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Effect of vermicompost and zinc application on yield and profitability of greengram (*Vigna radiata* L.) crop grown under loamy sand soil

Anita Todawat and SR Sharma

Abstract
The effect of vermicompost and zinc levels on yield and economics of greengram (*Vigna radiata* L.) grown under loamy sand soil of Rajasthan. A field experiment was undertaken during *Kharif* 2016 at Agronomy Farm, S. K. N. College of Agriculture, Jobner, Jaipur (Rajasthan). The treatments comprised of four levels of vermicompost (VC) i.e. control, VC @ 2.5, 5.0 and 7.5 t ha^{-1} and four levels of zinc application i.e. control, 2.0, 4.0 and 6.0 kg Zn ha^{-1}.The experiment was laid out in a factorial randomized block design with three replications. The increasing levels of vermicompost and zinc up to 5.0 t ha^{-1} and 4.0 kg Zn ha^{-1}, respectively increased significantly (P=0.05) the grain and straw yield of greengram. However, the combined application of vermicompost @ 7.5 t ha^{-1} and 6.0 kg Zn ha^{-1} was found to record significantly higher net return (57836 ₹ ha^{-1}) of greengram.

Keywords: Vermicompost, zinc, profitability, greengram, *Vigna radiata* L.

Introduction
Pulses are important sources of protein in the diets of a large section of vegetarian population in the developing countries in general and India in particular among the many cultivated legumes, green gram is the most important rainfed pulse crop grown on marginal lands. Optimum nutrition is required for getting maximum grain yield and good quality of the grain. India is one of the largest producer as well as consumer of a wide variety of pulses that is dominated by the tropical and sub-tropical crops such as chickpea, blackgram, pigeon pea, greengram and lentil. In India, total pulses are grown on 28.34 million ha area with a production of 25.75 million metric tonnes and an average productivity of 817 kg ha^{-1} (FAI, 2020-21) [4]. Greengram is a rainfed crop predominantly grown in *kharif* in the state of Rajasthan. In Rajasthan, greengram occupy 2.46 lakh ha area with a production of 1.22 lakh tonnes. However, productivity (495 kg ha^{-1}) of greengram is low in Rajasthan (FAI, 2020-21) [4]. One of the important reasons of low productivity is poor fertility of soil. The problem is compounded by the fact that the majority of the farmers in rainfed areas are resource poor with low risk bearing capacity and they generally do not apply recommended dose of fertilizers, either through organic or inorganic sources. Hence, there is an urgent need for the evaluation of appropriate nutrient management practices for enhancing greengram productivity.

Integrated use of fertilizer with various organic sources is reported to sustain higher crop productivity, soil quality, as well as soil productivity (Kusro *et al*., 2014) [6]. The decline in soil organic matter due to lack of recycling enough crop or animal residues, coupled with insufficient nutrient applications often led to impaired soil health and declining factor productivity. The effect of physical and chemical degradation of soils are quite obvious, but biological degradation due to loss of specific soil organic matter fractions and the 'autochthonous microbial communities' dependent upon them is insidious (Rao, 2007) [11]. Use of vermicompost for enhancing crop productivity and improving soil health is gaining popularity among the farming community. Vermicompost enhances soil biodiversity by promoting beneficial microbes, which in turn enhances plant growth directly by production of plant growth regulating substances (hormones and enzymes) and indirectly by controlling plant pathogens, nematodes and other pests, thereby enhancing plant health and minimizing the yield loss (Pathama and Sakthivel, 2012) [10].

Vermicompost is also reported to contain plant nutrients in the readily available form (Edwards and Burrows, 1988) [3] and the presence of biologically active substance such as plant growth regulators (Tomati *et al*., 1987) [17]. Sinha *et al*. (2009) [15] reported that vermicompost can significantly influence the growth and productivity of plants due to their micro and macro elements, vitamins, enzymes, hormones etc.

Shukla *et al*. (2021) [13] reported that 36.5, 23.2, 13, 12.8, 7.1 and 4.2% soils of India are deficient in zinc, boron, molybdenum, iron, manganese and copper, respectively. Zinc is one of the essential micronutrient and plays an important role in various enzymatic and physiological activities of the plant. It is also essential for photosynthesis and nitrogen metabolism and important for the stability of cytoplasmic ribosome's, cell division, as co factor to enzymes like dehydrogenase, proteinase and peptidase in the synthesis of tryptophan, a component of some proteins and a compound needed for production of growth hormones (auxin) such as indole acetic acid. Most of the soils of Rajasthan have been found deficient in zinc and assigned low availability of zinc in light textured soils with medium organic carbon content (Singh and singh, 1981) [14].

