International Journal of Chemical Studies 2019; 7(5): 4494-4497

International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(5): 4494-4497

Received: 16-07-2019
Accepted: 18-08-2019

Sandeep Navrang
Department of Agronomy, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Sunil Kumar
Department of Agronomy, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Manju Tandon
Department of Agronomy, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Corresponding Author:
Sandeep Navrang
Department of Agronomy, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Effect of nutrient management and cropping system on physico-chemical and nutrient availability of soil in soybean (*Glycine max* L. Merril)

Sandeep Navrang, Sunil Kumar and Manju Tandon

Abstract
A field experiment was conducted at Research cum instructional Farm, IGKV, Raipur during *Kharif* 2018 and 2019. The data on bulk density (Mg m^{-3}), pH, EC(dSm^{-1}**),** organic carbon and availability of N, P and K, the bulk density significantly influenced by nutrient management and cropping system, the highest bulk density in (NM_5) 100% RDN through inorganic sources. Whereas the organic carbon in 2018 was remained unaffected and further 2018 it was slightly increases. While the availability of N, P and K in soil was possessed by the treatment supplying in (NM_6) 100% RDN through inorganic sources along with FYM @ 5t ha^{-1}. It was found at par with $NM_{1,}$ NM_4, and $NM_{5,}$ respectively during 2018.

Keywords: Cropping system, nutrient, soybean, FYM, vermicompost

Introduction
Soybean (*Glycine max* L. Merril) is the 2^{nd} most important oilseed crop after groundnut. It is also known as gold of 20^{th} century due to its easy cultivation, high cost: benefit ratio, less requirement of nitrogen etc. It has atmospheric nitrogen fixing ability and deep root system; thus soybean cultivation enhances soil health. It contains about 40 per cent protein, 18-20 per cent oil, 26 per cent carbohydrates, 2 per cent phospholipids and 4 per cent minerals (Haldankar *et al*., 1992). The origin of soybean is reported to be in eastern Asia or China. According to Food and Agriculture Organization (FAO), during 2018-19, area under soybean cultivation in the world was 125.69 million hectares, with global production of 362.08 million metric tonnes and productivity of 2088 kg ha^{-1} (Anonymous, 2019) [1].
India occupies an area of 11.8 million hectare, with 12.5 million tonnes production and about 1228 kg ha^{-1} productivity during 2018-19 (Anonymous, 2019) [1]. The estimate for cost of production of soybean during 2017-18 accounts for about Rs. 2121 q^{-1} of produce. During 2018-19, the area under soybean cultivation in Chhattisgarh was limited to 128.1 thousand hectare with productivity of 865 kg per hectare (Anonymous, 2018). Soybean is important kharif crop in Chhattisgarh grown under upland, unbunded heavy black soils (*Vertisols*) locally known as "*Bharri*". Nutrient requirement of crop in Asian countries may not be met with the use of chemical fertilizers solely. Secondly, the results of a large number of experiments on manures and fertilizers conducted in several countries reveal that neither chemical fertilizers alone, nor organic sources used exclusively, can sustain the productivity of soils under high intensive cropping systems. The long - term use of inorganic fertilizers without organic supplements damage the soil physical, chemical and biological properties which is directly related to soil degradation and cause environmental pollution. Chemical fertilizers have been linked to serious environmental problems (Cordell *et al*., 2009, Ju *et al*., 2006, Guo *et al*., 2010) [9, 10, 8].

Material and methods
A field experiment was carried out at Research cum instructional Farm, IGKV, Raipur during *Kharif 2018* and 2019.The soil of experimental field was '*Vertisols*' which is locally known as '*kanhar*'. The soil was neutral in reaction and medium in fertility levels having low in N, medium in P and high in K. The six (6) treatments of nutrient management and four cropping system (CS) *viz.* ($NM_{1)}$ 100% RDN through organic sources, (NM_2) 75% RDN through

organic sources + foliar spray of VW (10%) fb CU (10%) at 30 and 50 DAS/DAT, NM_3 -50% RDN through organic + 50% RDN through inorganic sources, (NM_4) 75% RDN through organic+ 25% RDN through inorganic sources, (NM_5)100% RDN through inorganic sources, (NM_6)100% RDN through inorganic sources + FYM @ 5t ha^{-1}, and (CS_1) soybean -sweet corn, (CS_2) soybean -garden pea, (CS_3) soybean-chilli and (CS_4) soybean-onion were tested in strip plot design with three replications. The soybean cultivar 'JS-9752' was used during the investigation. All the organic source of nutrients such as vermicompost, neem cake and FYM were used before the sowing of crop and in split doses as per the required of treatments in respective plots to fulfil the nutrient requirement 30:60:30 kg N:P_2O_5:K_2O ha^{-1}. The N, P and K content of different available organic manures were determined in laboratory and accordingly, and required quantity were applied in different treatment on the basis of nitrogen content (%) of organic sources. P was supplemented through rock phosphate (22% P_2O_5) after adjusting the quantity of P supplied through manures.

