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Impact of organic manures, zinc and boron on growth and yield of maize (*Zea mays* L.)

Kalyani Dwivedi, Biswarup Mehera, Sudhanshu Suman and Mannepu Venkata Sai Ganesh

Abstract

A field experiment was conducted during *Kharif* 2021 at Crop Research Farm. Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36%), available N (171.48 kg/ha), available P (15.2 kg/ha) and available K (232.5 kg/ha). The experiment was laid out in Randomized Block Design with Ten treatments each replicated thrice on the basis of one year of experimentation. The treatments which are T_1- Control (120 kg N/ ha: 60kg P_2O_5/ ha: 60kg K_2O/ha.), T_2- Vermicompost- 3.3 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha, T_3- Vermicompost- 3.3 t/ha + Urea- 130.5 kg/ha + Boron- 0.5 kg/ha, T_4- Vermicompost- 3.3 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha + Boron- 0.5 kg/ha, T_5- Neem cake- 1.154 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha, T_6- Neem cake- 1.154 t/ha + Urea- 130.5 kg/ha + Boron 0.5 kg/ha, T_7- Neem cake -1.154 t/ha + Urea- 130.5 kg/ha + Zinc- 5kg/ha + Boron- 0.5 kg/ha, T_8- Vermicompost- 1.66 t/ha + Neem cake- 0.57 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha, T_9- Vermicompost- 1.66 t/ha + Neem cake- 0.57 t/ha + Urea- 130.5 kg/ha + Boron- 0.5 kg/ha, T_{10}- Vermicompost- 1.66 t/ha + Neem cake- 0.57 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha + Boron- 0.5 kg/ha used. The results showed that application of Vermicompost- 1.66 t/ha + Neem cake-0.57 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha + Boron- 0.5 kg/ha was recorded maximum plant height (207.20 cm), plant dry weight (179.52 g/plant), crop growth rate (41.38 g/m2/day), number of cobs per plant (1.80), length of cob (17.43 cm), diameter of cob (12.37 cm), number of grains per Cob (358.27), test weight (254.16 g), grain yield (9.73 t/ha), straw yield (21.20 t/ha) and harvest index (31.45) as compared to other treatments.

Keywords: Maize, vermicompost, neem seed cake, zinc, boron, growth parameters, yield attributes and yield

Introduction

Maize (*Zea mays* L.) is one of the most flexible crops grown throughout the tropical as well as temperate regions of the world. A crop of maize is sown and harvested somewhere in the world in every month of the year. There is no cereal on the earth which has so enormous potentiality and that is why it is also called "QUEEN OF CEREALS". It is a most important cereal crop which ranks third after wheat and rice in the world. Globally, India stands 5th rank in acreage and 8th rank in maize production. Maize belongs to poaceae (or), Graminae family. (De Candolle 1986) [3] assumed that corn must have originated in origin in new Granada, now colombia. Reeves (1994) [15] postulated that maize had its origin in the lowlands of South America primarily because of historical references to pod corn in that area. Maize is one of the most important cereal crop in the world grown over an area of 132 mha with a production of 57 mt. Maize is C4 plant and capable of utilizing solar radiation more efficiently compared to other cereals. It requires higher amount of nutrient thought the crop grown period, but due to heavy utilization of chemical fertilizer as to maintain the crop health. To maintain the soil health we have to go for organic fertilizer management. Maize grains contain about 9% protein, 4% oil, 70% starch and 2.7% crude fiber. Maize protein. "Zein" is rich in tryptophan and lysine, the two essential amino acids. Most of cereals have been the staple human diet from prehistoric times because of their wide cultivation, good keeping quality, blend flavor and great variety. Maize is an important staple food in many parts of the world. In addition to staple food for human being and quality feed for animals, maize serves as basic raw material as an ingredient to thousands of industrial products that includes starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceutical, cosmetics, film, textile, gum, package and paper industries etc.

Maize is mainly cultivated as rainfed crop and water stress affects both the productivity and yield stability of the crop. The productivity of maize mainly depends on its nutrients management (Kumar *et al.* 2007) [10]. Maize should be sown in moist soils to provide the necessary moisture for proper germination and inoculation. Maize is very sensitive to drought and water logging condition.

