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Effect of organic and inorganic fertilizers on yield and yield attributes of groundnut and wheat

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Abstract
In order to evaluate the effects of different combinations of organic and inorganic fertilizers on yield and yield attributes of groundnut and wheat, a field experiment was conducted at Agronomy Farm, B. A. College of Agriculture, Anand, and Gujrat. These two crops were tested during 2013 and 2014 under six fertilizer treatments (T_1 = 75% N (FYM) + 25% N (Vermicompost), T_2 = 50% N (FYM) + 50% N (Castor Cake), T_3 = 50% N (FYM) + 25% N (VC.) + Azotobactor/Rhizobium + PSB (Seed treatment)), T_4 = NPK as per STV, T_5 = RDF + 5 t FYM /ha) and T_6 = RDF + ZnSO4/Gypsum) in a randomized block design. The results of present investigation revealed that the application of 50 % N (FYM) + 25 % N (V.C.) + Rhizobium + PSB (ST) (T_3) had significant effect on haulm yield of groundnut (4622 kg ha-1),and the application RDF-NPK as per STV (T_4) had significant effect on grain yield of wheat. The increased haulm yield in groundnut was to the extent of 11.8 percent over treatment T_4, which received NPK as per STV and recorded minimum yield of 4067 kg ha^{-1} haulm. The increase in yield of wheat grain under inorganic treatment T_4 was to the extent of 14.1 respectively over other treatments. The yield attributes also exhibited similar trend with a significantly increased response due to organic and inorganic treatments in groundnut and wheat respectively.

Keywords: organic, inorganic fertilizers, yield, yield attributes, groundnut and wheat

1. Introduction
Groundnut (*Arachis hypogaea* L.) is considered one of the most important leguminous crops cultivated in diverse climatic conditions around the country. Among the Asian countries, India holds the largest acreage (6.7 million ha) followed by China (4.7 million ha), Indonesia, Myanmar, Pakistan and Thailand. More than 25% of the groundnut area harvested in the world is in India followed by 20% in China. In India the important groundnut growing states are Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra, Madhya Pradesh, Uttar Pradesh, and Rajasthan. It provides a major source of edible oil and vegetable protein (Prasad *et al*., 2011) [17]. Generally, the legumes in the rotation increase the available soil nitrogen because legumes are a large, diverse and agriculturally important family in plant kingdom (Heywood, 1971) [8]. The benefits of the legumes in cereal cropping systems are well established. Legumes are reported to have favorable impact on the soil fertility and help in increasing the yield of succeeding crop (s) Jain *et al*. (2005) [9]. Legumes have the ability to fix atmospheric nitrogen and convert it to a useable form for plant growth (Allen & Allen, 1981) [2]. Wheat (*Triticum aestivum* L.) is the world's leading cereal crop cultivated over an area of about 226.45 m ha with a production of 161.9 m tonnes. In India, the wheat production is about 72 m tonnes from an area of around 25 m ha (Singh *et al*. 2011) [3]. It requires a good supply of nutrients especially nitrogen for its growth (Mandal *et al*., 1992) [11] and yield (Krylov and Pavlov, 1989) [10].

Nutrient management in cropping sequence is an important step among the agronomic practices which is responsible for the sustainable production of these crops in long run. Nutrient requirement varies with different crops in the system and, if investigated systematically, may help to regulate the nutrient demands of the succeeding crops in terms of saving in fertilizer and changes in soil fertility. Use of nutrient for agricultural production is an essential factor to increase crop production but continuous use of chemical fertilizers has deleterious effects on soil which in turn cause decline in productivity, low nutrient recovery efficiency and increase in cost of production and environmental pollution (Sarkar *et al*., 1997) [19]. Reduction in the use of chemical fertilizer and increased used of organic manures is

advisable as, the global environment pollution can be controlled considerably. Application of organic manures may also improve availability of native nutrients in soil as well as the efficiency of applied fertilizers (Sawrup, 2010) [20], stimulate the proliferation of diverse group of soil microorganisms and play an important role in the maintenance of ecological balance of rhizosphere (Chowdhury *et al* 2011) [5].