Result and discussion

Bulk density

The data on bulk density of soil as influenced by several nutrient management treatments and cropping systems during both the years and on mean basis have been shown in the Table 1. It varied from 1.36 to 1.42 Mg m^{-3} in mean data. Significantly lowest bulk density of soil (1.37, 1.35 and 1.36 Mg m^{-3} respectively) was noticed after application of 100% RDN through organic sources (NM_1) and was comparable with (1.38, 1.36 and 1.37 Mg m^{-3}, respectively) NM_2 *i.e.* 75% RDN through organic sources + foliar spray of VW (10%) fb CU (10%) at 30 and 50 DAS/DAT and NM_4 (1.39, 1.37 and 1.38 Mg m^{-3}, respectively) where 75% RDN through organic + 25% RDN through inorganic sources were applied during 2017, 2018 and on mean basis. Further, 100% RDN through inorganic sources (NM_5) recorded the highest bulk density (1.42, 1.41 and 1.42 Mg m^{-3}, respectively) during respective years and on mean basis Low bulk density in 100% organically managed plots might be due to the availability of organic matter to soil at proper time and proper proportions. Majajah and Dhyan (2001); and Khan *et al.* (2010) [4] reported that FYM applied plots have advantages of decreased soil bulk density. The effect of cropping systems on bulk density of soil remain unchanged during the course of investigation and mean over years. The interaction effects of nutrient management and cropping systems remained non significant during both the years and their mean.

Table 1: Effect of nutrient management practices and cropping system on bulk density, pH, EC and organic carbon of soil after harvest of *kharif* crop

Treatments	Bulk density (Mg m^{-3})			pH			EC(dSm^{-1})			Organic carbon (%)		
	2017-18	2018-19	Mean	2017-18	2018-19	Mean	2017-18	2018-19	Mean	2017-18	2018-19	Mean
Nutrient management												
NM_1	1.37	1.35	1.36	7.67	7.40	7.54	0.33	0.32	0.33	0.68	0.70	0.69
NM_2	1.38	1.36	1.37	7.64	7.47	7.56	0.34	0.32	0.33	0.67	0.68	0.67
NM_3	1.40	1.38	1.39	7.65	7.50	7.57	0.33	0.32	0.33	0.67	0.68	0.67
NM_4	1.39	1.37	1.38	7.62	7.45	7.53	0.34	0.33	0.33	0.67	0.68	0.67
NM_5	1.42	1.41	1.42	7.63	7.62	7.62	0.35	0.34	0.34	0.66	0.67	0.66
NM_6	1.39	1.38	1.39	7.65	7.56	7.60	0.34	0.33	0.34	0.68	0.68	0.68
SEm±	0.01	0.01	0.01	0.05	0.05	0.03	0.01	0.01	0.01	0.00	0.00	0.00
CD (P=0.05)	0.02	0.02	0.02	NS	NS	NS	NS	NS	NS	NS	0.01	0.01
Cropping system												
CS_1	1.39	1.38	1.39	7.63	7.48	7.56	0.34	0.33	0.33	0.67	0.67	0.67
CS_2	1.39	1.38	1.38	7.63	7.49	7.56	0.33	0.31	0.32	0.67	0.68	0.67
CS_3	1.39	1.38	1.38	7.65	7.51	7.58	0.33	0.32	0.32	0.67	0.68	0.67
CS_4	1.39	1.38	1.39	7.66	7.52	7.59	0.34	0.33	0.34	0.68	0.68	0.68
SEm±	0.01	0.01	0.01	0.03	0.03	0.03	0.01	0.01	0.00	0.00	0.00	0.00
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
N X C	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Nutrient management

NM_1 - 100% RDN through organic sources
NM_2 -75% RDN through organic sources + foliar spray of VW (10%) fb CU (10%) at 30 and 50 DAS/DAT
NM_3 - 50% RDN through organic + 50% RDN through inorganic sources
NM_4 - 75% RDN through organic+ 25% RDN through inorganic sources
NM_5 - 100% RDN through inorganic sources
NM_6 - 100% RDN through inorganic sources + FYM @ 5t ha^{-1}

Cropping system

CS_1- Soybean -sweet corn
CS_2 - Soybean -garden pea
CS_3 - Soybean-chilli
CS_4- Soybean-onion

pH

The data showing effect of nutrient management and cropping systems on soil pH after harvest of *kharif* crop have been presented in the Table 4.13. Soil pH affects nutrient availability because the H^+ ions take up space on the negative charges along the soil surface, displacing nutrients. Neutral conditions appear to be the best for crop growth. The effect of various fertilization schedules, cropping systems and the interaction between them on pH of the soil during both the years and their average analysis were found to be statistically non significant.

