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RESEARCH ARTICLE

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Effect of integrated nutrient management on nutrient uptake and soil fertility of soybean [*Glycine Max* (L) Merril]

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ABSTRACT

The uptake of NPK was significantly increased with increased levels of FYM. Further it was observed that nitrogen uptake showd graded response to increase levels of FYM. Recommended dose of fertilizer when applied with organics *i.e.* FYM 5 t ha^{-1} recorded significantly higher total uptake of N, P and K (218, 28.48 and 125.51 kg ha^{-1}) over the control (135.84, 14.66 and 82.68 kg ha^{-1}). Increasing the soil fertility status (available NPK) upto of 50 kg N + 75 kg P_2O_5 + 50 kg K_2O + 5 t FYM ha^{-1}. (N 237.32, P 26.30 and K 337.03 kg ha^{-1}). The soil fertility status decline in control treatment at initial value of available NPK. This might be owing to increased supply of nutrient source to the crop as well as due to indirect effect resulting from reduced loss of organically supplied nutrient.

KEY WORDS : Integrated nutrient management, Nutrient uptake, Soil fertility.

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INTRODUCTION

Imbalance nutrition is one of the important constraints of soybean productivity in North Indian Plains (Chandel, 1989. Tiwari, 2001). Continuous use of high level of chemical fertilizers has led to problems of soil degradation, which is proving detrimental to soybean production. A crop producing 6,720 kg/ha biomass removed about 614 kg N, 148 kg P and 486 kg K/ha (Nelson, 1989). Therefore, adequate and balanced fertilization is necessary to increase soybean productivity. The supplementary and complimentary use of organic mannures and bio-fertilizer improve soil physical, chemical and biological properties, fertilizer-use efficiency, mitigates short supply of micronutrients, stimulates the proliferation of diverse group of micro-organisms and plays and important role in the maintenance of soil fertility and improves the ecological balance of *rhizosphere*. Hence, an experiment was conducted to study the performance of soybean with different integrated nutrient management systems in terms of nutrient uptake and soil fertility.

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MATERIALS AND METHODS

The field experiment was conducted at the Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar during rainy (*Kharif*) season of 2005. The experimental soil was clayey in texture, contains 0.42% organic carbon, 209.52 kg/ha available N, 21.73 kg/ha available P and 313.20 kg/ha available K. The experiment consisted of 8 treatments *viz.,* different combination of integrated nutrient management comprised of fertilizer levels. T_1 : Control, T_2 : 50 kg N + 75 kg P_2O_5, T_3 : 50 kg N+ 75 kg P_2O_5 + 25 kg K_2O, T_4 : 50 kg N+ 75 kg P_2O_5+50 kg K_2O, T_5 : 50 kg N + 75 kg P_2O_5 + 25 kg K_2O + 2.5 t FYM ha^{-1}, T_6 : 50 kg N + 75 kg P_2O_5 + 25 kg K_2O + 5 t FYM ha^{-1}, T_7 : 50 kg N + 75 kg P_2O_5 + 50 kg K_2O + 2.5 t FYM ha^{-1}, T_8 : 50 kg N + 75 kg P_2O_5 + 50 kg K_2O + 5 t FYM ha^{-1} were laid out in randomized block design with 3 replications. The fertilizer dose of NPK and organic material through urea, single superphosphate, murate of potash and FYM, respectively were incorporated bassally, as per treatment at the time of sowing. The seeds were inoculated with *Rhizobium* and PSB culture to all treatments before sowing. The gross and net plot size were 4.80 x 3.60 m and 4.20 x 3.00 m, respectively. Sowing was done on 5th July 2005 by dibbling the seeds of soybean variety DS-228 (Phule Kalyani) at spacing of 30 x 10 cm. All recommended management practices were followed. Need-based inter culture and plant protection were

adopted. Harvesting of crop was done manually.