Organic materials are valuable by products, of farming allied industries, derived from plant and animal source. Organic manure supply nutrients, improves physical structure, increase nutrient content and provide food for soil organism. The use of organic manure could be adopted (Gee and Bauder, 1986 and Chiefetz *et al.* 1996) [4, 2].

Vermicompost was significantly influenced the grain yield of maize, starch content in the grain, a thousand kernel weight and content of the five observed macroelement vermicompost is a good substitute to commercial fertilizer and has more N, P and K content than the normal heap manures (Srivastava *et al.* 2004) [21]. The application of vermicompost imparts a dark colour of the soil and thereby help to maintain the temperature of soil. Vermicompost is one of the manure used by the farmer in cultivation of crops because of early availability and presence of almost all the nutrients required by plants. In addition, organic farming will reduce the additional burden of environmental pollution that is caused while manufacturing these synthetic fertilizers at the source (Rathier *et al.* 1989) [13]. Vermicompost is effective as it increases soil porosity, aeration and water holding capacity. It has been found that soil amended with vermicompost had significantly greater soil bulk density and the soil does not become compacted (Lunt and Jacobson, 1994; Martin, 1976) [9]. Vermicompost are organic materials broken down by interactions between micro-organism and earthworms in a mesophilic process, to produce fully stabilized organic soil amendments with low C: N ratios (Ramasamy *et al.* 2011) [14].

The Neem tree Azadirachta India A. Juss (Meliacceae), has been widely studied because it presents studied because it present a great number of compounds with insecticides properties which can effectively reduce the population of several insects pets. It protects soil, reduces damage to environments (water beds, etc.) when neem cake is ploughed into the soil it also protects plant roots from nematodes and ants. The seed coat is rich in lignin, cellulose etc. and can be used as a low calorific value fuel in brick kilns etc. The calcium and magnesium present in neem cake also aid in removing alkalinity. Neem as biopesticides, may be suitable as alternatives to synthetic pesticides which are not ecofriendly toxic to users for the management of maize stem borer and there will be substantial yield increase if stem borer infestation and activities can be protected in the field especially with biopesticides, such as neem. Azadiractin and neem seed derivatives have pronounced behavioural and physiological effects on insects (Schmutterer *et al.* 1982 Schmutterer *et al.* 1984) [18, 17]. Azadiractin the primary antifident component of neem seed has shown selective activity against many pest species (Jacobson, 1986) [9]. Neem cake applied to rice field has reduced nitrogen loss in experiments in India and the Philippines (Saxena, 1988) [16]. These characterstics make neem derivatives potentially valuable agricultural additives.

Zinc is an essential element for higher plants, and its importance is progressively being recognized in agriculture (Gene *et al.* 2006) [5]. Zinc play a key role in pollination and seed set processes; so that their deficiency can cause decrease in seed formation and subsequent yield reduction. Zinc deficiency has increased from 44% to 48%, and is expected to furthur increase up to 63% by 2025 in India. (Vitosh *et al.* 1997) [26] reported that B is essentially necessary for protein synthesis and involved in carbohydrates metabolism. Maize is one of the crops which is most sensitive to zinc deficiency (Mattiello *et al.* 2015) [11]. Zinc deficiency in maize is known as "WHITE BUD". Zinc is most crucial among the micronutrients that take part in plant growth and development due to its catalytic action in metabolism of almost all crops (George and Schmitt, 2002) [6]. Zinc is now been reported as the third most important limiting nutrient elements in crop production after N and P.

Boron is a micronutrient critical to the growth and health of all crops. It is a component of plant cell wall and reproductive structures. The requirements of boron to crop is affected by several environmental factors like temperature, light and soil water conditions (Shorrocks, 1997) [19]. It is a mobile nutrient present in the soil, meaning it is prone to movement within the soil. Because it is required in small amounts, it is important to deliver Boron as evenly as possible across the field. Boron plays a key role on a various range of plant functions including maintenance of structural and functional integrity of biological membranes, cell wall formation and stability, movement of sugar or energy into growing parts, and pollination and seed set. Adequate B is also required for effective nitrogen fixation and nodulation in legume crops. Boron deficiency in crops is more widespread than that of the other micronutrient (Gupta *et al.* 1985) [17].

