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GROWTH AND YIELD OF LENTIL AS INFLUENCED BY ZINC AND BORON MANAGEMENT

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Abstract

A field experiment was conducted at Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh, during the period from November 2021 to March 2022 to evaluate the influence of micronutrients management on growth and yield of two lentil varieties viz., BARI Masur-8 (V_1) and Binamasur-8 (V_2) and 6 micronutrients management (no fertilizer - F_1, recommended fertilizer dose (RFD) (40-90-40-55 Kg ha^{-1} of urea-TSP-MoP-Gypsum) with 10 Kg ha^{-1} $ZnSO_4$ as basal - F_2, RFD with zinc (Zn) as foliar spray - F_3, RFD with Zn and boron (B) as foliar spray - F_4, 50% RFD + 50% cow dung (5 t ha^{-1}) - F_5 and 50% RFD + 50% cow dung + Zn and B as foliar spray - F_6). No significant effect had found for variety except 1000-seed weight but micronutrients management along with interactions significantly effects on all studied parameters of lentil. The higher 1000-seed weight (34.16 g) was recorded in BARI Masur-8. The highest plant height (37.09 cm), number of branches plant^{-1} (7), dry weight of root plant^{-1} (159.17 mg), dry weight of shoot plant^{-1} (3319.33 mg) and number of pods plant^{-1} (62) was observed at F_6 treatment. The highest 1000-seed weight (31.68 g) were recorded at F_2 treatment. The highest weight of nodules plant^{-1} (10.33 mg at 60 DAS), seed yield (2.62 t ha^{-1}), straw yield (2.12 t ha^{-1}) and biological yield (4.74 t ha^{-1}) were found at F_3 treatment. The highest plant height (38.45 cm), number of branches plant^{-1} (7), number of pods plant^{-1} (63), seed yield (2.91 t ha^{-1}) and harvest index (58.65%) were recorded at V_2F_6 whereas the highest weight of nodules plant^{-1} (26 mg), straw yield (2.22 t ha^{-1}) and biological yield (5.02 t ha^{-1}) were found at V_1F_3 but the highest 1000-seed weight (34.87 g) at V_1F_1. The highest number of seeds pod^{-1} (1.83) was found at V_2F_1. So, two varieties showed similar performance on yield. Foliar application of Zn has the potentiality to increase seed yield. The variety Binamasur-8 with 50% RFD + 50% cow dung + Zn and B (F_6) as foliar spray could bring maximum yield (2.91 t ha^{-1}) of lentil followed by treatment F_2, F_3, and F_4.

Introduction

Pulses are vital components in diversification of Bangladesh's predominantly rice-based cropping system. Lentil (*Lens culinaris* Medik) is an important source of nutritional security, protein content of 18-30% and essential micronutrients, e.g., Fe, Zn and *β*-carotene for improving health of humans and domestic animals (Togay *et al.*, 2015; Bhatty, 1988). Lentil area and production in Bangladesh was about 1.41 lakh ha and 1.77 metric tons with an average yield of 1.26 t ha^{-1} which contributed about 35% to the total pulses production in Bangladesh (BBS, 2021).

Variation of seed yield and other yield attributes of lentil for different varieties were reported by Khatun *et al.* (2021) and Zaman *et al.* (2022). Singh and Bhatt (2013) reported that micronutrients required in small amount but contributed significantly on seed yield of lentil (16.2%) by increasing the growth and uptake of nutrients. Combined use of different micro and macronutrients can augment seed yield by 55 to 60%, of which 20 to 25% could be ascribed to the micronutrients (Islam *et al*., 2018). Hossain *et al*. (2020) reported the highest nutrient uptake, maximum nodulation (at 68 DAS, 63.5 plant^{-1}) and the highest protein content (26.6%) in seed from the micronutrients (Zn, B and Mo) application in lentil.

