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Foliar Application of Different Levels of Zinc and Boron on the Growth and Yield of Mungbean (*Vigna radiate* L.)

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ABSTRACT

An experiment was conducted during Kharif-1 of 2022 at Bangladesh Institute of Nuclear Agriculture (BINA), Substation, Satkhira to know the effect of foliar application of micronutrients (zinc and boron) on the growth and yield of mungbean. There were three levels of zinc (Zn) (0.2%, 0.4%, 0.6%) and boron (B) (0.2%, 0.4%, 0.6%) along with a blanket dose of urea (35 kg ha^{-1}, triple super phosphate (TSP) (80 kg ha^{-1}), murite of potash (MoP) (40 kg ha^{-1}) and Sulphur (60 kg ha^{-1}). The growth and yield of mungbean was significantly affected by foliar application of different levels of Zn and B. Results revealed that foliar application of Zn at the rate of 0.6% and at the rate of B 0.6% along with recommended dose at 45 days after sowing increases the branches/plant, fresh weight (g), dry weight (g), chlorophyll content, flower/plant, pod/plant, seed/pod thereby increase seed yield. Therefore, the foliar spray of 0.6% Zn significantly increased and influenced 1000 seed weight (g), decreased days to flowering, increased number of seed/pod and yield ton/ha along with blanket dose of Urea, TSP, MoP, gypsum might be considered as suitable dose for mungbean production in southern region of Bangladesh.

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Introduction

In Bangladesh, soil nutrient deficiency is the key factor for poor productivity of pulses where extent and magnitude of nutrient deficiency has aggravated in the recent past to practice intensive agricultural practices and use of plant nutrients (Anonymous, 2009). Among all the pulse crops, mungbean (Vigna radiata L.) is an important grain legume in Asia and covers an important position in this areas due to its high contents of digestible protein than other pulses (Tabasum, 2010) because it has less sulfur containing amino acid even with less methionine than lysine. Therefore, mungbean is a good component with cereal (Sharma et al., 2011). Among all other food crops, pulses are important due to cheaper sources of protein (Mensah and Ihenyen, 2009) and several essential micronutrients. One hundred gram of pulse seed contains 24.5% protein, 100-200 mg Ca, 59.9% carbohydrate, 8.5 mg Fe and 49 mg β-carotene (Afzal et al., 2008). it synthesizes N in symbiosis with Rhizobia (Kaisher et al., 2010) and enriches the soil along with total biomass of the soil is increased (Sekhon et al., 2007;Yaqub et al., 2010). In Bangladesh, for pulse crop production the problem is more in arid and semi-arid regions due to calcareous features of soil, less organic matter, repeated drought, high pH, emergence of salts and unbalance fertilizer application (Malakouti, 2008). For plant growth and development, micronutrients play an important role and act as cofactor in different enzymes and take part in many redox reactions. Plants required minimum amount of micronutrient for adequate growth and development (Nasiri et al., 2010). Legumes are incorporated with different rice fallow system seemed highly profitable compared to wheat and maize in terms of soil fertility, human nutrition and it brings high market prices. Sawan et al. (2001), reported that the adequate amount of fertilizers (macro and micronutrients) during growth period to increase the quality and yield of field crops including pluses otherwise genetic potential of legume is not achieved at field due to poor soil nutrient status, mineral deficiency etc. (Maskey et al., 2004). The nutrients uptake by plants can be improved by proper application technique. Betwixt many application methods, including foliar application of micronutrients which is an effective method to enhance the crop productivity (George and Schmitt, 2002). Among the micronutrients viz. Zn (zinc), B (Boron), Fe (iron) play very crucial role in development and growth and (Shenkin, 2006) where Zn and B are essential for modulates several metabolic processes including cell elongation, biosynthesis of proteins, nitrogen metabolism and photosynthesis (Cakmak, 2000; Ozturk et al., 2006; Potarzycki and Grzebisz, 2009; Sattar et al., 2017) and born is very important in cell division, pod and seed formation (Goldberg and Su, 2007). Zn was found in newly developed radicles and coleoptiles during seed germination Ozturk et al., (2006). On the other hand, Zn contents in higher seed may better resist invasion of soil borne pathogens during germination and seedling development and ultimately increase yield whereas B is also 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). In crop plants, flowering and fruiting (Ho, 1999) and discolored fruit or grain (Shorrocks, 1997) was observed due to B deficiency. Thus, these two nutrients which have residual impact on the successive crops, imperative application of Zn and B containing fertilizers are needed to exploit the production and to mitigate the deficiency of these two nutrients. Sukhla (2011), reported that use of Zn and B in balanced fertilization increased N, P and K utilization efficiency which highlights the role of micronutrients in increasing use efficiency. The present study was, therefore, undertaken to know the effect of foliar application of Zn and B and to find out the suitable doses of these micronutrients for the maximization of mungbean yield in Satkhira.

