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Micronutrients and Moisture Management Effect on Onion Cultivation

[1]Edward Binod Soren*, [2]Md. Abul Kalam Azad, [3]Md. Arifur Rahman, [4]Md. Ibrahim, [5]Maria Marzan,

[1]Upazila Education office, Naogaon, Manda-6510, Bangladesh.
[2]Department of Crop Science and Technology, University of Rajshahi, Rajshahi-6205, Bangladesh.
[3]Department of Agronomy and Agricultural Extension, University of Rajshahi, Rajshahi-6205, Bangladesh.
[4]BCSIR Laboratories, Binodpur Bazar, Rajshahi-6206, Bangladesh.
[5]EXIM Bank Agricultural University Bangladesh, Chapainowabgonj-6200, Bangladesh

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ABSTRACT

The experiment was conducted at the western side of Rajshahi during rabi season. The site is located under High Ganges River Floodplain soils (AEZ 11) is one of the most important calcareous soils of Bangladesh containing large amount of $CaCO_3$ as well as high concentration of available Ca^{2+} is in that soil. Taherpuri onion cultivar was used in the research work. The experiment comprised of 4 levels of moisture management (No irrigation, frequent irrigation, natural mulch and plastic mulch) with 3 levels of Boron (0, 0.20, 0.40 g m^{-2}) and 4 levels of Zinc (0, 0.50, 0.80, 1.25 g m^{-2}) was conducted to study the response of plastic mulch, zinc and boron on growth and yield of onion. Results demonstrated that most of the growth and yield contributing characters were significantly influenced by applying different levels of moisture management, B and Zn. The combination of borax at 4 kg ha^{-1} and zinc sulphate at 12.50 kg ha^{-1} with plastic mulching gave the highest yield (18.71 t ha^{-1}) of onion bulb under the AEZ-11. The maximum production of per hectare yield of bulb onion was observed with the interaction treatment of $M_3B_2Zn_3$ (18.71 t ha^{-1}) and the minimum yield was (5.29 t ha^{-1}) obtained from control ($M_0B_0Zn_0$).

Key words: Boron, Moisture management, Onion, Plastic mulch, Zinc

CORRESPONDENCE
* limon.soren@gmail.com
Upazila Education office, Naogaon, Manda-6510, Bangladesh.

1. INTRODUCTION

Onion (*Allium capa* L.) belonging to the family Alliaceae is one of the most important spices as well as vegetable crops in the world including Bangladesh (Parseglove et al., 1972). It was domesticated in the mountainous regions such as Iran, Afghanistan, Pakistan, Turkmenia, Tajikistan and Uzbekistan. This unique crop has been cultivated for 5000 years or more in that region (Brewster et al., 1994), and it is now widely grown both in tropical and temperate regions (FAO, 1998). In Bangladesh, onion ranks first in production and second in respect of area among the spice crops (BBS, 2006). It is grown in almost all areas of Bangladesh, but commercial cultivation is found to be concentrated only in the greater districts of Faridpur, Dhaka, Rajshahi, Jessore, Dinajpur, Rangpur and Pabna (BBS, 2006).

In Bangladesh, onion is produced over a short period of cool temperature when the weather usually remains dry.

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That is why, mulching because of its moisture conservation has profound effect on growth and yield of onion (Suh et al., 1991). Plastic mulching enhanced the crop growth rate due to effective weed control and better nutrient utilization owing to both scarce rainfall and inadequate irrigation water(Lamont et al., 1993).In soil management relationships, mulching has been reported to influence organic matter content, activity of microorganisms, availability of soil nutrients, control of erosion and soil compaction (Stowell et al., 2000).