Materials and Methods

Experimental site: The experiment was conducted during *Kharif* 2016 at the Agronomy Farm, S. K. N. College of Agriculture, Jobner, Jaipur situated at an altitude of 427 metres above mean sea level and at $26^{0}05'$ latitude and $75^{0}28'$ longitude. The region falls under agro-climatic zone-IIIa (Semi Arid Eastern Plain) of Rajasthan.

Experimental soil: Soil of the experiment was loamy sand in texture, saline in reaction (8.10+0.11), normal in electrical conductivity (0.90+0.02 dSm^{-1}), medium in organic carbon (0.18+0.01%), low in available N (136.60+4.45 kg ha^{-1}), P (17.50+0.30 kg ha^{-1}), medium in available K (149.50+4.10 kg ha^{-1}) and low in available zinc (0.430+0.010 mg kg^{-1}).

Experimental design and treatments: The experiment was laid out in factorial randomized block and replicated thrice in the plot size of 4.0 m x 3.0 m (12 m^2). The treatments comprised of four levels of vermicompost *viz*., control, 2.0, 5.0 and 7.5 t ha^{-1} and four levels of zinc application *viz*., control, 2.0, 4.0 and 6.0 Zn ha^{-1}. The greengram var. SML-668 was sown in lines 30 cm apart. As per the treatments, whole quantity of VC was broadcasted and incorporated in to the soil at the time of sowing. there commended dose of nitrogen (20 kg ha^{-1}) was applied in two equal splits, the half as basal and the remaining half was top dressed at the time of first irrigation. The basal dose was applied through urea after adjusting the quantity supplied through diammonium phosphate. The whole quantity of phosphorus (30 kg ha^{-1}) through diammonium phosphate and potassium (10 kg ha^{-1}) through muriate of potash and zinc through $ZnSO_4.7H_2O$ was drilled as basal dose at 8-10 cm depth along with half dose of nitrogen prior to sowing.

Observations recorded: The observations on yield character were recorded as per the standard method. The clean grain obtained from individual plots was weighed and the weight recorded as grain yield in terms of kg ha^{-1}. The data obtained from various characters under study were analyzed by the method of analysis of variance as described by Panse and Sukhatme (1985) [9].

Economics of treatments: The economics of treatments is the most important consideration making any recommendation to the farmers for its wide adoption. For calculation of economics, the average treatment yield along with prevailing market rates for inputs and outputs were used. Hence, to evaluate the effectiveness and profitability of the treatments comprehensive economics including net returns (₹ ha^{-1}) was calculated so that most effective and remunerative treatment could be recommended.

Statistical analysis: The data recorded for different parameters were analyzed with the help of analysis of variance (ANOVA) technique for a factorial randomized block design. The results are presented at 5% level of significance (P=0.05).

