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Effect of fertilizer with and without FYM on yield, nutrient uptake and balance in soybean (*Glycine max* (L) Merrill) in Vindhyan Plateau of Madhya Pradesh

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ABSTRACT

A field experiment was conducted during rainy (kharif) season at R. A. K. College of Agriculture Farm, Sehore, (M.P), to study the effect of fertilizer levels with and without FYM on Yield, nutrient uptake and balance in two soybean varieties JS 95-60 and JS 97-52. Treatments were evaluated in factorial randomized block design with 3 replications. The grain yield was significantly higher with application of 125% RDF + 5 t FYM ha^{-1} (1820 kg ha^{-1}), which was at par with 100% RDF + 5 t FYM ha^{-1} (1801 kg ha^{-1}). The increases in grain and straw yield with 125% NPK + 5t FYM ha^{-1} over the control were 12.6 and 4.3%, respectively. The variety JS 95-60 recorded significantly higher grain yield (2203 kg ha^{-1}) as compared to variety JS 97-52 (886 kg ha^{-1}). Number and dry weight of root nodules per plant were significantly higher with the application of 125% RDF + 5 t FYM ha^{-1} than other fertilizer treatments. Variety JS 97-52 proved better in respect of number and dry weight of root nodules per plant than JS 95-60. The uptake of N, P and K by the crop increased significantly with application of 125% RDF + 5 t FYM ha^{-1} followed by 100% RDF +5 t FYM ha^{-1}. The minimum values of number and weight of nodules, yields and uptake of nitrogen, phosphorus and potassium by grain and straw were recorded under control treatment. Variety JS 95-60 was utilized significantly higher amount of N, P and K in seed and straw,. Application of different treatment improved the available N status (20.2 kg ha^{-1}) in the soil. Phosphorus and potassium showed marginal gain over their initial values.

Keywords: Fertilizer, FYM, variety, yield, nutrient uptake, soybean

INTRODUCTION

Soybean (Glycine max L) is one of the important legume crops of India which not only helps in maintaining soil fertility but it is also a rich source of protein and fats. Oil and protein rich soybean has now been recognized all over the world as a potential supplementary source of edible oil and nutrition. The oil of soybean contains 85% unsaturated fatty acid and is cholesterol free. Soybean seeds contain 43.2% protein, 19.5% fat, 20.9% carbohydrate and a good amount of other nutrients like calcium, phosphorus, iron and vitamins. Soybean has 3% lecithin which is helpful for brain development. The appropriate combination of mineral fertilizers with organic manure can be feasible and visible to sustain agriculture as commercial and profitable ensuring high yield of crop without deterioration in quantity and quality of the produce and soil health. Combined application of organic manure and fertilizers is very effective in realization of high yield and high pressure to nutrients (Singh *et al.*2013) Farmyard manure is by far, the most popular and available for use as an organic source of plant nutrients with the farmers. The use of FYM is the tool to improve the physical, chemical and biological properties of the soil. Farmyard manure being the source of all essential elements, improves soil organic matter and humus part of soil. FYM also plays an important role inhabitation beneficial bacteria thus making the nutrients available to crop. Use of chemical fertilizers in combination with organic manure is essentially required to improve soil health (Raghuwanshi *et al.*2016). Therefore, the present study was undertaken to study the effect of applied inorganic fertilizer with FYM and without FYM on Yield, nutrient uptake and balance in soybean varieties.

MATERIALS AND METHODS

The field experiment was conducted during the rainy (kharif) season of 2011 at research farm of the R.A.K. College of Agriculture ,Sehore, Madhya Pradesh (23^0 12' N latitude, 77^0 05' E longitude and at 498.77 m above mean sea level). The experimental site characterized by sub-tropical zone with extreme

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temperature during summer (45.60^{0}c) and very low temperature (as low as 5^{0}c) during winters. The average rainfall varies from 1000 to 1200 mm, most of which is received during June-September. The soil was medium black clay loam having pH 7.3 electrical conductivity 0.12 dS m^{-1}, organic carbon 5.8 g kg^{-1} medium available N 245 kg ha^{-1} medium available P 17.80 kg ha^{-1} and high available K 425 kg ha^{-1}. The field trail consisting of eight treatments namely 75% RDF, 75% RDF + 5 t FYM ha^{-1}, 100% RDF, 100% RDF + 5 t FYM ha^{-1}, 125% RDF**,** 125% RDF + 5 t FYM ha^{-1}**,** 5 t FYM ha^{-1}**,** absolute control and two soybean varieties (JS 95-60 and JS 97-52) was laid out in randomized block design with three replications. The recommended doses of nutrients were 20 N+60 P_2O_5+20 K_2O+20 S, kg ha^{-1} which were through urea, single superphosphate, muriate of potash, elemental sulphur, respectively. The quantity of fertilizer was calculated for respective treatment separately and was drilled as per treatment at the time of sowing. Decomposed farmyard manure @ 5 t ha^{-1} was applied one week before sowing and incorporated in to the soil. The sowing was done on 5 July 2010 maintaining row spacing of 45 cm. Other agronomic management practices were followed as per the standard recommendation. The crop was harvested at maturity and grain and straw yield and nodulation were recorded. The soil samples collected after harvest of soybean crop were analysed for available N (Subbiah and Asija 1956), P (Olsen *et al.* 1954) and K (Hanway and Heidel 1952). The grain and straw samples were digested with di acid mixture of HNO_3 and $HClO_4$ in 9:1ratio. Phosphorus was determined by vanadomolybdate yellow colour method (Jackson, 1973), K by flame photometer. Nitrogen in plants was determined by modified micro Kjeldahl method. The nutrient uptake was calculated by multiplying the nutrient content values with the yield data. The data were statistically analyzed using standard procedures of ANOVA at 5% level of significance.

