated by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Results and Discussion

Yield components

When the growth and yield contributing characters were looked into, it appeared that except the cob breadth, all other characters, such as plant height, cob length, number of seeds/cob, and 1000-seed weight responded positively to Zn fertilization (Table 1 to 5). Practically, the Zn treatment positively influenced the seed set and seed weight which resulted in higher seed yield of the crop. The number of seeds/cob for composite varieties varied from 507 to 613 in the Zn treated plots against 432 to 527 in the Zn control plots. The seed number for hybrids were 514 to 583, and 445 to 494 in the Zn treated and untreated plots, respectively. The highest number of seeds/cob increased 26.5% in Pacific-984 and the lowest 4.05% in BARI Hybrid Maize-3 due to Zn fertilization (Table 1). Moussa and Barsoum (1995), and Zuo *et al.* (1995) reported that number of seeds/cob increased due to Zn application. In case of composite varieties, 1000-seed weight varied from 228 to 346 g due to Zn fertilization whereas it was 205 to 333 g in control, but for hybrid varieties, it was 350 to 365 g with Zn and 297 to 352g in control. The hybrid variety Pacific-984 produced 18.2% higher 1000-seed weight than the Zn control plot; whereas BARI Hybrid Maize-6 increased only 1.99% due to Zn fertilization (Table 2). Hybrid variety Pacific-984 produced the highest cob length 19.9 cm (mean of 3 years) in Zn treated plot which was followed by BARI Hybrid Maize-1 and Khoibhutta. Zinc fertilization increased the cob length varying from 5.20 to 29.5% in different maize varieties (Table 3).

Table 1. Number of seeds/cob of different varieties of maize due to Zn fertilization.

Group	Variety	Zinc level (kg/ha)	Number of seeds/cob				% increase over control
			2002-03	2003-04	2004-05	Average	
Composites	V_1	Zn_0	442f	439h	415d	432	-
		Zn_3	520cde	517b-e	485bc	507	17.4
	V_2	Zn_0	473ef	443fgh	428d	448	-
		Zn_3	563bc	533bcd	527b	541	20.8
	V_3	Zn_0	561bc	507cde	513b	527	-
		Zn_3	657a	588a	593a	613	16.3
	V_4	Zn_0	520cde	492d-f	460cd	491	-
		Zn_3	533cd	523b-e	489bc	515	4.89
Hybrids	V_5	Zn_0	472ef	442gh	420d	445	-
		Zn_3	546cd	545abc	514b	535	20.2
	V_6	Zn_0	519cde	474e-h	490bc	494	-
		Zn_3	535cd	493c-f	515b	514	4.05
	V_7	Zn_0	501 de	484d-h	445cd	477	-
		Zn_3	598b	566ab	529b	564	18.2
	V_8	Zn_0	506de	437h	441cd	461	-
		Zn_3	608bb	563ab	577a	583	26.5
CV (%)			5.30	5.46	5.66	-	-

Values within the same column with a common letter do not differ significantly (p=0.05), V_I = Mohor, V_2 = Barnali, V_3 = Khoibhutta, V_4 = BARI Maize-6, V_5 . BARI Hybrid Maize-1, V_6 = BARI Hybrid Maize-3, V_7 = BARI Hybrid Maize Top-1, V_8= Pacific-984.

Higher cob breadth ranged from 5.04 and 4.84 cm were recorded in BARI Maize-6 and lower with Khoibhutta 3.73 and 3.53 cm with and without zinc fertilization. In both the conditions, cob breadth for all varieties was higher than that of Khoibhutta. This variation might be due to genetical among the varieties. Zinc fertilization increased the breadth of cob in all the varieties ranged from 1.96 to 10.1 % (Table 4). Tallest plant 255 cm was recorded in BARI Hybrid Maize-3 and BARI Hybrid Maize-1 where Zn was applied and this was very closely with Barnali 253 cm and BARI Hybrid Maize Top-1 252 cm. All the varieties differed significantly in plant height due to Zn fertilization (Table 5) except BARI Hybrid Maize-3 and BARI Maize-6. Similar results were also reported by Moussa and Barsoum (1995). Reddy and Khera (1999) also observed the significant differences with maize varieties for Zn fertilization. Sharma *et al.* (1992) noted that yield components of maize varieties diferred significantly due to Zn fertilization.

Table 2. Thousand-seed weight of different varieties of maize due to Zn fertilization.