Electrical conductivity

Soil electrical conductivity (EC) is a measurement that correlates with soil properties that affect crop productivity. The data on EC of soil remained unaffected due to different nutrient management schedules and cropping systems during both the years and their mean analysis (Table 1). The interaction effect of nutrient management and cropping systems also remained non significant during both the years and their mean.

Organic carbon

The data on organic carbon of soil after harvest of the *kharif* crop as affected by nutrient management schedules during both the years and their mean analysis have been depicted in the Table 1. As per the observation, it could be cocluded that NM_1 *i.e.* treatment applied with 100% RDN through organic sources have gained maximum soil organic carbon (0.70 and 0.69%, respectively) whereas in NM_5, least increase in organic carbon (0.67 and 0.66%, respectively) was noticed during 2018 and the mean analysis. The differences among the effect of nutrient management practices on soil organic carbon remained unaffected during 2017. Tha data on organic carbon as influenced by cropping systems remain unchanged during both the years and on their average analysis. The interaction effects of nutrient management and cropping systems remained non significant during both the years and on mean basis. Continuous and appropriate use of organic sources with proper management can increase organic carbon content and physical properties of soils. The result is in confirmation with the findings of Atiyeh *et al*. (2002) and Sharma and Prasad (2013) [6]. Application of inorganic fertilizers only showed negative impact and reduced the organic carbon content of soil as reported by Singh *et al*. (2008) [7].

Available Nitrogen (kg ha^{-1})

The information regarding available soil nitrogen after harvest of *kharif* crop as a result of various nutrient management schedules and cropping systems have been picturized in the Table 2. The highest available nitrogen in soil was possessed by the treatment supplying 100% RDN through inorganic sources along with FYM @ 5t ha^{-1} (NM_6 - 245.0, 252.67 and 248.83 kg ha^{-1}, respectively) during the course of study and mean analysis followed by NM_1 (239.0, 251.50 and 245.25 kg ha^{-1}, respectively). NM_4 (237.15 kg ha^{-1}) was also at par during 2017. The least available nitrogen was recorded under NM_2 (229.70, 234.00 and 231.85 kg ha^{-1} during respective years and on mean basis respectively).No significant data on available soil nitrogen was recorded after the harvest of *kharif* crop as controlled by cropping systems. Similarly, the interaction effect of fertilization schedules and cropping systems remained unaltered.The response of soybean to FYM may be attributed to better nutrient availability, enhanced inherent nutrient supply capacity of the soil and physical and biological properties (Hati *et al*., 2005) [3]. Our results could be confirmed with the works done by Khan *et al*. (2010) [4], who reported that there was increase in N, P and K mineralization by addition of FYM @ 40 Mg ha^{-1} as compared to the recommended dose of inorganics.

Available Phosphorus (kg ha^{-1})

The available phosphorus content in soil after the harvest of *kharif* crop as influenced by different nutrient management levels have been presented in Table 2. Concerning the effect of nutrient management schedules, it can be figured out from the table that maximum phosphorus built up was recorded (20.90, 22.53 and 21.72 kg ha^{-1}, respectively) under application of 100% RDN through inorganic sources along with FYM @ 5t ha^{-1} (NM_6) during both the years and on mean data basis. It was found at par (22.33, 21.99 and 22.13 kg ha^{-1}) with NM_1, NM_4 and NM_5, respectively during 2018. Lowest soil available phosphorus (16.40, 19.31 and 17.85 kg ha^{-1} during 2017, 2018 and mean basis, respectively) was witnessed by treatment NM_2.

As far as effect of cropping systems is concerned, the data on available phosphorus in soil was non significant. Similarly, the nutrient management levels and cropping systems interaction effect on available soil phosphorus remained unchanged. In general, the treatment NM_6 recorded highest build up of phosphorus, the reason of which might be additional application of FYM to supplement 100% inorganic fertilization. Our result corroborates with the findings of Deshmukh *et al.* (2005) [2].

Available Potassium (kg ha^{-1})

The data on available potassium in soil after the harvest of *kharif* crop as simulated by different nutrient management levels and cropping systems have been delineated in the Table 2. It is obvious from the data that amog all the fertilization schedules tried, integration of 100% RDN through inorganic sources and FYM @ 5t ha^{-1} (NM_6) left maximum available potassium in the soil (374.0, 384.48 and 379.24 kg ha^{-1}, respectively) during both the years and on mean basis and was comparable with (372.58, 365.08 and 366.75 kg ha^{-1}, respectively) NM_1, NM_4 and NM_5 during
2017, and (383.82 and 378.20 kg ha^{-1}, respectively) NM_1 during 2018 and mean analysis. Meanwhile, the least available soil potassium was obtained under NM_2 during the course of study and their mean analysis.The interaction effects between nutrient management levels and cropping systems on the available potassium in the soil were found to be non-significant during both the years. Kumar *et al.* (2007) [5] also stated that there was hike in potassium availability with the continuous use of manure balance fertilizers and integrated use of manure and fertilizers. Similar results have been reported by Deshmukh *et al*. (2005) [2].