Materials and Methods

A field experiment was conducted at the Bangladesh Institute of Nuclear Agriculture (BINA), Substation, Satkhira's research farm in Satkhira, located in 22°45'7" NL to 89°6'24" EL where daily average day temperature was 29°C and night temperature was about 20°C in Bangladesh during the kharif-1 season of 2022 under the AEZ-11 and AEZ-13. The land topography was medium-low which was characterized by loam to sandy loam soil texture and low to medium in organic matter contents with pH5.9.

This experiment was conducted in a randomized complete block design (RCBD) with 3 replications where were 11 treatments and 33 plots each having a unit plot size of 4m x 3m=12m^2. Distance between replication to replication was 1m and plot to plot 50cm. However, 11 treatments were as follows: T_0= Control, T_1=100% Recommended dose chemical fertilizer (RDCF), T_2= RDCF (NPKgypsum+ Zn 0.2%), T_3= RDCF(NPKgypsum+ Zn 0.4%), T_4= RDCF (NPKgypsum+Zn 0.6%), T_5= RDCF (NPKgypsum+B 0.2%), T_6= RDCF (NPKgypsum+B 0.4%), T_7= RDCF (NPKgypsum+B 0.6%), T_8= RDCF (NPKgypsum+Zn,B 0.2%), T_9= RDCF (NPKgypsum+Zn,B 0.4%), T_{10}= RDCF (NPK gypsum + Zn, B 0.6%). An experimental field was prepared after harvesting mustard where, the mustard straws were removed from the plots. The experiment land was fully ploughed by two to three times with the help of a power tiller. Later, debris of the mustard and other things were removed from the land. The variety used for experimental tool of mungbean (*Vigna radiate* L.) was Binamoog-9. The seeds were sown as line broadcasting as per 20 kg ha^{-1} on 10 March 2022 having replication to replication distance, plot to plot distance, and line to line distance 1m, 50cm and 25cm, respectively. N, P, K and S fertilizers were applied as the form of urea, triple super phosphate (TSP), murite of potash (MoP) and gypsum at the rate of 35 kg ha^{-1}, 80 kg ha^{-1}, 40 kg ha^{-1}, and 60 kg ha^{-1} respectively following medium soil fertility interpretation level. A total amount of P, K and S fertilizers were applied as a basal dose during land preparation (Ahmmed et al., 2018). One-third of urea is applied as the basal dose and the rest of the urea in two equal split doses at 20 DAS and 35 DAS, respectively. Zn and B were applied as a form of zinc sulfate and boric acid. Zn and B were applied at the rate of 0.2%, 0.4 and 0.6% respectively after 45 days of sowing (DAS). Irrigation was applied when needed to the crop. Thinning was done during the 2-3 leaf stage to maintain the experimental plot. The experiment field was kept free from weed and disease.

Table 1. Physical properties of the initial soil of the experimental plot, 2022.

Particle size distribution	Value
Sand (%)	50
Silt (%)	24
Clay (%)	24
Textural class	Sandy Loam
Bulk density (g/cm^3)	1.65
Particle density (g/cm^3)	2.45
Total porosity (%)	32.64

Table 2. Chemical properties of the initial soil of the experimental plot at BINA substation, Satkhira during the rabi season of 2022

Soil characteristics	Analytical value (Initial soil)	
	Value	Interpretation
Soil p^H	5.9	Slightly acidic
Organic matter (%)	1.08	Moderate
Organic C (%)	0.63	
Total N (%)	0.064	Very low
Available P (ppm)	12.86	Medium
Exchangeable K (meq/100g soil)	0.15	Low
Available S (ppm)	5.64	Very Low
Available Zn (ppm)	0.38	Very low
Available Boron (ppm)	0.21	Medium

Data Collection and Analysis

Growth parameters: Plant height (cm), days to flowering, days to maturity, number of branches per plant, leaf chlorophyll content (measured using SPAD-502 chlorophyll meter, minolta made in Japan) fresh weight (g) and dry weight (g).

