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Response of different levels of zinc and FYM on soil health and yield attributes of cluster bean (*Cyamopsis tetragonoloba* L.) Cv. Durgapura Jay

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Abstract
The present investigation carried out at research farm, department of Soil Science and Agricultural Chemistry, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) during the *kharif* season of 2019 with the objective to response of different levels of Zinc and FYM on soil health, growth and yield attributes of guar [*Cyamopsis tetragonoloba* L.] Cv. Durgapura Jay. The experiment was laid out in a randomized block design with nine treatment combinations, consisting of three Zinc levels (0, 50 and 100%) and FYM (0, 50 and 100%). In soil parameters bulk density (Mg m^{-3}) of soil was recorded 1.03 (Mg m^{-3}) in treatment T_9 (100% Zinc + 100% FYM). Similar results were also reported in the particle density (Mg m^{-3}) of soil was recorded 2.48 (Mg m^{-3}) in treatment T_9 (100% Zinc + 100% FYM). Soil pore space was recorded 51.43*%* in treatment T_9 (100% Zinc + 100% FYM). It was observed that Soil pH after harvesting 7.20 which was recorded in T_9 (*i.e.* 100% Zinc + 100% FYM). Electrical conductivity (dS m^{-1}) after harvesting was 0.18 recorded with T_9 (*i.e.* 100% Zinc + 100% FYM). Organic carbon (%) of soil after harvesting was 0.71% in T_9 (*i.e.* 100% Zinc + 100% FYM). Available nitrogen in soil was 317.25 kg ha^{-1} after harvesting in T_9 (*i.e.* 100% Zinc + 100% FYM). Available phosphorus in soil was 32.99 kg ha^{-1} after harvesting and highest was in T_9 (*i.e.* 100% Zinc + 100% FYM). Available potassium in soil was 210.38 kg ha^{-1} after harvesting and highest was in T_9 (*i.e.* 100% Zinc + 100% FYM). It was observed that for post-harvest, treatment T_9 (*i.e.* 100% $ZnSO_4$ + 100% FYM) was best in terms of growth, yield and economic parameters with maximum plant height 235.02 cm, number of leaves per plant 42.97, number of clusters per plant 32.15, pods per cluster 13.61, pods per plant 99.29, seeds per pod 8.96 and pod yield 64.19 and maximum cost benefit ratio of 1:4.48.

Keywords: Soil parameters, organic fertilizers, micronutrient, $ZnSO_4$, FYM, Guar, etc.

Introduction
It is around 70% of the total production in India. In India Rajasthan is leading state in the production of the guar seed and guar gum. Haryana and Gujarat have second and third position respectively. Rajasthan has an area of 30 lakh hectare, production of 15.46 lakh tonnes with a productivity of 515 kg ha^{-1} (Anonymous, 2011) [1]. Haryana and Gujarat state themselves at the second and third highest producer regarding the production in India (Kherawat *et al*., 2013) [10]. Cluster bean popularly known as 'guar' is an important self pollinated, multipurpose, relatively drought resistant and restorative leguminous vegetable crop mainly grown under rainfed condition in arid and semi-regions of India during *kharif* season. It is grown for feed, fodder, vegetable, green manure as well as for gum production. Being legumes, it builds soil fertility and thus has a great role to play in nitrogen economy for succeeding crop. It is very hardy and drought tolerant crop. Its deep penetrating roots enable the plant to utilize available moisture more efficiently and thus offer better scope for rainfed cropping. The crop also survives even at moderate salinity and alkalinity conditions. There is no other legume crop so hardy and drought tolerant as cluster bean, which is especially suited for soil and climate of Rajasthan. This variety is moderately resistant to Bacterial blight and shown tolerance to lodging and drought. The pods of cluster bean are as rich in food value as that of French bean. According to [1] (Anonymous, 2011) [1] the composition of cluster bean is 81.0 g moisture, 10.8 g carbohydrate, 3.2 g protein, 1.4 g of fat, 1.4 g of minerals, 0.09 mg