Results and Discussion

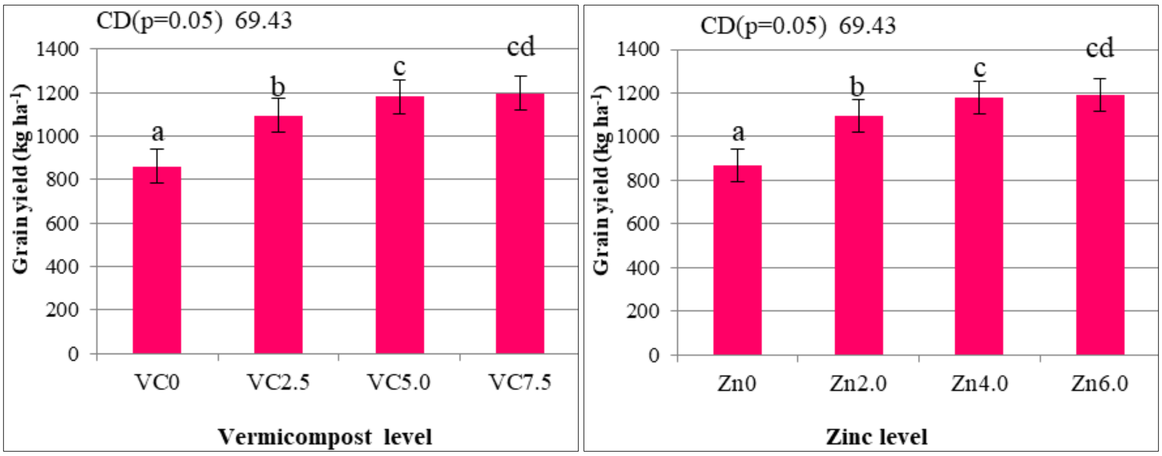
Yields

Effect of vermicompost

The significant increase in grain and straw yield under the influence of vermicompost was largely a function of improved growth and yield attributes (Table 1 and Figure 1). The significantly maximum increase in grain yield (1197.27 kg ha^{-1}) and straw yield (2968.34 kg ha^{-1}) was recorded under $VC_{7.5}$ followed by $VC_{5.0}$ and $VC_{2.5}$ treatments as compared to control respectively. However, the increase was significant upto $VC_{5.0}$ which was also found to be statistically at par with $VC_{7.5}$. The application of vermicompost @ 7.5 t ha^{-1} recorded the maximum value of these parameters. However, the increase was significant upto VC_2 which was also found to be statistically at par with VC_3. The increase in yield due to addition of vermicompost might be the result of overall improvement in soil physico-chemical properties of soil due to decrease in bulk density, pH, electrical conductivity and increase in particle density, porosity, water holding capacity and cation exchange capacity (Biswas, 2011) [1]. The beneficial response of vermicompost to yield attributes and yield might also be attributed to the availability of sufficient amounts of plant nutrients throughout the growth period and especially at critical growth periods of crops resulting in better uptake, plant vigour and superior yield attributes. The higher availability of nutrients in soil due to vermicompost application during seed development might have retarded senescence and resulted in large filling period for greater seed, stover and biological yield (Biswas and Narayansamy, 2006) [1]. The interrelationship between various yields attributes of the crop and its grain and straw and biological yield had also been observed by Biswas (2011) [1] and Meena *et al*. (2021) [8].

Effect of zinc

The grain and straw yield were also significantly increased by the application of zinc (Table 1 and Figure 2). The significantly maximum grain yield (1192.10 kg ha^{-1}) and straw yield (2941.89 kg ha^{-1}) was recorded under Zn_6 followed by Zn_4 and Zn_2 treatments as compared to control (Zn_0), respectively. However, the increase was significant upto Zn_4 which was also found to be statistically at par with Zn_6. The favourable influence of applied zinc on grain and straw yield may be due to catalytic or stimulatory effect of zinc on most of the physiological and metabolic processes of plants. The increase in grain and straw yield with zinc fertilizer application might be due to the fact that zinc plays an important role in biosynthesis of indole acetic acid and initiation of primordial for reproductive part which have favored the metabolic reaction within plant (Tak *et al.*, 2014) [16]. The increase in the yield due to zinc application may be attributed to the fact that the initial status of available zinc in the experimental soil was low. The increase in yield attributes may be due to increased supply of available zinc to plants by way of its addition to soil which resulted in proper growth and development. The significant increase in straw yield due to zinc fertilization could be attributed to the increased plant growth and biomass production, possibly as a result of the uptake of nutrients (Mahilane and Singh, 2018) [7].