Flowering parameters: Leaves/plant, number of flowers formed per plant, number of flowers dropped (number of flower drop per plant), fruiting efficiency.

Yield parameters: Number of pod/plant, pod length (cm), seed/pod, 1000 seed weight (g) and yield/plot.

Statistical Analysis

All data were analyzed by analysis of variance (ANOVA) procedure using R software package (version: 4.2.2). Treatment means were separated by LSD tests at 5% level of probability.

Result and Discussion

Vegetative Growth Parameters

Plant height: Plant height was recorded after 65 days of sowing. The plant height was significantly increased with foliar application of Zn 0.6% and B 0.4% over control (Table 3). The highest plant height (51.66 cm) was recorded in T_6 treatment and the lowest plant height (23.66 cm) was recorded in T_0 (control) treatment. It is mention that both nutrients namely Zn and B enhance the growth in mungbean. Moreover,some reviewer have reported that Zn and B increases the plant height. For instance, application of boron at different levels showed a significant effect on growth parameters (Sarkar et al., 2002). Necat Togay et al., (2004) and Nasri et al., (2011) reported that number of branches along with plant height increased in dry bean with soil application of zinc and foliar application of zinc significantly, improved the plant height, number of branches, radiation use efficiency and extinction coefficient in *Phaseolousvulgaris.* Plant height was higher in alternaria infected fababean with foliar spraying of Zinc (Usama et al., 2013).

Days to flowering: Foliar application of Zn and boron has a positive effect on days to flowering. From (Table 3) lowest days (34.33) were observed in T_4 as followed by T_5 (34.66) and this could possibly be explained that foliar application of zinc and boron decreased the days to flowering (Partha et al., 2017) whereas highest days were observed (44.00) in T_0 (control) treatment.

Days to maturity: The lowest days were observed in T_4 and T_5 treatments which were (63.66 days and 63.00 days) for maturity. On the other hand, highest days were observed in 73.33 days in T_0 (control) treatment. Ram et al., (2017) stated that boron and zinc application improved the flower development, pollen grain formation, pollen viability, pollen tube growth for proper pollination and seed development which is ultimately effect on decreased of maturity days.

Number of branches/plant: In mungbean, number of branches/plant was increased with foliar application of Zn and Boron. However, the highest number of branch/plant (7.00) was observed in T_{10} and (6.33) from T_4 treatments respectively which were statistically insignificant with each other but significant from other treatments (Table 3). The lowest number of branch/plant was observed (1.33) in T_0 (control) treatment. Earlier studies indicated that number of branches/plant increases with application of zinc and boron in soybean (Sarker et al., 2002), in dry bean (Necat Togay et al., 2004), in Faba bean (Ati and Ali 2011; Usama et al., 2013).

Fresh weight (g): Fresh weight of mungbean was recorded after harvest. It was observed that zinc and boron treated plot recorded highest fresh weight (53.10 g) from T_{10} (52.93 g) from T_4 which are statistically insignificant with each other but significant from other treatments and the lowest fresh weight (38.36 g) was recorded in T_0 (control). Pandey and Gupta (2012) reported that during the entire growing season Zn and B plays an important role in tissue differentiation and carbohydrate metabolism and it is required for sugar translocation in plant and improvement of new cell in meristematic tissue which may effectively explained the observed response.

Dry weight (g): The highest dry weight (16.63 g) and (16.40 g) were observed in $T_{10,}$ T_4 which were statistically similar with each other but statistically significant from others. The lowest dry weight (12.86 g) was recorded in T_0 (control). Khalil and Prakash, (2014) found the similar results where they stated that zinc treatment directly effect in the metabolism of growing plants and boron is a constituent of cell membrane and essential for cell division which may be effectively explained the observed findings.

Leaves/plant: Leave/plant could be increase due to application of zinc and boron. From (Table 4) highest leaves/plant (13.33) was recorded in T_4 (100% RDCF with 0.6%Zn) as followed by T_8 (11.33) treatments which were statistically insignificant with each other but significant from others treatments. Whereas, lowest leaves/plant (4.33) was recorded in T_0 (control). Several researchers have stated that the positive impact of the zinc and boron application on crops. Zinc is responsible to activate many enzymes and boron plays an important role in cell differentiation, development and translocation of photosynthates from source to sink (Ati and Ali, 2011).