thiamine, 0.03 mg and riboflavin 100g^{-1} of edible portion. Seed of cluster bean contains 28 to 33 percent gum. For commercial production, the crop prefers well-drained sandy loam soil. It is tolerant to saline and moderately alkaline conditions with pH ranging between 7.5- 8.0 and in heavy soils bacterial nodulation is hampered. It prefers long day condition for growth and short-day condition for induction of flowering. The production of cluster bean can be increased by various agronomical practices one of them is fertilizer management. The judicious use of fertilizer and organic manures plays a vital role to achieve higher yield of cluster bean. Among different plant nutrients nitrogen is the most important nutrient for plant growth and development. Cluster bean is grown for different purposes from very ancient time viz., vegetable, green fodder, manure and feed. It provides nutritional concentrate and fodder for cattle and adds to the fertility of soil by fixing considerable amount of atmospheric nitrogen. Clusterbean seed is used as a concentrate for animal and for extraction of "gum". Clusterbean has become popular not only for the consumption as a vegetables but also seeds of cluster bean are used for industrial purpose for the production of different lubricants. Currently, India accounts for 80 percent (3 million hectares) production of the world production (Anonymous, 2011) [1].

Materials and Method

The experiment was conducted at research farm of department of Soil Science and Agricultural Chemistry which is situated six km away from Prayagraj city on the right bank of Yamuna river, the experimental site is located in the sub–tropical region with 25^{0}24$'$23$''$N latitude, 81^{0}50$'$38$''$E longitude and at an altitude of 98 m above mean sea level. The area of Prayagraj district comes under subtropical belt in the South east of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46 ^{0}C-48 ^{0}C and seldom falls as low as 4 ^{0}C – 5 ^{0}C. The relative humidity ranges between 20 to 94 percent. The average rainfall in this area is around 1013.4 mm annually. The soil of experimental area falls in order of Inceptisol. The soil samples were randomly collected from three different sites in the experiment plot prior to tillage operation from a depth of 0-15 cm. The size of the soil sample was reduced by conning and quartering the composites soil sample and was air dried passed through a 2 mm sieve for preparing the sample for physical and chemical analysis.

Table 1: Treatment combinations of cluster bean

Treatment	Treatment combination
T_1	Control
T_2	@ RDF + 0% $ZnSO_4$+ @ 50% FYM
T_3	@ RDF + 0% $ZnSO_4$+ @ 100% FYM
T_4	@ RDF + 50% $ZnSO_4$+ @ 0% FYM
T_5	@ RDF + 50% $ZnSO_4$+ @ 50% FYM
T_6	@ RDF + 50% $ZnSO_4$+ @ 100% FYM
T_7	@ RDF + 100% $ZnSO_4$+ @ 0% FYM
T_8	@ RDF + 100% $ZnSO_4$+ @ 50% FYM
T_9	@ RDF + 100% $ZnSO_4$+ @ 100% FYM

Table 2: Physical analysis of pre sowing soil samples

Particulars	Results	Method employed
Sand (%)	58	Bouyoucos Hydrometer (1927) [5]
Silt (%)	27	
Clay (%)	15	
Textural class	Sandy loam	
Soil Colour		Munsell Colour Chart (1971) [12]
Dry Soil	Pale brown Colour	
Wet Soil	Olive brown Colour	
Bulk density (Mg m^{-3})	1.37	Graduated Measuring Cylinder (Muthuaval *et. al.*,1992) [13]
Particle density (Mg m^{-3})	2.42	
Pore Space (%)	47.53	

Table 3: Chemical analysis of pre sowing soil samples

Parameters	Method employed	Results
Soil pH (1:2)	Glass electrode,pH meter (Jackson, 1958) [8]	7.5
Soil EC (dS m^{-1})	EC meter (Conductivity Bridge) (Wilcox, 1950)	0.29
Organic Carbon (%)	Wet Oxidation Method (Walkley and Black's, 1947)	0.39
Available Nitrogen (Kg ha^{-1})	Kjeldahl Method (Subbaih and Asija, 1956) [20]	228.21
Available Phosphorus (Kg ha^{-1})	Colorimetric method (Olsen *et al*., 1954) [14]	20
Available Potassium (Kg ha^{-1})	Flame photometric method (Toth and Price, 1949) [42]	148.65