Micronutrients statuses have been decreasing day by day and finally fertility status of Bangladesh soils have been declining. Among 30 Agro-Ecological Zones (AEZ) in Bangladesh (Das et al.,1999) our experimental site is located under High Ganges River Floodplain soils (AEZ11) is one of the most important calcareous soils of Bangladesh containing large amount of $CaCO_3$ as well as high concentration of available Ca^{2+} is in that soil(Hunter et al.,1984).The p^H generally ranges from 7.0-8.5 but in most of the uplands soil p^H ranges between 7.5 - 8.5. Zinc (Zn) and boron (B) become less available to plants with increasing soil p^H (Hunter et al., 1984). Requirement of B for plant growth and yield is greater when calcium (Ca) availability is high (Tisdale et al., 1985). Boron (B) requirements are common on upland crops in humid regions and also in calcareous soil. It is wide spread and often incipient that B deficiency seems to exist in Bangladesh soils (Protch & Islam, 1984). Keeping in view, the importance of moisture conservation in soil surface through plastic mulch this experiment was conducted to observe the effect of zinc and boron on growth and yield of onion where irrigation facilities is not adequate.

2. MATERIALS AND METHODS

The experiment was conducted to study the response of some micronutrients and mulches on growth and yield of onion at the farmer's field of Gobindopur, Rajshahi, Bangladesh under High Ganges River Floodplain Soils (AEZ-11) (Alam et al., 2010) during the period from November 2017 to April 2018. The soil of the experimental field was medium fertile with high pH (8.3) and silty loam in texture containing 0.45 ppm zinc (Zn) and 0.50 ppm boron (B). During the experiment, the average temperature 22^0C, average humidity 75% and average rainfall 7mm were recorded.

The experimental plot was fertilized with 14 t ha^{-1}cow dung, 109 kg ha^{-1}urea, 143 kg ha^{-1}TSP and 169 kg ha^{-1}MOP at final land preparation, 7 days before planting. All micro-nutrient fertilizers were applied as basal dose.

The onion cultivar "Taherpuri" was used in the research work. For better germination, seeds were soaked in water for 15 hours before sowing. Almost 40 day old healthy and disease free seedlings were uprooted from the seed bed and transplanted to the main field. More or less uniform seedlings of about 14-20cm in height were used for transplanting. The seedlings were planted in rectangular system of planting at a spacing of 10cm×10cm. The depth of planting was 2.5cm from the surface of the soil. Seedlings were watered just after transplanting.

The trials comprised of 3 levels of B (0, 0.20, 0.40 g m^{-2}), 4 levels of Zn (0, 0.50, 0.80, 1.25 g m^{-2}) with 4 levels of moisture management (no irrigation, irrigation during transplanting at 25 DAP, natural mulching and mulching with polythene Sheet). The plots required irrigation treatment (without mulch and control plots) were irrigated at 15 days after planting bulb onion in such a way that sufficient water reached to the root zone. Green colored plastic mulch was used as mulch material on the respective plots before planting of mother plants. After transplanting bulb onion plants were irrigated frequently where needed. No irrigation was given to the mulched plots and control plots.

The experiment was laid out in a split-split plot design with three replications assigning the moisture management on the main plot, boron level to the sub-plot and zinc level to the sub-sub plot. The whole experimental plot was divided into four blocks; each was then divided into 12 unit plots. Therefore, the total numbers of plots were 144 (4 moisture management x 4 levels of Zn x 3 levels of B x 3 Replication) and the size of each unit plot was 2m×2m. The distance between one block to another was 60cm and one plot to another was 40 cm.

Data of various parameters under the study were analyzed statistically to find out the statistical significant difference of the experimental results by using statistical package program MSTAT-C (Russel, 1986).

3. RESULTS AND DISCUSSION

Four different levels of moisture management were applied with three different levels of boron B (0, 0.20, 0.40 g m^{-2}) in combination with four different levels of Zn (0, 0.50, 0.80, 1.25 g m^{-2}). The superior results on the growth and yield of onion due to the combined effect of above treatments has been shown below.

Plant height

Differences in plant height were appeared from early growth stages to final harvest. The combined effects of moisture management, boron and zinc on plant height at different days after planting (DAP) were statistically significant at 30 DAP except at 45 DAP and 60 DAP (Fig. 1).

