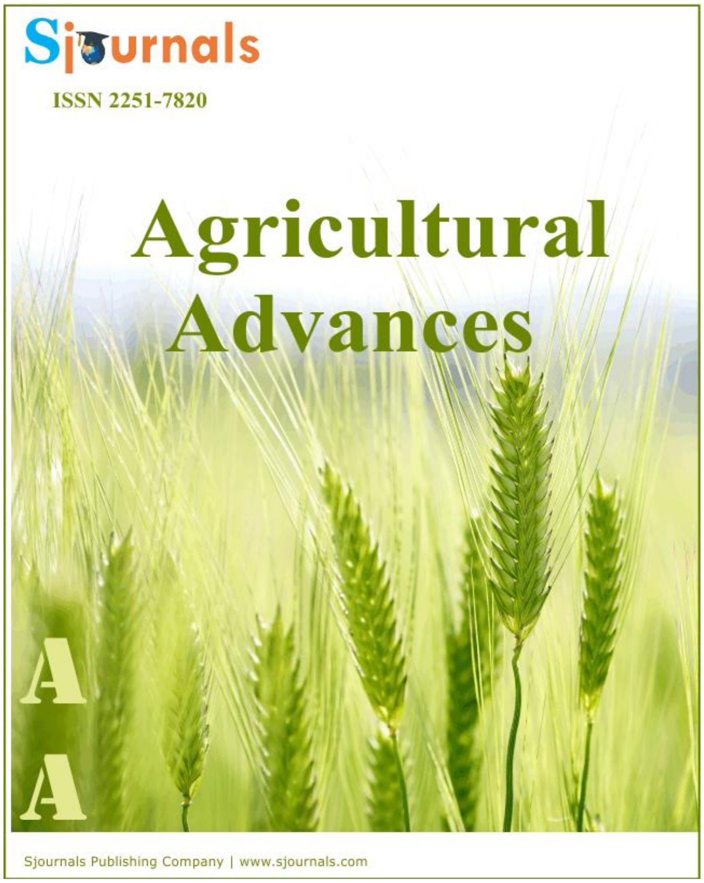
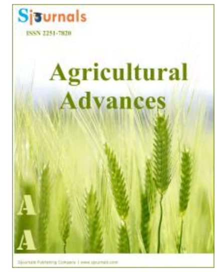

Sjournals
ISSN 2251-7820
Agricultural
Advances
A
A
Sjournals Publishing Company | www.sjournals.com

Sjournals
Scientific Journals
Agricultural Advances (2017) 6(1) 391-397
ISSN 2251-7820
doi: 10.14196/aa.v6i1.2362



Contents lists available at Sjournals
Agricultural Advances
Journal homepage: www.Sjournals.com

Original article

Yield and yield contributing characters of mungbean as influenced by zinc and boron

Mohammad Sohidul Islam[a,*], Kamrul Hasan[a], Nur-A-Alam Sarkar[b], Ayman EL Sabagh[c], Emad Rashwan[d], Celaleddin Barutçular[e]

[a]*Department of Agronomy, Hajee Mohammad Danesh Science and Technology University, Bangladesh.*
[b]*Controller Section, Hajee Mohammad Danesh Science and Technology University, Bangladesh.*
[c]*Department of Agronomy, Faculty of Agriculture, Kafrelsheikh University, Egypt.*
[d]*Department of Agronomy, Faculty of Agriculture, Tanta University, Egypt.*
[e]*Department of Field Crops, Faculty of Agriculture, Cukurova University, Turkey.*

*Corresponding author; Department of Agronomy, Hajee Mohammad Danesh Science and Technology University, Bangladesh.

A R T I C L E I N F O

Article history,
Received 13 December 2016
Accepted 14 January 2017
Available online 21 January 2017
iThenticate screening 15 December 2016
English editing 12 January 2017
Quality control 19 January 2017