Materials and Methods

The experiment was conducted during the *kharif* season 2021, at the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P.) which is located at $25^0$24'33'' N latitude, $81^0$51'11" E longitude 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 soil of the experimental field constituting a component of central Gangetic alluvium is neutral and deep. The climate of the region is sub-tropical and semi-arid. Treatments comprised of T_1- Control (120 kg N/ ha: 60kg P_2O_5/ ha: 60kg K_2O/ha.), T_2- Vermicompost- 3.3 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha, T_3- Vermicompost- 3.3 t/ha + Urea- 130.5 kg/ha + Boron- 0.5 kg/ha, T_4- Vermicompost- 3.3 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha + Boron- 0.5 kg/ha, T_5- Neem cake- 1.154 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha, T_6- Neem cake- 1.154 t/ha + Urea- 130.5 kg/ha + Boron 0.5 kg/ha, T_7- Neem cake -1.154 t/ha + Urea- 130.5 kg/ha + Zinc- 5kg/ha + Boron- 0.5 kg/ha, T_8- Vermicompost- 1.66 t/ha + Neem cake- 0.57 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha, T_9- Vermicompost- 1.66 t/ha + Neem cake- 0.57 t/ha + Urea- 130.5 kg/ha + Boron- 0.5 kg/ha, T_{10}- Vermicompost- 1.66 t/ha + Neem cake- 0.57 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha + Boron- 0.5 kg/ha. These were replicated thrice and experiment was laid out in Randomized Block Design. Pre harvest observation *viz.* plant height, dry weight, crop growth rate (CGR) and relative growth rate (RGR). Post-harvest observation *viz.* number of cobs per plant, number of grains per cob, length of cob, diameter of cob, test weight, seed yield, straw yield and harvest Index were also recorded. In addition to pre and post-harvest observation were also studied to find out the best treatment combination for higher yield of maize.

Table 1: Impact of organic manures, zinc and boron on growth parameters of maize

S. No.	Treatment Combinations	Plant height (cm) At 80DAS	Dry matter (g) At 80 DAS	Crop growth rate ($g/m^2/day$) At 40-60 DAS	Relative growth rate(g/g/day) At 20-40 DAS
1.	Control (120 kg N/ ha: 60kg P_2O_5/ ha: 60kg K_2O /ha.)	152.33	135.60	31.45	0.1085
2.	Vermicompost- 3.3 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha	190.97	160.44	36.88	0.1005
3.	Vermicompost- 3.3 t/ha + Urea- 130.5 kg/ha + Boron- 0.5 kg/ha	185.63	157.93	36.14	0.1025
4.	Vermicompost- 3.3 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha + Boron- 0.5 kg/ha	201.53	162.50	37.24	0.1000
5.	Neem cake- 1.154 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha	175.87	151.60	34.95	0.1020
6.	Neem cake- 1.154 t/ha + Urea- 130.5 kg/ha + Boron- 0.5 kg/ha	171.60	139.70	32.21	0.1025
7.	Neem cake- 1.154 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha + Boron- 0.5 kg/ha	181.17	156.23	36.19	0.1005
8.	Vermicompost- 1.66 t/ha + Neem cake- 0.57 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha	204.93	171.23	39.15	0.0980
9.	Vermicompost- 1.66 t/ha + Neem cake- 0.57 t/ha + Urea- 130.5 kg/ha + Boron- 0.5 kg/ha	203.07	168.80	38.58	0.1000
10.	Vermicompost- 1.66 t/ha + Neem cake- 0.57 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha + Boron- 0.5 kg/ha	207.20	179.52	41.38	0.0980
	F-test	S	S	S	NS
	SEm±	0.91	1.07	1.38	0.0021
	CD (P= 0.05)	2.70	3.19	4.11	-