The tallest plants were recorded in the plots covered with polythene mulch .The highest plant height (36.89cm) was observed from the treatment combination $M_3B_2Zn_2$ and the lowest plant height (22.41cm) was observed in $M_0B_0Zn_0$ at 60 DAP. The highest value (19.69cm) from the treatment combination M_3 B_2Zn_2 at 30 DAP and lowest value (13.46cm) at 30 DAP were found in $M_0B_0Zn_0$ combination.

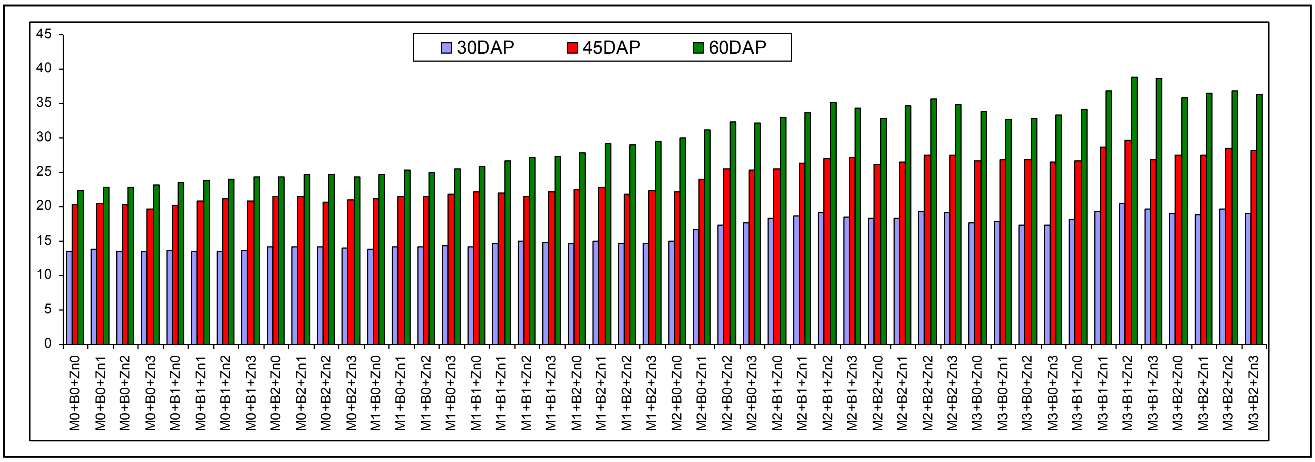

Fig 1. Interaction effect of moisture management, boron and zinc on plant height of onion

Number of leaves

Leaf number per plant was gradually increased from 30 to 60 days after planting and then declined during final harvest (Acharya et al., 2015). This trend was obvious for all the treatments used. Due to interaction of moisture management, boron and zinc there had no significant effect on number of leaves per plant (Fig. 2). Stimulatory effects of polythene sheets on the number of leaves were observed. Numerically the highest number of leaves (6.55) found in $M_3B_2Zn_3$ at 60 DAP and at 30 DAP highest leaves number (2.55) was observed in $M_3B_2Zn_3$ combination. The lowest number of leaves (1.55) at 30 DAP and (4.22) at 60 DAP were found in $M_0B_0Zn_0$ treatment combination.

Dry weight of leaves

Due to interaction effect of moisture management, boron and zinc significant variation were found in dry weight of leaves (Table 1). Dry weight of leaves ranged from 1.64g to 1.047g. Dry weight of leaves per plant produced maximum value (1.64g) with the combinations of $M_3B_2Zn_3$ and the lowest (1.06g) from $M_0B_1Zn_1$ combination.

