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Comparative Study of Zinc and Boron Nano-fertilizer with Conventional fertilizer on Nutrient Status of Soil in Lentil Crop (*Lens culinaris* Medik.) cv. K-75

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ABSTRACT: Farmers all around world are challenged with the onerous task of feeding increasing mouths every year from agricultural lands that are shrinking as a result of global population growth and rising urbanisation. Considering, land and water supplies are limited, agriculture can only flourish with increasing productivity through the skillful application of modern technologies. As a result, the demand for nano-fertilizer is steadily increasing as it improves nutrient utilisation efficiency. It has a large surface area, holds a lot of nutrients, and minimizes the need for conventional fertilizer. Thus, agricultural plant productivity improves. Micronutrients are necessary for plant growth and yield; even if they are only required in little amounts. The purpose of this study was to compare the effects of nano zinc and boron fertilizer to conventional fertilizer on soil nutrient status in lentil crops. The experiment consisted of 9 treatment combinations which were replicated thrice and laid out in a simple RBD of three levels of conventional fertilizer (0% Zn B, 50% Zn B and 100% Zn B) and foliar spray of nano- Zn and B chelate fertilizer at three concentrations (0, 60 and 120 mg Zn L^{-1}) and (0, 3.25 and 6.5 mg B L^{-1}) respectively. The results showed that progressive decrease in bulk density (Mg m^{-3}), particle density (Mg m^{-3}) and pH as depth increases, % of pore space, Water retaining capacity (%), EC (dS m^{-1}), Organic Carbon (%), Available Nitrogen (kgha^{-1}), Available Phosphorus (kgha^{-1}). Available Potassium (kg ha^{-1}), Available Zn (mg kg^{-1}) and Available B (mg kg^{-1}) increases with decreasing depth. From the result it can be concluded that treatment T_9 (Zn+B 100%, Nano Zn+B 100% 20Kg Zn+1.6 Kg B ha^{-1} Nano 120 mg L^{-1} Zn+ 6.5 B mg L^{-1}) was found the best treatment combinations.

Keywords: Soil physico-chemical properties, Nano-fertilizer, Zinc, Boron and Lentil.

INTRODUCTION

Pulses are one of the most sustainable crops sources of protein, fibre and various vitamins in the Indian diets as majority of population is vegetarian. Lentil (*Lens culinaris* Medik.) is one of the important *Rabi* pulses, which is equally oldest and the most nutritious also. Lentil seed is high in vital vitamins, minerals, and soluble and insoluble dietary fibre, and comprises 25% protein, 1.1 percent fat, and 59 percent carbohydrate (Faris *et al.*, 2013). Every year, the world's population grows, and worldwide output must rise. But, due to urbanization, growth of industries the arable agricultural lands are decreasing globally (Sekhon, 2014). So that the majority of the fertile agricultural lands are occupied with cereal crops. One of the greatest obstacles to pulse production is a lack of effective management methods, which has resulted in constant micronutrient depletion owing to intensive cultivation (Fageria *et al.*, 2002). Therefore, adequate supply of macro and micro nutrients, proper management and care may play a significant role in boosting lentil production.

The genotypic potential of lentils, as well as their resilience to biotic and abiotic stressors has a significant impact on their output (Singh *et al.*, 2012). Micronutrients, in particular, were shown to have altered lentil development and yield (Zeidan *et al.*, 2006; Deo *et al.*, 2014). Though micronutrients are required in less quantity for plant growth and development but their deficiency may reduce growth and yield and also disturbance in physiological and metabolic pathways in the plant (Nadi *et al.*, 2013). Micronutrients influence the symbiotic nitrogen- fixing process and help in uptake of different plant nutrients, thus, increase the production.

Zinc is essential for plant metabolism and auxin, glucose, phosphate, and nucleic acid production (Latef *et al*., 2017). The deficiency of zinc causes some symptoms in pulses and so what in lentil crop too. It takes 5-6 weeks after sowing of the lentil crop to show deficiency symptoms which include the colour change of matured leaves from green to yellowish white starting, the severity of the deficiency results into the turning of leaflet brown and ultimately fall down, stunted growth of plants with poor pod formation (Singh *et al.*, 2015). Zinc is required for the production of proteins and nucleic acids, as well as the proper usage of nitrogen and phosphorus in plants. Several studies have found that alluvial soil in the Indo-gangetic plains is severely deficient in micronutrients, and that response to added minerals such as zinc and boron from lentils is beneficial (Singh and Bhatt 2013).

