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Influence of boron and zinc on growth and yield of green gram (*Vigna radiata* L.)

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Abstract
The field experimentation was conducted during *Zaid* 2021 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.). The soil of experimental plot was sandy loam in texture, Basic in soil reaction (pH 7.4), low in organic carbon (0.49%), available N (219 kg/ha), available P (21.3 kg/ha), available K (235.8 kg/ha). The treatments consisted of two sources zinc (soil application zinc at three levels 10 kg/ha, 12.5 kg/ha, 15 kg/ha) and boron (foliar application of boron at three levels 0.1%, 0.2%, 0.3%) respectively. The treatments which are Zinc at 10, 12.5, 15 kg/ha along with it Boron foliar spray with 0.1%, 0.2% and 0.3% were used. The research was laid out in Randomized Block Design with nine treatments each replicated three times. In that study maximum plant height up to (44.08 cm), maximum branches per plant (6.04), nodules per plant up to (6.33), plant dry weight of (6.20 g/plant), Crop growth rate (2.62 g/m2/day), Maximum pods per plant (39.70), maximum seeds per plant (8.84), Test weight up to (37.93 g), Seed yield of (1,072,.33 kg/ha), Stover yield of (2,793.36 kg/ha), Harvest index (27.78%), Cost of cultivation (38,526.29 Rs./ha), Gross returns (85,786.40 Rs./ha), Net returns (47,260.11 Rs./ha) and B:C ratio (1.22) noted with by application of Zinc at 15 kg/ha + Boron foliar spray of 0.3%.

Keywords: Green gram, zinc, boron, growth, yield and economics, foliar spray

Introduction
India is the major producer of green gram in the world and grown in almost all the States. It is grown in about 4.5 million hectares with the total production of 2.5 million tonnes with a productivity of 548 kg/ha and contributing 10% to the total pulse production. According to Government of India 3rd advance estimates, green gram production in 2020-21 is at 2.64 million tonnes. In the marketing year 2020-21, the consumption of green gram was 22.5 lakh tonnes against the production of 21.42 lakh tonnes with the rest of the demand-supply gap was covered by importing around 1.08 lakh tones along with the opening stocks 2.10 lakh tonnes. The important green gram producing states in the country are Rajasthan, Maharashtra, Andhra Pradesh, Madhya Pradesh and Bihar. Andhra Pradesh ranks 6th in green gram production with 0.83 lakh tonnes under an area of 1.13 lakh ha with productivity of 735 kg/ha according to third advance estimates of 2020-21 (DES, AP). Rajasthan and Madhya Pradesh states showed an increased in the area grown over the two decades while the states Andhra Pradesh, Bihar, Karnataka and Maharashtra showed a decreased area grown over two decades. The reason behind the decline in green gram production is that the improved irrigation facilities, which allows to grow-intensive crops such as rice and wheat. So, the government is incentivizing MSP of green gram which increased from Rs. 4350 in 2014-15 to Rs. 6000 in 2020-21 (Agricultural Market Intelligence Centre, ANGRAU, Lam) like heritability and genetic advance were calculated. Correlation coefficients were calculated as per the formulae suggested by Falconer (1981). Pulses are least preferred by farmers because of high risk and less remunerative than cereals; consequently, the production of the pulses is significantly low to meet the demand of pulses. Majority of Indian population is vegetarian, pulses are cheap and best source of protein for Indian diet. It contains 20-25 per cent protein, which is more than two times of cereals. India importing about 3 million tonnes and the future demand of pulses by 2015 will be 27.0 million tonnes (Singh *et al.*, 2011) Green gram locally called as moong or mung [*Vigna radiata* (L.) Wilczek]. It belongs to the family leguminaceae so it has the capacity to fix atmospheric nitrogen. It's one of the important kharif pulse crops of India which can be grown as catch crop between rabi and kharif seasons. India alone accounts for 65% of its world acreage and 54% of the total production.