Foliar application of micronutrients was 6 to 20 times more useful than the soil application and improves the nutrition (Arif *et al.*, 2006). Foliar application of Zn reduces the micronutrient deficiencies and it was an efficient method because nutrients are easily absorbed through leaves and is best option to

compensate micronutrient deficiencies in shorter period of time under rainfed regions (Nasiri *et al.*, 2010). Combined application of Zn and B significantly increased the plant height, root length, leaf area index, shoot and root dry weight and chlorophyll content (Panhwar *et al.*, 2011). Therefore, the study was undertaken to compare the yield and other attributes of two lentil varieties and determine the effect of Zn and B on lentil yield and also find out the interaction of variety and micronutrient (Zn and B) management on growth and yield of lentil.

Materials and Methods

The experiment was conducted during November 2021 to April 2022 at the Agronomy field of Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh. The seeds of lentil var. BARI Masur-8 and Binamasur-8 were used as plant materials and the seeds were collected from Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur and Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh, respectively.

The experiment was laid out in a split-plot design with three replications. The treatments were two variety viz., i) BARI Masur-8 (V_1) and ii) Binamasur-8 (V_2) in the main-plot and six different fertilizer management viz., i) No fertilizer (F_1); ii) Recommended N, P, K, and S (RFD) with Zn as basal (F_2); iii) RFD with Zn as foliar spray (F_3); iv) RFD with Zn and B as foliar spray (F_4); v) 50% RFD + 50% cow dung (F_5), and vi) 50% RFD + 50% cow dung + Zn and B as foliar spray (F_6) in the sub-plot. The basal recommended dose i.e., urea (45 Kg ha^{-1}), TSP (90 Kg ha^{-1}), MoP (40 Kg ha^{-1}), Gypsum (55 Kg ha^{-1}), $ZnSO_4$ (10 Kg ha^{-1}) and Boric Acid (10 Kg ha^{-1}) along with cow dung (5 t ha^{-1}) were used in the experiment as per treatment during final land preparation. The foliar application of Zn and B were applied as per treatment during flower initiation. The seeds of BARI Masur-8 and Binamasur-8 were sown by hand in 30 cm apart lines with continuous spacing at about 3 cm depth on 24 November, 2021. Irrigation was given to each plot, first irrigation as pre-sowing and other two irrigations 3 days before weeding. Two hand weeding were done for all the treatments on 15 and 30 DAS. The field was infested by different insects and diseases those controlled by applying appropriate ways in time.

Five plants $plot^{-1}$ was randomly selected for collecting plant height, number of branch $plant^{-1}$, dry weight of root and shoot at stipulated dates. The inner six lines were harvested for recording yield and yield attributes data. The seed yield and straw yield were recorded at 12% moisture level. Statistical analyses were done by using the CropStat computer package and the mean differences among the treatments were compared by least significant difference (LSD) test at 5% level of significance following Gomez and Gomez (1984).

Results and Discussion

Effect of variety

All the studied characters showed non-significant variation between the two varieties except 1000-seed weight where BARI Masur-8 (34.16 g) showed higher 1000-seed weight compared to that of Binamasur-8 (28.28 g) (Table 1-3). Similar variation of 1000-seed weight of lentil varieties was also found by Zaman *et al.* (2022) and Khatun *et al*. (2021).

Effect of micronutrient management

The fertilizer treatments showed significant variations on most of the studied parameters where the highest plant height (37.09 cm), branches $plant^{-1}$ (7), shoot dry weight $plant^{-1}$ (3319.33 mg),

pods $plant^{-1}$ (62) were recorded from the F_6 (50% RFD + 50% cow dung + Zn and B as foliar spray) treatment but the lowest result given by F_1 (no fertilizer) treatment (Table 1-3).