Boron is considered an important micronutrient for plant growth and development. Boron can affect the absorption of nitrogen, phosphorus, and potassium. Boron deficiency can cause sterility in plants by causing reproductive tissue distortion, which affects pollen germination and results in increased flower loss and reduction in fruit set (Subasinghe *et al.,* 2003).

Nano fertilizer is a new technology and a suitable substitution for traditional chemical fertilizer in agricultural practices; it can prevent soil and water pollution by gradual and controlled release of nutrients into the soil and subsequently on the plant (Naderi and Abedi, 2012; Sekhon, 2014). The nanostructured formulation may allow fertilisers to intelligently alter the rate at which nutrients are released to meet the crop's uptake pattern. Mineral micronutrients have a controlled release formulation due to their solubility and dispersion. Nano-sized mineral micronutrient formulations may improve insoluble nutrient solubility and dispersion in soil, minimise soil adsorption and fixation, and boost bio-availability, resulting in increased nutrient uptake efficiency. As a result, nano-fertilisers may improve production and nutrient content in edible sections while reducing their accumulation in the soil.

The impact of conventional Zn and B on lentil output and soil nutrient status has been studied in the past (Quddus *et al.,* 2014; Islam *et al.,* 2018). As a result, the study's goal is to look at the comparison effect of zinc and boron nano-fertilizer and conventional fertilizer on nutrient status of soil in Lentil crop.

MATERIALS AND METHODS

Experimental site: The experiment was carried out at SHUATS' Soil Science Research Farm, Allahabad (Prayagraj), which is located at 25°24′30″N latitude, 81°51′10″ E longitude and 98 metres above sea level (MSL) and is situated 6 km away on the right bank of Yamuna river, representing the Agro-Ecological Sub Region [North Alluvium plain zone (0-1% slope)] and Agro-Climatic Zone (Upper Gangetic Plain Region). Allahabad has sub tropical climate with extremes of summer and winter. Temperatures in the winter, particularly in December and January, can plummet to as low as 3-5°C, while in the summer (May-June), temperatures can reach 45-48°C. During the summer, scorching winds are a common occurrence, but frost may occur on occasion during the winter. The yearly rainfall is between 850 and 1100 mm, with most of it falling during the monsoon season (July to September), with a few showers thrown in throughout the winter months.

Soil: Soil samples were taken at random depths of 0-15 cm and 15-30 cm from the experimental plot after the crop was harvested using a soil auger and khurpi. With the use of a mallet, these soil samples were ground and blended. To prepare the sample for mechanical, physical, and chemical analysis, the volume of the soil sample was reduced by conning and quartering and then passed through a 2 mm sieve.

Experimental Design and Treatments: A randomised block design (RBD) was used for the experiment by taking zinc and boron nano-fertilizer and traditional zinc and boron chemical fertilizer with 3 (0, 50, 100 %) levels of each. The treatments were replicated into three times dividing the experimental area into twenty-seven plots. The plot size was 2m × 2m. The treatments were T_1 Control (Absolute control), T_2(Zn+B 50%, Nano Zn+B 0% 10kg Zn+0.8kg B ha^{-1}), T_3 (Zn+B 100%, Nano Zn+B 0% 20kg Zn +1.6 kg B ha^{-1}), T_4(Zn+B 0%, Nano Zn+B 50% Nano 60mg Zn+ 3.25mg B L^{-1}), T_5 (Zn+B 50%, Nano Zn+B 50% 10kg Zn +0.8 kg B ha^{-1} Nano 60mg Zn+ 3.25mg B L^{-1}), T_6 (Zn+B 100%, Nano Zn+B 50% 20kg Zn +1.6 kg B ha^{-1}Nano 60mg Zn+ 3.25mg B L^{-1}), T_7(Zn+B 0%, Nano Zn+B 100% Nano 120mg Zn+ 6.5mg BL^{-1}), T8 (Zn+B 50%, Nano Zn+B 100% 10kg Zn +0.8 kg B ha^{-1} Nano 120mg Zn+ 6.5mg B L^{-1}), T_9 (Zn+B 100%, Nano Zn+B 100% 20kg Zn +1.6 kg B ha^{-1} Nano 120mg Zn+ 6.5mg B L^{-1}). Foliar spraying by nano-fertilizers were done three times during the vegetative growth and flower development period of the plant (first spraying at 4 to 6 leaf stage, the second spraying at 30 days later from the beginning of flowering and third spraying during the pod filling).