Groundnut being a legume leaves lot of residual fertility which in turn helps succeeding crop. Hence, incorporation of organic manures such as farmyard manure, vermicompost and castor cake is undertaken in this experiment as they are a good source of nutrients and low C: N ratio for quick decomposition, high N content helps to improve soil structure, soil microbial activity stabilize the production and productivity of the crops in a cropping system as well as these organic manures are low cost and easily available near this experimental area. Groundnut-wheat is one of the pre-dominant cropping sequences found suitable especially under Saurashtra conditions however the potential of groundnut-wheat cropping sequence has never been studied in Middle Gujrat conditions. Therefore, an attempt has been made to study the effect of different organic and inorganic fertilizers on yield and yield attributes of groundnut and wheat.

2. Material and Method

2.1 Study Area: The experiment was undertaken at the Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand, during summer and winter season of 2014 and 2015. The farm is situated at 22.35^0 N latitude and 72.55^0 E longitude with an altitude of 45.1 meters above the mean sea level in middle Gujarat Agro-climatic Zone- IV of Gujarat state. The annual precipitation received during 2014 and 2015 was 1354 and 966 mm, respectively. Two cycles of the system were completed in fixed plots. Soil of the experimental field was (Typic Haplustalf) loamy sandy in texture, low in salinity and alkaline in soil reaction. Low in OC: 0.43 % (Wet oxidation method), low in available-N: 280 kg ha^{-1}(Alkaline permanganate method), medium in available phosphorus: 42 kg P_2O_5 ha^{-1}(Spectrophotometer), Potassium: 210 kg K_2O ha^{-1}(Flame photometry) and marginal in Sulphur: 12mg kg^{-1}($CaCl_2$ extractable turbidimetre) with pH:8.1 (Potentiometer) and electrical conductivity: 0.21 mmhos cm^{-1} (Conductometre). The experiment was laid out in randomized block design (RBD) with six (6) treatments and four replications, tested with groundnut crop var. GG 20 and wheat crop Var.GW 496. Each plot of the experimental field for groundnut and wheat was of area $45m^2$ (4.5m x 10m), with a spacing of 30cm row to row and 10cm plant to plant during both the years. The details of the treatments were: T_1 = 75% N (Farm yard manure- FYM) + 25% N (Vermicompost-VC), T_2 = 50% N (FYM) + 50% N (Castor cake), T_3 = 50% N (FYM) + 25% N (VC) + Azotobactor/Rhizobium + PSB (Seed treatment) (Azotobacter and Rhizobium were applied @ 5 ml kg^{-1} seed for wheat and groundnut crops, respectively and PSB was applied @ 5 ml kg^{-1} seed), T_4 = NPK as per Soil test value(STV), T_5 = Recommendeddose of fertilizer (RDF) + 5 t FYM /ha and T_6 =RDF + ZnSO4/Gypsum (ZnSO4 @ 20 kg ha-1 and gypsum @ 40 kg ha^{-1} were for wheat and groundnut crops, respectively as per treatment). The organic manures were uniformlyspread on the soil surface and then incorporated in the soil by a cultivator. The FYM, VC and castor cake contained on average: 19.2, 17.6 and 23.9% organic C; 0.85, 1.48 and 4.97% total N; 0.88, 1.53 and 0.80% total P; and 0.52, 1.16 and 1.15% total K, respectively. The recommended doses of inorganic fertilizers were 25: 50: 0 and 120: 60: 0 kg ha^{-1} of N, P and K for groundnut and wheat respectively. For nitrogen the source was CH_4N_2O (Urea- Carbonic diamide) and for P the source was $(NH_4)_2HPO_4$ (DAP- Di-ammonium phosphate) as inorganic fertilizer treatment.

2.2 Observations recorded: The biometrical observations were taken during the groundnut (Kharif) and wheat (Rabi) cropping sequence in 2014 and 2015. Yield attributes were observed for groundnut crop were plant height (cm), number of branches per plant, No. of pods per plant, test weight (g), shelling percentage (%), oil percentage (%) and the yield parameters recorded were pod yield (kg ha^{-1}) and haulm yield (kg ha^{-1}). Yield attributes observed for wheat crop were plant height (cm), length of spike (cm), No. of effective tillers per meter, test weight (g), protein content (%) and the yield parameters recorded were grain yield (kg ha^{-1}) and straw yield (kg ha^{-1}).