Table 1. Plant height of lentil as affected by micronutrient management in different growth stages of lentil

Treatments	Plant height (cm)			
	30 DAS	55 DAS	80 DAS	Harvest
Variety				
V_1	14.44	26.52	32.59	34.57
V_2	13.47	25.52	31.07	34.51
$LSD_{(0.05)}$	NS	NS	NS	NS
CV (%)	8.54	5.33	11.06	9.43
Micronutrient (Zn and B) management				
F_1	13.11b	25.48	31.12ab	32.60b
F_2	13.92ab	25.52	31.27ab	33.53b
F_3	15.14a	25.79	30.90b	34.95ab
F_4	14.46ab	26.49	31.40ab	34.45ab
F_5	13.65b	26.03	32.60ab	34.60ab
F_6	13.46b	26.81	33.70a	37.09a
$LSD_{(0.05)}$	1.425	NS	2.588	3.424
CV (%)	8.48	6.11	6.75	8.23
Interaction				
V_1F_1	13.37bcd	25.52ab	31.10abc	32.67b
V_1F_2	14.27abcd	25.30ab	32.87ab	34.20ab
V_1F_3	15.76a	26.98ab	32.80ab	35.50ab
V_1F_4	15.06ab	27.27ab	31.63abc	34.23ab
V_1F_5	14.92ab	26.41ab	33.47a	35.07ab
V_1F_6	13.27bcd	27.65a	33.67a	35.73ab
V_2F_1	12.86cd	25.43ab	31.15abc	32.53b
V_2F_2	13.56bcd	25.74ab	29.67bc	32.87b
V_2F_3	14.53abc	24.61b	29.00c	34.40ab
V_2F_4	13.85abcd	25.71ab	31.17abc	34.67ab
V_2F_5	12.37d	25.65ab	31.73abc	34.13ab
V_2F_6	13.66bcd	25.97ab	33.73a	38.45a
$LSD_{(0.05)}$	2.015	2.709	3.660	4.842
CV (%)	8.48	6.11	6.75	8.23

Note: NS= Non-significant; V_1: BARI Masur-8, V_2: Binamasur-8, F_1: Control (No fertilizer), F_2: Recommended fertilizer dose of N, P, K, and S (RFD) with Zn as basal, F_3: RFD with Zn as foliar spray, F_4: RFD with Zn and B as foliar spray, F_5: 50% RFD + 50% cow dung, F_6 : 50% RFD + 50% cow dung + Zn and B as foliar spray

The highest 1000-seed weight (31.68 g) was recorded from the F_2 (Recommended fertilizer dose of N, P, K, and S (RFD) with Zn as basal) treatment but the lowest result given by F_3 (RFD with Zn as foliar spray) treatment (Table 3). The highest seed yield (2.62 t ha^{-1}), straw yield (2.12 t ha^{-1}) and biological yield (4.74 t ha^{-1}) was recorded from the F_3 treatment those similar to F_6 treatment but the lowest result given by F_1 treatment for most of the studied parameters (Table 3).

Table 2. Effect of variety and micronutrient management on growth and yield attributes of lentil

Treatments	Branches plant^{-1} (No.)	Shoot dry wright plant^{-1} (mg)	Pods plant^{-1} (No.)	Pod length (cm)	Seeds pod^{-1} (No.)
Variety					
V_1	5.64	2837.17	55.42	1.17	1.71
V_2	5.72	2665.83	48.54	1.18	1.73
$LSD_{(0.05)}$	NS	NS	NS	NS	NS
CV (%)	15.38	22.46	16.76	34.08	32.98

Micronutrient (Zn and B) management					
F_1	5.43b	2065.17c	47.53ab	1.19	1.73
F_2	5.57b	2762.50abc	45.30b	1.18	1.72
F_3	5.50b	2575.67abc	52.00ab	1.16	1.70
F_4	5.43b	3238.33ab	49.17ab	1.15	1.62
F_5	5.13b	2548.00abc	55.53ab	1.19	1.78
F_6	7.03a	3319.33a	62.37a	1.17	1.78
$LSD_{(0.05)}$	1.093	1158.84	15.439	NS	NS
CV (%)	15.97	34.97	24.66	6.73	29.46
Interaction					
V_1F_1	5.73bc	1934.00	48.40ab	1.20	1.62ab
V_1F_2	5.53bc	2348.33	50.53ab	1.16	1.70ab
V_1F_3	5.20bc	2815.67	61.00ab	1.16	1.67ab
V_1F_4	5.27bc	3318.00	53.93ab	1.15	1.70ab
V_1F_5	5.47bc	3054.67	57.13ab	1.20	1.77ab
V_1F_6	6.67ab	3552.33	61.53ab	1.17	1.79ab
V_2F_1	5.13bc	2196.33	46.67ab	1.18	1.83a
V_2F_2	5.60bc	3176.67	40.07b	1.21	1.73ab
V_2F_3	5.80bc	2335.67	43.00ab	1.17	1.73ab
V_2F_4	5.60bc	3158.67	44.40ab	1.15	1.53b
V_2F_5	4.80c	2041.33	53.93ab	1.18	1.80ab
V_2F_6	7.40a	3086.33	63.20a	1.17	1.77ab
$LSD_{(0.05)}$	1.546	NS	21.835	NS	0.273
CV (%)	15.97	34.97	24.66	6.73	29.46