Soil physical properties i.e. BD, PD, % Pore space and Water Retaining Capacity was determined by Graduated Measuring Cylinder (Muthuval *et al.,* 1992). In chemical properties, pH was determined by potentiometric method by making 1:2.5 soil water suspensions whereas a digital EC metre was used to determine the EC (Wilcox, 1950). The wet-oxidation method was used to evaluate organic carbon (Walkely and Black, 1947). The alkaline permanganate method was used to assess available nitrogen in an 800 mL kjeldahl flask (Subbiah and Asija, 1956). The amount of available phosphorus was calculated using a colorimetric technique and a spectrophotometer (Olsen *et al.*, 1954). The amount of available potassium was calculated using a flame photometer and neutral ammonium acetate solutions (Toth and Prince, 1949). Available Zinc and Boron was estimated by DTPA extraction by using Atomic Absorption Spectrophotometer (Lindsay and Norvell, 1978).

RESULT AND DISCUSSION

Various data analysis revealed that nano-fertilizer had a considerable impact on soil physico-chemical parameters. Tables 1, 2 and 3 provide the results of physico-chemical properties of soil.

From the results it can be seen that as the depth increases, the value of bulk and particle density and pH also increases whereas the value of % pore space, water holding capacity, organic carbon, nitrogen, phosphorus, potassium, zinc and boron decreases with increasing depth.

Table 1: Physical analysis of soil sample after harvesting of lentil crop at different depths.

Treatment	Bulk Density (Mgm^{-3})		Particle Density (Mgm^{-3})		Pore space (%)		Water holding capacity (%)	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1	**1.19**	**1.29**	**2.21**	**2.59**	**41.28**	**31.29**	**50.67**	**41.63**
T_2	1.17	1.26	2.20	2.57	44.31	32.31	51.86	44.38
T_3	1.16	1.25	2.18	2.56	46.65	30.08	52.67	45.72
T_4	1.14	1.23	2.15	2.53	47.75	33.48	54.54	46.54
T_5	1.12	1.20	2.12	2.52	49.56	36.59	56.42	48.11
T_6	1.13	1.21	2.14	2.52	50.74	38.86	57.47	48.88
T_7	1.15	1.24	2.17	2.54	48.67	34.59	55.47	46.82
T_8	1.13	1.23	2.14	2.53	50.30	38.49	57.15	48.36
T_9	**1.11**	**1.18**	**2.10**	**2.50**	**52.37**	**40.48**	**59.06**	**50.17**
F-test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
SE. d(+)	**0.011**	**0.018**	**0.012**	**0.020**	**0.521**	**1.158**	**0.861**	**0.707**
C.D. (P= 0.05)	**0.033**	**0.038**	**0.027**	**0.042**	**1.520**	**2.466**	**1.834**	**1.506**

Table 2: Chemical parameters of soil samples (pH, EC, and organic carbon) following lentil crop harvesting at various depths.

Treatments	pH		EC ($dS\ m^{-1}$)		Organic Carbon (%)	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1	**7.56**	**7.61**	**0.15**	**0.12**	**0.45**	**0.38**
T_2	7.43	7.59	0.16	0.14	0.47	0.40
T_3	7.41	7.52	0.18	0.16	0.50	0.43
T_4	7.33	7.45	0.20	0.17	0.54	0.47
T_5	7.21	7.36	0.20	0.18	0.59	0.52
T_6	7.37	7.49	0.23	0.20	0.65	0.59
T_7	7.40	7.52	0.20	0.19	0.57	0.49
T_8	7.34	7.47	0.24	0.21	0.61	0.55
T_9	**7.15**	**7.31**	**0.26**	**0.22**	**0.69**	**0.62**
F- test	**S**	**S**	**S**	**S**	**S**	**S**
SE. d(+)	**0.037**	**0.038**	**0.018**	**0.024**	**0.021**	**0.015**
CD at 5%	**0.079**	**0.081**	**0.038**	**0.052**	**0.045**	**0.033**

Table 3: Chemical parameters of soil samples after harvesting the lentil crop at various depths (available nitrogen, phosphorus, potassium, zinc and boron).