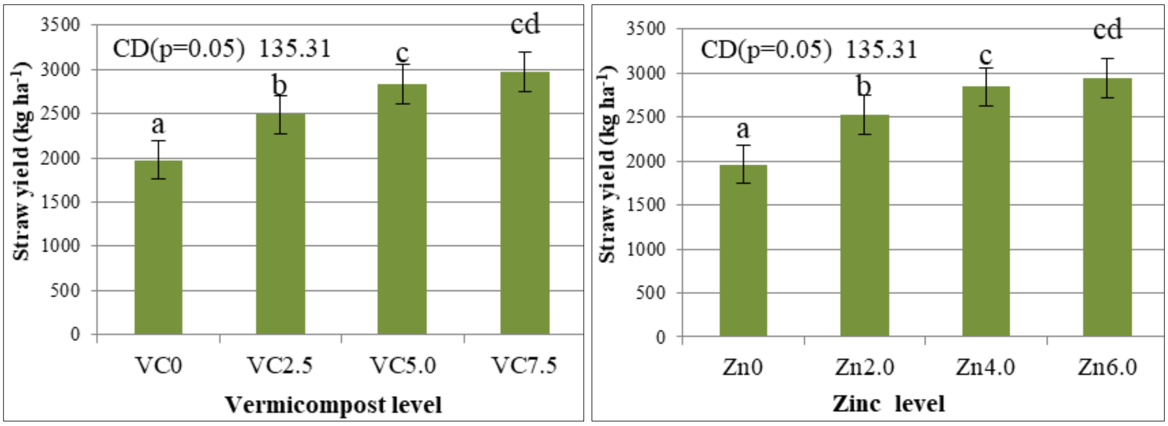


A B

Fig 1: Effect of A) VC and B) zinc application on grain yield of greengram

*Error bars indicates the standard error of mean

**Columns marked with same letters are statistically similar at p=0.05



A B

Fig 2: Effect of A) VC and B) zinc application on straw yield of greengram

*Error bars indicates the standard error of mean

**Columns marked with same letters are statistically similar at p=0.05

Table 1: Effect of vermicompost and zinc on grain and straw yield of greengram

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
Vermicompost levels (t ha^{-1})		
Control (VC_0)	862.18	1977.72
2.5 ($VC_{2.5}$)	1095.26	2487.74
5.0 ($VC_{5.0}$)	1182.17	2839.47
7.5 ($VC_{7.5}$)	1197.27	2968.34
S.Em+	24.04	46.85
CD (P=0.05)	69.43	135.31
Zinc levels (kg ha^{-1})		
Control (Zn_0)	868.08	1962.74
2 (Zn_2)	1098.03	2524.43
4 (Zn_4)	1178.67	2844.19
6 (Zn_6)	1192.10	2941.89
S.Em+	24.04	46.85
CD (P=0.05)	69.43	135.31

Economics (Net returns)

Effect of vermicompost

The perusal of data in Table 2 and Figure 3 revealed that net returns increased significantly with increasing levels of vermicompost. The significantly maximum net return (49046 ₹ ha^{-1}) was observed under the treatment $VC_{5.0}$ (vermicompost @ 5.0 t ha^{-1}) and minimum (39606 ₹ ha^{-1}) under control (VC_0). However, the difference between $VC_{2.5}$ & $VC_{5.0}$ and $VC_{2.5}$ and $VC_{7.5}$ treatments was also found to be statistically at par. The increase in net returns was obtained to the extent of 22.16, 23.83 and 14.25 per cent with the application of vermicompost @ 2.5, 5.0 and 7.5 t ha^{-1}, respectively as compared to control (VC_0). The application of 7.5 t vermicompost ha^{-1} to greengram crop significantly enhanced the net returns which was mainly due to increase in grain yield of greengram owing to enhanced nutritional environment of soil (Sharma *et al*., 2017) [12].

Effect of zinc

A critical examination of data in Table 2 and Figure 3 revealed that the effect of zinc on net returns was found significant. The application of zinc significantly increased the net returns as compared to control. The significantly maximum net returns was obtained under the treatment Zn_6 (51495 ₹ ha^{-1}) and the minimum under Zn_0 (33264 ₹ ha^{-1}). However, the increase was significant upto Zn_4 which was also found to be statistically at par with Zn_6. The treatment Zn_2, Zn_4 and Zn_6 increased the net returns to the extent of 39.63, 53.55 and 54.80 per cent, respectively as compared to control (Zn_0). The application of zinc also significantly increased the net returns of greengram as compared to control. The net returns significantly increased due to consequence of increase in grain and straw yield (Meena *et al*., 2021) [8].

Table 2: Effect of vermicompost and zinc on net returns of greengram

Treatments	Net returns (₹ ha^{-1})
Vermicompost levels (t ha^{-1})	
Control (VC_0)	39606
2.5 ($VC_{2.5}$)	48384
5.0 ($VC_{5.0}$)	49046
7.5 ($VC_{7.5}$)	45250
S.Em+	1304
CD (P=0.05)	3766
Zinc levels (kg ha^{-1})	
Control (Zn_0)	33264
2 (Zn_2)	46447
4 (Zn_4)	51079
6 (Zn_6)	51495
S.Em+	1304
CD (P=0.05)	3766