Keywords,
Boron
Yield
Vigna radiate
Zinc

A B S T R A C T

A field experiment was carried out during February to April 2014 at the Crop Museum plot, Department of Agronomy, Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur to investigate the effect of zinc and boron on growth and yield characteristics of mungbeen (BARI mung-5). In this study mungbean plant was affected by three zinc levels (0, 1.5 and 3.0 kgha^{-1}) and three boron levels (0, 1.0 and 2.0 kgha^{-1}). It was conducted by RCBD with three replications. The yield and yield contributing characteristics of mungbean plant was significantly affected by the different levels of zinc and boron. The maximum plant height, number of branches plant^{-1}, number of pod plant^{-1}, pod length, number of grains pod^{-1}, 100-grains weight, grain yield, stover yield, biological yield and harvest index were recorded from in the treatment combination of Zn_1B_1 (1.5 kg Zn ha^{-1} and 1.0 kg B ha^{-1}) among all the treatments. From the yield and yield traits, it is clear that 1.5 kg Zn ha^{-1} + 1.0 kg B ha^{-1} of was congenial for the cultivation of mungbean.

1. Introduction

Among pulse crops, mungbean [*Vigna radiate* (L.)] is an important grain legume in Bangladesh. It holds the 4th in both acreage and production in Bangladesh (Sarkar et al., 2012). Its edible seed is characterized by higher digestibility, flavour, high protein content and absence of any flatulence effects (Ahmad et al., 2008). The total production of pulses in Bangladesh is only 0.65 million tons against the requirement 2.7 million tons (MoA, 2013). This means the shortage is almost 76% of the total requirement and this is mostly due to low yield (MoA, 2013). Mungbean seed contains 1-3% fat, 5.4% carbohydrates, 25.67% protein, 3.5-4.5% fibers and 4.5-5.5% ash, while calcium and phosphorus are 132 and 367 mg per 100 grams of seed, respectively (Frauque et al., 2000). Genetic potential of legume is not obtained at field due to poor soil nutrient status, mineral deficiency etc. (Maskey et al., 2004).

At present the population of Bangladesh is increasing and land is decreasing day by day, so it is essential to produce more food from our limited or confined land. Farmers are growing more cereal crops to meet up the basic demand of food. For this reason farmers do not want to use their fertile land in pulse cultivation. Mungbean can be cultivated almost throughout the year in the agro-climatic condition of Bangladesh. Due to its lower productivity of mungbean, our poor socio-economi condition and lack of proper knowledge, the farmers of our country generally produced mungbean by one ploughing and hardly use minimum fertilizers and irrigations So, there is an ambient scope to increase the mungbean yield through proper fertilizers management practices. The farmers are normally used NPK containing fertilizers for cultivation of mungbean but micro-nutrients like zinc and boron play an important role in mungbean productivity. Zinc is involved in auxin formation, activation of dehydrogenase enzymes and stabilization of ribosomal fractions (Hafeez et al., 2013). The involvement of Zn in physiological processes during early seedling development, possibly in protein synthesis, cell elongation membrane function and resistance to abiotic stresses were reported by Cakmak (2000). Ozturk et al. (2006) found that newly developed radicles and coleoptiles in germinating seeds contained Zn as much higher as up to 200 mg kg^{-1}. Zinc deficiency in plants affect photosynthesis due to altered chloroplast pigments (Kosesakal and Unal, 2009).

Boron is very important in cell division, pod and seed formation (Goldberg and Su, 2007). Boron is also functionally associated with one or more of the processes of calcium utilization, cell division, flowering and fruiting, carbohydrate and nitrogen metabolism, disease resistance, water relations, and catalyst for certain reactions (Sprague, 1951). Common B deficiency symptoms in crop plants are interrupted in flowering and fruiting (Ho, 1999) and poor yields, with deformed or discolored fruit or grain (Shorrocks, 1997). To exploit the production potential of crops under cropping systems and mitigate the deficiencies of these nutrients, the application of Zn and B containing fertilizers are needed. Addition of Zn and B in balanced fertilization schedule increased N, P and K utilization efficiency which highlights the role of micronutrients in increasing macronutrient use efficiency (Shukla, 2011). Therefore, the study was undertaken to investigate the response of Zn and B on the yield and yield contributing characteristics of mungbean and to increase the mungbean yield by selecting the suitable dose of Zn and B fertilizer.

