The Pharma Innovation Journal 2022; 11(7): 895-899

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(7): 895-899

www.thepharmajournal.com
Received: 01-05-2022
Accepted: 06-06-2022

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Influence of phosphorus, iron and zinc levels on growth attribute, yield attribute of chickpea (*Cicer arietinum* L.) Prayagraj condition

Dalu Sreekanth and Biswarup Mehera

Abstract
A field experiment was conducted during *rabi* season of 2021-22 at SHUATS Crop Research Farm (CRF), Department of Agronomy, SHUATS, Prayagraj (UP) on sandy loam soil to investigate the effect of Phosphorus, Iron and Zinc levels on growth and yield of Chickpea (*Cicer arietinum* L.). The treatment consisted of 3 levels of phosphorus *viz.*, phosphorus at 40 kg/ha, phosphorus at 50 kg/ha and phosphorus at 60 kg/ha. 3 levels of micronutrients *viz., Fe* at 0.1% $FeSO_4$, Zn at 0.5% $ZnSO_4$ and Fe + Zn at 0.1% $FeSO_4$ + 0.5% $ZnSO_4$. The experiment was laid out in randomized block design with ten treatments replicated thrice. Study revealed that with application of Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate recorded significantly higher plant height (37.15 cm), Nodule per plant (23.41), number of branches (14.21) and maximum plant dry weight (16.36 g) at harvest stage as same treatment combinations. The treatment with application Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate also recorded significantly higher number of pods/plant (51.32), number of seed/pod (1.49), test weight (221.32), seed yield (3.07 q/ha) and stover yield (4.17 q/ha) as compared to all the treatment combinations.

Keywords: Chickpea, N Phosphorus, Fe, Zn, growth, yield

Introduction

Pulses are the edible dry seeds of leguminous plants. They are of special nutritional and economic importance due to their contribution to the diets of millions of people worldwide. The importance of pulses lies primarily in their high protein content besides being a valuable source of energy. In addition, pulses also contain good amount of nutritionally rich essential minerals and vitamins such as calcium, phosphorus, iron and vitamin C. By 2030, India's chickpea demand is expected to reach around 10.18 million tonnes, implying a 4.2 percent increase in yearly growth rate (IIPR, 2016). Chickpeas are often regarded as a nutritious food. It's a high-protein supplement for cereal-based diets, especially for the poor in developing nations who are vegetarians or can't afford animal protein.

In the production of legumes, phosphorus is crucial. It is a component of the cell membrane, chloroplast and mitochondria. It can be found in ATP, ADP, nucleic acid, nucleoproteins, purines, pyrimidines, nucleotides, and many other co-enzymes. It participates in the basic photosynthetic reaction and improves the grain to stalk ratio, which improves crop quality. Zinc is required for the proper functioning of various metabolic processes. It's required for chlorophyll and glucose production. Several enzyme systems, auxin, and protein synthesis all require zinc, either directly or indirectly. Zinc is thought to help with RNA synthesis, which is required for protein creation. Due to a lack of micronutrients in the soil, in general, and Zn in particular, normal crop yields could not be obtained in numerous locations despite the use of NPK fertilisers. Zinc levels in chickpeas range from 2.2 to 20 mg per 100 g edible amount (Ray *et al*. 2014). It also improves the plant's tolerance to dry and hot weather, which are known to reduce chickpea output (Ashok *et al*., 2005). Iron is vital for plant growth and development because it is involved in chlorophyll and thylakoid synthesis and chloroplast development. Zn treatment affects Auxin synthesis, nodulation and nitrogen fixation, all of which improve crop growth and development and, as a result, seed yield (Kasthurikrishna and Ahlawat, 2000). Application of Zn enhance quality and yields of chickpea reported by (Khan *et al*., 2003). Iron is essential for the cell's redox system and a variety of enzymes. Iron acquisition techniques differ between dicotyledonous and graminaceous plants (Marschner, 2012). The sensitivity of chickpea genotypes to iron deficiency varies.

It was in view of these facts that the present study entitled "Influence of Phosphorus, Iron and Zinc levels on growth attribute, yield and yield attribute of Chickpea (*Cicer arietinum* L.) Prayagraj condition" was conducted at Department of Agronomy, Sam Higginbottom University of Agricultural Technology and Sciences, during *rabi* 2021-2022.