Treatments	Available Nitrogen ($kg\ ha^{-1}$)		Available Phosphorus ($kg\ ha^{-1}$)		Available Potassium ($kg\ ha^{-1}$)		Available Zinc ($mg\ kg^{-1}$)		Available Boron ($mg\ kg^{-1}$)	
	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1	**250.17**	**180.37**	**22.29**	**20.26**	**123.18**	**112**	**0.73**	**0.53**	**0.64**	**0.52**
T_2	258.29	183.07	24.38	23.23	126.15	118.31	0.80	0.63	0.82	0.62
T_3	263.11	185.10	23.54	21.52	133.17	122.41	0.93	0.70	0.90	0.73
T_4	269.07	188.20	23.45	21.30	142.40	130.20	0.83	0.68	0.89	0.67
T_5	280.18	193.14	26.56	24.80	145.54	134.33	1.03	0.86	0.93	0.80
T_6	292.04	196.26	30.53	28.35	175.44	160.8	1.23	0.90	1.25	0.87
T_7	273.12	190.16	25.36	24.19	157.41	141.38	1.00	0.83	0.21	0.76
T_8	286.13	195.15	28.35	27.31	187.45	169.52	1.30	0.90	1.31	0.91
T_9	**298.22**	**198.50**	**31.53**	**28.76**	**201.63**	**179.29**	**1.40**	**1.04**	**1.45**	**0.96**
F- test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
SE. d(+)	**1.645**	**1.651**	**2.073**	**1.822**	**1.960**	**1.971**	**0.081**	**0.067**	**0.034**	**0.060**
CD at 5%	**3.502**	**3.516**	**4.412**	**3.878**	**4.412**	**4.081**	**0.173**	**0.142**	**0.073**	**0.129**

A. Physical

Bulk density (Mgm^{-3}): The reaction in levels of conventional and nano-fertiliser, the bulk density of soil was shown to be considerable. In treatment T_1(control), the maximum bulk density of soil was 1.19 Mgm^{-3} at 0-15 cm and 1.29 Mg m^{-3} at 15-30 cm, respectively and minimum Bulk density of soil was recorded 1.11 Mgm^{-3} at depth 0-15cm and 1.18 Mgm^{-3} at depth 15-30cm in treatment T_9 (Fig. 1).

Particle density (Mgm^{-3}): The response of Particle density of soil was shown to be significant in levels of Conventional and Nano-fertilizer. The maximum Particle density of soil was recorded 2.21 Mgm^{-3} and 2.59 Mgm^{-3} at depth 0-15cm and 15-30 cm respectively in treatment T_1 (control) and minimum Particle density of soil was recorded 2.10 Mgm^{-3} and 2.50 Mgm^{-3} at depth 0-15cm and 15-30cm respectively in treatment T_9 (Fig. 1).

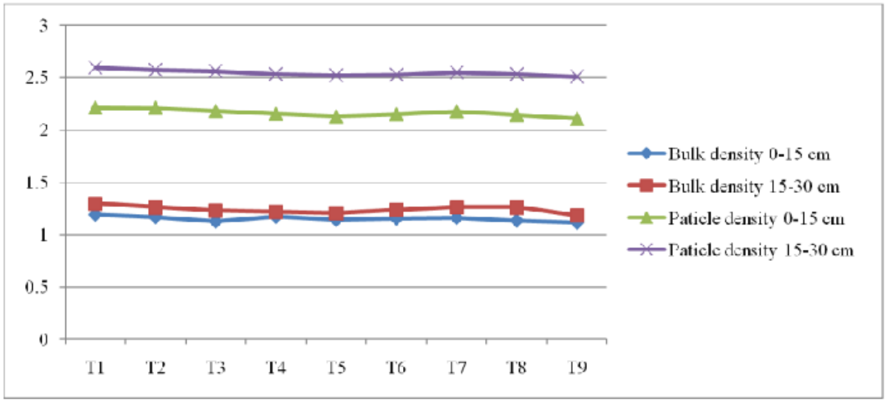

Fig. 1. Effect of Nano fertilizer Conventional fertilizer along withon Bulk Density and Particle Density (Mgm^{-3}) of soil after crop harvest.