Table 2: Effect of nutrient management practices and cropping system on available nitrogen, phosphorus and potassium in soil after harvest of *kharif* crop

Treatments	Nitrogen (kgha^{-1})			Phosphorus (kgha^{-1})			Potassium (kgha^{-1})		
	2017-18	2018-19	Mean	2017-18	2018-19	Mean	2017-18	2018-19	Mean
Nutrient management									
NM_1	239.00	251.50	245.25	19.94	22.33	21.14	372.58	383.82	378.20
NM_2	229.70	234.00	231.85	16.40	19.31	17.85	357.08	366.42	361.75
NM_3	230.36	243.33	236.84	17.30	21.71	19.50	362.25	374.72	368.49
NM_4	237.15	245.17	241.16	17.70	21.99	19.85	365.08	377.74	371.41
NM_5	233.10	249.17	241.13	18.20	22.13	20.16	366.75	370.97	368.86
NM_6	245.00	252.67	248.83	20.90	22.53	21.72	374.00	384.48	379.24
SEm±	3.16	0.99	1.87	0.22	0.22	0.16	3.02	1.20	1.43
CD (P=0.05)	9.95	3.13	5.89	0.68	0.71	0.52	9.52	3.77	4.49
Cropping system									
CS_1	233.03	242.61	237.82	18.13	21.37	19.75	365.94	377.54	371.74
CS_2	238.42	250.17	244.29	18.78	21.86	20.32	368.67	375.87	372.27
CS_3	236.50	246.83	241.67	18.39	21.61	20.00	362.50	377.59	370.05

CS_4	234.92	244.28	239.60	18.32	21.83	20.07	368.06	374.43	371.24
SEm±	1.43	1.89	1.44	0.23	0.39	0.19	1.94	0.71	1.08
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
N X C	NS	NS	NS	NS	NS	NS	NS	NS	NS

Nutrient management

NM_1 - 100% RDN through organic sources

NM_2 -75% RDN through organic sources + foliar spray of VW (10%) fb CU (10%) at 30 and 50 DAS/DAT

NM_3 - 50% RDN through organic + 50% RDN through inorganic sources

NM_4 - 75% RDN through organic+ 25% RDN through inorganic sources

NM_5 - 100% RDN through inorganic sources

NM_6 - 100% RDN through inorganic sources + FYM @ 5t ha^{-1}

Cropping system

CS_1- Soybean -sweet corn

CS_2 - Soybean -garden pea

CS_3 - Soybean-chilli

CS_4- Soybean-onion

References

1. Anonymous, Foreign Agricultural Service/USDA Office of Global Analysis, 2019.
2. Deshmukh KK, Saraiya AB, Dubey DP. Effect of integrated nutrient managemaent on productivity trends economics and soil fertility in soybean – chickpea cropping system. JNKVV Research Journal. 2005; 39(2):29-32.
3. Hati KM, Mishra AK, Mandal KG, Gosh PK, Bandyopadhya PK. Irrigation and nutrient management effect on soil physical properties under Soybean - mustard cropping system. Environment and Ecology. 2005; 23(3):640-643.
4. Khan A. and Khalil, A. Effect of leaf area on dry matter production in aerated mungbean seed. International Journal of Plant Physiology and Biochemistry. 2010; 2:52-61.
5. Kumar A, Tripathi HP, Yadav DS. Correcting nutrient for sustainable crop production. Indian Journal of Fertilizer. 2007; 2:37-44.
6. Sharma MP, Prasad K. Effect of organic, inorganic and integrated nutrient management practices on soil health and productivity of soybean based cropping systems. Annals of Agricultural Research New Series. 2013; 34(2):144-148.
7. Singh AB, Saha JK, Gosh PK. Effect of nutrient management practices on soybean – chickpea cropping system for improving seed yield, quality and soil biological health under rainfed condition. Indian Journal of Agricultural Sciences. 2008; 78(6):485-489.
8. Guo JH, Liu XJ, Zhang Y, Shen JL, Han WX, Zhang WF, Christie P, Goulding KW, Vitousek PM, Zhang FS. Significant acidification in major Chinese crop lands. Science. 2010; 327(5968):1008-1010.
9. Cordell D, Drangert JO, White S. The story of phosphorus: Global food security and food for thought. Global Environmental Change. 2009; 19(2):292-305.
10. Ju XT, Kou CL, Zhang FS, Christie P. Nitrogen balance and groundwater nitrate contamination: Comparison among three intensive cropping systems on the North China Plain. Environmental Pollution. 2006; 143(1):117-125.