Materials and Methods

The field experiment was conducted during *Rabi* season 2021-22, at the experimental area of the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P.), situated at which is located at 25° 39' 42''N latitude, 81° 67' 56" 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 average annual rainfall of the zone was 1077 mm. The other distinct climatic features of experimental site has tropical climate, characterized by high temperature and humidity. The soil chemical analysis revealed that soil was sandy loam in texture, acidic in reaction (pH 7.1) medium in organic carbon (0.36%) and potassium (232.5 kg/ha), high in available phosphorus (15.2 kg/ha) and available nitrogen (171.48 kg/ha). The electrical conductivity of the soil was 0.29 dS/m. The experiment was laid out in Randomized Block Design (RBD), having four phosphorus management practices (40, 50 and 60 kg/ha) and three micronutrients (0.1% $FeSO_4$, Zn at 0.5% $ZnSO_4$ and Fe + Zn at 0.1% $FeSO_4$ + 0.5% $ZnSO_4$). There were nine treatments replicated thrice, nine. treatments combinations, comprising (*i*) Phosphorus 40 kg/ha + 0.1% $FeSO_4$ (*ii*) Phosphorus 40 kg/ha + 0.5% $ZnSO_4$ (*iii*) Phosphorus 40 kg/ha + 0.1% $FeSO_4$ + 0.5% $ZnSO_4$ (*iv*) Phosphorus 50 kg/ha + 0.1% $FeSO_4$ (*v*) Phosphorus 50 kg/ha + 0.5% $ZnSO_4$ (*vi*) Phosphorus 50 kg/ha + 0.1% $FeSO_4$ + 0.5% $ZnSO_4$ (*vii*) Phosphorus 60 kg/ha + 0.1% $FeSO_4$ (*viii*) Phosphorus 60 kg/ha + 0.5% $ZnSO_4$ (*ix*) Phosphorus 60 kg/ha + 0.1% $FeSO_4$ + 0.5% $ZnSO_4$. Crop was seeded in line manually on 28th of September, 2021. Seeds were covered with the soil immediately after sowing. The seeds were drilled at 3-4 cm depth. The P was applied as specified by the treatments while the N and K fertilizers were applied at 20 and 40 kg/ha in all the treatments. Nitrogen, phosphorus and potassium were supplied through urea, Di-Ammonium Phosphate and muriate of potash respectively. Full dose of phosphorus and potassium were applied uniformly as basal to all the plots. Half dose of nitrogen was applied as basal and remaining half dose applied 45 days after sowing. The observation on growth parameters *viz.* plant height, number of leaves and dry weight were taken at 20, 40, 60, 80 and at harvest after sowing. The data on yield attributing characters *viz.* seed yield, straw yield and oil content were recorded at harvest.

Statistical analysis

The experimental data analyzed statistically by applying the technique of analysis of variance (ANOVA) prescribed for the design to test the significance of overall difference among treatments by the F test and conclusion were drawn at 5% probability level. Economics of treatments was also worked out (Gomez and Gomez, 1984) [6].

Chemical analysis of soil

Before the experiment plan is laid out, composite soil samples are taken at random to determine the soil qualities. The soil samples were taken at a depth of 0-15 cm and dried in the shade before being powdered with a wooden pestle and mortar and sieved through a 2 mm sieve for further analysis. The physical parameters of soil were assessed using Bouyoucos (1927) [3] hydrometer method, while organic carbon was assessed using Nelson's fast titration method (1975). Subbiah and Asia (1956) [18] used the alkaline permanganate method to estimate available nitrogen, Olsen's method to estimate available phosphorus as outlined by Jackson (1967) [10] and flame photometer normal ammonium acetate solution to estimate available potassium as outlined by Jackson (1973) [11], (Anonymous, 2010).

Results and Discussions

Growth attributes

Data pertaining to growth parameters which are plant height (cm), nodule per plant (no), number of branches and dry weight (g/plant), were recorded and tabulated in Table 1.

