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Nutrient content and uptake by soybean as influenced by continuous application of fertilizer and manure in black soil

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Abstract
This study aimed to investigate the impact of long term application of inorganic fertilizers and farmyard manure on pattern of nutrient content and nutrient uptake of soybean in black soil. The field experiments was conducted on the Research Farm of Department of Soil Science and Agricultural Chemistry, JNKVV, Jabalpur during 2017-18 and 2018-19 with ten treatments i.e. 50% NPK, 100% NPK, 150% NPK, 100% NPK+HW, 100% NPK+ Zn, 100% NP, 100% N, 100% NPK+FYM, 100% NPK-S and control. The highest content and uptake pattern of nutrient in soybean ware associated with integrated application of fertilizer along with Farmyard manure (100% NPK + FYM). While, the lowest value was found in control as well as 100% N alone. But supplementation of fertilizer P with N (100% NP) enhanced the content uptake in soybean. Moreover, applied 150 % NPK observed the higher value as compared to 100 % NPK and 50% NPK. However, in general higher content and uptake of nutrients were found in grain as compared to straw.

Keywords: Farmyard manure, nutrient content, nutrient uptake, soybean

Introduction
Soybean (*Glycine max* (L.) Merrill) is considered to be an important grain legume and oil crop. It is called as vegetarian meat and wonder crop because it is a rich and cheap source of protein 40-42% and oil 18-20% (Ferrier 1975) [7]. The productivity of soybean is low in this region due to erratic distribution of monsoonal rains, imbalanced use of major and minor nutrients, continuously growing of soybean in the same piece of land and low organic carbon status of soil.

The studies of Osaki (1991) [12], and Tanaka *et al*. (1993) [20] investigated nutrient uptake by soybeans in Brazil and were used as references for several fertilization and liming recommendation guidelines in Brazil. However, soybean cultivars have improved since their publications and now soybean cultivars have increased yields, shortened crop cycles and growth habits to allow cropping systems with corn as second harvest. These changes have led to changes in nutrient demands. Bender *et al*. (2015) [1] observed that modern soybean cultivars exhibited doubled daily biomass production and nutrient uptake compared to cultivars planted in the country. The maximum N content in grain and straw was observed with the application of super optimal dose and the lowest content in grain and straw was recorded in control treatment Raghuwanshi *et al*. (2016) [13].

The balanced fertilization has required for crop production, but combined application of manure may reduce the need for chemical fertilizer. An application of chemical fertilizers in combination with FYM may increase the yield and yield contributing characters such as grain yield, straw yield and biological yield, nutrient content and nutrient uptake, hence ultimately resulting in increased productivity of soybean (Shirpurkar, *et al*., 2006) [17]. Use of organic manure alone or in combination with chemical fertilizers will help to improve physicochemical properties of the soils (Maheshbabu *et al.*, 2008) [10]. Therefore, adequate and balanced application of organic and inorganic fertilizers is necessary to increase productivity and soil fertility.

Materials and Methods
Present study was conducted during 2017-18 and 2018 -19 in Kharif season at experimental site of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India (23°10′N, 79°57′E), with soybean (Glycine max (L.) Merrill) as rainy season crop .The region has a semi-arid and sub-tropical climate, with a mean annual temperature of 25.7°C and precipitation of 1350 mm. Soil was medium black soil classified as Vertisol. The experiment

consisted of 10 treatments replicated four times in a randomized block design consist of gross plot size 17x10.8 m with 1 m spacing between plots and 2 m spacing between the replications With soybean variety JS 20-29; included; 100% NPK (43.5, 500, and 33.34 kg ha-1 Urea, SSP, and MOP, respectively), 150% NPK (65.1, 750, and 49.99 kg ha-1 Urea, SSP, and MOP, respectively), combination of 100% NPK+ FYM (5 t ha-1), and no fertilizer (control). Inorganic fertilizers include urea (460 g N kg-1 of Urea), super phosphate (160 g P kg-1 of Super phosphate), and potassium chloride (600 g K kg-1 of MOP) as the sources of N, P, and K respectively. All soybean plants were harvested at crop maturity and grain yield was obtained. Next to this, grain nutrients NPK were analyzed (Bhargava *et al*., 1984 and Bradstre *et al*., 1965) and nutrient uptake was calculated by using. Formula: Nutrient uptake (kg ha -1) = Nutrient content (%) x Yield (kg ha-1) [3].