RESULTS AND DISCUSSION

Root nodules

Fertilizer levels increased the number and dry weight of root nodules per plant (Table 1) over control and maximum values were recorded with 125% RDF + 5 t FYM ha^{-1} which might be due to better root development and profuse nodulation on account of increase in the rhizobial activity in the rhizosphere under fertilizer levels especially due to increased P availability, which resulted in the formation of active and more number of root nodules. The results are in close agreement with the findings of Singh *et al.* (2013). The variety JS 97-52 proved significantly superior in respect of number and dry weight of root nodules per plant than variety JS 95-60. The minimum number and weight of nodule was recorded in control.

Table 1: Effect of fertilizer levels and varieties on nodules, uptake of nutrients and yields of soybean

Treatments	Nodules/ plant	Dry weight nodules / plant (g)	Uptake studies (kg ha^{-1})						Yields (kg ha^{-1})	
			Nitrogen		Phosphorus		Potassium			
			Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
Fertilizer levels (F)										
75% RDF	44.94	111.38	23.4	102.1	2.9	12.4	33.5	40.05	1599	2955
75 % RDF + FYM 5 t ha^{-1}	49.61	124.85	24.6	106.6	3.1	13.7	37.5	42.89	1657	2980
100% RDF	46.61	117.83	24.9	110.1	3.1	13.8	36.6	44.02	1710	3044
100 % RDF + FYM 5 t ha^{-1}	51.44	130.86	26.5	116.9	3.7	15.8	42.7	48.30	1801	3081
125% RDF	50.17	126.98	25.9	111.0	3.5	14.5	41.1	45.66	1716	3069
125 % RDF + FYM 5 t ha^{-1}	56.50	144.01	27.7	119.0	4.0	16.5	42.7	50.25	1820	3127
FYM 5 t ha^{-1}	47.61	118.95	22.8	66.5	2.7	7.7	32.4	25.90	1054	2929
Control	40.94	100.78	21.6	60.5	2.4	6.8	32.4	23.32	997	2875
SEm ±	0.63	1.61	0.56	2.1	0.12	0.26	0.92	0.92	33.67	63.30
CD (P=0.05)	1.81	4.64	161	6.2	0.35	0.75	2.65	2.66	96.97	NS
Varieties (V)										
JS 95-60	47.03	118.75	20.1	142.4	2.8	19.1	34.1	59.10	2203	2439
JS 97-52	49.93	125.16	29.2	55.8	3.6	6.1	40.6	21.00	886	3576
SEm ±	0.31	0.80	0.28	1.0	0.06	0.13	0.46	0.46	16.84	31.65
CD (P=0.05)	0.90	2.32	0.80	3.1	0.18	0.38	1.32	1.33	48.49	91.58

Yields

Fertilizer levels significantly influenced the grain yield of soybean over control (Table 1) and 125% RDF + 5 t FYM ha^{-1} proved significantly superior in respect of grain yield over other treatments. This might be due to balanced use of fertilizers in soil which increased their availability in soil. The increment in supply of essential elements through organic and inorganic sources, their availability, mobilization and influx into the plant tissues increased and thus improved with growth and yield components and finally the seed yield of soybean. The results corroborate the findings of Ram *et al.* (2014). The variety JS 95-60 produced highest grain yield (2203 kg ha^{-1}) than variety JS 97-52 (886 kg ha^{-1}). It may be due to higher seeds per pod and better seed index. Maximum straw yield was obtained in 125% RDF + FYM 5 t ha^{-1} (3127 kg ha^{-1}) which may be due to better growth and yield attributes. The variety JS 97-52 produced significantly higher straw yield (3576 kg ha^{-1}) compared to the variety JS 95-60. The highest straw yield may be due to the plant height and higher number of branches and dry weight per plant. This favourable morphological phenomenon in this variety resulted highest straw yield.