Data related to plant height at 80 DAS, significantly highest plant height (37.15 cm) was recorded in Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate. However, Phosphorus @ 60 kg/ha + 0.5% zinc sulphate, Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate, Phosphorus @ 50 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate, Phosphorus @ 40 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate was statistically at par with in Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate. This might be due to as phosphorus is directly or in directly involved in the production of chlorophyll and foliar application is known to be very responsive as the availability of food in the plant affected by soil pH in tandem which ensures higher yield, while in case of nodule per plant at 80 DAS, significantly highest number of nodules/plant (23.41) was recorded in Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc. However, Phosphorus @ 60 kg/ha + 0.5% zinc sulphate (22.42), Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate (22.07), Phosphorus @ 50 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate (22.99), Phosphorus @ 40 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate (21.80) was statistically at par with Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc. Data related to number of branches at 80 DAS, Treatment with the application of Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate was shown significantly maximum branches which is of (14.21). However, Phosphorus @ 60 kg/ha + 0.5% zinc sulphate (13.45), Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate (12.73), Phosphorus @ 50 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate (14.07), Phosphorus @ 40 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate (12.23) was at par with the treatment combination Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate and lowest branches was obtained with the application of Phosphorus @ 40 kg/ha + 0.1% Ferrous sulphate (10.64) as compared to other treatments. Phosphorus is the most important nutrient, which determines the growth of the crop and increases the amount of yield. While in case of data recoded to plant dry weight at 80 DAS, significantly highest dry weight (16.36 g) was recorded in Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate. However, Phosphorus @ 60 kg/ha + 0.5% zinc sulphate (15.89g), Phosphorus @ 50 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate (16.23) was statistically at par with Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate. Phosphorus and potash are known to be efficiently utilized in the presence of nitrogen. It promotes flowering, setting of pods and in increase the size of pods and yield. Zn and Fe is also an important nutrient and plays an important role in physiological functions like synthesis of cysteine, methionine, chlorophyll and oil content of pulses crops. It is also responsible for synthesis of certain vitamins (B, biotin and thiamine), metabolism of carbohydrates, proteins and seed formation of flavored compounds in legume. The injection of phosphorus boosted the plant's height since phosphorus is a critical component structure of ATP during photosynthesis. These findings are similar to those obtained by Dotaniya *et al.* (2013). The increased availability of iron to plants may have enhanced metabolic and enzymatic activity, resulting in increased crop growth. Trivedi and colleagues (2011) [19]. The symbiotic root nodule, an organ formed on leguminous plants, is a product of successful interactions between the host plant and the soil bacteria, Rhizobium spp. Phosphorus is one of the essential nutrients to support root growth for plants. Balanced Phosphorus and Iron is essential not only for plant growth but also for maximum activity of Rhizobium for N fixation Kuldeep *et al.* (2018) [13]. Increasing Phosphorus and Iron levels significantly increased the branches and improved soil fertility status and crop yield Sarawgi, *et al*. (2009) [16]. The overall dry matter output of a plant is determined by its photosynthetic ability, which is determined by the dry matter accumulation in leaves, dry matter accumulation per plant were significantly higher with increasing levels of Phosphorus in chickpea Arya *et al.* (2002) [2]. Increasing levels of Iron significantly increased the dry matter accumulation Kuldeep *et al.* (2018) [13].

Table 1: Effect of phosphorus, iron and zinc levels on growth attributes of Chickpea

Sr. No.	Treatment details	Growth attributes 80 DAS			
		Plant height (cm)	Nodule/Plant (no)	No. of branches	Dry weight (g)
1.	Phosphorus @ 40 kg/ha + 0.1% Ferrous sulphate.	34.13	19.93	10.64	13.08
2.	Phosphorus @ 40 kg/ha + 0.5% zinc sulphate.	34.63	20.39	11.34	13.37
3.	Phosphorus @ 40 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate.	36.09	21.80	12.23	14.19
4.	Phosphorus @ 50 kg/ha + 0.1% Ferrous sulphate.	35.12	20.54	11.59	13.65
5.	Phosphorus @ 50 kg/ha + 0.5% zinc sulphate.	35.72	21.23	12.02	14.03
6.	Phosphorus @ 50 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate.	37.03	22.99	14.07	16.23
7.	Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate.	36.34	22.07	12.73	14.63
8.	Phosphorus @ 60 kg/ha + 0.5% zinc sulphate.	36.78	22.42	13.45	15.89
9.	Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate.	37.15	23.41	14.21	16.36
	S.Ed (+)	S	S	S	S
	CD (p=0.5)	0.83	2.39	1.19	0.59

Yield attributes

Data recorded to No. of pods/plant, no. of seeds/pod, test weight, seed yield (q/ha), straw yield (q/ha) and harvest index were recorded and tabulated in Table 2.