Result and Discussion

Nutrient content in soybean

Nutrient content in seed

The data of table 1 indicate that the highest N content (6.40 %) was recorded in 100% NPK+FYM, whereas the lowest value was noticed as 4.63 % in control. Nitrogen content in seed was significantly higher in all the treatments over control. While, further addition of P (100% NP) was significantly raised the uptake. The higher N uptakes in grain and straw were recorded where 150% NPK applied, as compared to 100% N and 50% NPK dose. Applied FYM along with optimal dose helped to increase the uptake of N as compared to the other treatments. Similar, trend of N uptake was also noticed in case of straw Raghuwanshi *et al*. (2016) [13]. Phosphorus content in seed raised successively from 0.25 % (control) to 0.27%, 0.36 % and 0.37 % in 50 %NPK, 100 %NPK and 150 %NPK treatments, respectively. Phosphorus content in seed was higher in 100% NPK+FYM (0.40%) than 150% NPK (0.37%). Phosphorus content in seed was significantly higher in all the treatments over control except 100% N and 50% NPK. Similar finding have been reported by Sharma and Vikas (2007) [15]. The content of P was recorded maximum under applied fertilizer with organic manure and super optimal doses within seed of the soybean. The lowest concentration of P in seed was found in control plots. Similar, trend of P content was also noticed as earlier reported by Chandrol (2017) [4].

The highest Potassium content (1.67%) in seed of soybean was recorded under 100% NPK+FYM, whereas the lowest value was noticed as 1.20 % in control. Potassium content in seed was significantly higher in all the treatments over control except 100% N and 100 % NPK. Hence, its lowest content was observed in the treatment where K was omitted (i.e. 100% N and control). Similar finding was reported by Raghuwanshi *et al*. (2016) [13]

Sulphur content in seed raised successively from 0.13% (control) to 0.22%, 0.31% and 0.34% in 50%NPK, 100%NPK and 150%NPK treatments, respectively. Sulphur content of seed was higher in 100% NPK+FYM (0.40%) than 150% NPK (0.34%). Sulphur content in seed was significantly higher in all the treatments over control. The data also revealed that the maximum values of S content seed rather than the straw. As an essential constituent of amino acids, the sulphur transformed into organic compounds which accumulates as seed storage reserves, there by leading to a apparent depletion of S content straw as reported by Sharma (1992) [16], and Jadhav *et al*. (2007) [9].