Uptake studies

Uptake of nitrogen by soybean seed and straw increased significantly with different treatments over control (Table 1). The mean increase in N uptake was from 21.6 to 27.7 kg ha^{-1} and 60.5 to 119.0 kg ha^{-1} respectively by seed and straw with increase in level of RDF and 5t FYM ha^{-1} from control to 125% NPK. The highest N uptake by soybean was recorded with the application of 125% NPK + 5 t FYM ha^{-1}. Supplementation of FYM with inorganic fertilizer improves the crop growth and thereby uptake of nitrogen and Gawande (Bonde, 2017). The variety JS 97-52 recorded significantly higher N uptake than JS 95-60. The increase in uptake of nitrogen could be the results of enhanced physiological processes within the plant system which resulted in the increased absorption of nitrogen by soybean and thereby translocation of nitrogen and also may be attributed to increased seed and straw production (Arbad and Ismail 2011). The P uptake by seed and straw ranged from 2.4 to 4.0 kg ha^{-1}and 6.8 to 16.5 kg ha^{-1}respectively. Application of 125% RDF +5 t FYM ha^{-1}recorded the highest (4.0 kg ha^{-1}) P uptake which was significantly superior to others treatments but was at par with 100% RDF + 5 t FYM ha^{-1}.The variety JS 95-60 recorded significantly higher P uptake than JS 97-52. The increase in uptake of phosphorus could be the results of enhanced physiological process within the plant system which resulted in the increased absorption of phosphorus by soybean and thereby translocation of phosphorus which might have resulted in good yield of soybean. These results are in close conformity of the result observed by Singh (2011). Combined application of NPK levels + FYM also improved the P uptake by the crop over control. This may be due to more availability of P from soil due to solubility action of FYM (Bonde and Gawande, 2017).The K uptake by soybean increased significantly with different treatments over control. The K uptake by seed and straw ranged from 32.4 to 42.7 kg ha^{-1} and 23.3to 50.2 kg ha^{-1} respectively. The variety JS 95-60 recorded significantly higher K uptake than variety JS 97-52. Application of 125% RDF + 5 t FYM ha^{-1} recorded the highest (50.2 kg ha^{-1}) K uptake which was significantly superior to other treatments but was at par with 100% RDF+ 5 t FYM ha^{-1}. It might be due to combined application of organics and in-organics which ultimately enhanced K absorption by plants. The higher yields of seed and straw fewer than 100 or 125 % NPK levels coupled with 5 t FYM ha^{-1} absorbed large quantities of K from soil thus depleting the soil more K consequently showing its higher uptake in plants (Arbad and Ismail 2011).

Nutrients balance in soil

The soil N nutrient balance in the present study revealed that much of the nitrogen was added from the soil. The actual nitrogen left in soil ranged from 2.11 to 20.20 kg ha^{-1}. It was maximum (20.20 kg ha^{-1}) with combination of variety JS 97-52 + 125% RDF + FYM 5 t ha^{-1} and minimum in variety JS 97-52+ no fertilizer. Combined application of both FYM and inorganic N sources mostly resulted in a positive balance of soil N. The observed highest N balance was just due to the higher amount of N application. The increase in actual N left in the soil may also be due to increased nodulation and thereby

Table 2: Balance sheet of NPK in soil as influenced by fertilizer levels and varieties

Treatments	N- Balance				P- balance				K- balance			
	N-added through fertilizer (kg ha^{-1})	Total available N (kg ha^{-1})	Crop removal N (kg ha^{-1})	Loss/gain of N over initial (kg ha^{-1})	P-added through fertilizer (kg ha^{-1})	Total available P (kg ha^{-1})	Crop removal P (kg ha^{-1})	Loss/gain of P over initial (kg ha^{-1})	K-added through fertilizer (kg ha^{-1})	Total available K (kg ha^{-1})	Crop removal of K (kg ha^{-1})	Loss/gain of K over initial (kg ha^{-1})
JS 95-60 +75% RDF	15	260	171.2	5.12	45	62.8	21.8	-3.83	15	440	91.7	-34.8
JS 95-60 +75 % RDF + FYM	40	285	173.9	8.66	55	72.8	23.5	-3.57	40	465	96.8	-25.6
JS 95-60 +100% RDF	20	265	183.4	6.00	60	77.8	24.3	-2.57	20	445	101.2	-33.1
JS 95-60 +100 % RDF + FYM	45	290	188.7	10.50	70	87.8	27.0	-2.29	45	470	109.6	-23.0
JS 95-60 + 125% RDF	25	270	177.8	8.35	75	92.8	24.5	-1.80	25	450	103.3	-31.4
JS 95-60 +125 % RDF + FYM	50	295	186.7	12.02	85	102.8	27.7	-0.93	50	475	110.3	-19.6
JS 95-60 +FYM	25	270	114.3	7.05	10	27.8	14.0	-4.19	25	450	67.0	-31.2
JS 95-60 + Absolute Control	-	245	105.0	1.78	-	17.8	12.5	-9.60	-	425	66.0	-42.8
JS 97-52 75% RDF	15	260	80.1	10.77	45	62.8	8.8	-3.29	15	440	55.5	-31.0
JS 97-52 +75 % RDF + FYM	40	285	88.5	15.00	55	72.8	10.1	-2.93	40	465	63.9	-21.3
JS 97-52 +100% RDF	20	265	86.7	13.50	60	77.8	9.6	-1.86	20	445	60.0	-28.3
JS 97-52 +100 % RDF + FYM	45	290	98.1	16.25	70	87.8	11.9	-1.62	45	470	72.4	-16.9
JS 97-52 + 125% RDF	25	270	96.2	14.05	75	92.8	11.4	-1.34	25	450	70.2	-26.6
JS 97-52 +125 % RDF + FYM	50	295	106.9	20.20	85	102.8	13.4	-0.57	50	475	75.6	-14.6
JS 97-52 + FYM	25	270	64.4	14.75	10	27.8	6.9	-3.36	25	450	49.5	-28.0
JS 97-52 + Absolute Control	-	245	59.4	2.11	-	17.8	5.9	-8.30	-	425	45.4	-39.6