The production has increased from 0.60 million tonnes to 1.81 million tonnes during the same period. Throughout the India, the mungbean is used for different purposes. The major portion is utilized in making dal, soup, sweets and snacks (Anonymous, 2012). Micronutrients are essential for plant growth. Zinc is one of the seven pillars of nutrition and is needed for the growth of plant, animals and humans. The amount of zinc in pasture and forage is very little and varies from 20 to 30 mg/kg in soil. Zinc is necessary to activate many enzymes, enzymes that are activated by the zinc are Tryptophan synthetase superoxide dismutase and dehydrogenases. Lack of zinc causes deficiency in formation of RNA and protein. Therefore, the plant with lack of zinc is poor in amount of protein. Foliar spraying of micronutrients for the growth of green gram and its quality in industry views is necessary for growth and quality of green gram. (Rengel *et al*., 2001) showed that zinc fertilizer application causes root and shoot growth during the growing season and therefore, lead to increased seed yield. Spraying the leaves with the nutrient elements is one of the methods of plant supply. Although the leaves and shoots can absorb nutrients as well as water, gas through the stomata, leaf spraying method in addition to the rapid response, will also save money. The fertilization procedure in addition to economic aspects and the effectiveness of the immediate environment in order to achieve sustainable agriculture is also very effective and useful (Fard *et al*., 2012). Micronutrients like boron is one of the mineral nutrients required for normal plant growth. The most important functions of boron in plants are thought to be its structural role in cell wall development, cell division, seed development and stimulation or inhibition of specific metabolic pathways for sugar transport and hormone development (Ahmed *et al*., 2009). Furthermore, boron deficiency causes decrease in pollen grain count, pollen germination etc. It also influences growth parameters and filling up of seeds. It is usually accepted that boron availability is decreased under dry soil conditions. Thus, boron deficiency is often associated with dry weather and low soil moisture conditions. This behaviour may the related to restricted release of boron from organic complexes which ultimately impaired ability of plants to extract B from soil due to lack of moisture in the rizosphere. Even of B levels in soil is high, then also low soil moisture impairs transport of B to absorbing root surfaces (Das, 2011). Keeping the above points in view the present investigation entitled “Influence of Boron and Zinc on the Growth and Yield of Green gram (*Vigna radiata* L.)” was conducted.

Materials and Methods

The experiment was carried out during *Zaid* season of 2021 at the CRF (Crop Research Farm), Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh. The CRF is situated at 25º24‘41.27” N latitude, 81°50‘56” E longitude (Google, 2018) and 98 m altitude above the mean sea level (MSL). This area is situated on the right side of the Yamuna River by the side of Prayagraj - Rewa road about 12 km from the city. The experiment was laid out in Randomized Block Design (RBD) consisting of 9 treatments each replicated thrice. Treatments were randomly arranged in each replication, divided into 27 plots. The soil of the experimental field constituting a part of central Gangetic alluvium is neutral and deep. Pre- sowing soil sample were taken from 5 different places with a depth of 15 cm with the help of an auger. The composite samples were used for the chemical and mechanical analysis. The soil was sandy loam in texture, low in organic carbon with (0.49) and medium in available nitrogen (219 kg), Phosphorus (21.3 kg) and low in potassium (235.8 kg), the climate of the region is semi-arid subtropical. Treatment combination of T1- Zn 10/kg/ha + B 0.1%, T2- Zn 10 kg/ha + B 0.2%, T3- Zn 10 kg/ha + B 0.3%, T4- Zn 12.5 kg/ha + B 0.1%, T5- Zn 12.5 kg/ha + B 0.2%, T6- Zn 12.5 kg/ha + B 0.3%, T7- Zn 15 kg/ha + B 0.1%, T8- Zn 15 kg/ha + B 0.2% and T9- Zn 15 kg/ha + B 0.3% were used. The nine treatments were replicated thrice in Randomized Block Design. The nutrient sources used in the research plot were urea, DAP and MOP to fulfill the requirements of nitrogen, phosphorous and potassium. The recommended dose of 20 kg N, 40 kg P2O5, 20 kg K2O/ha. Between the period of germination to harvest several plant growth parameters were recorded at equal intervals and after harvest several yield parameters and economics were recorded. Data regarding growth parameters *viz*., plant height (cm), No. of branches per plant, No. of dry weight (g), Crop growth rate (g/m2/day), and Nodules per plant. Yield parameters *viz*., No. of pods/plant, No. of seeds/pod, test weight (g), seed yield (kg/ha), stover yield (kg/ha) and harvest index (%) and economic were recorded with standard process of observation. The data was statically analysed using analysis of variance (ANOVA) as applicable in Randomized Block Design (RBD) by Gomez and Gomez, 1984.