Nutrient content in Stover

The data present in table 2. Indicate that the highest N content (3.22 %) in stover was resulted by 100% NPK+FYM, where as the lowest value was noticed as 1.93 % in control. Nitrogen content in stover was significantly higher in all the treatments over control except 50 % NPK treatment. Similar findings were reported by Nagawanshi *et al*. (2018). Also reported the higher N content in straw where 150% NPK were applied, as compared to 100 % N and 50% NPK dose. Applied FYM along with optimal dose helped to increase the uptake of N as compared to the other treatments. As regard the phosphorus content in stover raised successively from 0.14 % (control) to 0.15%, 0.18% and 0.19% in 50% NPK, 100% NPK and 150% NPK treatments, respectively. Phosphorus content in stover was highest in 100% NPK+FYM (0.20%) followed by 150% NPK (0.19%). P content in stover was significantly higher in all the treatments over control except 100% N alone and 50% NPK treatments. The lowest concentration of P in stover was found in control plots. Similar, trend of P content was also noticed in case of stover as earlier reported by Ravankar *et al*. (2003) [14]. Further, the highest K content (2.57%) in stover of soybean was observed in 100%NPK+FYM, where as the lowest value was obtained (1.84%) in control. Hence, its lowest content was observed in the treatment where K was omitted (i.e. 100% N and control). It has also been observed that low content of K was found in grain as compared to the straw. Similar finding was reported by Suman *et al*. (2017) [19]. Sulphur content in stover raised successively from 0.12% (control) to 0.16%, 0.21% and 0.23% in 50%NPK, 100%NPK and 150%NPK treatments, respectively. Sulphur content of stover was higher in 100% NPK+FYM (0.26%) than 150% NPK (0.23%). Sulphur content in stover was significantly higher in all the treatments over control except 100%N and 100% NPK (-S) treatment in soybean stover was confined in control. Similar results were reported by Dubey *et al*. (2015) [5]. Jadhave *et al*. (2007) [9], Sime and Nand ram (2012) [18].

Nutrient uptake by Soybean

Nutrient uptake by seed and stover

The data pertaining to uptake of nitrogen by soybean is presented in Table 3. Pooled mean value indicate the N uptake was noticed to differ significantly with different treatment combinations. In seed, maximum uptake (134.7 kg ha-1) of N was recorded under treatment receiving 100 % NPK + 5 t FYM ha-1. Applied FYM with 100% NPK helped to increase the N uptake by soybean seed as compared to the application of 100% NPK (97.48 kg ha-1), while the lowest N uptake in seed (34.12 kg ha-1) was found in control plot. All the treatments were found significantly higher N uptake by soybean seed over control except 100% N. Optimum dose (T2) was significantly higher over sub optimal dose (T1).The similar trend of N uptake was also reported by Gupta *et al*. (2018) [8].

In stover the highest nitrogen uptake (112.1 kg ha-1) was recorded in treatment receiving 100% NPK + 5 t FYM ha-1 followed by 150% NPK (96.16 kg ha-1) and the minimum uptake was recorded in control (33.31 kg ha-1) followed by 100% N (51.34 kg ha-1) (table 4). The uptake of N was significantly increased with increase the rate of fertilizer application 50% NPK, 100% NPK and 150% NPK (49.87, 83.88 and 96.16 kg ha-1) respectively. Similar results were reported by Dwivedi *et al*. (2016) [13].

It is revealed from the data given in Table 3. The Phosphorus uptake in soybean (Seed and Stover) was markedly affected due to various treatments. In seed of soybean the maximum uptake of P (8.35 kg ha-1) was recorded under treatment receiving 100 % NPK + 5 t FYM ha-1 followed by 150% NPK treatments (7.43 kg ha-1). The lowest of P in seed (1.84 kg ha-1) was found in control plot. The entire treatments inclusive P dose were found significantly higher phosphorus uptake by soybean in seed over control.

In stover the highest phosphorus uptake (6.90 kg ha-1) was recorded with treatment receiving 100% NPK + 5 t FYM ha-1 followed by 150% NPK (6.09 kg ha-1). The minimum uptake was observed in control (2.39 kg ha-1) followed by 100% N (3.11 kg ha-1). The uptake of Phosphorus was significantly increased with increase the dose of fertilizer i.e. 50% NPK, 100% NPK and 150% NPK (3.49, 5.30 and 6.09 kg ha-1) respectively (Table 4). The successive addition of fertilizer had resulted in higher uptake by and stover of soybean. This could be due to successive addition of phosphorus through fertilizer which had resulted in proportionately, higher availability in the soil for its subsequent uptake and utilization by plants. Hence, the lowest content of Phosphorous coincided with control and 100% N alone plots. Similar finding have been reported by Chandrol (2017) [4]. and Dwivedi *et al*. (2018) [6, 8, 11]

The data pertaining to uptake of potassium by soybean (seed are presented in (Table 3). Pooled mean value indicate the maximum uptake of K (35.04 kg ha-1) by soybean seed was recorded under treatment receiving 100% NPK +FYM which was significantly higher with T3 (31.89 kg ha-1). All the treatments were found significantly higher K uptake by soybean seed over control except 100% N (T7).Similar trend of k uptake by soybean was found by Dwivedi and Dwivedi, (2015) [5].