Table 2: Impact of organic manures, zinc and boron on yield attributes of maize

S. No.	Treatment combinations	Number of cobs per plant	Length of Cob (cm)	Diameter of cob (cm)	Number of grains per cob	Test weight (g)
1.	Control (120 kg N/ ha: 60kg P_2O_5/ ha: 60kg K_2O /ha.)	1.20	12.99	11.73	262.42	237.71
2.	Vermicompost- 3.3 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha	1.53	15.90	11.93	310.55	248.32
3.	Vermicompost- 3.3 t/ha + Urea- 130.5 kg/ha + Boron- 0.5 kg/ha	1.47	15.47	11.90	297.49	244.58
4.	Vermicompost- 3.3 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha + Boron- 0.5 kg/ha	1.60	16.39	11.97	322.95	249.65
5.	Neem cake- 1.154 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha	1.33	14.78	11.83	289.62	242.80
6.	Neem cake- 1.154 t/ha + Urea- 130.5 kg/ha + Boron- 0.5 kg/ha	1.27	14.05	11.80	287.89	241.67
7.	Neem cake- 1.154 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha + Boron- 0.5 kg/ha	1.43	15.15	11.87	296.68	243.62
8.	Vermicompost- 1.66 t/ha + Neem cake- 0.57 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha	1.73	16.77	12.33	352.69	252.00
9.	Vermicompost- 1.66 t/ha + Neem cake- 0.57 t/ha + Urea- 130.5 kg/ha + Boron- 0.5 kg/ha	1.67	16.50	12.30	337.62	250.37
10.	Vermicompost- 1.66 t/ha + Neem cake- 0.57 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha + Boron- 0.5 kg/ha	1.80	17.43	12.37	358.27	254.16
	F-test	S	S	NS	S	NS
	SEm±	0.06	0.39	0.22	10.25	3.63
	CD (P= 0.05)	0.18	1.17	-	30.47	-

Table 3: Impact of orgainc manures, zine and boron on yield of maize

S. No.	Treatment combinations	Grain yield (t/ha)	Straw yield (t/ha)	Harvest Index (%)
1.	Control (120 kg N/ ha: 60kg P_2O_5/ ha: 60kg K_2O /ha.)	5.00	12.50	28.57
2.	Vermicompost- 3.3 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha	8.70	19.20	31.16
3.	Vermicompost- 3.3 t/ha + Urea- 130.5 kg/ha + Boron- 0.5 kg/ha	8.63	19.80	30.35
4.	Vermicompost- 3.3 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha + Boron- 0.5 kg/ha	8.70	19.50	30.83
5.	Neem cake- 1.154 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha	8.37	18.63	30.77
6.	Neem cake- 1.154 t/ha + Urea- 130.5 kg/ha + Boron- 0.5 kg/ha	8.23	18.77	30.46
7.	Neem cake- 1.154 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha + Boron- 0.5 kg/ha	8.53	20.10	29.79
8.	Vermicompost- 1.66 t/ha + Neem cake- 0.57 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha	9.47	20.97	31.11
9.	Vermicompost- 1.66 t/ha + Neem cake- 0.57 t/ha + Urea- 130.5 kg/ha + Boron- 0.5 kg/ha	9.03	21.00	30.06
10.	Vermicompost- 1.66 t/ha + Neem cake- 0.57 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha + Boron- 0.5 kg/ha	9.73	21.20	31.45
	F-test	S	S	S
	SEm±	0.43	0.42	0.53
	CD (P= 0.05)	1.26	1.25	1.58