Pesudostem diameter

The variation in diameter of pseudo-stem due to the combined effect of moisture management, boron and zinc was found to be statistically significant (Table 1). The treatment combination $M_3B_1Zn_2$ produced the largest

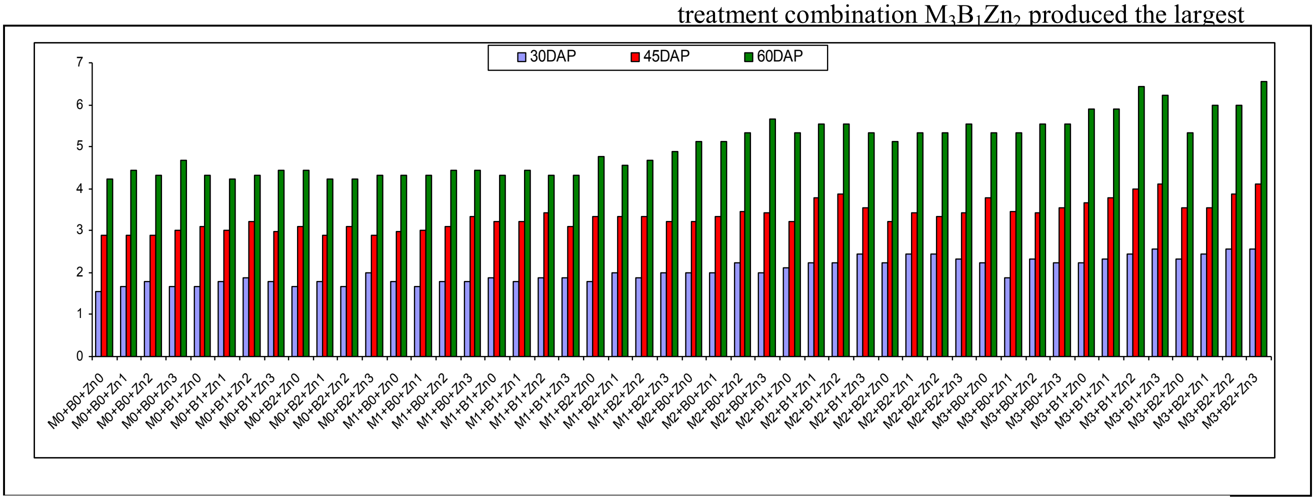

Fig 2. Interaction effect of moisture management, boron and zinc on Number of leaves of onion

(1.260cm) pseudo-stem diameter of onion bulb. The minimum diameter (0.79cm) was obtained from the control ($M_0B_0Zn_0$). The highest Pesudostem diameter was statistically identical with the combination of moisture management, boron and zinc at interaction $M_3B_1Zn_1$ (Table 1).

Fresh weight of leaves

The interaction effect of moisture management, boron and zinc varied significantly among different treatment combination. The treatment combination of $M_3B_2Zn_3$ produced greatest (13.59g) fresh weight of leaves, while the lowest (6.25g) was obtained (Table 1) with the combination of $M_0B_0Zn_0$.

Table 1. Interaction effect of moisture management, boron and zinc on the growth and yield of onion