In soybean stover the highest potassium uptake (89.63 kg ha-1) was recorded with treatment receiving 100% NPK + 5 t FYM ha-1 followed by 150% NPK (80.22 kg ha-1). The minimum uptake was recorded in control (31.63 kg ha-1) followed by 100% N (40.05 kg ha-1). The uptake of K by soybean stover was significantly increased with increase the rate of fertilizer application 50% NPK, 100% NPK and 150% NPK (50.36, 70.0 and 80.22. kg ha-1) respectively. There was a progressive increase in K uptake with successive additions of NPK fertilizer over sub optimal, imbalance or without fertilizer addition, which could obviously be a result of successive addition of K through higher fertilizer doses (Suman *et al*., 2017) [19]. Hence, its lowest uptake was observed in the treatment where K was omitted (i.e. 100% N and control). It has also been observed that low uptake of K was found in seed as compared to the stover, the highest K content and uptake in seed and stover was noticed with 100% NPK + FYM treatment. Similar finding was reported by Dwivedi *et al*, (2018) [6, 8, 11].

The data pertaining to uptake of sulphur by soybean (seed) is presented in (Table 3). Pooled mean value indicate sulphur uptake in seed raised successively from 1.14 kg ha -1 (control) to 2.80 kg ha -1, 4.92 kg ha -1 and 6.71 kg ha -1 in 50%NPK, 100%NPK and 150%NPK treatments, respectively. Sulphur uptake of seed was higher in 100% NPK+FYM (8.16 kg ha -1) than 150% NPK (6.71 kg ha -1). Sulphur content in seed was significantly higher in all the treatments over control except 100%N treatments.

Sulphur uptake by soybean stover raised successively from 1.80 kg ha -1 (control) to 3.71 kg ha -1, 6.10 kg ha -1 and 7.53 kg ha -1 % in 50%NPK, 100%NPK and 150%NPK treatments, respectively. Sulphur uptake by stover was higher in 100% NPK+FYM (8.65 kg ha -1) than 150% NPK (7.53 kg ha -1). Sulphur uptake in stover was significantly higher in all the treatments over control except 100%N treatments (table 4). Sulphur uptake increased regularly with each increment of applied NPK fertilizers on the contrary, the lowest uptake was noted in control and 100% N which could be obvious as earlier reported by Sime and Nand Ram (2012) [18]. The maximum sulphur uptake was found in optimal dose with FYM than control. The data also revealed that the maximum value of sulphur uptake was attained in grain rather than the straw Sharma (1992) [16], Jadhav *et al*. (2007) [9]. Dwivedi and Dwivedi. (2015) [5].