Result and Discussion

Effect on growth parameters

It is observed from Table 1, the plant height increased with crop growth duration. At harvest treatment T9 with 44.08 cm plant height recorded significantly higher with application of Zinc at 15 kg/ha+ Boron at 0.3% and Zinc at 12.5 kg/ha+ Boron at 0.3%, Zinc at 15 kg/ha+ Boron at 0.2% which were statistically at par to Zinc at 15 kg/ha+ Boron at 0.3% Increase in plant height might be the involvement of micronutrients in different physiological processes like enzyme activation, electron transport, chlorophyll formation, stomatal regulation, etc. With the increase in levels of zinc and change in methods of application of boron from soil application to foliar application, the plant height gradually increased, which might be attributable to greater photosynthetic activity and chlorophyll synthesis due to zinc and boron fertilization resulting into better vegetative growth. The improvement in plant height was due to interaction of both boron and zinc application to green gram crop. Similar results were reported by Singh *et al.* (2015) [11] and Shil *et al.* (2007) [10]. Data regarding number of branches per plant was recorded at all growth intervals and at harvest (Table 1) treatment T9 with 6.04 recorded significantly higher with application of Zinc at 15 kg/ha+ Boron at 0.3% and Zinc at 12.5 kg/ha+ Boron at 0.3%, Zinc at 15 kg/ha+ Boron at 0.2% which were statistically at par to Zinc at 15 kg/ha+ Boron at 0.3%, the reported positive effect of application of Zn on an enhanced branching in pulses mainly attributed to promotion of bud and branch development by the auxins whereas Zn application ultimately increased the availability of other nutrients and accelerated the translocation of photo assimilates. Similar results were reported by Upadhyay and Anita Singh (2016) [15], the best obtained results were found with effect of boron might be attributedto the favourable influence on plant metabolism and biological process activity and stimulating effect on photosynthetic pigments and enzyme activity which in turn encourage vegetative growth. The results were in accordance with Shekhawat and Shivay (2012) [9]. Data regarding number of nodules per plant was recorded at all growth intervals and at harvest (Table 1) treatment T9 with 6.33 recorded significantly higher with application of Zinc at 15 kg/ha+ Boron at 0.3% and Zinc at 12.5 kg/ha+ Boron at 0.2%, Zinc at 12.5 kg/ha+ Boron at 0.3% and Zinc at 15 kg/ha+ Boron at 0.2% which were statistically at par to Zinc at 15 kg/ha+ Boron at 0.3%. Data regarding plant dry weight (g) was recorded at all growth intervals and at harvest (Table 1) treatment T9 with 6.20 g recorded significantly higher with application of Zinc at 15 kg/ha+ Boron at 0.3% and Zinc at Zinc at 12.5 kg/ha+ Boron at 0.3%, Zinc at 15 kg/ha+ Boron at 0.2% which were statistically at par to Zinc at 15 kg/ha+ Boron at 0.3%, Data regarding number of nodules per plant was recorded at all growth intervals and at harvest (Table 1) treatment T9 with 6.33 recorded significantly higher with application of Zinc at 15 kg/ha+ Boron at 0.3% and Zinc at 12.5 kg/ha+ Boron at 0.2%, Zinc at 12.5 kg/ha+ Boron at 0.3%, Zinc at 15 kg/ha+ Boron at 0.2% which were statistically at par to Zinc at 15 kg/ha+ Boron at 0.3%, Dry weight was increased significantly with increasing levels of zinc at 30 kg ZnSO4.As boron generally influences cell division and nitrogen absorption from the soil might enhance plant growth which reflects in terms of plant dry weight. These findings are in harmony with those obtained by Masih *et al.* (2020) [7] and Tekale *et al.* (2009) [13]. Data regarding crop growth rate (g/m2/day) was recorded at all growth intervals and at harvest (Table 1) treatment T9 with 2.62 recorded significantly higher with application of Zinc at 15 kg/ha+ Boron at 0.3% and Zinc at 12.5 kg/ha+ Boron at 0.3%, Zinc at 15 kg/ha+ Boron at 0.2% which were statistically at par to Zinc at 15 kg/ha+ Boron at 0.3%, the application of zinc and boron on growth of green gram, in terms of dry matter and crop growth rate can be interpreted in terms of the metabolic function of micronutrients in the plant. These results are in agreement with the findings of Masih *et al.* (2020) [7] and Subasinghe *et al.* (2003) [12].