Group	Variety	Zinc level (kg/ha)	1000-seed wt (g)				% increase over control
			2002-03	2003-04	2004-05	Average	
Composites	V_1	Zn_0	305c	3118	301gh	306	-
		Zn_3	333b	339cde	339cde	336	9.80
	V_2	Zn_0	315c	317fg	304fgh	312	-
		Zn_3	340ab	345bcd	342b-e	342	9.92
	V_3	Zn_0	209e	205i	200j	205	-
		Zn_3	231d	226h	227i	228	11.22
	V_4	Zn_0	334b	333def	328def	332	-
		Zn_3	341ab	342bcd	356abc	346	4.22
Hybrids	V_5	Zn_0	311c	322efg	32lefg	318	-
		Zn_3	355a	369a	372a	365	14.78
	V_6	Zn_0	346ab	354abc	355abc	352	-
		Zn_3	35 lab	360ab	367ab	359	1.99
	V_7	Zn_0	306c	312g	314fg	311	-
		Zn_3	341ab	353abc	356abc	350	12.54
	V_8	Zn_0	302c	304g	285h	297	-
		Zn_3	347ab	355abc	350a-d	351	18.18
CV (%)			2.31	2.31	3.26	-	-

Values within the same column with a common letter do not differ significantly (p=0.05) V_1 = Mohor, V_2 = Barnali, V_3= Khoibhutta, V_4 = BARI Maize-6, V_5 = BARI Hybrid Maize-1, V_6 = BARI Hybrid Maize-3, V_7 = BARI Hybrid Maize Top-1, V_8= Pacific-984.

Seed yield

Differential response was observed in yield among the maize varieties to Zn fertilization (Table 6). Hybrids showed higher response to Zn fertilization compared with composites except BARI Hybrid Maize-3. Among the hybrids, response was highest in Pacific-984 which was followed by BARI Hybrid Maize-1 and BARI Hybrid Maize Top-1 (Table 6). Statistically no variation was observed between BARI Hybrid Maize-I and BARI Hybrid Maize Top-1. Among the composite varieties, response can be ranked as Barnali ≈ Mohor > Khoibhutta > BARI Maize-6. Hybrids, such as Pacific-984, BARI Hybrid Maize-3, BARI Hybrid Maize Top-1, and BARI Hybrid Maize-1 produced yields of 10.46, 9.03, 8.50, and 8.34 t/ha, respectively, with Zn fertilization which were 39.8, 5.12, 26.9, and 26.9 % higher over control (Table 6). On the other hand, composite varieties viz. BARI Maize-6, Mohor, Barnali, and Khoibhutta produced yield 6.70, 6.55, 6.42, and 5.57 t/ha which were 8.60, 23.8, 24.9, and 16.3% yield increase, respectively, over control. The variety BARI Hybrid Maize-3 produced second highest yield. Lowest seed yield was observed with Khoibhutta (Table 6). From this result, it can be said that the seed yield of maize varied significantly due to Zn fertilization. Similar results were also reported by various scientists like Das *et al.* (1993), Alam *et al.* (2000), Santi *et al*. (1997), Chowdhury and Islam (1993), Sankhyan and Sharma (1995) and Turambeker and Daftardar (1992). Sharma *et al.* (1992) reported that the seed yield of maize increased by 11.4% upto Zn levels from 0 to 9 kg Zn/ha. Similar result was also reported by Cakmak *et al.* (1997) with other crops like rye, triticale, bread and durum wheats increase due to application of Zn in calcareous soils. As stated by Romheld and Kirkby (2007) that the higher susceptibility of some genotypes to Zn deficiency is mainly due to inadequate Zn acquisition by plant roots.

Table 3. Cob length of different varieties of maize due to Zn fertilization.

Group	Variety	Zinc level (kg/ha)	Cob length (cm)				% increase over control
			2002-03	2003-04	2004-05	Average	
Composites	V_1	Zn_0	14.30f	15.31 cd	14.69d	14.77	-
		Zn_3	17.58bc	18.26ab	18.09ab	17.98	21.73
	V_2	Zn_0	15.80e-f	15.81cd	14.83d	15.48	-
		Zn_3	18.58ab	18.85ab	17.95ab	18.46	19.25
	V_3	Zn_0	17.40bcd	16.19cd	15.91cd	16.50	-
		Zn_3	19.86a	18.90ab	18.74ab	19.17	16.18
	V_4	Zn_0	14.23f	14.96d	14.07d	14.42	-
		Zn_3	15.01f	15.21cd	15.30cd	15.17	5.20
Hybrids	V_5	Zn_0	15.13ef	15.10cd	15.35cd	15.19	-
		Zn_3	19.07ab	19.20a	19.70a	19.32	27.19
	V_6	Zn_0	17.24b-e	17.02bc	17.14bc	17.13	-
		Zn_3	18.45ab	18.38ab	18.18ab	18.34	7.60
	V_7	Zn_0	15.50c-f	15.18cd	14.87d	15.18	-
		Zn_3	18.64ab	18.87ab	18.97ab	18.83	24.04
	$^{V}8$	Zn_0	15.34def	15.66cd	15.11d	15.37	-
		Zn_3	19.92a	20.20a	19.60a	19.91	29.54
CV (%)			5.06	4.65	6.24	-	-

Values within the same column with a common letter do not differ significantly (p=0.05), V_I = Mohor, V_2 = Bamali, V_3 = Khoibhutta, V_4 = BARI Maize-6, V_5 = BARI Hybrid Maize-1, V_6 = BARI Hybrid Maize-3, V_7 = BARI Hybrid Maize Top-1, V_8= Pacific-984.