Interaction (moisture management × boron× zinc)	Fresh weight of leaves (g)	Dry weight of leaves (g)	Fresh weight of bulb (g)	Dry weight of bulb (g)	Pseudo-stem diameter (cm)	Bulb diameter (cm)	Bulb yield (t ha^{-1})
M0B0Zn0	6.253y	1.060rs	14.220no	1.220o	0.790 p	2.417	5.297t
M0B0Zn1	6.340xy	1.130m-s	14.050o	1.237no	0.793 p	2.540	5.730Sst
M0B0Zn2	6.497wxy	1.180k-q	14.007o	1.233o	0.807 op	2.400	5.877st
M0B0Zn3	6.680v-y	1.067rs	14.373mno	1.300mno	0.817 n-p	2.423	6.110rst
M0B1Zn0	6.857t-y	1.077rs	14.927k-o	1.357l-o	0.813 n-p	2.493	5.600st
M0B1Zn1	6.860t-y	1.047s	16.143j-o	1.380l-o	0.833 m-p	2.507	6.210rst
M0B1Zn2	7.120t-x	1.107o-s	14.227no	1.303mno	0.833 m-p	2.630	6.157rst
M0B1Zn3	7.687p-t	1.087p-s	15.733k-o	1.363l-o	0.833 m-p	2.487	6.663p-t
M0B2Zn0	7.327s-w	1.137m-s	15.890j-o	1.400l-o	0.853 k-p	2.720	6.550p-t
M0B2Zn1	7.570r-u	1.203i-o	14.933k-o	1.357l-o	0.823m-p	2.617	6.413q-t
M0B2Zn2	7.620q-u	1.193i-o	14.413mno	1.317l-o	0.847 l-p	2.760	6.850o-s
M0B2Zn3	8.273o-r	1.210i-n	14.810l-o	1.347l-o	0.847 l-p	2.643	6.783p-s
M1B0Zn0	6.847t-y	1.090p-s	15.510k-o	1.407l-o	0.870 j-o	2.847	6.420p-t
M1B0Zn1	6.827u-y	1.070rs	16.290j-n	1.453lm	0.870 j-o	2.903	6.113rst
M1B0Zn2	7.383s-v	1.147l-s	14.937k-o	1.347l-o	0.887 i-m	2.810	6.493p-t
M1B0Zn3	8.320o-r	1.137m-s	15.313k-o	1.417l-o	0.923 h-j	3.043	6.300q-t
M1B1Zn0	7.567r-u	1.110n-s	15.283k-o	1.413l-o	0.890 i-m	2.857	6.487p-t
M1B1Zn1	8.533op	1.150l-r	16.437i-m	1.477klm	0.903 i-l	2.867	7.703m-q
M1B1Zn2	8.433opq	1.087p-s	16.713i-l	1.420l-o	0.880 j-n	2.983	7.353n-r
M1B1Zn3	8.683no	1.187j-p	16.023j-o	1.413l-o	0.950 hi	3.063	7.520n-r
M1B2Zn0	8.093o-s	1.083ors	16.487i-m	1.440lmn	0.920 h-k	2.883	7.457n-r
M1B2Zn1	8.550o	1.180k-q	17.100ijk	1.520kl	0.977 h	3.210	7.883m-p
M1B2Zn2	9.500mn	1.273g-k	18.557i	1.660k	0.977 h	3.313	8.307l-o
M1B2Zn3	9.457mn	1.217i-m	17.967ij	1.663k	1.087g	3.297	8.367lmn
M2B0Zn0	9.450mn	1.247h-l	23.593gh	2.127j	1.067 g	3.493	7.467n-r
M2B0Zn1	9.620lm	1.283f-j	24.133fgh	2.183ij	1.100 fg	3.770	8.547k-n
M2B0Zn2	9.727klm	1.257g-k	25.653d-h	2.317f-j	1.090 g	3.743	9.107j-m
M2B0Zn3	9.790klm	1.333e-h	23.880gh	2.163ij	1.103 fg	3.853	9.847ijk
M2B1Zn0	10.470jkl	1.280f-k	26.147def	2.283g-j	1.123 d-g	4.003	10.473ij
M2B1Zn1	11.347ghi	1.223i-m	27.210cde	2.470d-g	1.190 b-d	4.190	11.097hi
M2B1Zn2	12.733b-e	1.327e-h	30.643ab	2.777bc	1.240 ab	4.253	15.883def
M2B1Zn3	11.467fgh	1.290f-i	26.187def	2.507def	1.187 b-d	4.073	15.507d-g
M2B2Zn0	11.480fgh	1.343e-h	25.080e-h	2.273g-j	1.097 fg	3.897	12.053h
M2B2Zn1	12.180d-g	1.520b	25.683d-g	2.337f-i	1.107 fg	4.140	14.423fg
M2B2Zn2	12.023e-g	1.407cde	27.363cd	2.447d-h	1.160 c-f	4.153	15.007efg
M2B2Zn3	12.600cde	1.497bc	26.470cde	2.397e-h	1.103 fg	4.070	15.563d-g

Table 1. (Continued).