Pore space (%): As bulk density increases, % pore space decreases. So the values of both % pore space was Treatment T_9 recorded maximum 52.37% and 40.48% at depth 0-15 cm and 15-30 cm respectively followed by 50.74% and 38.86% with T_6. T_1 (Control) recorded the minimum 41.28% at depth 0-15 cm and 31.29% at depth 15-30 cm.

Water retaining capacity (%): With decrease in bulk density water retaining capacity increases. Therefore, maximum water retaining capacity from treatment T_9 recorded maximum i.e. 59.06% and 50.17% at depth 0-15 cm and 15-30 cm respectively followed by 57.47% and 48.88% with T_6. T_1 (Control) recorded the minimum 50.67% at depth 0-15 cm and 41.63% at depth 15-30 cm.

B. Chemical

pH (1:2): The maximum pH of soil was obtained 7.56 and 7.61at 0-15cm and 15-30 cm respectively from treatment T_1 (control) and minimum pH of soil was recorded 7.15 at depth 0-15cm and 7.31 at depth 15-30cm in treatment T_9.

EC (dS m^{-1}): At depths of 0-15 cm and 15-30 cm, Treatment T_9 observed maximum values of 0.26 dS m^{-1} and 0.22 dS m^{-1}, respectively. T_1 (Control) measured minimum of 0.15 dS m^{-1} at depths of 0-15 cm and 0.12 dS m^{-1} at depths of 15-30 cm.

Organic Carbon (%): Treatment T_9 yielded the highest levels of organic carbon, 0.69%, 0.62%, and 0.69% at depths of 0-15 cm and 15-30 cm, respectively. T_1 (Control) had a minimum of 0.45% at depths of 0-15 cm and 0.38% at depths of 15-30 cm.

The absorption of N, P, and K from soil is influenced by micronutrients. The highest values of N, P, K, Zn, and B in treatment T_9 were found to be significant, while the minimum values were determined to be significant in T_1 at both depths.

Available Nitrogen (kg ha^{-1}): Treatment T_9recorded maximum 298.22 and 198.50 at depth 0-15 cm and 15-30 cm respectively. T_1 (Control) recorded the minimum 250.17 at depth 0-15 cm and 180.37 at depth 15-30 cm (Fig. 2).

Available Phosphorus (kg ha^{-1}): The minimum Phosphorous (kg ha^{-1}) of soil was recorded 22.29 kg ha^{-1} and 20.26 kg ha^{-1} at 0-15cm and 15-30 cm respectively in treatment T_1 (control) and maximum Phosphorous (kg ha^{-1}) of soil was recorded 31.53 kg ha^{-1} at depth 0-15cm and 28.76 kg ha^{-1} at depth 15-30cm in treatment T_9 (Fig. 2).

Available Potassium (kg ha^{-1}): Treatment T_9 recorded maximum 201.63 kg ha^{-1}, 179.29 kg ha^{-1} at depth 0-15 cm and 15-30 cm respectively. T_1 (Control) recorded the minimum 123.18 kg ha^{-1} at depth 0-15 cm and 112 kg ha^{-1} at depth 15-30 cm (Fig. 2).

Available Zn (mg kg^{-1}): Treatment T_9 recorded maximum available Zn 1.40 mg kg^{-1} and 1.04 mg $kg^{-1}$and T_1 (Control) recorded the minimum 0.73 mg kg^{-1} and 0.53 mg kg^{-1}at both depths (0-15cm and 15-30cm) respectively (Fig. 3).

Available Boron (mg kg^{-1}): Treatment $T_9$was recorded maximum available Boron i.e. 1.45 mg kg^{-1} and 0.96 mg kg^{-1} and T_1 (Control) recorded the minimum 0.64 mg $kg^{-1}$and 0.52 mg kg^{-1} at both depths (0-15cm and 15-30cm) respectively (Fig. 3).