Table 1: Effect of treatment on nutrient content on soybean seed

Treatments	Nitrogen %			Phosphorus %			Potassium %			Sulphur %		
	Seed			Seed			Seed			Seed		
	2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled
50% NPK	4.75	5.21	4.98	0.26	0.29	0.27	1.29	1.35	1.32	0.22	0.23	0.22
100%NPK	5.72	6.17	5.94	0.34	0.38	0.36	1.42	1.46	1.44	0.30	0.31	0.31
150%NPK	6.33	6.28	6.31	0.36	0.39	0.37	1.60	1.61	1.61	0.31	0.37	0.34
100%NPK+ HW	5.63	5.81	5.72	0.34	0.35	0.35	1.36	1.41	1.38	0.31	0.31	0.31
100%NPK+ Zn	5.87	6.12	6.00	0.35	0.36	0.36	1.37	1.42	1.40	0.30	0.30	0.30
100%NP	5.50	5.61	5.56	0.27	0.32	0.30	1.24	1.24	1.24	0.27	0.28	0.28
100%N	5.21	5.36	5.29	0.25	0.27	0.26	1.25	1.23	1.24	0.18	0.16	0.17
100%NPK+ FYM	6.50	6.31	6.40	0.40	0.40	0.40	1.69	1.66	1.67	0.39	0.41	0.40
100%NPK-S	5.51	5.71	5.61	0.32	0.34	0.33	1.29	1.39	1.34	0.18	0.18	0.18
Control	4.21	5.04	4.63	0.24	0.26	0.25	1.19	1.21	1.20	0.13	0.14	0.13
SEm±	0.21	0.17	0.13	0.02	0.02	0.01	0.05	0.04	0.03	0.01	0.01	0.01
CD (p=0.05)	0.61	0.49	0.39	0.06	0.05	0.03	0.15	0.12	0.10	0.04	0.03	0.03

Table 2: Effect of treatment on nutrient content on soybean Stover

Treatments	Nitrogen %			Phosphorus %			Potassium %			Sulphur %		
	Stover			Stover			Stover			Stover		
	2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled
50% NPK	1.98	2.23	2.10	0.12	0.17	0.15	2.11	2.16	2.14	0.15	0.17	0.16
100%NPK	2.51	3.06	2.79	0.16	0.20	0.18	2.33	2.31	2.32	0.21	0.21	0.21
150%NPK	2.60	3.35	2.97	0.17	0.21	0.19	2.49	2.49	2.49	0.23	0.24	0.23
100%NPK+ HW	2.82	3.00	2.91	0.16	0.19	0.17	2.25	2.29	2.27	0.20	0.21	0.21
100%NPK+ Zn	3.02	3.02	3.02	0.15	0.20	0.18	2.28	2.31	2.29	0.19	0.20	0.19
100%NP	2.71	2.72	2.71	0.18	0.18	0.18	1.92	1.95	1.94	0.17	0.18	0.18
100%N	2.49	2.49	2.49	0.14	0.16	0.15	1.94	1.94	1.94	0.15	0.12	0.13
100%NPK+ FYM	2.93	3.51	3.22	0.19	0.21	0.20	2.57	2.57	2.57	0.24	0.28	0.26
100%NPK-S	2.41	2.86	2.63	0.17	0.19	0.18	2.27	2.27	2.27	0.16	0.15	0.15
Control	1.81	2.06	1.93	0.11	0.16	0.14	1.76	1.91	1.84	0.12	0.14	0.12
SEm±	0.17	0.07	0.08	0.01	0.02	0.01	0.07	0.08	0.06	0.02	0.01	0.01
CD (p=0.05)	0.50	0.20	0.24	0.03	0.05	0.02	0.21	0.22	0.17	0.05	0.03	0.04

Table 3: Impact of long term fertilizer and FYM application on nutrient uptake by soybean seed

Treatments	Nitrogen (kg ha^{-1})			Phosphorus (kg ha^{-1})			Potassium (kg ha^{-1})			Sulphur (kg ha^{-1})		
	Seed			Seed			Seed			Seed		
	2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled
50% NPK	61.51	67.98	64.75	3.41	3.72	3.57	16.84	17.49	17.16	2.72	2.89	2.80
100%NPK	93.97	101.00	97.48	5.59	6.16	5.88	23.24	23.79	23.52	4.84	5.01	4.92
150%NPK	125.7	124.8	125.32	7.18	7.67	7.43	31.77	32.0	31.89	6.14	7.28	6.71
100%NPK+ HW	91.29	94.11	92.70	5.54	5.65	5.60	22.09	22.78	22.44	4.98	5.08	5.03
100%NPK+ Zn	92.41	96.66	94.54	5.62	5.75	5.69	21.84	22.74	22.29	4.63	4.64	4.58
100%NP	79.78	81.32	80.55	3.94	4.61	4.27	17.83	17.83	17.83	3.93	4.72	4.82
100%N	42.95	44.27	43.61	2.11	2.21	2.16	10.33	10.15	10.24	1.19	1.22	1.20
100%NPK+ FYM	136.7	132.7	134.7	8.35	8.35	8.35	35.29	34.79	35.04	8.10	8.22	8.16
100%NPK-S	81.56	84.32	82.94	4.77	5.07	4.92	19.20	20.65	19.92	2.68	2.49	2.53
Control	31.01	37.23	34.12	1.73	1.94	1.84	8.71	8.92	8.82	1.18	1.10	1.14
SEm±	4.79	4.61	3.61	0.39	0.36	0.29	1.0	1.1	0.84	0.33	0.37	0.27
CD (p=0.05)	13.90	13.38	10.29	1.14	1.0	0.83	3.0	3.2	2.39	0.96	1.04	0.76