Table 4. Cob breadth of different varieties of maize due to Zn fertilization.

Group	Variety	Zinc level (kg/ha)	Cob breadth (cm)				% increase over control
			2002-03#	2003-04#	2004-05#	Average	
Composites	V_1	Zn_0	4.27	4.20	4.14	4.20	-
		Zn_3	4.63	4.54	4.49	4.55	8.30
	V_2	Zn_0	4.25	4.21	4.12	4.19	-
		Zn_3	4.43	4.47	4.41	4.44	6.0
	V_3	Zn_0	3.48	3.62	3.49	3.53	-
		Zn_3	3.68	3.79	3.73	3.73	5.67
	V_4	Zn_0	4.80	4.90	4.81	4.89	-
		Zn_3	4.96	5.10	5.06	5.04	4.13
Hybrids	V_5	Zn_0	4.21	4.26	4.31	4.26	-
		Zn_3	4.53	4.67	4.74	4.65	9.15
	V_6	Zn_0	4.57	4.60	4.60	4.59	-
		Zn_3	4.65	4.65	4.74	4.68	1.96
	V_7	Zn_0	4.53	4.38	4.29	4.40	-
		Zn_3	4.84	4.76	4.62	4.78	8.63
	V_8	Zn_0	4.16	4.22	4.35	4.24	-
		Zn_3	4.54	4.66	4.81	4.67	10.1
CV (%)			4.76	3.85	3.29	-	-

Not significant, V_I = Mohor, V_2= Barnali, V_3 = Khoibhutta, V_4= BARI Maize-6, V_5= BARI Hybrid Maize-1, V_6 = BARI Hybrid Maize-3, V_7 = BARI Hybrid Maize Top-1, V_8= Pacific-984.

Table 5. Plant height of different varieties of maize due to Zn fertilization.

Group	Variety	Zinc level (kg/ha)	Plant height (cm)				% increase over control
			2002-03	2003-04	2004-05	Average	
Composites	V_1	Zn_0	204.9d	215.7bc	201.7cd	208	-
		Zn_3	241.4ab	255.4a	241.3ab	246	18.3
	V_2	Zn_0	217.8cd	220.2bc	205.5cd	215	-
		Zn_3	253.5a	260.5a	245.1ab	253	17.7
	V_3	Zn_0	200.3d	186.8d	182.3e	190	-
		Zn_3	231.2bc	216.7bc	213.1 c	220	15.8
	V_4	Zn_0	211.7d	216.9bc	202.2cd	210	-
		Zn_3	218.9cd	231.8b	217.2c	223	6.19
Hybrids	V_5	Zn_0	216.9cd	217. 1 bc	209.5cd	215	-
		Zn_3	253.3a	257.5a	253.4a	255	18.6
	V_6	Zn_0	247.0ab	251.5a	235.3b	245	-
		Zn_3	256.3a	262.8a	246.4ab	255	4.08
	V_7	Zn_0	215.2cd	218.3bc	211.5cd	215	-
		Zn_3	252.3a	254.8a	249.6ab	252	16.3
	V_8	Zn_0	207.8d	202.0cd	196.1de	202	-
		Zn_3	245.5ab	250.2a	238.1ab	245	21.3
CV (%)			4.32	4.26	2.97	-	-

Values within the same column with a common letter do not differ significantly (p=0.05), V_I = Mohor, V_2 = Barnali, V_3 = Khoibhutta, V_4 = BARI Maize 6, V_5 = BARI Hybrid Maize-1, V6.BARI Hybrid Maize-3, V_7 = BARI Hybrid Maize Top-1, V_8= Pacific-984.

Table 6. Seed yields of different varieties of maize due to zinc fertilization.