The results revealed that significantly higher Number of pods per plant (51.32) was recorded in Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate. However, Phosphorus @ 50 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate (50.87), Phosphorus @ 60 kg/ha + 0.5% zinc sulphate (49.63), Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate (49.12) was statistically at par with Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate.

Growth and yield indicators were directly proportional to sulphur rates. However, the intensity of increase was found variable among parameters due to synergistic effect of sulphur with nitrogen and phosphorus. Number of pods per plant increased from 5 to 10% when different rates of sulphur applied as compared to control. Similar results were reported by Gupta and Sahu (2020).

Data recorded to significantly higher number of seed/pod (1.49) was observed in Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate. However, spacing 40 cm + Sulphur 40 kg/ha (1.43) is statistically at par with Spacing 30 cm + Sulphur 40 kg/ha.

Plants compete for limited resources being essential for their life, i.e. light, water and nutrients. Yet, whole plant growth and competitive ability depends not only on the photosynthetic rate of individual leaves, but also on the geometry and dynamics of a plant's canopy. On the other hand, 15cm intra row spacing resulted in the highest number of seeds per pod which was statistically in parity with 10cm intra row spacing. Similar results were reported by Singh (2005).

Data parenting to maximum test weight (g) was recorded with application of Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate (221.32 g) which was significantly superior over rest of all the treatments and minimum test weight (g) was recorded with the Phosphorus @ 40 kg/ha + 0.1% Ferrous sulphate (210.63 g).

Growth and yield indicators were directly proportional to Phosphorus rates. However, the intensity of increase was found variable among parameters due to synergistic effect of phosphorus, iron and with zinc. Seed index (1000 grain weight grams) increased from 43 to 86% when different rates of P applied as compared to control. Similar results were reported by Dubey *et al.* (2013) [5].

Significantly highest seed yield (3.07 t/ha) was observed in Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate. However, Phosphorus @ 60 kg/ha + 0.5% zinc sulphate, Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate, was statistically at par with Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate.

Seed yield of chickpea was higher with the application of higher doses of potassium and Zn might be due to improved yield components and nodulation of the crop. Similar results were reported by Ram *et al.* (2013) [8].

Data recoded to significantly highest stover yield (4.17 t/ha) was recorded in Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate.

Application of phosphorus with rate of 50 kg/ha gave maximum straw yield which remain at par with 40 kg/ha. Sulphur besides improving vegetative growth it activates certain photolytic enzymes and co-enzymes. Thus, these bio-activities of Phosphorus might have played important role in improving yield attributing characters and total yield of chickpea. Similar results were reported by Roy *et al.* (2013) [15].

Data recoded to significantly highest harvest index (42.37%) was recorded in Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate. However, Phosphorus @ 50 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate was statistically at par with Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate.

This reduction in harvest index in narrower spacing 20 cm might be due to the higher plant population per unit area which might have increased the flower abortion due to competition for nutrients, moisture and solar radiation. Similar results were reported by Singh (2005).

Table 2: Effect of phosphorus, iron and zinc levels on yield attributes of Chickpea

Sr. No.	Treatment details	Yield and yield attributes					
		No. of Pods/Plant	No. of Seeds/Pod	Test weight (gm)	Seed yield (q/ha)	Stover yield (q/ha)	Harvest index (%)
1.	Phosphorus @ 40 kg/ha + 0.1% Ferrous sulphate	45.36	1.19	210.63	2.10	3.15	39.43
2.	Phosphorus @ 40 kg/ha + 0.5% zinc sulphate	46.78	1.21	211.79	2.17	3.27	39.97
3.	Phosphorus @ 40 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate	48.53	1.32	215.27	2.52	3.62	41.37
4.	Phosphorus @ 50 kg/ha + 0.1% Ferrous sulphate	47.76	1.24	213.53	2.23	3.39	40.26
5.	Phosphorus @ 50 kg/ha + 0.5% zinc sulphate	48.23	1.29	214.39	2.39	3.43	40.57
6.	Phosphorus @ 50 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate	50.87	1.42	219.45	3.01	4.13	42.13
7.	Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate	49.12	1.34	215.87	2.69	3.85	41.57
8.	Phosphorus @ 60 kg/ha + 0.5% zinc sulphate	49.63	1.38	218.21	2.91	3.93	41.83
9.	Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate	51.32	1.49	221.32	3.07	4.17	42.37
	S.Ed (+)	S	S	S	S	S	NS
	CD (p=0.5)	2.37	0.23	4.17	0.42	0.21	0.37

Conclusion

Findings of present research trail well demonstrated the positive effects of nutrients particularly treatment on various growth and yield parameters of groundnut plant. The application Phosphorus @ 60 kg/ha + 0.1% Ferrous sulphate + 0.5% zinc sulphate obtaining higher yield attributes and yield of Chickpea crop useful for eastern Uttar Pradesh condition.