Table 3. Effect of micronutrients on plant height (cm), days to flowering, days to maturity number of branches/plant, fresh weight and dry weight in Mungbean

Treatments name	Plant height (cm)	Days to flowering	Days to maturity	Branch/plant (no.)	Fresh weight (g)	Dry weight (g)
T_0	23.66 f	44.00 a	73.33 a	1.33 e	38.36 e	12.86 e
T_1	47.00 bc	41.00 b	69.00 b	3.33 d	43.03 d	14.30 cd
T_2	37.33 e	38.00 c	66.33 c	5.00 bc	45.56 d	15.23 b
T_3	40.66 de	37.00 c	65.33 cde	4.33 cd	50.43 abc	15.06 bc
T_4	48.83 abc	34.33 e	63.66 ef	6.33 ab	52.93 ab	16.40 a
T_5	44.33 cd	34.66 e	63.00 f	5.00 bc	48.70 c	14.03 d
T_6	51.66 a	35.33 de	64.00 def	5.00 bc	50.40 bc	15.10 bc
T_7	40.33 de	35.33 de	64.00 def	4.00 cd	50.46 abc	14.83 bcd
T_8	39.00 e	36.66 cd	66.00 c	4.00 cd	51.63 ab	14.83 bcd
T_9	38.00 e	35.33 de	65.33 cd	5.33 bc	50.80 abc	14.43 bcd
T_{10}	49.40 ab	35.33 de	65.00 cde	7.00 a	53.10 a	16.63 a
CV (%)	6.32	2.21	1.20	18.95	3.23	3.30

In a column figures having similar letter (s) do not differ significantly at 5% level of probability where (T_0= Control, T_1=100% Recommended dose chemical fertilizer (RDCF), T_2= RDCF (NPKgypsum+Zn 0.2%), T_3= RDCF (NPKgypsum+Zn 0.4%), T_4= RDCF (NPKgypsum+Zn 0.6%), T_5= RDCF (NPKgypsum+B 0.2%), T_6= RDCF (NPKgypsum+B 0.4%), T_7= RDCF (NPKgypsum+B 0.6%), T_8= RDCF (NPKgypsum+Zn,B 0.2%), T_9= RDCF (NPKgypsum+Zn,B 0.4%), T_{10}= RDCF (NPK gypsum + Zn, B 0.6%)

Table 4. Effect of micronutrients on leaves/plant, chlorophyll content, number of flowers/plant, and number of flowers drop/plant in mungbean

Treatments	leaves/plant	SPAD	Number of flowers/plant	Number of flowers drop/plant
T_0	4.33 f	32.66 f	9.00 f	5.33 ab
T_1	6.66 ef	39.96 ab	11.66 ef	5.66 ab
T_2	7.00 def	35.00 e	13.00 de	5.00 ab
T_3	10.00 cde	36.33 de	15.33 cd	6.00 ab
T_4	13.33 a	40.33 a	22.66 a	6.66 a
T_5	8.66 bcde	37.66 cd	16.33 cd	4.66 b
T_6	11.00 ab	38.83 abc	18.66 bc	4.66 b
T_7	9.33 bcde	39.23 abc	22.00 ab	5.00 ab
T_8	11.33 ab	38.20 bcd	21.66 ab	5.00 ab
T_9	9.66 bcd	38.96 abc	23.33 a	6.33 ab
T_{10}	10.33 bc	40.36 a	24.66 a	6.66 a
CV (%)	18.87	3.23	10.95	20.10

In a column figures having similar letter (s) do not differ significantly at 5% level of probability where (T_0= Control, T_1=100% Recommended dose chemical fertilizer (RDCF), T_2= RDCF (NPKgypsum+Zn 0.2%), T_3= RDCF (NPKgypsum+Zn 0.4%), T_4= RDCF (NPKgypsum+Zn 0.6%), T_5= RDCF (NPKgypsum+B 0.2%), T_6= RDCF (NPKgypsum+B 0.4%), T_7= RDCF (NPKgypsum+B 0.6%), T_8= RDCF (NPKgypsum+Zn,B 0.2%), T_9= RDCF (NPKgypsum+Zn,B 0.4%), T_{10}= RDCF (NPK gypsum + Zn, B 0.6%)

Table 5. The effect of micronutrients on number of pods/plant, number of seeds/pod, 1000 seeds weight (g) and yield ton/ha in mungbean