2.3 Statistical analysis

Statistical analysis of the yield and yield attributes data of groundnut and wheat was subjected to randomized block design model for individual year and split plot design model for pooled analysis so at to get effect of different fertilizer treatments at 5% level of significance in two consecutive years i.e. 2013 and 2014.

3. Results and Discussion

3.1 Yield and yield attributes of groundnut

In the present experiment different treatments of organic and inorganic fertilizer combination had a significant effect yield attributes of groundnut as presented in Table1. Among the various tested combinations the yield attributes exhibited highest plant height (57.65 cm) was observed in treatment T_1 (75% N (FYM) + 25% N (Vermicompost)), which was at par with T_2 (50% N (FYM) + 50% N (Castor Cake)) and T_3 (50% N (FYM) + 25% N (VC.) + Azotobactor/Rhizobium + PSB (Seed treatment)). Number branches/plant (10.11) was maximum in T_2 which was at par with T_3, T_1 and T_5 (RDF + 5 t FYM /ha) treatments. However, number of pods/plant (29.33), test weight (49.88 g), Shelling percentage (63.09 %), and oil content (54.92 %) was recorded to be highest in T_3 which is at par with T_2 and T_1 treatments. On the contrary, groundnut did not performed well in completely inorganic fertilizer treatments i.e. T_4 (NPK as per STV) and T_6 (RDF + ZnSO4/Gypsum) exhibiting the minimum values of yield attributes compared to other treatments. These results were in confirmation to results obtained by, Mohapatra and Dixit (2010) that the applications of organic manures like vermicompost @ 2.5 t ha^{-1} and 5 t ha^{-1}, FYM @ 5 t ha^{-1} and biofertilizers (*Rhizobium*, VAM sole and in integration) to groundnut increased its plant height, no. of branches$plant^{-1}$and pod yield over RDF through chemical fertilizers. The overall better performance of groundnut in T_3 treatment might be due to the fact that groundnut like other legumes forms symbiosis relationship with rhizobia fixes the nitrogen and plays an important role in sustaining crop productivity and maintaining the fertility of the semi-arid lands (Desoky *et al*, 2011) [6]. Dharma, 1996 observed that FYM might have stimulated the activities of microorganisms that made the plant nutrients readily available to the crops which augmented pod yield of groundnut. The results relating yield of groundnut pod and haulm also gave similar trend as that of yield attributes, registering maximum yield of both the kinds under treatment

T_3, but only haulm yield was significantly changed over different treatments, wherein T_3 recorded the highest haulm yield of 4622 kg ha^{-1}, which was at par with T_2 (4601 kg ha^{-1}), T_6 (4518 kg ha^{-1}) and T_5 (4314 kg ha^{-1}) differed significantly from the rest of treatments. The effect of organic and inorganic sources of nutrients also was non-significant for the yield of groundnut pod and haulm; however maximum values were noted under organics. The increased haulm yield was to the extent of 11.8 percent over treatment T_4, which received NPK as per STV and recorded minimum yield of 4067 kg ha^{-1} haulm. The results are similar with Tiwari *et al.* (2002) [21] who reported that groundnut yield was significantly highest due to application of FYM + biofertilizer (*Rhizobium*) over sole application of 40 kg N ha^{-1}. Akbari *et al.* (2011) [1] reported the enhanced groundnut yield with the use of biofertilizers and organic fertilizers. Therefore, Mean of the two years data on groundnut yield and yield attributes, indicated that treatment T_3 had advantage over other treatments as it received seed treatment of Rhizobium + PSB, which might have provided better nutrition as Rhizobium fixes atmospheric nitrogen and PSB has added advantage of releasing native phosphorus by releasing organic acids like malic, citric, oxalic etc., which release phosphorus from chemically bound calcium phosphate also enhanced photosynthesis, production of photosynthates and their partitioning between vegetative and reproductive structure which might have helped in improving the yield attributes (Ola *et al*. 2013) [16].