Acknowledgement

The authors are thankful to Advisor Dr. Biswarup Mehera. for constant support and guidance. I am indebted for the support Prof. (Dr.) Joy Dawson, Dr. Umesha C., Dr. Rajesh Singh, Dr. (Mrs.) Shikha Singh and Dr. Victor Debbarma and all faculty members and seniors, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211007, Uttar Pradesh, India for providing us necessary facilities to undertake the studies.

Reference

1. Anonymous. Agricultural Statistics at a Glance. Directorate of Economics and Statistics, Ministry of Agriculture, GOI, New Delhi, 2015.
2. Arya RL, Kushwaha BL, Singh BN. Effect of phosphorus management on growth, yield attributes and yield of maize-chickpea cropping system. Indian J Pulse Res. 2002;15:161-165.
3. Bouyoucos GJ. The hydrometer as a new method for the mechanical analysis of soils. Soil Science. 1927;23:343-353.
4. Dotaniya ML. Role of phosphorus in chickpea (*Cicer arietinum* L.) production. 2014;9(51):3736-3743.
5. Dubey SK, Tripathi SK, Singh B. Effect of phosphorus and zinc levels on growth, yield and quality of mustard. Journal of Crop Science and Technology. 2013;2:2319-3395.
6. Gomez KA, Gomez AA. Statistical procedures for agricultural research (2 ed.). John wiley and sons, New York, 1984, 680.
7. Gupta SC, Sahu S. Response of chickpea to micronutrients and bio-fertilizers in vertisol. Legume Research. 2012;35(3):248-251.
8. Ram S, Katiyar TPS. Effect of phosphorus and zinc on the seed yield and protein Content of summer mungbean under arid Climate. Int. J of sci. and nature. 2013;4(3):563-566.
9. Jackson ML. Soil chemical analysis. Prentice Hall of Indian Pvt. Ltd., New Delhi, 1973.
10. Jackson ML. Soil chemical analysis. Prentice-Hall of India Pvt. Ltd., New Delhi, 1967, 498.
11. Jackson ML. Soil Chemical Analysis. Prentice Hall of India (Pvt.) Ltd., New Delhi, 1973.
12. Khan MR, Ashraf S, Rasool F, Salati KM, Mohiddin FA, Haque Z. Field performance of *Trichoderma* species against wilt disease complex of chickpea caused by *Fusarium oxysporum* f. sp. *ciceri* and *Rhizoctonia solani*. Turkish J Agric. Forestry. 2014;38:447-454.
13. Kuldeep PD Kumawat, Vipen Bhadu, Sumeriya HK, Vinod Kumar. Effect of Iron and Zinc Nutrition on Growth Attributes and Yield of Chickpea (*Cicer arietinum* L.). Int. J Curr. Microbial. App. Sci. 2018;7(08):2837-2841.
14. Nelson, Paul. Le Carré Bleu 4/75. Feuille International d'Architecture, 1975, 3.
15. Roy DP, Narwal RP, Malik RS, Saha BN, Kumar S. Impact of zinc application on checkpea productivity and grain zinc fortication. J of enviro. Biology. 2013;35:851-854.
16. Sarawgi SK, Tiwari PK, Tripathi RS. Uptake and balance

sheet of iron and phosphorus in gram (*Cicer arietinum*) as influenced by phosphorus, bio-fertilizer and micronutrients under rainfed condition. Indian J Agron. 2009;44(4):768-722.
17. Singh PN, Ram H. Effect of phosphorus and Sulphur on concentration and uptake of micronutrients in chickpea. J Indian Soc. Soil Sci. 1992;40:307-312.
18. Subbiah BV, Asija GL. A rapid procedure for assessment of available nitrogen to rice plots. Curr. Sci. 1956;31:196-200.
19. Trivedi AK, Hemantaranjan A, Pandey SK. Iron application may improve growth and yield of soyabean. Indian Journal of plant physiology. 2011;16(3-4):309-313.