Results and Discussion

As depicted in table no. 2 The maximum bulk density Mg m^{-3} of soil was recorded 1.35 Mg m^{-3} in treatment T_1 (control) and minimum Bulk density Mg m^{-3} of soil was recorded 1.03 Mg m-3 in treatment T_9 (100% Zinc + 100% FYM). Similar results were also reported in the maximum particle density Mg m^{-3} of soil was recorded 2.48 Mg m^{-3} in treatment T_9 (100% Zinc + 100% FYM) and minimum particle density (Mg m^{-3}) of soil was recorded 2.32 Mg m^{-3} in treatment T_1 (control). The maximum soil pore space was recorded 51.43% in treatment T_9 (100% Zinc + 100% FYM) and minimum soil pore space was recorded 45.23% in treatment T_1 (Control). The maximum soil pH was recorded 7.70 in treatment T_1 (control) and minimum soil pH was recorded 7.20 in treatment T_9 (100% Zinc + 100% FYM). The maximum EC (dS m^{-1}) of soil was recorded 0.18 dS m^{-1} in treatment T_9 (100% Zinc + 100% FYM) and minimum EC (dS m^{-1}) of soil was recorded 0.12 dS m^{-1} in treatment T_1 (control). The maximum% organic carbon in soil was recorded 0.71% in treatment T_9 (100% Zinc + 100% FYM) which was significantly higher than any other treatment combination and the minimum% Organic carbon in soil was recorded 0.55% in treatment T_1 (control). Legumes have potential to improve soil nutrients status through biological nitrogen fixation and incorporation of biomass in to the soil as green manure. The maximum available Nitrogen in soil was recorded 317.25 kg

ha^{-1} in treatment T_9 (100% Zinc + 100% FYM) which was significantly higher than any other treatment combination and the minimum available Nitrogen in soil was recorded 248.49 kg ha^{-1} in treatment T_1 (control). The increase in available Nitrogen in soil after crop harvest by Zinc and FYM seed inoculation might be due to increased efficiency of Nitrogen fixing capacity and nodule formation. Legumes have potential to improve soil nutrients status through biological nitrogen fixation and incorporation of biomass in to the soil as green manure. Similar findings were also recorded by Sajid *et al.* (2009) [11] and Chavan *et al.* (2016). The available Phosphorus in soil increased significantly with the increase in levels of Zinc and FYM seed inoculation. The maximum available Phosphorus in soil was recorded 32.99 kg ha^{-1} in treatment T_9 100% Zinc + 100% FYM which was significantly higher than any other treatment combination and the minimum available Phosphorus in soil was recorded 23.57 kg ha^{-1} in treatment T_1 control. Legumes have potential to improve soil nutrients status through biological nitrogen fixation and incorporation of biomass in to the soil as green manure. The maximum available potassium in soil was recorded 210.38 kg ha^{-1} in treatment T_9 which was significantly higher than any other treatment combination and the minimum available potassium in soil was recorded 130.58 kg ha^{-1} in treatment T_1 (control). Legumes have potential to improve soil nutrients status through biological nitrogen fixation and incorporation of biomass in to the soil as green manure. Similar findings were also recorded by Muhammad *et al.* (2009) [11] and Chavan *et al.* (2016).

Table 4: Physical properties of soil sample after harvesting of cluster bean

Treatment	Bulk Density (Mg m^{-3})	Particle Density (Mg m^{-3})	Pore space (%)
T_1	1.35	2.32	45.23
T_2	1.34	2.37	45.89
T_3	1.34	2.40	46.71
T_4	1.23	2.41	46.69
T_5	1.21	2.41	47.73
T_6	1.18	2.44	48.38
T_7	1.06	2.44	49.30
T_8	1.05	2.47	56.76
T_9	1.03	2.48	51.43
F-test	NS	NS	S
S. Em. (±)	0.02	0.02	0.52
C.D	0.05	0.05	1.11