Table 1: Influence of Boron and Zinc on growth parameters of Green gram

Treatments	Plant height (cm)	No. of Branches per plant	No. of Nodules per plant	Plant dry weight (g)	Crop growth rate (g/m2/day)
Zn 10/kg/ha + B 0.1%	41.57	4.86	4.37	4.99	2.10
Zn 10g/ha + B 0.2%	41.90	5.13	4.73	5.24	1.95
Zn 10kg/ha + B 0.3%	42.29	5.40	5.43	5.54	1.98
Zn 12.5kg/ha + B 0.1%	42.05	5.15	5.20	5.42	2.07
Zn 12.5kg/ha + B 0.2%	42.94	5.65	5.80	5.73	1.97
Zn 12.5kg/ha + B 0.3%	43.43	5.83	5.90	5.97	2.52
Zn 15kg/ha + B 0.1%	42.66	5.50	5.50	5.63	2.21
Zn 15kg/ha + B 0.2%	43.83	5.93	6.00	5.99	2.58
Zn 15kg/ha + B 0.3%	44.08	6.04	6.33	6.20	2.62
F-Test	S	S	S	S	S
S.Em+	`0.36	0.11	0.24	0.08	0.13
CD (P=0.05)	1.09	0.34	0.73	0.24	0.40

Effect on yield and yield parameters

It is observed from Table 2, the pods per plant increased at harvest. At harvest treatment T9 with 39.70 pods per plant recorded significantly higher with application of Zinc at 15 kg/ha+ Boron at 0.3% and Zinc at 12.5 kg/ha+ Boron at 0.3%, Zinc at 15 kg/ha+ Boron at 0.2% which were statistically at par to Zinc at 15 kg/ha+ Boron at 0.3%, Zinc plays a very important role in the metabolism of the plant process by influencing the activity of growth enzymes as well as it is involved in carbohydrate metabolism, maintenance of the integrity of cellular membranes, protein synthesis, and regulation of auxinsynthesis and pollen formation. The similar results were observed by Upadhyay and Anita Singh (2016) [15]. The positive effect of boron may be due to key role in plant metabolism and in the synthesis of nucleic acid. Similar findings were under the conformity Kumar *et al.* (2013) [7]. Data regarding seeds per pod was recorded at harvest (Table 2) treatment T9 with 8.84 recorded significantly higher with application of Zinc at 15 kg/ha+ Boron at 0.3% and Zinc at 12.5 kg/ha+ Boron at 0.2%, Zinc at 12.5 kg/ha+ Boron at 0.3% and Zinc at 15 kg/ha+ Boron at 0.2% which were statistically at par to Zinc at 15 kg/ha+ Boron at 0.3%, Application of Zinc and boron to green gram crop generally improves fruit growth by synthesizing tryptophan and auxin. The enhancement effect on seeds/pod and pods/plant attributed to the favorable influence of the Zn application to crops on nutrient metabolism, biological activity and growth parameters and hence, applied zinc resulted in taller and higherenzyme activity which in turn encouraged more seeds/pod and pods/plant. Similar findings have been reported earlier by Srivastava *et al.* (2017) and Shekhawat and Shivay (2012) [9]. Data regarding test weight was recorded at harvest (Table 2) treatment T9 with 37.93 recorded significantly higher with application of Zinc at 15 kg/ha+ Boron at 0.3% and Zinc at 12.5 kg/ha+ Boron at 0.3% and Zinc at 15 kg/ha+ Boron at 0.2% which were statistically at par to Zinc at 15 kg/ha+ Boron at 0.3%, Increase in this attribute by foliar spray might be due to the involvement of the sprayed zinc and boron in enzyme activation, membrane integrity, chlorophyll formation, stomatal balance and starch utilization at early stages which enhanced accumulation of assimilate in the grains resulting in heavier grains. These results are in agreement with the findings of Upadhyay and Anita Singh (2016) [15] and Ceyhan and Onder (2007) [3]. Data regarding Seed yield (kg/ha) was recorded at harvest (Table 2) treatment T9 with 1072.33 kg/ha recorded significantly higher with application of Zinc at 15 kg/ha+ Boron at 0.3% and Zinc at 12.5 kg/ha+ Boron at 0.3% and Zinc at 15 kg/ha+ Boron at 0.2% which were statistically at par to Zinc at 15 kg/ha+ Boron at 0.3%, Zinc and boron play a vital role in increasing seed yield because zinc and boron takes place in many physiological process of plant such as chlorophyll formation, stomatal regulation, starch utilization which enhance seed yield. Zinc also converts ammonia to nitratein crops which contribute to yield. Boron is a required for many physiological processes and plant growth, also adequate nutrition is a critical for increase yields and quality of crops. These results are in confirmatory with the work of Debnath *et al.* (2018) [4] and Tekale *et al.* (2009) [13]. Data regarding Stover yield (kg/ha) was recorded at harvest (Table 2) treatment T9 with 2793.36 kg/ha recorded significantly higher with application of Zinc at 15 kg/ha+ Boron at 0.3% and Zinc at 12.5 kg/ha+ Boron at 0.3% and Zinc at 15 kg/ha+ Boron at 0.2% which were statistically at par to Zinc at 15 kg/ha+ Boron at 0.3%. Data regarding Harvest index (%) was recorded at harvest (Table 2), maximum harvest index 27.78% is recorded with application of Zinc at 15 kg/ha+ Boron at 0.3% and minimum harvest index 24.12% id recorded with application of Zinc at 12.5 kg/ha+ Boron at 0.1%.