Interaction (moisture management × boron× zinc)	Fresh weight of leaves (g)	Dry weight of leaves (g)	Fresh weight of bulb (g)	Dry weight of bulb (g)	Pseudo-stem diameter (cm)	Bulb diameter (cm)	Bulb yield (t ha^{-1})
M3B0Zn0	10.557ijk	1.340e-h	23.483h	2.263hij	1.117 e-g	3.893	9.930ijk
M3B0Zn1	10.970hij	1.343e-h	25.677d-h	2.297g-j	1.117 e-g	3.777	9.627jkl
M3B0Zn2	10.867hij	1.350efg	26.133def	2.367f-i	1.093 fg	3.813	10.103ij
M3B0Zn3	10.960hij	1.377def	24.183fgh	2.183ij	1.083g	3.833	14.277g
M3B1Zn0	10.890hij	1.277f-k	25.190d-h	2.287g-j	1.117 e-g	3.853	15.300efg
M3B1Zn1	12.890a-d	1.417cde	30.447ab	2.800ab	1.217 a-c	4.270	16.287b-e
M3B1Zn2	13.367abc	1.407cde	29.887b	2.807ab	1.260 a	4.323	16.060cde
M3B1Zn3	12.777a-e	1.400cde	30.470ab	2.827ab	1.207 a-c	4.243	17.557ab
M3B2Zn0	12.287def	1.467bcd	26.547cde	2.453d-h	1.177 b-e	3.993	16.940bcd
M3B2Zn1	13.000a-d	1.530b	28.510bc	2.637bcd	1.193 a-c	4.150	16.220b-e
M3B2Zn2	13.503ab	1.480bc	30.467ab	2.590cde	1.200 a-c	4.193	17.373abc
M3B2Zn3	13.590a	1.643a	32.467a	3.000a	1.197 a-c	4.173	18.710a
CV	4.09	5.13	4.78	5.00	2.68	3.92	6.74
LSD	0.8505	0.1029	2.194	0.2049	0.06832	-	1.467
Level of significance	**	*	**	**	**	NS	**

In a column, figures bearing similar letter (s) or without letter are identical and those having dissimilar letter (s) differed significantly as per DMRT.
M_0 = No irrigation, M_1 = Irrigation, M_2 = Natural mulching, M_3 = Plastic mulching.
B_0= 0 kg B/ha, B_1= 2 kg B/ha, B_2= 4 kg B/ha
Zn_0= 0 kg Zn/ha, Zn_1= 5 kg Zn/ha, Zn_2= 8 kg Zn/ha, Zn_3 =12.50 kg Zn/ha
** = 1% level of significant. * = 5% level of significant. LSD= Least significant difference

Bulb diameter

Analysis of variance revealed that the interaction effects of moisture management, boron and zinc were found non-significant in respect of diameter of bulb. The highest diameter of onion bulb (4.323cm) produced from the treatment combination of $M_3B_1Zn_2$ and the lowest (2.40cm) found from the control ($M_0B_0Zn_2$) treatment (Table 1). On the contrary, the interaction $M_3B_1Zn_1$ produced the second highest diameter of onion bulb (4.270cm) from the same table.

Yield of bulb onion

a) Fresh weight of bulb

The result revealed that the combined effect of moisture management, boron and zinc were statistically significant. The highest fresh weight of bulb per plant (32.46g) found in $M_3B_2Zn_3$ combination (Table 1). Apparently, the highest fresh weight of bulb was statistically identical with the combination of moisture management, boron and zinc at interaction $M_2B_1Zn_2$ (Table 1). The lowest value was (14.00g) recorded from the treatment combination of $M_0B_0Zn_2$.

b) Dry weight of bulb

Dry weight of bulb of onion was significantly influenced by the interaction effect of moisture management, boron and zinc. The maximum and minimum dry weights of bulb were 3.00g and 1.22g obtain from the treatment combination of $M_3B_2Zn_3$ and $M_0B_0Zn_0$ (Table 1). On the other hand the second maximum dry weights of bulb were 2.82g found from the combination of $M_3B_1Zn_3$ and the second minimum dry weights of bulb were 1.23g found from the combination of $M_0B_0Zn_2$.

c) Bulb yield of onion

Per hectare yield of bulb onion significantly varied due to different combination of moisture management, boron and Zinc (Table 1). The maximum production of per hectare yield of bulb onion was observed with the interaction treatment of $M_3B_2Zn_3$ (18.71 t ha^{-1}).The minimum yield was (5.29 t ha^{-1}) obtained from control ($M_0B_0Zn_0$) Bulb yield significantly increased by using micronutrient fertilizer and mulching (Manna et al., 2014).