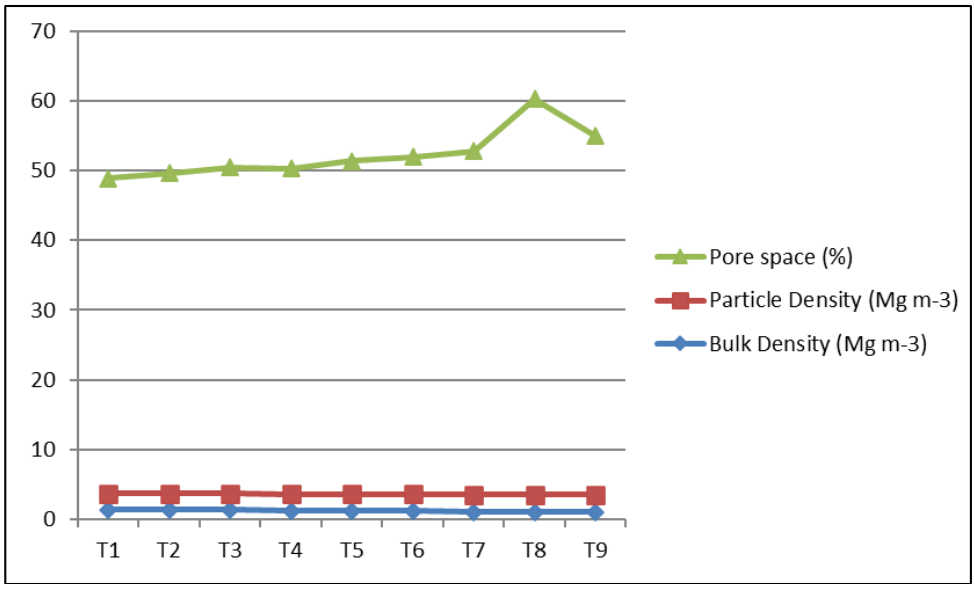

Fig 1: Physical properties of soil sample after harvesting of cluster bean

Table 5: Chemical properties of soil sample after harvesting of cluster bean

Treatments	pH	EC (dS m^{-1})	Organic carbon (%)	Available Nitrogen (Kg ha^{-1})	Available Phosphorus (Kg ha^{-1})	Available potassium (Kg ha^{-1})
T_1	7.70	0.12	0.55	248.49	23.57	130.58
T_2	7.63	0.13	0.57	268.29	26.72	138.95
T_3	7.63	0.13	0.59	277.09	27.50	147.15
T_4	7.45	0.14	0.61	281.73	27.79	160.38
T_5	7.38	0.14	0.62	288.11	28.05	172.42
T_6	7.33	0.16	0.64	293.89	28.85	182.69
T_7	7.26	0.16	0.68	303.42	30.13	189.71
T_8	7.21	0.17	0.69	312.22	31.27	198.67
T_9	7.20	0.18	0.71	317.25	32.99	210.38
F-test	S	S	S	S	S	S
S. Em. (±)	0.04	0.01	0.01	1.09	0.67	0.90
C.D. (P= 0.05)	0.09	0.02	0.02	2.32	1.42	1.91