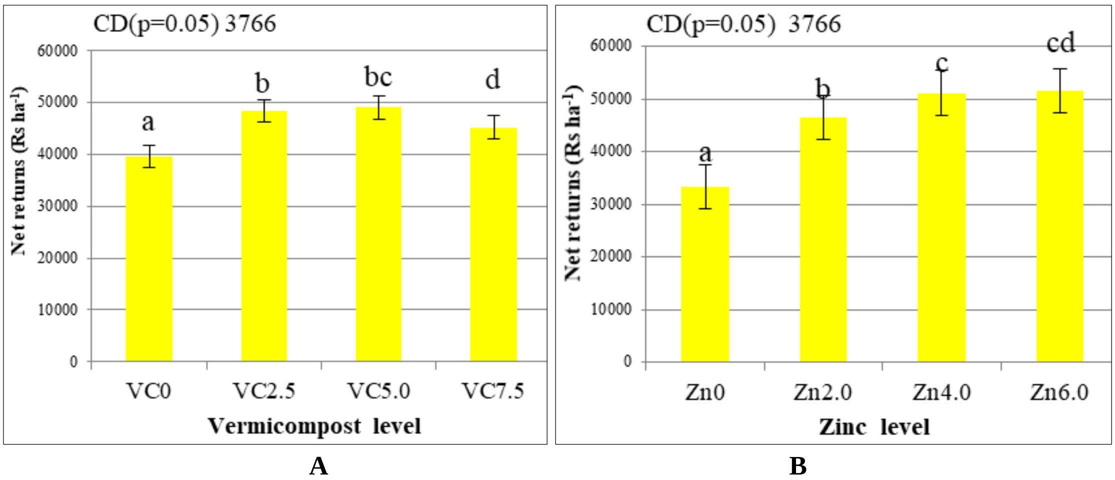


Fig 3: Effect of A) VC and B) zinc application on net returns of greengram
*Error bars indicates the standard error of mean
**Columns marked with same letters are statistically similar at p=0.05

Interactive effect of vermicompost and zinc on net returns

The data presented in Table 3 and Figure 4 revealed that the interactive effect of vermicompost and zinc on net return of greengram crop. The net returns of greengram increased with increasing levels of zinc under all the levels of vermicompost except $VC_{7.5}$ over $VC_{5.0}$ and $VC_{2.5}$ under Zn_2, Zn_4 and Zn_6 levels of zinc. However, the difference between Zn_4 & Zn_6 under all the levels of vermicompost was found to be significantly at par. Irrespective of zinc the increasing level of vermicompost increased the net returns significantly. The highest net returns (57836 ₹ ha^{-1}) of greengram were obtained with combined use of 7.5 t vermicompost ha^{-1} + Zn @ 6 kg ha^{-1} which was significantly higher as compared to other treatment combinations (Table 3). It is obvious because the grain yield of greengram also increased significantly under this treatment which is main contributor to net returns and thus resulted in higher net returns under application of 7.5 t vermicompost ha^{-1} + Zn @ 6 kg ha^{-1} (Jat *et al*., 2015).

Table 3: Interactive effect of vermicompost and zinc on net returns (₹ ha^{-1}) of greengram

Treatments	VC_0	$VC_{2.5}$	$VC_{5.0}$	$VC_{7.5}$
Zn_0	32443	40225	38766	21619
Zn_2	40220	48607	49075	47884
Zn_4	43646	53057	53953	53659
Zn_6	42112	51644	54388	57836
S.Em±		2607		
CD (P=0.05)		7532		

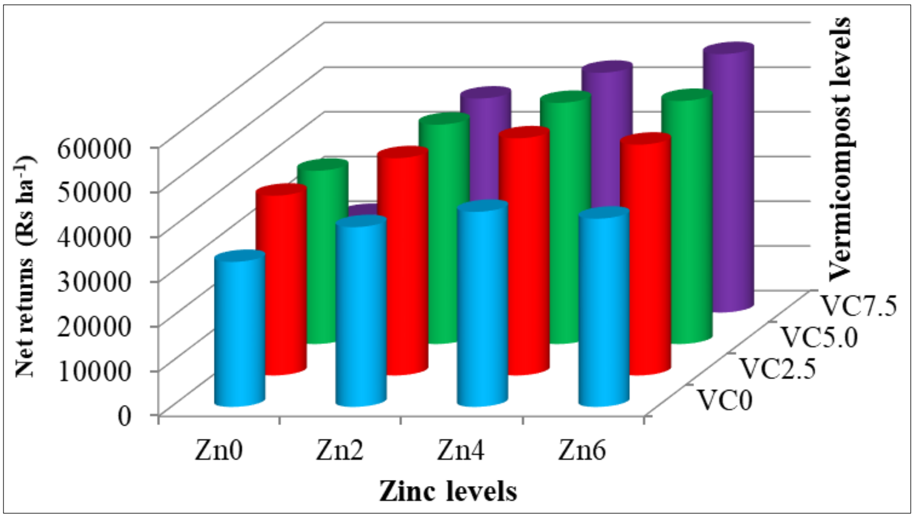


Fig 4: Interactive effect of vermicompost and zinc on net returns (₹ ha^{-1}) of greengram