Note: NS= Non-significant; V_1 : BARI Masur-8, V_2 : Binamasur-8, F_1 : Control (No fertilizer), F_2 : Recommended fertilizer dose of N, P, K, and S (RFD) with Zn as basal, F_3 : RFD with Zn as foliar spray, F_4 : RFD with Zn and B as foliar spray, F_5 : 50% RFD + 50% cow dung, F_6 : 50% RFD + 50% cow dung + Zn and B as foliar spray

Hossain *et al*. (2020) reported 44% higher yield of lentil using micronutrient and the increased lentil yield might be associated with increased nodulation and nutrient uptake by the crop under micronutrient-applied treatments. Significant effect of Zn and B on plant height of lentil was reported by Quddus *et al.* (2014), branches plant^{-1} by Paul *et al.* (2019), shoot dry weight plant^{-1} by Singh and Bhatt (2013), pods plant^{-1}, seeds pod^{-1}, 1000-seed weight and seed yield by Quddus *et al.* (2014) and biological yield by Khurana and Sanjay (2012).

Interaction of variety and micronutrient management

The treatment combination of V_2F_6 (Binamasur-8 and 50% RFD + 50% cow dung + Zn and B as foliar spray) showed the highest plant height (38.45 cm), number of branches plant^{-1} (7.40), number of pods plant^{-1} (63.20), seed yield (2.91 t ha^{-1}), and harvest index (58.65%) compared to that of other interactions whereas the highest number of seeds pod^{-1} (1.83) by V_2F_1 (Binamasur-8 and no fertilizer), 1000-seed weight (34.87) by V_1F_1 (BARI Masur-8 and no fertilizer), straw yield (2.22 t ha^{-1}) and biological yield (5.02 t ha^{-1}) by V_1F_3 (BARI Masur-8 and RFD with Zn as foliar spray) treatment combinations (Table 1-3). The lowest parameters were recorded from V_2F_1 (Binamasiur-8 and no fertilizer application) interactions having plant height (32.53 cm) and straw yield (1.63 t ha^{-1}) compared to that of other interactions whereas the number of branches plant^{-1} (4.80) and harvest index (53.13%) by V_2F_5 (Binamasur-8 and 50% RFD + 50% cow dung), number of pods plant^{-1} (40) by V_2F_2 (Binamasur-8 and recommended fertilizer dose of N, P, K, and S (RFD) with Zn as basal), number of seeds pod^{-1} (1.53) by V_2F_4 (Binamasur-8 and RFD with Zn and B as foliar spray), 1000-seed weight (27.13) by V_2F_3 (Binamasur-8 and RFD with Zn as foliar spray), seed yield (1.96 t ha^{-1}) and biological yield (3.69 t ha^{-1}) by V_1F_4 (BARI Masur-8 and RFD with Zn and B as foliar spray) treatment combinations (Table 1-3).