3.2 Yield and yield attributes of wheat

Results on effect of different treatments of organic and inorganic fertilizers on the yield and yield attributes of wheat (Table 1) revealed that, there is significant difference ($P<0.05$) among all treatments (Table 3). Highest plant height (81.57 cm), test weight (39.64 g), protein content (11.65 %) and maximum number of effective tillers m^{-1} (109.93), was observed in treatment T_4 (NPK as per STV) which was at par with T_6 (RDF + ZnSO4/Gypsum), T_5 (RDF + 5 t FYM /ha) and T_3 (50% N (FYM) + 25% N (VC.) + Azotobactor / Rhizobium + PSB (Seed treatment)). However, maximum Spike length (8.56 cm) was observed in T_2 (50% N (FYM) + 50% N (Castor Cake)) which was at par with T_6, T_5 and T_4 treatments. These results are in harmony with Marshall *et al.* (1987) [12], who found that STV treatment proved to be beneficial over other treatments and yield attributes such as test weight (31.63 g) and plant height (92.4 cm) of wheat was observed to be maximum due to STV fertilizer application. Mohr *et al.* (2007) [15] also reported the influence of STV treatment was kept in addition. It was observed that test weight of wheat (36.31 g) was significantly highest due to STV treatment over other treatment combinations. Further, the results related to yield revealed that the mean maximum and significantly higher grain yield (4865 kg ha^{-1}) of wheat was observed in the treatment T_4 over T_1 (75% N (FYM) + 25% N (Vermicompost)); (4006 kg ha^{-1}) which is closely followed by T_6 and at par with T_5 and T_2 Although there was not significant difference in straw yield of wheat under various treatments the maximum yield was exhibited in T_4 over other combinations. Similar results were also reported by May *et al.* (2004) that the application of RDF through STV recorded significantly higher grain yield (5.23 t ha^{-1}) of wheat as compared with application of 50 % N through FYM + 50 % N through vermicompost (7.5 t ha^{-1}) and through RDF (100:60:60 NPK kg ha^{-1}), Chaturvedi (2006) and Rajkhova and Borah (2008).The increase in yield of wheat grain and straw under inorganic treatments was to the extent of 14.1 and 9.6 per cent, respectively over organics this might be due to the immediate release and availability of nutrients by inorganic sources of nutrients compared with organic manures or even the combined use of inorganic and organic manures. Above results clearly indicated that to get better quality wheat seed and higher yield of grain and straw, application of fertilizers as per soil test values is of prime significance.

Table 1: Effect of different organic and inorganic treatments on yield attributes of groundnut at harvest

Treat.	Plant height (cm)			No. of branches $plant^{-1}$			No. of pods $plant^{-1}$			Test weight (g)			Shelling percentage			Oil content (%)		
	2013	2014	Pooled mean	2013	2014	Pooled mean	2013	2014	Pooled mean	2013	2014	Pooled mean	2013	2014	Pooled mean	2013	2014	Pooled mean
T_1	68.50	46.80	57.65	9.65	9.91	9.81	22.50	34.40	27.95	49.01	48.44	46.29	60.90	63.26	62.08	51.73	55.80	54.71
T_2	65.90	46.70	56.30	10.13	10.10	10.11	22.83	34.15	28.49	50.78	48.32	49.11	60.73	64.92	61.32	52.64	55.81	53.88
T_3	66.00	46.75	56.80	9.75	10.05	9.90	23.92	34.75	29.33	52.90	50.98	49.88	62.90	63.27	63.09	53.42	55.91	54.92
T_4	60.00	46.60	52.80	9.80	9.83	9.41	21.08	33.83	26.94	47.11	41.05	40.08	59.31	64.83	60.07	51.15	55.98	52.28
T_5	63.25	46.50	54.83	9.63	9.98	9.80	22.50	34.95	27.77	49.93	48.02	41.51	60.98	63.31	61.75	52.54	55.82	54.12
T_6	62.25	46.65	53.65	9.75	9.78	9.51	21.33	34.40	26.87	47.48	45.10	43.79	56.38	64.19	58.28	51.24	55.90	52.14
S.Em.±	2.3	1.1	1.1	0.54	0.26	0.24	1.21	0.85	0.80	1.70	2.37	1.09	2.28	2.02	1.13	0.20	0.29	0.21
CD (P=0.05)	2.9	NS	1.45	NS	0.21	0.36	1.31	NS	1.13	3.1	3.75	3.42	2.09	NS	2.17	0.91	NS	1.03
CV%	7.25	4.76	0.79	11.23	5.24	0.15	10.84	5.06	0.40	6.86	9.89	0.67	7.59	6.52	0.73	0.76	1.05	0.11

Table 2: Effect of different organic and inorganic treatments on growth and yield attributes of wheat at harvest