Table 4: Impact of long term fertilizer and FYM application on nutrient uptake by soybean stover

Treatments	Nitrogen (kg ha^{-1})			Phosphorus (kg ha^{-1})			Potassium (kg ha^{-1})			Sulphur (kg ha^{-1})		
	Stover			Stover			Stover			Stover		
	2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled
50% NPK	47.1	52.6	49.87	2.90	4.09	3.49	49.6	51.0	50.36	3.69	3.74	3.71
100%NPK	75.3	92.3	83.88	4.65	5.94	5.30	70.3	69.6	70.00	6.02	6.19	6.10
150%NPK	84.0	108.0	96.16	5.61	6.57	6.09	80.2	80.2	80.22	7.44	7.61	7.53
100%NPK+ HW	84.2	89.5	86.89	4.80	5.59	5.19	67.1	68.2	67.70	6.26	6.12	6.19
100%NPK+ Zn	90.5	90.5	90.52	4.50	6.09	5.30	68.5	69.3	68.91	4.67	4.85	4.62
100%NP	78.2	78.5	78.40	5.28	5.28	5.28	55.6	56.3	55.98	5.15	4.99	5.07
100%N	51.3	51.3	51.34	2.96	3.27	3.11	40.05	40.05	40.05	2.99	2.42	2.70
100%NPK+ FYM	101.9	122.0	112.1	6.50	7.30	6.90	89.6	89.6	89.63	8.33	8.98	8.65
100%NPK-S	68.0	81.4	74.72	4.67	5.34	5.00	64.6	64.6	64.60	4.42	4.20	4.31
Control	31.0	35.5	33.31	1.96	2.81	2.39	30.3	32.9	31.63	1.76	1.84	1.80
SEm±	5.6	4.5	3.6	0.45	0.46	0.29	3.76	3.8	0.01	0.52	0.39	0.36
CD (p=0.05)	16.4	13.3	10.4	1.31	1.3	0.82	10.9	11.0	0.03	1.52	1.12	1.08

References

1. Bender RR, Haegele JW, Below FE. Nutrient uptake, partitioning, and remobilization in modern soybean varieties. Agronomy Journal. 2015; 107:563-573.
2. Bhargava BS, Raghupati HB. Analysis of plant materials for macro and micronutrients, in Methods of Analysis of Soil, Plants, Water and Fertilizers (Tandon HLS ed), 1993, 49-82, FDCO, New Delhi.
3. Bradstreet RB. The Kjeldahl Method for Organic Nitrogen, Academic Press, London, 1965.
4. Chandrol A. Effect of long term fertilizer and manure application on physiological character of soybean and nutrients status of soil. M.sc. Thesis, JNKVV, Jabalpur, 2017.
5. Dubey L, Dwivedi AK, Dubey M. Long term application of fertilizer and manures on physicochemical properties and N, P and K uptake in soybean-wheat cropping system. 2015; 15(1):143-147.
6. Dwivedi BS, Dwivedi AK, Sharma A. Effect of continuous fertilizer and manure application on productivity of soybean-wheat cropping sequence. International Conf. on sustainability of small holder a GRIAN. In developing countries changing climate Scenario, CSAUAT, Raipur held on 14-17 Feb, 2018, 156.
7. Ferrier LK. Simple processing of whole soybean. Processing of Conference for Scientists of Africa and South Asia on Soybean Production, Protection International Agriculture Publication. Urbana,

Champaign, USA, Soybean 3 Report, 1975-1989, 178-182.