* Initial-N 245 kg ha^{-1} * Initial-P 17.8 kg ha^{-1} * Initial-K 425 kg ha^{-1}

symbiotic N fixation, and application of organic matter (FYM) along with in-organic fertilizer. Similarly, the phosphorus balance in soil showed a negative trend in all most all the plots as influenced by different levels of fertilizer application and varieties. The reduction in net available phosphorus was lesser under variety JS 97-52 + 125% RDF + FYM 5 t ha^{-1}. The depletion of P might be due to more removable of P from furrow layers, poor availability and fixation of P. In line with the present findings Tiwari *et al.*(2010) also reported similar findings. The potassium balance in soil also showed a negative which may be due to more removable of K by soybean due to more complimentary uptake with N and P and less supplementation losses were observed when K was applied with 125% RDF + FYM 5 t ha^{-1}.

REFERENCES

Arabad, B.K. and Ismail, S. (2011) Effect of integrated nutrient management on Soybean (*Glycine max)* safflower (*Carthamus tinctorius*) cropping system. *Indian Journal of Agronomy* **56** (4): 340-345**.**

Bonde, A.S.and Gawande,S.N. (2017) Effect of integrated nutrient management on growth ,yield and nutrient uptake by Soybean (*Glycine max*). *Annals of plant and Soil Research* **19**(2**):** 154-158.

Hanway, J. and Heidal , H.S. (1952) Soil testing laboratory procedure. *IOWA Agri*. **57** (1): 31.

Jackson, M.L.(1973) Soil Chemical analysis, Prentice Hall of India Pvt. Ltd., New Delhi.

Lone, Bilal Ahmed, Hasan,Badrul, Ansar,S. and Singh , Amarjeet (2009) Effect of seed rate , row spacing and fertility levels on growth and nutrient uptake of soybean[*Glycine max* (L) Merrill] under temperature conditions. *Journal of Agricultural and biological Science* **4**(3) :7-10.

Olsen, S.R., Cole, C.V., Watanabe, F.S. and Dean, L.A. (1954) Estimation of available- P in soil by extraction with $NaHCO_3$.*United States Department of Agriculture* Circular, 939:1-9.

Raghuwanshi, P.,Khaddar,V.K., and Bhanger,K.S.,(2016) Changes in status of organic carbon, available nitrogen and bacterial population in soils with organic manures. *Annals of Plant and Soil Research* **18 (4):** 366-369.

Shinde, P.S., Sankpal, V.Y., Jawale, S.M., Shaikh, A.A., Dalavi, N.D. and Jadhav, M.B. (2009) Effect of integrated nutrient management on yield attributes and quality of soybean. *Journal of Maharashtra Agricultural Universities* **34** (1):107-108.

Singh, Guriqbal (2009) Effect of FYM, Macro and micro-nutrients on the growth and grain yield of soybean. *Journal of Plant Science Research* **25** (2):155-158.

Singh, P.(2011) Effect of weed and nutrient management on nutrient dynamics, productivity and quality of soybean in vertisols. *Annals of plant and Soil Research* **13** (4)**:** 137-141.

Singh,R., Sharma,H.B.,Kumar,P.,Paliwal,D.K.and Kumar.(2013) Effect of integrated nutrient management on growth yield and nutrient uptake by soybean (Glycine max)cultivars. *Indian journal of Agronomy* **58 (3):**379-383.

Subbaih,B.V.and Asija,G.L.(1956) A rapid method for the estimation of available nitrogen in soil. *Current Science* **25**: 259-260.