Treatments	Pods/plant (no.)	Seeds/pod (no.)	1000- seed weight (g)	Yield ton/ha
T_0	3.66 f	4.00 d	22.70 f	0.94 e
T_1	6.00 ef	8.00 c	50.25 de	1.44 d
T_2	9.33 de	9.33 bc	52.43 bcd	1.46 d
T_3	9.33 de	9.00 bc	49.33 e	1.47 d
T_4	16.33 ab	11.67 a	65.16 a	1.82 a
T_5	11.66 cd	10.00 abc	50.10 de	1.63 c
T_6	14.33 bc	10.00 abc	51.06 cde	1.63 c
T_7	17.00 ab	10.66 abc	54.59 b	1.63 c
T_8	16.66 ab	11.00 ab	51.43 cde	1.58 c
T_9	17.00 ab	10.66 abc	51.86 bcde	1.65 c
T_{10}	18.00 a	12.00 a	53.90 bc	1.73 b
CV (%)	16.90	13.14	3.56	2.61

In a column figures having similar letter (s) do not differ significantly at 5% level of probability where (T_0= Control, T_1=100% Recommended dose chemical fertilizer (RDCF), T_2= RDCF (NPKgypsum+Zn 0.2%), T_3= RDCF (NPKgypsum+Zn 0.4%), T_4= RDCF (NPKgypsum+Zn 0.6%), T_5= RDCF (NPKgypsum+B 0.2%), T_6= RDCF (NPKgypsum+B 0.4%), T_7= RDCF (NPKgypsum+B 0.6%), T_8= RDCF (NPKgypsum+Zn,B 0.2%), T_9= RDCF (NPKgypsum+Zn,B 0.4%), T_{10}= RDCF (NPK gypsum + Zn, B 0.6%)

Chlorophyll content: To correlate with leaf chlorophyll content, a SPAD meter reading was recorded on the plants and observed that values ranges from 27 to 42. Amongst the treatments there was a difference with regards to leaf chlorophyll content observed in (Table 4). However, Weisany et al., (2011) and Soheil et al., (2011) reported that chlorophyll a, chlorophyll b, carotenoids and protein contents of soybean increased with supply of zinc. On the other hand, Hemantaranjan et al., (2000); Sarker et al. (2002) and Bellaloui (2011) stated that foliar application of boron on soybean increases leaf chlorophyll content. However, SPAD meter reading was recorded to be found statistically similar with T_4 and T_{10} treatments but statistically significant with other treatments.

Number of flowers per plant: Until maturity, number of flowers/plant/day was recorded and cumulative number was treated as number of flowers/plant. Among the treatments, the number of flowers formed varied and it was noticed that zinc and boron application enhance the number of flowers (Table 4). On the other hand, boron influence on number of flower formation was also noticed. The highest flower/plant (nos.) was recorded in T_{10} (24.66), T_4 (22.66), T_9 (23.33) were statistically similar with each other but significant from other treatments whereas the lowest flower/plant (nos.) was recorded in T_0 (9). Foliar application of zinc along with NPK in *Phaseolous vulgaris* significantly increased the flowers number per plant (Nasri et al., 2011). Several researchers also reported that boron application improves the quality of bearing the number of flower per plant (Vaseghi et al., 2013; Sarker et al., 2002).

Number of flowers drop per plant: Flowers dropped was counted on daily basis and cumulative number was counted as number of flowers dropped per plant and the dropped ranged from 2 to 15 flowers per plant (Table 4). However, flower drop was reduced because of application of zinc and boron whereas Boron influence on the reduction of flower drop was much more than zinc (Fakir, 2011). The lowest flower drop was recorded in T_5 (4.66) and T_6 (4.66) respectively whereas highest flower drop was recorded in T_{10} (6.66).

Number of pod/plant: The number of pod/plant ranged from 3 to 18. The highest number of pod/plant (18.00) was recorded in T_{10} treatment (16.33) in T_4 treatment from (Table 5) which was statistically significant from all other treatments and the lowest (3.66) was recorded in T_0 treatment. Although, zinc and boron showed similar pattern and treatment effect was noticed (Table 3). Taiz and Zeiger (2010) reported that zinc works as growth promoter in plants. (Ezzat et al., 2012, Ali and Adel (2013) reported that foliar application of zinc enhanced the pod number, seed weight and yield in mungbean. Nasri et al., (2011) stated that foliar application of zinc with soil application of NPK in *Phaseolous vulgaris* significantly increased number of pods per plant, number of pods, number of seed per pod, 100 seed weight, fresh pod yield, seed yield, biological yield and harvest index.