The grain and haulm were analyzed for nitrogen content by micro-kjeldhal's method, phosphorous by Vando-molydate-yellow colour method and potassium was estimated by flame photometer method as per A.O.A.C (1992) and Jackson (1973). The total uptake of these nutrients was computed as:

$$\text{Nutrient uptake} = \frac{\text{Nutrient content (\%) x Yield (kg/ha) (grain/haulm)}}{100}$$

RESULTS AND DISCUSSION

The findings of the present study have been discussed in the following sub heads :

Nutrient content:

The nutrient content *viz.,* nitrogen, phosphorous and potassium concentration (%) in grain and haulm as affected by various treatments are presented in Table 1. The treatment 50 kg N+ 75 kg P_2O_5 + 50 kg K_2O + 5 t FYM ha^{-1} was recorded maximum nitrogen, phosphorous and potassium content in grain (7.07%, 0.66% and 0.96%) and haulm (0.62%, 0.30% and 2.96 %). Nitrogen, phosphorous and potassium content at flowering and harvesting stages significantly enhanced due to increase levels of fertilizer and farm yard manure. Similar results were also reported by Patel and Chandravanshi (1996)

NPK uptake:

The NPK uptake differed significantly due to different

Table 1 : Effect of integrated nutrient management on nutrient content (%) of soybean

Treatments	Nitrogen		Phosphorus		Potassium	
	Grain	Haulm	Grain	Haulm	Grain	Haulm
T_1 : Control	6.95	0.54	0.55	0.20	0.73	2.80
T_2 : 50 kg N+ 75 kg P_2O_5 ha^{-1}	6.98	0.55	0.57	0.22	0.80	2.82
T_3 : 50 kg N+ 75 kg P_2O_5 +25 kg K_2O ha^{-1}	6.99	0.55	0.58	0.23	0.81	2.84
T_4 : 50 kg N+ 75 kg P_2O_5+50 kg K_2O ha^{-1}	7.01	0.57	0.59	0.24	0.88	2.85
T_5 : 50 kg N + 75 kg P_2O_5 + 25 kg K_2O + 2.5 tonne FYM ha^{-1}	7.03	0.59	0.59	0.26	0.91	2.87
T_6 : 50 kg N + 75 kg P_2O_5 + 25 kg K_2O + 5 tonne FYM ha^{-1}	7.04	0.59	0.60	0.27	0.93	2.89
T_7 : 50 kg N + 75 kg P_2O_5 + 50 kg K_2O + 2.5 tonne FYM ha^{-1}	7.06	0.60	0.65	0.29	0.95	2.93
T_8 : 50 kg N + 75 kg P_2O_5 + 50 kg K_2O + 5 tonnes FYM ha^{-1}	7.07	0.62	0.66	0.30	0.96	2.96
S.E. ± Mean	0.02	0.01	0.01	0.01	0.02	0.01
C.D. (P=0.05)	0.07	0.04	0.03	0.04	0.07	0.03

Table 2 : Total uptake of NPK in grain and haulm kg ha^{-1} as influenced by different integrated nutrient management treatments.

Treatments	Yield	Nitrogen			Phosphorus			Potassium		
	q/ha	Grain	Haulm	Total	Grain	Haulm	Total	Grain	Haulm	Total
T_1 : Control	17.61	122.38	3.46	135.84	9.68	4.98	14.66	12.85	69.83	82.68
T_2 : 50 kg N+ 75 kg P_2O_5 ha^{-1}	20.93	146.09	14.34	160.43	11.93	5.73	17.66	16.74	73.54	90.28
T_3 : 50 kg N+ 75 kg P_2O_5 + 25 kg K_2O ha^{-1}	22.03	153.99	14.92	168.91	12.78	6.23	19.01	17.84	77.04	94.80
T_4 : 50 kg N+ 75 kg P_2O_5+50 kg K_2O ha^{-1}	23.10	161.93	15.53	177.46	13.63	6.54	20.17	20.33	77.69	98.02
T_5 : 50 kg N + 75 kg P_2O_5 + 25 kg K_2O + 2.5 t FYM ha^{-1}	24.45	171.86	16.81	188.69	14.42	7.41	21.83	22.25	81.79	104.04
T_6 : 50 kg N + 75 kg P_2O_5 + 25 kg K_2O + 5 t FYM ha^{-1}	26.33	185.36	17.48	202.84	15.80	8.00	23.80	24.49	86.65	111.14
T_7 : 50 kg N + 75 kg P_2O_5 + 50 kg K_2O + 2.5 t FYM ha^{-1}	26.50	187.09	19.15	206.24	17.22	9.25	26.47	25.17	93.55	118.72
T_8 : 50 kg N + 75 kg P_2O_5 + 50 kg K_2O + 5 t FYM ha^{-1}	28.01	198.03	20.65	218.68	18.49	9.99	28.48	26.89	98.62	125.51
S.E. ± Mean	0.94	4.09	1.06	4.62	0.52	0.42	0.83	0.85	2.98	3.37
C.D. (P=0.05)	2.88	12.20	3.16	13.78	1.58	1.29	2.55	2.61	9.15	10.34