Table 3. Effect of variety and micronutrient (Zn and B) management on seed weight and yield of lentil

Treatments	1000-seed wt. (g)	Seed yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)

Variety					
V_1	34.16a	2.37	1.94	4.31	54.95
V_2	28.28b	2.47	1.97	4.43	55.77
$LSD_{(0.05)}$	3.129	NS	NS	NS	NS
CV (%)	6.99	15.41	20.44	9.98	9.68
Micronutrient (Zn and B) management					
F_1	31.60ab	2.15b	1.71b	3.86b	55.88
F_2	31.68a	2.53a	2.01ab	4.54a	55.85
F_3	30.22c	2.62a	2.12a	4.74a	55.22
F_4	31.57ab	2.22b	1.91ab	4.13ab	54.08
F_5	31.37ab	2.41ab	1.97ab	4.38ab	55.25
F_6	30.88abc	2.57a	2.01ab	4.58a	55.90
$LSD_{(0.05)}$	0.928	0.358	0.338	0.625	NS
CV (%)	2.47	38.91	45.44	11.88	5.39
Interaction					
V_1F_1	34.87a	2.09de	1.79abc	3.89bc	53.73a-d
V_1F_2	34.57abc	2.64abc	2.13ab	4.78a	55.62a-d
V_1F_3	33.30c	2.79ab	2.22a	5.02a	55.52a-d
V_1F_4	34.77ab	1.96e	1.74bc	3.69c	53.32bcd
V_1F_5	33.93abc	2.48a-d	1.79abc	4.27abc	58.36ab
V_1F_6	33.50bc	2.24cde	1.96abc	4.20abc	53.16cd
V_2F_1	28.33de	2.20cde	1.63c	3.83bc	58.03abc
V_2F_2	28.80d	2.41a-e	1.89abc	4.29abc	56.07a-d
V_2F_3	27.13e	2.45a-e	2.01abc	4.46abc	54.91a-d
V_2F_4	28.37de	2.48a-d	2.07abc	4.56ab	54.83a-d
V_2F_5	28.80d	2.35cde	2.15ab	4.49abc	53.13d
V_2F_6	28.25de	2.91a	2.05abc	4.96a	58.65a
$LSD_{(0.05)}$	1.313	0.506	0.478	0.884	5.087
CV (%)	2.47	38.91	45.44	11.88	5.39

Note: NS= Non-significant; V_1 : BARI Masur-8, V_2 : Binamasur-8, F_1 : Control (No fertilizer), F_2 : Recommended fertilizer dose of N, P, K, and S (RFD) with Zn as basal, F_3 : RFD with Zn as foliar spray, F_4 : RFD with Zn and B as foliar spray, F_5 : 50% RFD + 50% cow dung, F_6 : 50% RFD + 50% cow dung + Zn & B as foliar spray

Zinc being essential nutrient plays a significant role in stomatal regulation and reducing the tensions of less water by creating ionic balance in plants system (Baybordi, 2006) and is involved in various physiological processes such as synthesis of protein and carbohydrates (Yadavi *et al*., 2014). Similarly, B application improves growth, and enhances stress tolerance in plants and improves grain production (Hussain *et al*., 2012). Both Zn and B plays an important role in the basic plant functions like photosynthesis, protein and chlorophyll synthesis (Cakmak, 2008).

Conclusion

The varieties showed similar performance on most of the parameters except 1000-seed weight. Foliar application of Zn and B showed the potentiality to increase seed yield and hence application of Zn and B reflected their effectiveness on lentil cultivation. The variety Binamasur-8 with 50% recommended fertilizer dose + 50% cow dung + Zn and B as foliar spray could bring maximum yield (2.91 t ha^{-1}) of lentil. As the experiment was conducted on one year and in one Agro-Ecological Zone (AEZ), it is suggested to conduct more study in longer period of times and in different AEZ before final recommendation.

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References

Arif, M., M.A. Chohan, S. Ali and S. Khan. 2006. Response of wheat to foliar application of nutrients. J. Agric. Biol. Sci. 1: 30-34.

Baybordi, A. 2006. Effect of Fe, Mn, Zn and Cu on the quality and quantity of wheat under salinity stress. J. Water Soil Sci. 17: 140-150.

BBS (Bangladesh Bureau of Statistics). 2021. Statistical Yearbook of Bangladesh. Bangladesh Bureau of Statistics. Statistics Division, Ministry of Planning. Government of the People's Republic of Bangladesh.