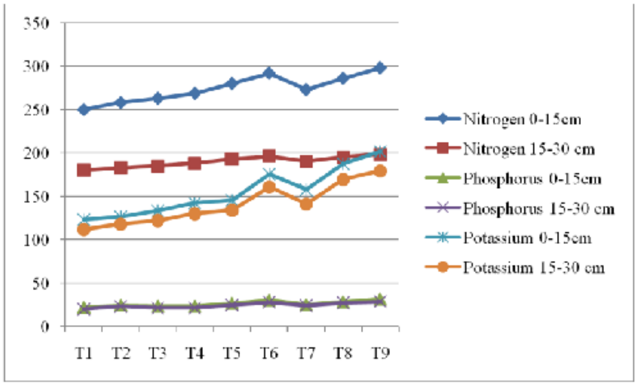

Fig. 2. Effect of Nano fertilizer alongwith Conventional fertilizer on Available Nitrogen (kg ha^{-1}), Available Phosphorus (kg ha^{-1}) and Available Potassium (kg ha^{-1}) of soil after crop harvest.

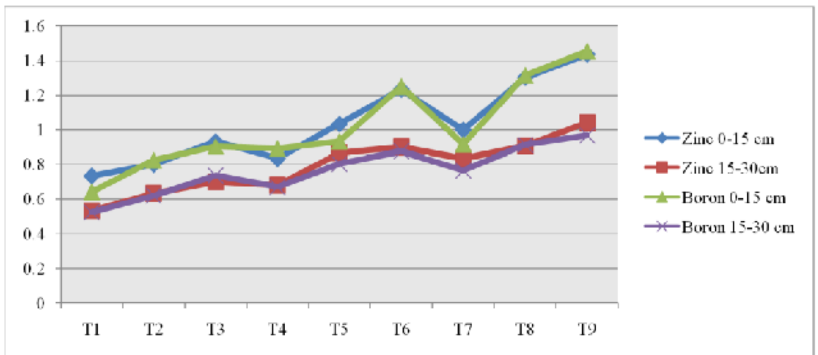

Fig. 3. Effect of Nano fertilizer Conventional fertilizer along with on available Zinc (mg kg^{-1}) and Boron (mg kg^{-1}) of soil after crop harvest.

The effect of nano-fertilizer and conventional fertiliser on soil nutrient status is obvious from the current investigation. These results are in lined with that reported by Islam *et al.*, (2018); Quddus *et al.*, (2014), Bhattacharya *et al.*, (2017) ; Prakash *et al.*, (2017).

CONCLUSION

Results obtained indicate that application of nano-fertilizers along with conventional fertilizers led to increase in nutrient status of soil. The best results were obtained from treatment T_9 (100% nano-fertilizer along with 100% chemical fertilizers).Farmers should turn traditional fertilizers towards nano-fertilizer as its nutrient use efficiency is more than traditional fertilizer and also require in small amount.

The present study provides new findings about to effect of different nano-micronutrients on nutrients status of soil in lentil crop. Thus, may improve soil fertility and crop yield. Since the results were based on one-year experimental data. As a result, more research is needed to determine the mode of action of various nano-micronutrients and their impact on soil nutrient status.

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Conflict of Interest. As a Corresponding Author, I Priyanka Roy, confirm that no-one else have any conflicts of interest associated with this publication.

REFERENCES

Bhattacharya, R., Vedprakash, Kundu, S., Srivastava, A. K., & Gupta, H. S. (2017). Effect of long term manuring on soil organic carbon, bulk density and water *Int. J. Curr. Microbiol. App. Sci.*, *6*(10): 1374-1378.

Deo, K., Singh, S. B., & Sundaram, P. K. (2014). Effect of zinc and boron application on yield of lentil and nutrient balance in the soil under Indo-Gangetic plain zones. *J. Agri. Search*, 206-209.

Fageria, N. K., Baligar, C., & Clack, R. B. (2002). Micronutrients in crop production. *Adv. Agron.*, *77*: 185-268.

Faris, M. A. I. E., Thakuri, H. R., & Issa, A. Y. (2013). Role of lentils (*Lens culinaris* L.) in human health and nutrition: A review. *Mediterr. J. Nutr. Metab.*, *6*: 3-16.

Islam, Md. M., Karim, Md. R., Oliver, M.H., Urmi, T. A., Hussain, A., & M. Moynul Haque. (2018). Impacts of Trace Element Addition on Lentil. *Agronomy*, *8*: 100.