2. Materials and methods

The experiment was conducted during February to April 2014 at the Crop Museum plot, Department of Agronomy, Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpurto investigate the effects of zinc and boron levels on yield and yield contributing characteristics of mungbean. The land was prepared with two ploughing cross ploughing followed by uniformly laddering. Soil of the land was acidic having very poor organic matter. The experiment was conducted in RCBD with three replications. The plot size was 4×2.5 m^2. The seeds of BARI mung-5 were sown @ 40 kg/ha with a spacing of 30 cm x 5 cm on 15 February 2014. Three levels of zinc (0, 1.5 and 3.0 kg/ha) and three levels of boron (0, 1.0 and 2.0 kg/ha) were used in this experiment. At final land preparation the blanket dose of fertilizers were applied. Zinc sulphate and boric acid were applied as per treatment for zinc and boron, respectively, during final land preparation. Weeding, irrigation and plant protection measures were properly managed for better growth and development of the mungbean. The crop was harvested at 80-90% pods ripening. The harvested crop of each plot was bundled separately, properly tagged and brought to threshing floor. From each plot 10 randomly selected plants were recorded for determining yield contributing characters. Yield (tha^{-1}) was recorded from the whole plot technique. The biological yield is the combined yield of grain and stover yield. It was calculated with the following formula:

Biological yield = Grain yield + Stover yield

Harvest index was calculated by using the following formula of Gardner et al. (1985) as shown below:

$$\text{Harvest index (\%)} = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

The collected data were statistically analyzed by using 'R' Command.

3. Results and discussion

3.1. Effect of zinc

The plant height significantly varied due to different levels of zinc application. The tallest plant height (37.18cm) was recorded from 1.5 kg Zn ha^{-1} which was statistically similar with the dose of 3.0 kg Zn ha^{-1}. The application of different Zn levels showed significant variation on the number of branches per plant. The maximum number of branches (3.13) was recorded from 1.5 kg Zn ha^{-1} and the minimum (2.58) for control. The Zn level at 1.5 kg ha^{-1} produced the highest number of pods (18.60) per plant while the minimum (15.14) was recorded at control condition. The tallest pod length (8.04cm) was observed from the Zn level of 1.5 kg ha^{-1}. The total number of grains per pod was maximum (8.04) for 1.5 kg Zn ha^{-1} and the lowest (5.90) for control. In the application @ 1.5 kg Zn ha^{-1} gave the highest (4.07g) 100-grains weight. The maximum yield (1.453tha^{-1}) of mungbean was found from 1.5 kg Zn ha^{-1} while the minimum found from control (Table 1). These above results reconfirm the finding of Ahmed et al. (1986); Ryan and El-Moneim (2007); Quddus et al. (2011); Valenciano et al. (2011). Alam and Islam (2016) reported that the highest plant height, number of branches per plant, pod length, number of pods per plant, number of seeds per pod, 1000-seed weight and seed yield (1.418 tha^{-1}) was obtained from 2.0 kg $Znha^{-1}$. They also observed that the yield increased gradually with the increase of Zn level up to 2.0 $kgha^{-1}$ but decreased with Zn level 4.00 $kgha^{-1}$. The maximum stover yield (0.56 tha^{-1}) was obtained from 1.5 kg Zn ha^{-1} while the minimum was obtained from control. The highest biological (2.02 tha^{-1}) and harvest index (71.80%) was recorded from 1.5 kg Zn ha^{-1}. The yield and yield components of mungbean were gradually increased up to 1.5 kg Zn ha^{-1} but they decreased with 3.0 kg Zn ha^{-1}. However, the result observed in the present study is in contrast to those reported by Bharti et al. (2002) reported that the stover yield decreased with the increasing Zn rates. Wu et al. (1994) observed that harvesting index in soybean was positively correlated with Zn concentration.