Treat.	Plant height (cm)			Spike length (cm)			No. of effective tillers m^{-1}			Test weight (g)			Protein content (%)		
	2013	2014	Pooled mean	2013	2014	Pooled mean	2013	2014	Pooled mean	2013	2014	Pooled mean	2013	2014	Pooled mean
T_1	78.94	76.88	77.91	7.38	8.83	8.10	101.49	104.08	101.28	35.34	37.48	36.41	10.75	10.57	10.26
T_2	79.33	77.13	78.38	8.09	9.03	8.56	107.75	103.42	104.08	35.85	38.89	37.17	10.65	11.86	11.25
T_3	80.38	77.63	79.00	7.44	8.91	8.18	108.45	102.92	103.46	36.44	39.95	37.99	10.61	11.79	11.35
T_4	84.31	78.83	81.57	7.54	9.34	8.44	114.19	104.66	109.93	37.63	41.65	39.64	10.48	12.97	11.65
T_5	80.63	77.88	79.25	7.60	9.33	8.47	109.19	103.66	106.42	37.48	39.75	38.61	10.97	11.10	11.04
T_6	80.81	78.38	79.59	7.72	9.67	8.53	109.81	104.33	107.07	36.71	40.06	38.39	10.32	11.92	11.20
S.Em.±	1.91	1.59	0.97	0.17	0.33	0.18	3.23	2.91	2.54	0.76	0.90	0.69	0.44	0.35	0.23
CD (P=0.05)	4.8	0.61	2.7	NS	NS	1.1	5.8	NS	4.12	1.61	2.10	1.86	NS	1.56	0.70
CV%	4.73	4.09	0.69	4.61	7.12	0.10	5.97	5.63	1.43	4.18	4.59	0.27	8.43	6.15	0.18

Table 3: Effect of different organic and inorganic treatments on yield of groundnut and wheat

Treat.	Pod yield (kg ha^{-1})			Haulm yield (kg ha^{-1})			Grain yield (kg ha^{-1})			Straw yield (kg ha^{-1})		
	2013	2045	Pooled mean	2013	2014	Pooled mean	2013	2014	Pooled mean	2013	2014	Pooled mean
T_1	2665	2596	2630	4826	3446	4136	3749	4262	4006	5343	4635	4989
T_2	2839	2795	2817	5321	3880	4601	4540	4592	4566	6167	4826	5496
T_3	2865	2917	2891	5330	3915	4622	4271	4332	4301	5500	4783	5142
T_4	2587	2674	2630	4566	3568	4067	4766	4965	4865	6485	5148	5816
T_5	2804	2769	2786	4913	3715	4314	4653	4826	4740	6229	4957	5593
T_6	2813	2795	2804	5304	3733	4518	4764	4896	4830	6353	5069	5711
S.Em.±	124	147	91	230	162	125	223	226	142	304	301	192
CD (P=0.05)	NS	NS	NS	NS	NS	376	672	NS	429	NS	NS	NS
CV%	8.99	10.68	53	9.14	8.71	83	10.01	9.73	84	10.10	12.29	11.7

4. Conclusion

The study indicated that the groundnut showed greater response to the organic treatments (T_3- 50 % N (FYM) + 25 % N (V.C.) + *Rhizobium* + PSB (ST) and exhibited higher haulm yield (4601 kg ha^{-1}) and yield attributes than inorganic treatments viz. RDF-NPK as per STV (T_4) and RDF + ZnSO4/Gypsum(T_6). However there was not significant effect of this response of organic manure in the consecutive wheat crop as the highest yield and yield attributes were reported to be maximum in the inorganic fertilizer treatments. Exhibited increased wheat grain yield due to application of T_4 over organic treatments viz., 75 % N (FYM) + 25 % N (V.C.) (T_1) and 50 % N (FYM) + 25 % N (V.C.) + *Azatobacter* + PSB (ST) (T_3) and it was increased by 21.44 and 13.11 per cent, respectively. It can be concluded from the present study that kharif groundnut crop though had higher yield and yield attributes due to the application of organic manure were not significant due to any of the treatment. Hence, it is not advisable in middle Gujrat condition. In case of wheat the application of adequate amount of fertilizer dose or integrated application of organic or inorganic manure increase the yield.