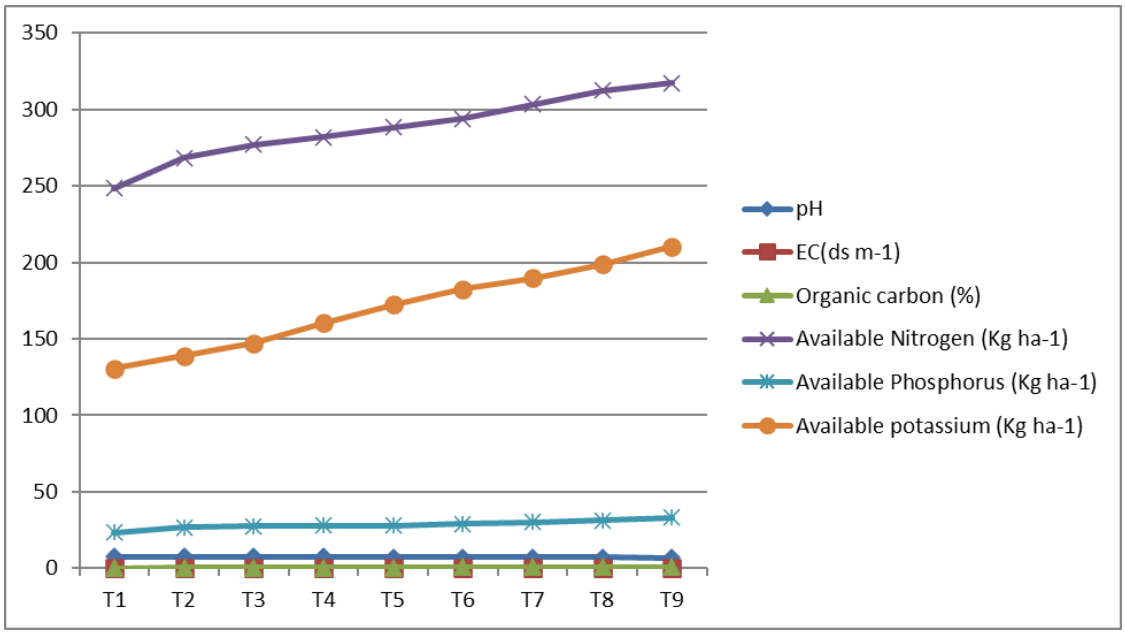

Fig 2: Chemical properties of soil sample after harvesting of Cluster bean

Summary

The salient findings of the present investigation are summarized as follows. As for as the growth and yield parameters are concerned maximum plant height 235.02 cm, number of leaves per plant 42.97, number of clusters per plant 32.15, pods per cluster 13.61, pods per plant 99.29, seeds per pod 8.96 and pod yield 64.19 remained with T_9 *i.e.* 100% Zinc + 100% FYM followed by T_8 (*i.e.* 100% Zinc + 50% FYM). Minimum plant height 79.07 cm, number of leaves 12.92, number of clusters per plant 11.79, pods per cluster 5.05, pods per plant 34.94, seeds per pod 4.24 and pod yield 34.26 was observed in the treatment T_1 (*i.e.* 0% Zinc + 0% FYM).

Soil pH before sowing was 7.50 and after harvesting decreased to 7.20 which was recorded in T_9 and T_8 7.21 followed by 7.25 by T_7. Electrical conductivity (dS m^{-1}) of soil before sowing was 0.19 dS m^{-1} and after harvesting was 0.18 dS m^{-1} recorded with T_9 followed by T_8 -0.17 and T_7 (0.16). Organic carbon (%) of soil before sowing was 0.39 and in soil after harvesting was 0.71% in T_9, followed by T_8-0.69% Available nitrogen in pre-sowing soil was 228.4 kg ha^{-1} increased up to 317.25 kg ha^{-1} after harvesting and highest was in T_9 followed by T_8 – 312.22 kg ha^{-1}. Available phosphorus in pre-sowing soil was 20.0 kg ha^{-1} increased up to 32.99 kg ha^{-1} after harvesting and highest was in T_9, followed by T_8 31.27 kg ha^{-1}. Available potassium in pre-sowing soil was 148.30 kg ha^{-1} increased up to 210.38 kg ha^{-1} after harvesting and highest was in T_9, followed by T_8 198.67 kg ha^{-1}.

The maximum gross return of ₹ 2,56,760.00 and Maximum net profit of ₹ 1,99,470.00 was in treatment T_9 was best in increasing plant height, number of leaves, number of branches, yield, physical and chemical properties of soil like bulk density, particle density, pore space (%), EC, organic carbon, N, P, K, in guar plants. Maximum cost benefit ratio of 1:4.48 was in the treatment combination T_9 followed by 1:4.25 in T_8.

Conclusion

It was concluded that the treatment T_9 was the best in terms of all soil parameters like bulk density (Mg m^{-3}), particle density (Mg m^{-3}), pore space (%), Soil pH, Electrical Conductivity (dS m^{-1}), Organic Carbon (%), Available Nitrogen, Phosphorus and Potassium (Kg ha^{-1}) and in growth parameters the plant height, number of leaves per plant, number of clusters per plant, pods per cluster, pods per plant, seeds per pod and pod yield was highest. Treatment T_9 (*i.e.* 100% Zinc + 100% FYM) was best in terms of economic parameters too with maximum gross return of ₹ 2,56,760.00 and net profit was ₹ 1,99,470.00 with cost benefit ratio (C: B) (1:4.48).