3.2. Effect of boron

Boron application in mungbean exhibited significant variation in case of plant height, number of branches, total pods per plant and pod length. The highest plant height (36.45cm), number of branches $plant^{-1}$ (3.08), number of pods $plant^{-1}$ (18.22) and pod length (7.55cm) were obtained with 1.0 kg B ha^{-1}. On the other hand, the lowest plant height (31.00cm), number of branches $plant^{-}$ (2.75), number of pods $plant^{-1}$ (15.74) and pod length (6.62cm) were observed in the 0 kg B ha^{-1}boroni.e. at control condition (Table 2). There were statistically significant variation was observed in case of grains pod^{-1}, 100-grains weight and yield. Mungbean plant produced the maximum grains per pod (7.48), 100-grains weight (4.07g) and grain yield (1.29 tha^{-1}) when the crop is fertilized with 1.0 kg B ha^{-1} among all the treatments. Application B might be reason in better Rhizobial growth, more N fixation and in better crop growth (Singh, 1993). Higher growth attributes were observed by Pal (2010) and Awomi et al. (2011), Singh et al. (2012). Singh et al. (2014) suggested that beneficial effect of boron was initiated during the early stage of growth and has been carried over at successive stage of plant growth. Boron @2.50 kg/ha significantly given good response in the dry weight of pod/plant, chlorophyll intensity and carotene oil content. Boron spray improved the sex ratio and early production of fruit and gave high fruit yields reported by El-Yazied et al. (2007). The proper management of boron fertilizer significantly influenced the stover yield, biological yield and harvest index. The highest amount of stover yield (0.56 tha^{-1}), biological yield (1.86 tha^{-1}) and harvest index (69.86%) was recorded from 1.0kg B ha^{-1} among all of the treatments. Other researchers have also reported increased yield of mungbean with application of boron (Ashraf, 2007; Kaiser et al., 2010; Quddus et al., 2011; Ganie et al., 2014). Mahajan et al. (1994) found that soil application of B (0.5 kg ha^{-1}) increased and harvest index significantly of groundnut. Wu et al. (1994) observed that harvesting index in soybean was positively correlated with Zn concentration. However, the result observed in the present case is in contrast to those reported by Bharti et al. (2002) reported that the stover yield decreased with the increasing B rates.

3.3. Interaction effect of zinc and boron

The combined application of Zn and B significantly influenced the yield and yield components of mungbean. The combination of 1.5 kg Zn ha^{-1} +1.0 kg B ha^{-1} produced the maximum the plant height (42.37cm), number of branches $plant^{-1}$ (3.40), number of pods $plant^{-1}$ (20.40), pod length (8.57cm), grains per pod (8.60), 100-grains weight (4.30g), grain yield (1.51 tha^{-1}), stover yield (0.59 tha^{-1}), biological yield (2.10 tha^{-1}) and harvest index (71.87%) among all of the treatment combinations (Table 3). On the other hand, the minimum plant height (27.23cm), number of branches $plant^{-1}$ (2.30), number of pods $plant^{-1}$ (14.17), pod length (5.67cm), grains per pod (6.03), 100-grains weight (3.70g), grain yield (1.09tha^{-1}), biological yield (1.63tha^{-1}) and harvest index (67.18%) was found, when crop is nourished with 0 kg Zn ha^{-1} +0 kg B ha^{-1} or control.

Table 1

Effect of zinc on plant height (PH), branches per plant (NB), total pods per plant (TP), pod length (PL), grains per pod (GP), hundred grains weight (HGW), grain yield (GY), stover yield (SY), biological yield (BY) and harvest index (HI).

Sulfur	PH (cm)	NB	TP	PL (cm)	GP	HGW (g)	GY tha^{-1}	SY tha^{-1}	BY tha^{-1}	HI (%)
Zn_0	27.41b	2.588b	15.14c	5.90c	6.265b	3.78b	1.178b	0.50c	1.73b	68.04b
Zn_1	37.18a	3.133a	18.60a	8.04a	7.76a	4.07a	1.453a	0.56a	2.02a	71.80a
Zn_2	37.61a	2.977ab	17.36b	7.14b	6.544b	3.86b	1.126b	0.52b	1.62c	69.10b
LSD	0.880	0.420	1.062	0.50	0.435	0.088	0.093	0.016	0.101	1.37
CV (%)	2.586	14.52	6.23	7.19	6.35	2.275	7.43	2.98	5.65	1.96

Zn_0 = 0,Zn_1 =1.5 and Zn_2 =3.0 $kgha^{-1}$

Table 2

Effect of boron on plant height (PH), branches per plant (NB), total pods per plant (TP), pod length (PL), grains per pod (GP), hundred grains weight (HGW), grain yield (GY), stover yield (SY), biological yield (BY) and harvest index (HI).