5. References

1. Akbari LF, Butani BM, Naria JN, Golakiya BA. Effect of integrated nutrient management on groundnut-wheat cropping sequence. Asian Journal of Soil Science. 2011; 6:14-18.
2. Allen ON, Allen EK. The leguminosae: A source book of characteristics, uses, and nodulation. Univ. of Wisconsin Press, Madison, USA. 1981.
3. Chandra Mohan Singh, Sharma PK, Prem Kishor PK, Mishra AP, Singh Rajhans Verma, Raha P. Impact of Integrated Nutrient Management on Growth, Yield and Nutrient Uptake by Wheat (*Triticum aestivum* L.). Asian Journal of Agricultural Research. 2011; 5:76-82.
4. Chaturvedi I. Effects of different nitrogen levels on growth, yield and nutrient uptake of wheat (*Triticum aestivum* L.). International Journal of Agricultural Sciences. 2006; 2(2):372-374.
5. Choudhary SK, Singh JP, Jha S. Effect of integrated nitrogen management on yield, quality and nutrient uptak of rice (Oryza sativa) under different dates of planting. Indian Journal of Agronomy. 2011; 56:228-231.
6. Desoky AH, El-Saw WA, Taher HME. Enhancement of peanut growth and productivity by inoculation with Bradyrhizobium and some rhizobacteria under graded levels of mineral Nfertilization in newly soils. Egypt. J Appl. Sci. 2011; 26:409-427.
7. Dharma AK. Organic farming for sustainable agriculture. Agro Botanical Publishers India. 1996; l15-130.
8. Heywood VH. The leguminosae: A systematic purview. In Chemotaxonomy of the Leguminosae. (Eds.): Harborne JB, Boulter D Turner BL. Academic Press, London. 1971, 1-29.
9. Jain NK, Singh SK, Poonia BL. Optimization of N, P and K requirement for wheat (*Triticum aestivum*) grown in sequence with different kharif crops. Research on Crops. 2005; (1):14-17.
10. Krylov YAI, Pavlov VD. Effect of fertilizer on yield and protein contents in wheat grain. Agrochimiya. 1989; 1:49-51.
11. Mandal NN, Chaudhry PP, Sinha D. Nitrogen, phosphorus and potash uptake of wheat (var. Sonalika). Env. Econ. 1992; 10:297-97.
12. Marshall A, Jackson SD, Smith FC. Long-term effect of nitrogen, sulfur and molybdenum on a subterranean wheat. Soil Science. 1987; 155:343-348.
13. May SR, Cole CV, Watanabe FS, Dean LA. Long term nitrogen, phosphorus and potassium fertilization of wheat influences soil chemical properties in North Vietnam. Canadian J of Soil Science. 2004; 83(3):481-488.
14. Mohapatra S, Dixit BS. Yield trends and soil fertility changes in groundnut-wheat cropping system under long term integrated nutrient management. Annals of Agricultural Research. 2010; 54(2):201-205.
15. Mohr NC, Maliwal GL, Mandal SR. Influence of nitrogen, phosphorus and potash fertilizer application on wheat. Environment and Ecology. 2007; 34(3):430-434.
16. Ola BL, Pareek BL, Rathore PS, Kumawat A. Effect of integrated nutrient management on productivity of groundnut (*Arachis hypogaea* l.) in arid Western Rajasthan. Agriculture for Sustainable Development. 2013; 1(1):13-15.
17. Vara Prasad PV, Vijaya Gopal Kakani, Hari Upadhyaya D. Growth and Production of Groundnuts. Soils, Plant Growth and Crop Production. 2011; l(II):4.
18. Rajkhova DJ, Borah D. Effect of rice straw management on growth and yield of wheat (*Triticum aestivum*). Indian Journal of Agronomy. 2008; 53(2):112-115.
19. Sarkar RK, Karmakar S, Chakraborty A. Response of summer green gram to N, P and bacterial inoculation. Indian Journal of Agronomy. 1997; 38:578-81.
20. Sawrup A. Integrated plant nutrient supply and management strategies for enhancing soil fertility, input use efficiency and crop productivity. J Indian Soc. Soil Sci. 2010; 58:25-30.
21. Tiwari A, Dwivedi AK, Dikshit PR. Long term influence of organic and in organic fertilization on soil fertility and productivity of groundnut-wheat system in vertisols. Journal of the Indian Society of Soil Science. 2002; 50: 472-475.