Bhatty, R.S. 1988. Composition and quality of lentil (*Lens culinaris* Medik.): A review. Can. Inst. Food Sci. Technol. J. 21: 144-160.

Cakmak, I. 2008. Enrichment of cereal grains with zinc: Agronomic or genetic biofortification. Plant Soil. 302: 1–17.

Gomez, K.A. and A.A. Gomez. 1984. Statistical procedures for agricultural research. 2nd Edn. IRRI, Los Banos, Languna, Philippines. pp. 62-74.

Hossain, M.A., A. Quddus, K. Alam, H.M. Naser, B. Anwar, F. Khatun, H. Rashid, F. Khatun and A. Siddiky. 2020. Application of zinc, boron, and molybdenum in soil increases lentil productivity, nutrient uptake, and apparent balance. Can. J. Soil Sci. 101: 113-124.

Hussain, M., M.A. Khan, M.B. Khan, M. Farooq and S. Farooq. 2012. Boron application improves the growth, yield and net economic return of rice. Rice Sci. 19(3): 259-262.

Islam, M.M., M.R. Karim, M.M.H. Oliver, T.A. Urmi, M.A. Hossain and M.M. Haque. 2018. Impacts of trace element addition on lentil (*Lens culinaris* L.). Agronomy. 8(7): 100.

Khatun, S., M.I. Khalil and M. Roknuzzaman. 2021. Yield performance of BINA developed Lentil varieties, Bangladesh J. Nuclear Agric. 35: 183-187.

Khurana, M.P.S. and A. Sanjay. 2012. Comparative efficiency of borax and granubor as boron fertilizers for lentil and soybean grown on alluvial alkaline soils. J. Plant Nutr. 35(14): 2145-2155.

Nasiri, Y., S. Zehtab-Salmasi, S. Nasrullahzadeh, N. Najafi and K. Ghassemi-Golezani. 2010. Effects of foliar application of micronutrients (Fe and Zn) on flower yield and essential oil of chamomile (*Matricaria chamomilla* L.). J. Med. Plants Res. 4(17): 1733 -1737.

Panhwar, Q.A., O. Radziah, Y.M. Khanif and U.A. Nahar. 2011. Application of boron and zinc in the tropical soils and its effect on maize (*Zea mays* L.) growth and soil microbial environment. Aust. J. Crop. Sci. 5(12): 1649-1654.

Paul, S., T.S. Roy, R. Chakraborty, M. Roy and S.C. Sarker. 2019. Growth performance of lentil by the effect of irrigation and boron splitting as foliar application, Bangladesh Agron. J. 22(2): 139-150.

Quddus, M.A., H.M. Naser, M.A. Hossain and M.A. Hossain. 2014. Effect of zinc and boron on yield and yield contributing characters of lentil in low Ganges river floodplain soil at Madaripur, Bangladesh. Bangladesh J. Agril. Res. 39(4): 591-603.

Singh, A.K. and B.P. Bhatt. 2013. Effect of foliar application of zinc on growth and seed yield of late-sown lentil (*Lens culinaris*). Indian J. Agric. Sci. 83(6): 622-626.

Togay, N., Y. Togay, M. Erman and F. Cig. 2015. Effect of Fe (iron) and Mo (molybdenum) application on the yield and yield parameters of lentil (*Lens culinaries* Medic.). Legume Res. 38(3): 389-393.

Yadavi, A., R.S. Aboueshaghi, M.M. Dehnavi and H. Balouchi. 2014. Effect of micronutrıents foliar application on grain qualitative characteristics and some physiological traits of bean (*Phaseolus vulgaris* L.) under drought stress. Indian J. Fund. Appl. Life Sci. 4(4): 124-131.

Zaman, M.S.U., M.A. Hossain, M.J. Alam, A.K.M.M. Alam, M.O. Ali, D. Sarker and A. Sarker. 2022. 'BARI Masur-8': A high-yielding and biofortified lentil cultivar in Bangladesh. J. Plant Regist: 16(3): 504-510.