Group	Variety	Zinc level (kg/ha)	Seed yield (t/ha)				% increase over control
			2002-03	2003-04	2004-05	Average	
Composites	V_1	Zn_0	5.66f	5.26gh	4.95hij	5.29	-
		Zn_3	6.77def	6.59def	6.29efg	6.55	23.8
	V_2	Zn_0	5.68f	5.04h	4.79ij	5.14	-
		Zn_3	6.70def	6.39efg	6.18efg	6.42	24.9
	V_3	Zn_0	5.41f	4.87h	4.09j	4.79	-
		Zn_3	6.05ef	5.49fg	5.17g-j	5.57	16.3
	V_4	Zn_0	6.73def	6.36de	5.42f-i	6.17	-
		Zn_3	7.12cd	6.84def	6.14e-h	6.70	8.60
Hybrids	V_5	Zn_0	6.77def	7.16cde	5.78f-i	6.57	-
		Zn_3	8.53b	8.73b	7.77cd	8.34	26.9
	V_6	Zn_0	8.61b	8.50b	8.67bc	8.59	-
		Zn_3	8.81b	8.86b	9.43ab	9.03	5.12
	V_7	Zn_0	7.20cd	6.53de	6.36efg	6.70	-
		Zn_3	8.55b	8.79b	8.17cd	8.50	26.9
	V_8	Zn_0	7.48cd	7.70bcd	7.27de	7.48	-
		Zn_3	9.87a	11.17a	10.34a	10.46	39.8
CV (%)			5.60	7.04	7.76	-	-

Values within the same column with a common letter do not differ significantly (p=0.05), V_I= Mohor, V_2= Barnali, V_3= Khoibhutta, V_4= BARI Maize-6, V_5= BARI Hybrid Maize-1, V_6= BARI Hybrid Maize-3, V_7=BARI Hybrid Maize Top-1, V_8= Pacific-984.

Table 7. Stover yields of different varieties of maize due to zinc fertilization.

Group	Variety	Zinc level (kg/ha)	Stover yield (t/ha)				% increase over control
			2002-03	2003-04	2004-05	Average	
Composites	V_1	Zn_0	6.74de	7.26bc	6.48def	6.83	-
		Zn_3	8.3 5 abc	8.52a	8.16bc	8.34	22.1
	V_2	Zn_0	6.52e	7.18bc	6. 1 Oef	6.60	-
		Zn_3	8.32abc	8.41a	7.76c	8.16	23.6
	V_3	Zn_0	3.91 f	3.86e	3.91 h	3.89	-
		Zn_3	4.42f	4.65e	5.09g	4.72	21.3
	V_4	Zn_0	6.07e	5.65de	5.87f	5.86	-
		Zn_3	6.4le	6.08d	6.95d	6.48	10.6
Hybrids	V_5	Zn_0	6.80de	5.56de	6.37def	6.24	-
		Zn_3	8.14bc	7.98ab	8.2 1 bc	8.11	30.0
	V_6	Zn_0	8.50abc	8.16a	8.48abc	8.34	-
		Zn_3	9.1 la	8.79a	9.02a	8.97	7.55
	V_7	Zn_0	6.84de	6.39cd	6.42def	6.55	-
		Zn_3	8.94ab	8.14a	8.63ab	8.57	30.8
	V_8	Zn_0	7.62cd	7.15bc	6.80de	7.19	-
		Zn_3	9.00ab,	8.59a	8.84ab	8.81	22.5
CV(%)			6.86	7.05	6.14	-	-

Values within the same column with a common letter do not differ significantly (p=0.05), V_I= Mohor, V_2 = Barnali, V_3 = Khoibhutta, V_4 = BARI Maize-6, V_5 = BARI Hybrid Maize-1, V_6 = BARI Hybrid Maize-3, V_7 = BARI Hybrid Maize Top-1, V8= Pacific-984.

Stover yield

Like seed yield, the stover yield of maize for all varieties increased significantly due to Zn fertilization (Table 7). On an average, the BARI Hybrid Maize-3 gave the highest stover yield 8.97 t/ha which was followed by Pacific-984 8.81 t/ha, BARI Hybrid Maize Top-1 8.57 t/ha, Mohor 8.34 t/ha and Barnali 8.16 t/ha, BARI Hybrid Maize-1 8.11 t/ha, BARI Maize-6 6.48 t/ha and Khoibhutta 4.72 t/ha which were 7.5 5, 22.5, 30.8, 22.1, 23.6, 30.0, 10.6, and 21.3 % increase over control, respectively (Table 7). Percent stover yield increased 30.8 with BARI Hybrid Maize-3 and 7.55 with BARI Hybrid Maize Top-1 (Table 7). Moussa and Barsoum (1995), Das *et al.* (1993), Singh *et al.* (1988), Thind *et al.* (1990) and Hussain and Fayad (1996) reported that stover yield of maize increased significantly due to Zn application.

Conclusion

From this study, it can be concluded that the BARI Hybrid Maize-3 and BARI Maize-6 were Zn in responsive (Zn efficient) among the used varieties. On the other hand, Pacific 984 was the Zn responsive (Zn in-efficient) variety. The variety pacific 984 can be cultivated in the Zn deficient soil with a Zn dose 3 kg/ha but for BARI Hybrid Maize-3, it would be 1-2 kg/ha.

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