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References

1. Anonymous. Ministry of Agricultural, Government of India, 2011.
2. Ayub M, Nadeem MA, Naeem M, Tahir M, Tariq M, Ahmad W. Effect of different levels of P and K on growth, forage yield and quality of cluster bean (*Cyamopsis tetragonolobus* L.) The journal of animal and plant sciences. 2012; 22(2):479-483.
3. Ayub M, Tahir M, Nadeem MA, Zubair MA, Tariq M, Ibrahim M. Effect of Nitrogen Applications on Growth, Forage Yield and Quality of Three Cluster Bean Varieties. Pak. j. life soc. Sci. 2010; 8(2):111-116.
4. Bairwa HL, Mahawe LN, Shukla AK, Kaushik RA, Mathur SR. Response of integrated nutrient management on growth, yield, and quality of Okra (*Abelmoschus esculentus*). Indian Journal of Agricultural Sciences, 2009; 79(5):381-384.
5. Bouyoucos GJ. The hydrometer as a new method for the mechanical analysis of soils. *Soil Sci.*, 1927; 23:393-395.
6. Chavan BL, Vedpathak MM, Pirgonde BR. Effects of organic and chemical fertilizers on cluster bean (*Cyamopsis tetragonolobus*). European Journal of Experimental Biology. 2015; 5(1):34-38.

7. Deshmukh RP, Nagre PK, Wagh AP, Dod VN. Effect of Different Bio-fertilizers on Growth, Yield and Quality of Cluster bean. Indian Journal of Advances in Plant Research (IJAPR) 2014; 1(2):39-42; ISSN: 2347-8918.
8. Jackson ML. Soil chemical analysis, Second edition Indian Reprint, prentice hall of India, New Delhi, 1958, 498.
9. Jat RS, Ahlawat IPS. Direct and residual effect of vermicompost, biofertilizers and phosphorus on soil nutrient dynamics and productivity of chickpea fodder maize sequence. Journal of Sustainable Agriculture, 2006; 28:41-54.
10. Kherawat BS, Munna lal, Agarwal M, Yadav HK, Kumar S. Effect of Applied Potassium and Manganese on Yield and Uptake of Nutrients by Cluster bean (*Cyanosis tetragonoloba*). Journal of Agricultural Physics. 2013; 13(1):22-26.
11. Muhammad Sajid, Imtiaz Ahmed, Abdur Rab. Effect of nitrogen level on the yield and yield component of guar gum (*Cyamopsis tetragonoloba*) Eurasian J. Sustain Agric 3(1); 29-32, 2009. Journal of Agriculture Science 2009; 7(5):583-590, ISSN 1817-3047 IDOSI Publications, 2011.
12. Munsell AH. A Color Notation. Baltimore, MD: Munsell Color Company. ed. 1971; 12:65.
13. Muthuval P, Udaysoorian C, Natesan R, Ramaswami PP. Introduction to Soil analysis, Tamil Nadu Agricultural University, Coimbatore, 641002, 1992.
14. Olsen SR, Cole CV, Watanhe FS, Dean LA. Estimation of available Phosphorus in soils by extraction with sodium bicarbonate. U. S. Dept. Agr. Circ. 1954, 939.
15. Piper CS. Soil and Plant analysis. International Service Publisher Inc. New York, 1950.
16. Ramawat N, Yadav R. Influence of bio-fertilizers on growth attributes of guar (*Cyamopsis tetragonoloba* L.). Plant archives. 2017; 17(2):869-870.
17. Ramawtar AC, Shivran, Yadav BL. Effect of NP fertilizers, vermicompost and Sulphur on growth, yield and quality of clusterbean and their residual effect on grain yield of succeeding wheat. Legume research. 2017; 36(1):74-78.
18. Reddy DS, Nagre PK, Reddaiah K, Reddy BR. Effect of integrated nutrient management on growth, yield, yield attributing characters and quality characters in cluster bean. The Ecoscan. 2014; 6:329-332.
19. Selvaraj S, Lakshmi Prasanna K. Dry matter production, yield attributes, yield and quality of cluster bean [(*Cyamopsis tetragonoloba* L.) Taub.] as influenced by nitrogen and zinc application Indian Journal of Plant Science ISSN; 2319-3824, 2012
20. Subbiah BV, Asija GL. A rapid procedure for the estimate of Available nitrogen in soil current sciences, 1956; 25:259-260
21. Swapana S, Bhardwaj SK, Dixit SP, Dhiman S. Effect of integrated nutrient management on yield attributes, yield and NPK uptake garden pea (*Pisum sativum* L.) in acid Alfisol, Journal of Food Legumes. 2012; 25(3):247-249.
22. Toth SJ, Prince AL. Estimation of Cation Exchange Capacity and exchangeable Ca, K and Na Content of Soil by Flame Photometer technique. Soil Sci. 1949; 67:439-445.