Latef, A. A. H., Abu Alhmad, M. F., & Abdelfattah, K. E. (2017). The possible roles of priming with ZnO nano-particles in mitigation of salinity stress in Lupine (*Lupinus termis*) plants. *J. Plant Growth Reg.*, *36*: 60-70.

Lindsay, W. L., & Norwell, W. A. (1978). Development of DTPA soil test for Zn, Iron, Manganese and Copper. *Soil Science Society of America Journal, 42*: 421-428.

Muthuval, P., Udayasoorian, C., Nateson, R., & Ramaswqamy, P. P. (1992). The laboratory manual on soil analysis for physical and chemical characteristic of soil, introduction to soil analysis. Laser typesetting and offset printing by scroll EDP, 68, D.B. Road, R.S.P uram, Coimbatore – 641002.

Naderi, M. R., & Abedi, A. (2012). Application of nanotechnology in agriculture and refinement of environmental pollutants. *Journal of Nanotechnology, 11*(1): 18-26.

Nadi, E., Aynehband, A.< & Mojaddam, M. (2013). Effect of nano-iron chelate fertilizer on grain yield, protein percent and chlorophyll content of Faba bean (*Vicia faba* L.) *International Journal of Biosciences, 3*(9): 267-272.

Olsen, S. R., Cole, C. V., Watnahe, F. S., & Dean L. A. (1954). Estimation of available phosphorous in soil by extraction with sodium bicarbonate U.S. Dept. *Agr. Cric.*, 939.

Prakash Dev Verma, Narendra Swaroop, Yogesh Upadhyay, Akash Swamy & Soman Singh Dhruw (2017). Role of Phosphorus, Zinc and Rhizobium on Physico-Chemical Properties of Soil in Field Pea (*Pisum sativum* L.) Cv. Rachna. *Int. J. Curr. Microbiol. App. Sci., 6*(7): 4423-4428.

Quddus, M. A., Naser, H. M., Hossain M. A., & Abdulhossain M. (2014). Effect of zinc and boron on yield and yield contributing characters of lentil on low ganges river flood plain soil at Madaripur Bangladesh. *Bangladesh J. Agric. Res., 39*(4): 591-603.

Sekhon, B. S. (2014). Nano technology in agri-food production: an overview. *Nanotechnology, Science and Applications, 7*: 31-53.

Singh, A. K., & Bhatt, B. P. (2013). Effect of foliar application of zinc on growth and seed yield of late sown lentil (*Lens culinaris*) *Indian J. Agric. Sci., 83*(6): 622-626.

Singh, A. K., Bhatt, B. P., Upadhya, A., Singh, B. K., Kumar, S., Sundaram, P. K., Chandra, N., & Bharati, R. C. (2012). Improvement of Faba bean (*Vicia faba* L.) yield and quality through biotechnological approach. A. revies. *Afr. J. Biotechnol*., *11*: 15264-15271.

Singh, D. K., Singh, A. K., Singh, S. K., Singh, M.. & Srivastava, O. P. (2015). Effect of balanced nutrition on yield and nutrient uptake of pea (*Pisum sativum* L.) under Indo Gangetic plains of India. *The Bioscan., 10* (3): 1245-1249.

Subasinghe, S., Dayatilake, G. A., & Senaratne, R. (2003). Effect of B, Co and Mo on nodulation, growth and yield of cowpea (*Vigna unguiculata*). *Trop. Agric. Rex. Ext., 6*: 108-112.

Subbiah, B. V., & Asija, C. L. (1956). A rapid procedure for the estimation of available nitrogen in soil, *Current Sci*., *25*: 259-260.

Toth, S. J., & Prince, A. L. (1949). Estimation of cation exchange capacity and exchangeable Ca, K and Na Content of Soil by Flame photometer technique. *Soil Sci*., *67*: 439-445.

Walkely, A., & Black, I. A. (1947). Critical examination of rapid method for determining organic carbon in soils, effect of variance in digestion conditions and of inorganic soil constituents. *Soil Sci., 63*: 251-257.

Wilcox, L. V. (1950). Electrical conductivity, Amer. *water works assoc. J*., *42*: 775-776.

Zeidan, M.S., Hozayn, M., & Abd El-Salam, M.E.E. (2006). Yield and quality of lentil as affected by micronutrient deficiencies in sandy soils. *J. Appl. Sci. Res., 2*: 1342-1345.

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