Result and Discussion

Growth and yield attributes *viz*. plant height, dry weight, crop growth rate, number of cobs per plant, number of grains per cob, length of cob, grain yield, straw yield and harvest index increased significantly in treatment 10 with application of Vermicompost- 1.66 t/ha + Neem cake-0.57 t/ha + Urea-130.5 kg/ha + Zinc- 5 kg/ha + Boron- 0.5 kg/ha. The maximum plant height (207.20 cm) at 80 DAS, maximum dry weight (179.52 g) at 80 DAS, maximum crop growth rate (41.38 g/m2/day) at 40-60 DAS, maximum number of cobs per plant (1.80), maximum number of grains per cob (358.27), maximum length of cob (17.43 cm), maximum grain yield (9.73 t/ha), maximum straw yield (21.20 t/ha) and maximum harvest index (31.45) were recorded in treatment 10 with application of Vermicompost- 1.66 t/ha + Neem cake- 0.57 t/ha + Urea- 130.5 kg/ha+ Zinc- 5 kg/ha + Boron- 0.5 kg/ha. However, maximum diameter of cob (12.37 cm) and maximum test weight (254.16 g) were found to be non-significant in treatment 10 with application of Vermicompost-1.66 t/ha + Neem cake- 0.57 t/ha + Urea- 130.5 kg/ha + Zinc-5 kg/ha + Boron- 0.5 kg/ha. This result obtained might be due to application of zinc along with recommended dose of fertilizer may be responsible for the availability of nitrogen which resulted in increased growth parameters, which increased the dry matter accumulation. These findings are in relevance with the findings of Tetarwal *et al.* (2011) [25]. Similar results were also reported by Adiloglu *et al.* (2005) [1]. The increase in plant height may be the balanced application of Zn along with NPK fertilizer, as many researchers state that zinc is involved in a number of physiological processes of plant growth and metabolism. The favourable effect of application of zinc on plant height and other growth attributes may be ascribed to its stimulatory effect on most of the physiological and metabolic processes of plant (Panneerselvam and Stalin 2014) [22]. The increase in number of grains might be larger cob size, proper pollination, translocation of sugars and starch by zinc fertilizer application. These finding are similar with the findings of Raskar *et al.* (2012) [24]. Further, the involvement of zinc in various enzymatic processes helps in catalysing reaction for growth leading to development of more yield attributing character. The findings were in close conformity with Jakhar *et al.* (2006) [8]. The increase supply of nitrogen and their higher uptake by plants might have stimulated the rate of various physiological processes in plant and leads to increased growth parameters, yield attributes and yield. The enhanced growth with nitrogen has also been reported by Sofi *et al.* (2004) [20]. Further, the increase in grain yield might be better growth and yield attributing character with zinc fertilization. Similar findings have been reported by Meena *et al.* (2013) [12].

Conclusion

It is concluded from the experimental finding that the treatment 10 with application of Vermicompost- 1.66 t/ha + Neem cake- 0.57 t/ha + Urea- 130.5 kg/ha + Zinc- 5 kg/ha + Boron- 0.5 kg/ha was found more productive and can be adopted by the farmers for getting maximum yield and returns from maize crop as compared to other treatment combination.

References

1. Adiloglu S, Saglam MJ. The effect of increasing nitrogen doses on zinc content of maize plant in soils of different properties. Pak. J Bio. Sci. 2005;8:905-909.
2. Cheifetz S, Li IWS, McCulloch CAG, Sampath K, Sodek J. Influence of Osteogenic Protein-1 (OP-l; BMP-7) and Transforming Growth Factor-βl on Bone Formation *in vitro*. Connective tissue research. 1996;35(1-4):71-78.
3. De Candolle AP. Origin of cultivated plants (2nd edition). Hafner Publishing Co., New York, 1986.
4. Gee GW, Bauder JW. Particle-size analysis, hydrometer method. In: Klute, A. (Ed.), Methods of Soil Analysis, Part I, 3rd Ed., Am. Soc. Agron., Madison. WI. 1986, pp. 404- 408.
5. Gene Y, McDonald GK, Graham RD. Contribution of different mechanisms to zinc efficiency in bread wheat during early vegetative stage. Plant Soil. 2006;281:353–367.
6. George R, Schmitt M. Zinc for Crop Production. Regents of the University of Minnesota, 2002.
7. Gupta UC, Jame YW, Campbell CA, Leyshon AJ, Nicholaichuk W. Boron toxicity and deficiency: Are view. Canadian Journal of Soil Science. 1985;65:381-409.
8. Jakhar SR, Singh M, Balap CM. Effect of farmyard manure, phosphorus zinc levels on growth, yield, quality and economics of pearl millet (*Pennisetum glaucum*) Indian J Agric. Sci. 2006;76(1):58-61.