Boron	PH (cm)	NB	TP	PL (cm)	GP	HGW (g)	GY tha^{-1}	SY tha^{-1}	BY tha^{-1}	HI (%)
B_0	31.00c	2.75a	15.74c	6.62b	6.48b	3.77c	1.20a	0.51c	1.72b	69.83a
B_1	36.45a	3.08a	18.22a	7.555a	7.48a	4.07a	1.29a	0.56a	1.86a	69.36a
B_2	34.75b	2.85a	17.14b	6.911b	6.60b	3.87b	1.25a	0.53b	1.78ab	69.74a
LSD	0.88	0.420	1.062	0.50	0.435	0.088	0.093	0.016	0.101	1.37
CV (%)	2.58	14.52	6.23	7.19	6.35	2.275	7.43	2.98	5.65	1.96

B_0 = 0,B_1 =1.0 and B_2=2.0 $kgha^{-1}$

Table 3

Interaction effect of zinc and boron levels on plant height (PH), branches per plant (NB), total pods per plant (TP), pod length (PL), grains per pod (GP), hundred grains weight (HGW), grain yield (GY), stover yield (SY), biological yield (BY) and harvest index (HI).

Interactions	PH (cm)	NB	TP	PL (cm)	GP	HGW (g)	GY tha^{-1}	SY tha^{-1}	BY tha^{-1}	HI (%)
Zn_0B_0	27.23e	2.30c	14.17f	5.67f	6.03d	3.70d	1.09d	0.53b	1.63e	67.18c
Zn_0B_1	29.00d	2.80abc	16.17cde	6.20def	6.71cd	3.90bc	1.27bc	0.59a	1.85cd	68.29c
Zn_0B_2	26.00e	2.67bc	15.10ef	5.83ef	6.06d	3.76cd	1.18cd	0.54b	1.71de	68.65bc
Zn_1B_0	30.00d	3.00abc	17.07bcd	7.50bc	7.00bc	3.90bc	1.36ab	0.54b	1.90bc	71.31a
Zn_1B_1	42.37a	3.40a	20.40a	8.57a	8.60a	4.30a	1.51a	0.59a	2.10a	71.87a
Zn_1B_2	39.20b	3.00abc	18.33b	8.07ab	7.69b	4.02b	1.50a	0.57a	2.06ab	72.22a
Zn_2B_0	35.77c	2.97abc	16.00def	6.70cde	6.44cd	3.73d	1.18cd	0.48bc	1.66e	71.01ab
Zn_2B_1	38.00b	3.07ab	18.10b	7.90ab	7.13bc	4.03b	1.12cd	0.53b	1.64e	67.92c
Zn_2B_2	39.07b	2.90abc	18.00bc	6.83cd	6.06d	3.83	1.09d	0.50bc	1.59e	68.38c
LSD	1.52	0.728	1.83	0.874	0.754	0.144	0.154	0.024	0.173	2.373
CV (%)	2.77	14.50	6.79	7.17	6.38	2.13	7.138	2.61	5.577	1.969

Zn_0 = 0,Zn_1 =1.5 and Zn_2 =3.0 $kgha^{-1}$, B_0 = 0,B_1 =1.0 and B_2=2.0 $kgha^{-1}$

Sakal et al. (1986) observed that the combined application of Zn and B showed significant effect on mungbean yield than the single application of Zn and B. Alam and Islam (2016) observed that yield of mungbean was nearly doubled with the application zinc and boron. Similar results were previously reported by Zaman et al. (1996), Howeler et al. (1978) and Biswas et al. (2010). Rahman (2015) reported that application of Zn and B significantly reduced the stover yield but increased the harvest index of mungbean. Single application of Zn produced the maximum biological yield as compare to the combination of Zn and B (Rahman, 2015). Bharti et al. (2002) reported that the stover yield decreased with the increasing Band Zn rate. The combined application of Zn and B showed significant effect on munbean yield than the single application of Zn and B (Quddus et al., 2011). Abdo (2001) reported the same in mungbean with foliar spray of Zn and B.

4. Conclusion

Application of zinc and boron significantly increased all the yield contributing characteristics and yield of mungbean. The results of the study revealed that the application of 1.5 kg Zn ha^{-1} with 1.0 kg B ha^{-1} was found most suitable for maximizing mungbean productivity.

References

Abdo, F.A., 2001. The response of two mungbean cultivers to zinc, manganese and boron I. Morphological, physiological and anatomical aspects. Bull. Fac. Agr. Cairo Univ., 52(3), 445-466.