Table 2: Influence of Boron and Zinc on yield and yield attributes of Green gram

Treatments	Pods/plant	Seeds/pod	Test weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)
Zn 10/kg/ha + B 0.1%	35.67	6.20	35.21	633.00	1,960.23	24.41
Zn 10g/ha + B 0.2%	36.80	6.71	35.50	666.07	2,062.74	24.42
Zn 10kg/ha + B 0.3%	37.15	7.32	36.10	859.17	2,476.72	25.77
Zn 12.5kg/ha + B 0.1%	36.86	6.94	35.79	720.30	2,270.07	24.12
Zn 12.5kg/ha + B 0.2%	38.28	8.03	36.83	952.57	2,590.05	26.90
Zn 12.5kg/ha + B 0.3%	38.83	8.23	37.18	991.90	2,668.97	27.08
Zn 15kg/ha + B 0.1%	37.88	7.56	36.44	875.13	2,453.05	26.28
Zn 15kg/ha + B 0.2%	39.06	8.44	37.44	1,012.00	2,734.96	27.03
Zn 15kg/ha + B 0.3%	39.70	8.84	37.93	1,072.33	2,793.36	27.78
F-Test	S	S	S	S	S	NS
S.Em+	0.33	0.28	0.31	26.97	71.89	0.92
CD (P=0.05)	0.99	0.84	0.92	80.85	215.53	-

Effect on Economics

From Table 3, Boron foliar spray and zinc soil application increased economic stability and returns, the cost of cultivation of green gram crop recorded numerically higher (₹ 85786.40/ha) value for the treatment of application Zinc at 15 kg/ha+ Boron spray at 0.3% and numerically average cost of cultivation was recorded with application of Zinc at 15 kg/ha + Boron spray at 0.3% (₹ 38,526.29/ha). Numerically highest gross return (₹ 85,786.40/ha), net return (₹ 47,260.11/ha) and B:C ratio (1.22) were obtained with application of Zinc at 15 kg/ha+ Boron spray at 0.3% among all the treatments.

Table 3: Influence of Boron and Zinc on Economics of Green gram

Treatments	Total cost of cultivation (INR/ha)	Gross returns (INR/ha)	Net returns (INR/ha)	B:C ratio (%)
Zn 10/kg/ha + B 0.1%	36,937.54	50,640.00	13,702.46	0.37
Zn 10g/ha + B 0.2%	37,497.54	53,285.60	15,788.06	0.42
Zn 10kg/ha + B 0.3%	38,057.54	68,733.60	30,676.06	0.80
Zn 12.5kg/ha + B 0.1%	37,171.91	57,624.00	20,452.09	0.55
Zn 12.5kg/ha + B 0.2%	37,731.91	76,205.60	38,473.69	1.01
Zn 12.5kg/ha + B 0.3%	38,291.91	79,352.00	41,060.09	1.07
Zn 15kg/ha + B 0.1%	37,406.29	70,010.40	32,604.11	0.89
Zn 15kg/ha + B 0.2%	37,966.29	80,960.00	42,993.71	1.13
Zn 15kg/ha + B 0.3%	38,526.29	85,786.40	47,260.11	1.22

Conclusion

On the basis of one season of experimentation with Zinc at 15 kg/ha + Boron foliar spray at 0.3% were found more productive (1,072.33 kg/ha) as well as economic (85,786.40 Rs./ha).