Conclusion

On the basis of experimental finding, it can be concluded that the application of vermicompost @ 5.0 t and zinc @4.0 kg ha^{-1} along with the recommended dose of fertilizer results in significantly higher productivity and net returns of greengram under Typic Ustipsamment soil of Semi Arid Eastern Plain Region of Rajasthan.

References

1. Biswas DR. Nutrient recycling potential of rock phosphate and waste mica enriched compost on crop productivity and changes in soil fertility under potato-soybean cropping sequence in an Inceptisol of Indo-Gangetic Plains of India. Nutrient Cycling in Agroecosystems. 2011;89:15-30.
2. Biswas DR, Narayanasamy G. Rock phosphate enriched compost: an approach to improve low grade Indian rock phosphate. Bio-resource Technology. 2006;97:2243-2254.
3. Edwards CA, Burrows I. The potential of earthworm composts as plant growth media. In: Earthworms in Waste and Environmental Management (Eds.: C.A. Edwards and E. Neuhauser). SPB Academic Press, The Hague, the Netherlands. 1988, 21-32.
4. FAI. Fertiliser Statistics. The Fertiliser Association of India, New Delhi. 2020-21.
5. Jat G, Sharma KK, Choudhary R. Effect of FYM and mineral nutrients on yield, content and uptake of nutrients in mustard. Annals of Agricultural Research. 2015;34:236-240.
6. Kusro PS, Singh DP, Paikra MS, Kumar D. Effect of organic and inorganic additions on physicochemical propertiese in vertisol. American International Journal of Research in Formal, Applied & Natural Sciences. 2014;5:51-53.
7. Mahilane C, Singh V. Effect of zinc and molybdenum on growth, yield attributes, yield and protein in grain on summer blackgram (*Vigna mungo*). International Journal of Current Microbiology and Applied Science. 2018;7(1):1156-1162.
8. Meena M, Jat G, Meena RH, Sharma SK, Choudhary R, Yadav SK, *et al*. Effect of phospho enriched compost and zinc on soil properties and productivity of blackgram (*Vigna mungo*), Indian Journal of Agricultural Sciences. 2021;91(9):1333-6.
9. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. ICAR, New Delhi. 1985.
10. Pathama J, Sakthivel N. Microbial diversity of vermicompost bacterial that exhibit useful agricultural traits and waste management potential. Springer Plus. 2012;1:26.
11. Rao DLN. Microbial diversity, soil health and sustainability. Journal of the Indian Society of Soil Science. 2007;55:392-403.
12. Sharma JK, Jat G, Meena RH, Purohit HS, Choudhary RS. Effect of vermicompost and nutrients application on soil properties, yield and uptake and quality of Indian mustard. Annals of Plant and Soil Research. 2017;19(1):17-22.
13. Shukla AK, Behera SK, Prakash C, Patra AK, Rao Ch S, Chaudhari SK, *et al*. Assessing multi-micronutrients deficiency in agricultural soils of India. Sustainability. 2021;13:9136.
14. Singh M, Singh KS. Zinc and copper status of soil of Rajasthan. Annals of Arid Zone. 1981;20:77.
15. Sinha RK, Heart S, Valani D, Chauhan K. Vermiculture and sustainable agriculture. American-Eurasian Journal of Agricultural and Environmental Sciences. 2009;5:1-55.
16. Tak S, Sharma SK, Reager ML. Effect of vermicompost and zinc on yield attributes, yield and quality of Greengram [*Vigna radiate* (L.) Wilezek] in arid Rajasthan. International Journal of Agricultural Science. 2014;10(1):138-141.
17. Tomati U, Grappelli A, Galli E. The presence of growth regulators in earthworm-worked wastes. In: Proceeding of International symposium on Earthwarms (Eds.: A.M. Bonvicini Paglioi and P. Omodeo). Modena, Italy. 1987, 423-436.