Ahmad, M.S.A., Hossain, M., Ijaz, S., Alvi, A.K., 2008. Photosynthetic performance of two mungbean (*Vignaradiata*) cultivars under lead and copper stress. Int. J. Agr. Biol., 10, 167-172.

Ahmed, A.U., Rahman, S., Begum, Islam, N.M.S., 1986. Effect of phosphorus and zinc apptication on the growth, yield and P, Zn and protein content of mungbean. J. Indian Soc. Soil. Sci., 34(2), 305-308.

Alam, M.S., Islam, M.F., 2016. Effect of zinc and boron on seed yield and yield contributing traits of mungbean in acidic soil. J. Biosci. Agr. Res., 11(02), 941-946.

Ashraf, M.H., 2007. Requirement of boron for Mustard-Mungbean-Rice pattern and zinc for Maize-Mungbean-Rice pattern in Calcareous soil. In: Ph.D. Dissertation. Department of Soil Science. Bangladesh Agricultural University, Mymensingh.

Awomi, T.A., Singh, A.K., Singh, A.P., Bordoloi, L.J., 2011. Effect of phosphorus, molybdenum and cobalt on growth yield and nutrient content of mungbean and soil fertility. J. Soil. Crop., 21(2), 158-164.

BBS (Bangladesh Bureau of Statistics), 2013. Statistical Year book of Bangladesh. Stat. Divn., Min. Plann., Govt. of the Peoples Repub. Bangladesh, Dhaka, Bangladesh.

Bharti, N., Murtaza, M., Singh, A.P., 2002. Effect of boron-rhizobium relationship onyield, nitrogen and boron nutriation of chickpea. J. Res. Birsa. Agr. Univ., 14(2), 175-179.

Biswas, P.K., Bhowmick, M.K., Bhattacharyya, A., 2010. Effect of zinc and seed inoculation on nodulation, growth and yield in mungbean. J. Crop. Weed., 5(1), 119-121.

Cakmak, I., 2000. Possible role of zinc in protecting plant cells from damage by reactive oxygen species. New Phytologt., 146, 185-205.

El-Yazeid, A.A., Abou Aly, H.E., Mady, M.A., Moussa, S.A.M., 2007. Enhancing growth, productivity and quality of squash plant using phosphate dissolving micro organism combined with boron foliar spray. Res. J. Agr. Biol. Sci., 3(4), 274-286.

Frauque, A., Haraguchi, T., Hirota, O., Rahman, M.A., 2000. Growth analysis, yield, and canopy structure in maize, mungbean intercropping. Bu. Inst. Tropical. Agr., 23, 61-69.

Ganie, M.A., Akhter, F., Najar, G.R., Bhat, M.A., 2014. Influence of sulphur and boron supply on nutrient content and uptake of French bean (*Phaseolus vulgaris* L.) under inceptisols of North Kashmir. Afr. J. Agr. Res., 9(2), 230-239.

Gardner, F.P., Pearce, R.B., Mistechell, R.L., 1985. Physiology of Crop Plants. Iowa State Univ. Press, Powa. 66.

Goldberg, S., Su, C., 2007. New advances in boron soil chemistry. In advances in plant and animal boron nutrition, Springer, Netherlands. 313-330.

Hafeez, B., Khanif, Y.M., Saleem, M., 2013. Role of zinc in plant nutrition-a review. Am. J. Expt. Agr., 3(2), 374.

Ho, S.B., 1999. Boron deficiency of crops in Taiwan. In: Proc. Intl. Workshop on Micronutrient in Crop Prodn. held on Nov. 8-13, 1999, National Taiwan University, Taipei, Taiwan ROC.

Howeler, R.H., Flor, C.A., Gonzalez, C.A., 1978. Diagnosis and correction of B deficiency in beans and mungbeans in a mollisol from the cauce valley of Colombia. Agron. J., 70, 493-497.

Kaisher, M.S., Rahman, M.T., Amin, M.H.A., Amanullah, A.S.M., Ahsanullah, A.S.M., 2010. Effects of sulphur and boron on the seed yield and protein content of mungbean. Bangladesh Res. Pub. J., 3(4), 1181-1186.

Kosesakal, T., Unal, M., 2009. Role of zinc deficiency in photosynthetic pigments and peroxidase activity of tomato seedlings. IUFS J. Biol., 68(2), 113-120.