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Reference

1. AOAC. Official methods of analysis, Association of official Analytical Chemists. 15th ed. Washington, DC, USA, 1995.
2. Ahmad F, Ahmad J, Shah MA, Iqbal S, Mahemood Z, Abbas W. Influence of Different Levels Phosphorous and Zinc on Yield and Yield Attributes of Mung Bean (*Vigna radiata* L.) Juniper Online Journal Material Science, 2018;5(1);1-4.
3. Ceyhan E and Onder M. Response of chickpea cultivars to application of boron in boron deficient calcareous soil. Communications in Soil Science and Plant Analysis, 2007;38:2381-2399.
4. Debnath P, Pattanaaik SK, Sah D, Chandra G, Pandey AK. Effect of boronnd zinc fertilization on growth and yield of cowpea (*Vigna unguiculata* L Walp) in Inceptisols of Arunachal Pradesh. Journal of the Indian Society of Soil Science. 2018;66(2):229-234.
5. Humtsoe BM, Dawson J, Rajana P. Effect of nitrogen, boron andzinc as basal and foliar application on growth and yield of maize (*Zea mays* L). Journal of Pharmacognosy and Phytochemistry, 2018; **7**(6):1-4.
6. Kumar D, Padbhushan R. Influence of soil and foliar

applied Boron on Green gram calcareous soils. International Journal of Agriculture, Environment & Biotechnology. 2013;**7**(1):129-136.
7. Masih A, Dawson J, Singh RE. Effect of Levels of Phosphorus and Zinc onGrowth and Yield of Greengram (*Vigna radiata* L.). International Journal of Current Microbiology and Applied Sciences. 2020;9(10):3106-3112.
8. Prashantkumar, Rader BM. Effect of Zinc Sulphate on Yield and Yield Attributes of Green Gram (*Vigna radiata*). International Journal of Current Microbiology and Applied Sciences. 2020;9(2):2209-2213.
9. Shekhawat K, Shivay YS. Residual effects of nitrogen sources, sulphur and boron levels on mungbean (*Vigna radiata*) in a sunflower (*Helianthus annuus*) – mungbean system. Archives Agronomy and Soil Science. 2012;58(7):765-776.
10. Shil NC, Noor S, Hossain MA. Effects of boron and molybdenum on the yield of chickpea. Journal of Agriculture and Rural Development. 2007;5(1, 2):17-24.
11. Singh LB, Yadav R, Abraham T. Studies on the effect of zinc levels and methods of boron application on growth, yield and protein content of wheat (*Triticum aestivum* L.). Bulletin of Environment, Pharmacology and Life Sciences. 2015;4(2):108-113.
12. Subasinghe S, Dayatilake GA, Senaratne R. Effect of B, Co and Moon nodulation, growth and yield of cowpea (*Vigna unguiculata*). Tropical Agriculture Research. 2003;6:45-49.
13. Tekale RP, Guhey A, Agrawal K. Impact of boron, zinc and IAA on growth, drymatter accumulation and sink potential of pigeonpea (*Cajanus cajan* L.). Agriculture Science Digest. 2009;29(4):246-249.
14. Uddin Md S, Amin AKMR, Ullah Md J, Asaduzzaman Md. Interactive effect of variety and different fertilizers on the growth and yield of summer mungbean (*Vigna radiata*). American-Eurasian J Scientific Res. 2009;2(3):180-184.
15. Upadhyay RG, Anita Singh. Effect of nitrogen and zinc on nodulation, growth and yield of cowpea (*Vigna unguiculata*). Legume Research. 2016;39(1):149-151.
16. Vinodkumar HV, Channakeshava S, Basavaraja B, Ananathakumar. Effect of soil and foliar application of zinc on growth and yield of greengram (*Vigna radiata* L.). International Journal of Current Microbiology and Applied Sciences. 2020;9(4):501-512.