4. CONCLUSION

Soil moisture conservation by using polythene and ensuring availability of mulch needed micronutrient especially boron and zinc for bulb onion production with their optimum requirements caused higher production. The overall results gathered from this study facilitated to draw the following conclusion among the three factors (Boron 0.40 g m^{-2}, Zinc 1.25 g m^{-2} & Plastic mulch) and their combinations it was obtained that combined effect of all three treatments with higher dose (borax 4 kg ha^{-1} and zinc sulphate 12.50 kg ha^{-1} with plastic mulch) gave the highest bulb yield (18.71 t ha^{-1}) compared to those of other treatments as well as control. However, further investigation is needed in different regions of the country before recommending practice for use in farmer's level.

5. REFERENCES

Alam, M.N., Abedin, M.J. & Azad, M.A.K. (2010). Effect of micronutrients on growth and yield of onion under calcareous soil environment. International Research Journal of Plant Science 1(13), 56-61.

Acharya, U., Venkatesan, K., Saraswathi, T. & Subramanian, K.S. (2015). Effect of zinc and boron application on growth and yield parameters of multiplier onion (*Allium cepa* L. var*aggregatum* Don.) var. CO (On) 5. International Journal of Research (IJR) 2 (1), 757-765.

BBS. (2006). Monthly statistical Bulletin, Bangladesh, September, 2006. Bangladesh Bureau of Statistics. Statistics Division, Ministry of planning, Govt. of the people's republic of Bangladesh, Dhaka. p.54.

BBS. (2006). Statistical Yearbook of Bangladesh, Bangladesh Bureau of Statistics. Statistics Division, Ministry of planning, Govt. of the people's republic of Bangladesh, Dhaka. p.178.

Brewster, J. L. (1994). Onions and Other Vegetable Alliums. CAB International, ISBN 1845933990, Wallingford, U.K. pp. 1-15.

Das, D.K. (1999). Introductory soil science. Kalyani Publications.1/1,Rajinder Nagar, Ludhiana-141008, India. pp. 258-259.

FAO. (1998). Production Yearbook. Food and Agriculture organization of the United Nations. 52, 135-136.

Hunter, A.H. (1984). Soil fertility and analytical services in Bangladesh. BARC/IDAS Consultancy Rep. Contract Aid / 388-005.

Lamont, W.J., Jr. (1993). Plastic mulches for the production of vegetable crops. Hort Technology. 3, 35-39.

Manna D, Maity TK and Ghosal A. 2014. Influence of foliar application of boron and zinc on growth, yield and bulb quality of onion (*Allium cepa* L.) Journal of Crop and Weed 10(1):53-55.

Purseglove, J.W. (1972). Tropical crops (Monocotyledons-I). Longman Group Ltd., London. pp. 32-50.

Protch, S., Islam, M.S. (1984). Nutrient status of some of the more important Agricultural soils of Bangladesh. In: Proc. Int. Cong. Mtg. Common. IV, Int. Soc. Soil Sci. p. 97-105.

Russell, D.F. (1986). MSTAT-C computer based data analysis software. Crop and Soil Science Department, Michigan State University, USA.

Stowell, B., (2000). Organic kiwifruit production– maintaining soil fertility and yields. *Kiwifruit,* 139, 18–21

Suh, J.K., Lee, Y.B.Y.S. & Han, K.Y. (1991). A study improvement of the mulching cultivation method for onions (*Allium cepa*). 2. The effect of polythene film mulching and dates of removal; on growth and yield. Res. Rep. Rural Dev.Adn. Hort., 33 (3), 21-28. [Cited from Hort. Abstr., 64 (8), 61-87, 1994].

Tisdale, S.L., Nelson, W.L. & Beaton, J.D. (1985).Soil Fertility and Fertilizers. 4th Edition, Macmillan Publishing Company, New York. p. 285.