Mahajan, T.S., Chavan, A.S., Dongale, J.H., 1994. Effect of boron on yield andquality of groundnut on laterite soil. Indian J. Agr. Sci., 64(8), 532-535.

Maskey, S.L., Bhattarai, S., Karki, K.B., 2004. Long-term effect of different source of organic manures on wheat-soybean rotation. SARC J. Agr., 2, 243-256.

MoA (Ministry of Agriculture), 2013. Hand Book of Agricultural Statistics, Min. Agr. Govt. of the Peoples Repub. Bangladesh, Dhaka, Bangladesh. 14.

Ozturk, L., Yazici, M.A., Yucel, C., Torun, A., Cekic, C., Bagci, A., Ozkan, H., Braun, H.J., Sayers, Z., Cakmak, I., 2000. Concentration and localization of zinc during seed development and germination in wheat. Physiol. Plant., 128, 144-152.

Pal, A.K., 2010. Effect of Rhizobium inoculation and application of phosphorus and molybdenum on growth and yield in blackgram. Adv. Pl. Sci., 23(1), 53-55.

Quddus, M.A., Rashid, M.H., Hossain, M.A., Naser, H.M., 2011. Effect of zinc and boron on yield and yield contributing characters of mungbean in low Ganges river floodplain soil at Madaripur, Bangladesh. Bangladesh J. Agr. Res., 36(1), 75-85.

Rahman, M.A., 2015. Effect of zinc and boron on the growth and yield of mungbean. An MS. Thesis, Department of Soil Science, Sher-e –Bangla Agricultural University, Dhaka-1207. 43-51.

Ryan, J., El-Moneim, A.M.A., 2007. Implications of zinc deficiency for ameliorating toxicity (lathyrism) in grasspea. In: Conf. Proc., Zinc Crops 2007: Improving crop production and human health, Istambul, Turkey.

Sakal, R., Singh, A.P., Singh, B.P., 1986. Annual report of all Indian coordinated scheme of micronutrients in soil and plants, RAU, Pusa, Bihar, India.

Sarkar, P.K., Haque, M.S., Karim, M.A., 2012. Effects of GA_3, IAA and their frequency of application on morphology, yield contributing characters and yield of mungbean. Bangladesh J. Agr. Res., 1, 119-122.

Shorrocks, V.M., 1997. The occurrence and correction of boron deficiency. Plant. Soil, 193, 121-148.

Shukla, A.K., 2011. Micronutrient research in India: Current status and future strategies. Indian Soc. Soil. Sci., 59, 88-98.

Singh, A.K., Khan, M.A., Srivastava, A., 2014. Effect of boron and molybdenum application on seed yield of mungbean. Asian J. Bio. Sci., 9(2), 169-172.

Singh, D.K., Kumar, P., Mishra, N., Singh, A.K., 2012. Interactive effect of cobalt, boron and molybdenum at different fertility status on percentage translocation of nitrogen, phosphorus and sulfur in grain of pea. Environ. Ecol., 30(2), 262-265.

Singh, K.P., 1993. Response of boron and molybdenum in soil of Singbhum and Santal Parganas. Ann. Agr. Res., 14, 100-102.

Sprague, H.B., 1951. Hunger signs in crops. McKay, New York, USA.

Valenciano, J.B., Boto, J.A., Marcelo, V., 2011. Chickpea (*Cicerarietinum*L.) response to zinc, boron and molybdenum application under field conditions. New Zealand J. Crop. Hort. Sci., 39(4), 217-229.

Verma, R.J., Mishra, R.H., 1999. Effect of doses and methods of boron application on growth and yield of mungbean. Indian J. Puls. Res., 12(11), 115-118.

Wu, M., Xiao, M.C.W., Ziao, C.Z., 1994. A study of zinc in soybean. Soybean Sci., 13(3), 245-251.

Zaman, A.K.M.M., Alam, M.S., Roy, B., Beg, A.H., 1996. Effect of B and Moapplication on mungbean. Bagladesh J. Agr. Res., 21(1), 118-124.

How to cite this article: Sohidul Islam, M., Hasan, K., Sarkar, N.A.A., EL Sabagh, A., Rashwan, E., Barutçular, C., 2017. Yield and yield contributing characters of mungbean as influenced by zinc and boron. Agricultural Advances, 6(1), 391-397.