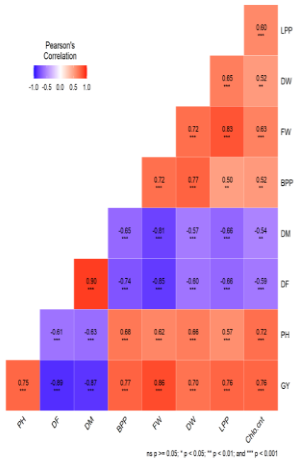
Number of seeds/pod: The highest number of seeds/pod (11.67) was recorded in T_4, (12.00) was recorded in T_{10} from (Table 5) the lowest (4.00) was recorded in T_0 (control). Valensiano et al., (2009); Ahmad and Garib (2010) reported that application of zinc and boron increased the pods weight, number of pods per plant, more dry matter and ultimately increased yield and its occurred due to foliar application of zinc and boron improves protein, oleic acid, sucrose, glucose and fructose content in seeds (Bellaloui et al., 2013).

1000 seed weight (g): 1000 dry seeds were selected randomly and separated. After that, weight was recorded using an electronic sensitive balance which was expressed in gram. Highest test weight was (65.16 g) in T_4, T_7 and T_{10} treatments (Table 5) and lowest test weight (22.70 g) was recorded in T_0 (control). Seifinadergholi et al. (2011) stated that foliar application of zinc at flowering stage and seed set remarkably increased yield components and grain yield in common bean.

Yield (ton/ha): From the study, the highest yield (1.82 t/ha) was recorded in T_4 (RDCF with 0.6% Zn) treatment (Table 5) which was statistically significant from other treatments whereas the lowest yield (0.94 ton ha^{-1}) was found in T_0 (control) treatment. Ram et al., (2017) reported that boron has significant effect on yield attributes may be due to flower development pollen grain formation, pollen viability, pollen tube growth for proper pollination and seed development. It has been reported that B 1.5 kg ha^{-1} resulted in maximum yield, low cost benefit ratio in soybean (Devi et al., 2012; Vaseghi et al., 2013) reported that application of B 1 $kgha^{-1}$ improves biological yield, seed yield and harvest index in soybean, Mahmud et al., (2006) stated that N 40 kg nitrogen per fadden along with 50-100 ppm boron enhanced number of pods per plant, number of seeds per pod, seed yield per plant, straw and seed yield. Zn and B application improves growth and yield in pigeopea (Varma et al., 2004), Usama et al., (2013) stated in fababean, Siddaraju (2012) in cluster bean, Nalini et al., (2013) in blackgram, Madani et al., (2007) and Vahid et al., (2010) in soybean, Rathod et al., (2020) in chick pea.. Grain yield and yield components were increased by foliar application of zinc sulphate along with manganese sufphate (Seifinadergholi et al., 2011).

Correlation Among Yield Contributing Characters

The correlation study revealed that the grain yield was found to be positively and significantly correlated with plant height (cm), branches/plant, fresh weight (g), dry weight (g), leaves/plant and chlorophyll content whereas days to flowering and days to maturity were found to be negatively correlated (Figure 1).



PH=plant height(cm); DF=Days to flowering; DM=Days to maturity; BPP=Branches/plant; FW=Fresh weight(g); DW=Dry weight(g); LPP=Leaves/plant; Chlo.cont.=Chlorophyll content

Figure 1. Correlation among the yield contributing attributes of mungbean

Conclusion

From the study, it indicated that the vegetative growth like plant height (cm), number of branches/plant, chlorophyll content, number of flower/plant formed, number of flower/plant dropped, fresh weight, dry weight, pod/plant, seed/pod, 1000 seed weight (g) were significantly influenced by foliar application of zinc and boron along with recommended dose chemical fertilizers. The treatment with foliar application of 0.6% zinc significantly influenced and increased the number of flowers/plant, pod/plant (no.), 1000 seed weight (g) and seed/pod compared to control and resulted in significant increase in yield $tonha^{-1}$ respectively.

Disclaimer

The variety used in this experiment is common and predominant in our country. There is no dispute of interest between the authors and the producers of this variety because the variety is not used for any plea but also used for the advancement of research. This experiment was funded by the authors affiliated institute but publication of the findings was from personal efforts of the authors.

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