9. Jacobson M. The neem tree: natural resistence par excellence. In natural resistence of plants to insects (M.B. Green and P.A. Hedin, Eds) (Washington, DC: American Chemical Society), 1986, pp. 220-232.
10. Kumar R, Kamra DN, Neeta Agarwal, Chaudhary LC. *In vitro* methanogenesis and fermentation of feeds containing oil seed cakes with rumen liquor of buffalo. Asian-Aust. J Anim. Sci. 2007;20(8):1196-1200
11. Mattiello EM, Ruiz HA, Neves JCL, Ventrella MC, Araújo WL. Zinc deficiency affects physiological and anatomical characteristics in maize leaves. J Plant Physiol. 183, 138-143. Annals of Agri-Bio Research. 2013;18(2):176-181.
12. Meena BP, Kumar A, Meena SR, Dhar S, Rana DS, Rana KS. Effect of sources and levels of nutrients ongrowth and yield behavior of pop corn (*Zea mays*) and potato (*Solanum tuberosum*) sequence. Indian Journal of Agronomy. 2013;58(4):474-479.
13. Rathier TM, Frink CR. Nitrate in runoff water from container grown juniper and albertam spruce under different irrigation and N fertilization regimes. J Environ Horticul. 1989;7(1):32-35.
14. Ramasamy PK, Suresh SN. Effect of vermicompost on root numbers and length of sunflower plant. J of pure and applied microbiology. 2011;4(1):297-302.
15. Reeves DW. Cover Crops and Rotations. In: Hatfield, J.L. and Stewart, B.A., Eds., Crops Residue Management. Advances in Soil Science, Lewis Publishers, Boca Raton, 1994, 125-172.
16. Saxena RC. IRRI research on neem products. Tropical pest management. 1988;43:438
17. Schmutterer H, Ascher KRS. Natural pesticides from the neem tree and tropical Plants. Proceedings of the second international neem conference, Rottach-egern. Federal Republic of Germany, 1983-1984 May.
18. Schmutterer H, Ascher KRS, Schmutterer H, Ascher KRS. Natural pesticides from the neem tree and tropical Plants. Proceedings of the first international neem conference Rottach-egern. Federal Republic of Germany, 16-18 June 1980, 1982.
19. Shorrocks VM. The occurrence and correction of boron deficiency. Plant and Soil. 1997;193:121-148.
20. Sofi KA, Sharma DP, Thomas T. Effect of nitrogen and potassium nutrition on yield, nutrient uptake and soil fertility of maize) under rain fed condition of Uttar Pradesh, Environ. Ecol. 2004;22(3):483-485.
21. Srivastava RK, Beohar PA. Vermicompost as an organic manure. A good substitute of fertilizers. J Curr. Sci. 2004;5:141-143.
22. Panneerselvam SP, Stalin P. Response of maize to soil applied zinc fertilizer under varying available zinc status of soil. Indian Journal of Science and Technology. 2014;7(7):939944.
23. Ravi N, Basavarajappa R, Chandrashekar CP, Harlapur SI, Hosamani MH, Rengel Z, *et al*. Importance of seed Zn content for wheat growth on Zn-deficient soil. Plant Soil. 1995;173:259–266.
24. Raskar SS, Sonani VV, Shelke AV. Effects of different levels of nitrogen, phosphorus and zinc on yield and yield attributes of maize (*Zea mays* L.). Advanced research journal of crop improvement, 2012, 3(2).
25. Tetarwal JP, Ram B, Meena DS. Effect of integrated nutrient management on productivity, profitability, nutrient uptake and soil fertility in rainfed maize. Ind. J Agron. 2011;56(4):373-376.
26. Vitosh ML, Warneke DD, Lucas RE. Boron. Mishigan State University Extension Soil and Managemnt Fertilizer, 1997. Available on the htpp://www.Msue.msu.EDV.