8. Gupta A, Nagwanshi A, Dwivedi AK. Dwivedi BS. Effect of Long Term Application of Chemical Fertilizers and Organic Manure Application on Crop Quality Parameters in Soybean Crop. Int. J Curr. Microbiol. App. Sci. 2018; 7:1403-1407.
9. Jadhav PM, Rane SD, Ranshur NJ, Todmal SM. Effect of integrated nutrient management on quality and yield of soybean. Asian J Soc. Sci. 2007; 2(1):68-73.
10. Maheshbabu HM, Hunje R, Patil NB, Babalad HB. Effect of organic manures on plant growth, seed yield and quality of soybean. Karnataka Journal of Agricultural Sciences. 2008; 21(2):219-221, 20.
11. Nagwanshi A, Dwivedi AK, Dwivedi BS, Anupama K. Effect of long term application of fertilizer and manure on soil properties of a Vertisol in soybean- wheat cropping sequence. International Journal of Chemical Studies. 2018; 6(3):2946- 2949.
12. Osaki M, Morikawa K, Shinano T, Urayama M, Tadano T. Productivity of high-yielding crops: II Comparison of N, P, K, Ca, and Mg accumulation and distribution among high-yielding crops. Soil Science and Plant Nutrition. 1991; 37:445-454.
13. Raghuwanshi C, Khamparia NK, Thakur R, Sahare SK, Sharma V, Dwivedi BS. Impact of long term application of inorganic fertilizers and organic manure on yield attribute characters, yield of soybean and soil fertility in a Vertisol. Eco. Env. & Cons. 2016; 22(2):745-753.
14. Ravankar HN, Patil RT, Sarap PA. Impact of inorganic fertilizers and organic manure on soil properties and crop yield under soybean wheat system. Res. Crops. 2003; 4(3):301-304.
15. Sharma V, Vikas A. Effect of phosphorous and zinc application on yield and uptake of P and Zn by chickpea under rainfed conditions. Journal of food legumes. 2007; 20(1):49-51.
16. Sharma RK. Nutrient removal by soybean, wheat and maize fodder taken in sequence as influenced by long-term fertilizer application on Typic Chromustert. Ph.D. Thesis, JNKVV, Jabalpur, 1992.
17. Shirpurkar GN, Kashid NV, Kamble MS, Pisal AA, Sarode ND. Effect of application of zinc, boron and molybdenum on yield and yield attributing characters of soybean {*Glycine max* (L.) Merrill}. Legume Research an International Journal. 2006; 29(4):242-246.
18. Sime T, Nand Ram. Impact of long-term integrated nutrient management on the availability of calcium, magnesium, sulphur and macronutrients and their removal by wheat on a Mollisol in North India. Acta Agronomica Hungarica. 2012; 60(2):151-156.
19. Suman J, Dwivedi BS, Dwivedi AK, Pandey SK. Impact of continuous addition of fertilizers and manures on soil nutrient status, uptake, protein and oil content of soybean in a Vertisol. Research Journal of Agricultural Sci. 2017; 8(1):159-163.
20. Tanaka RT, Mascarenhas HA, Borkert CM, Arantes NE, Souza PIM. Nutrição mineral da soja. In N. E. Arantes, & P. I. de M. Sousa (Eds.), Cultura da soja nos Cerrados. Piracicaba: Associação Brasileira para Pesquisa da Potassa e do Fosfato, 1993.