Table 3 : Total uptake by soybean soil fertility status after harvest as influenced by different integrated nutrient management treatments

Treatment Fertilizer levels	Total N uptake (kg/ha)	Total P uptake (kg/ha)	Total K uptake (kg/ha)	Available nitrogen (kg/ha)	Available phosphorus (kg/ha)	Available potassium (kg/ha)
T_1 : Control	135.84	14.66	82.68	208.40	18.66	310.12
T_2 : 50 kg N+ 75 kg P_2O_5 ha^{-1}	160.43	17.66	90.28	224.70	21.90	324.34
T_3 : 50 kg N+ 75 kg P_2O_5 + 25 kg K_2O ha^{-1}	168.91	19.01	94.8	225.42	22.30	328.41
T_4 : 50 kg N+ 75 kg P_2O_5+50 kg K_2O ha^{-1}	177.46	20.17	98.02	226.43	23.03	329.37
T_5 : 50 kg N + 75 kg P_2O_5 + 25 kg K_2O + 2.5 t FYM ha^{-1}	188.69	21.83	104.04	229.33	23.63	331.33
T_6 : 50 kg N + 75 kg P_2O_5 + 25 kg K_2O + 5 t FYM ha^{-1}	202.84	23.8	111.14	234.70	24.33	334.84
T_7 : 50 kg N + 75 kg P_2O_5 + 50 kg K_2O + 2.5 t FYM ha^{-1}	206.24	26.47	118.72	236.50	25.73	336.32
T_8 : 50 kg N + 75 kg P_2O_5 + 50 kg K_2O + 5 t FYM ha^{-1}	218.68	28.48	125.51	237.32	26.30	337.03
S.E. $\pm$ Mean	4.62	0.83	3.37	0.36	0.20	0.31
C.D. (P=0.05)	13.78	2.55	10.34	1.11	0.63	0.96
* Intial values of soil				209.52	21.73	313.20

treatments (Tabel 2). Recommended dose of fertilizer when applied with organics *i.e.* FYM @ 5 t/ha recorded significantly higher total uptake of N, P and K over the control. Increasing the fertility level up to of 50 kg N+ 75 kg P_2O_5 + 50 kg K_2O + 5 t FYM ha^{-1} resulted in higher uptake of N (135.84 kgha^{-1}), P (14.66 kg ha^{-1}) and K (82.68 kg ha^{-1}) in general. Moreover, FYM treatment was found superior to other treatments. Highest total uptake of N, P and K was observed in 50 kg N+ 75 kg P_2O_5 + 50 kg K_2O + 5 t FYM ha^{-1}. This might be owing to increased supply of nutrient source to the crop, as well as due to indirect effect resulting from reduced loss of organically supplied nutrients. The uptake of NPK were more in integrated treatments than chemical fertilizers alone. The beneficial effect of combined application of FYM and inorganic source of fertilizer of soybean was also supported by observations of Kumar and Singh (1996). This might be due to mineralization and slow release of nutrients to soybean crop.

Soil fertility status:

Integrated nutrient management had significantly increased the available nitrogen, phosphorous and potassium contents in soil; whereas in the control plots they declined significantly. (Table 3). The highest available nitrogen, phosphorous and potassium were recorded with the application of 50 kg N+ 75 kg P_2O_5+ 50 kg K_2O + 5 t FYM ha^{-1} over the control, indicating the benefits from the integrated use of the fertilizers and mannures which is also evident from the yield data. These findings confirm those of Shapira *et al*. (1987) and Bharadwaj and Omanwar (1994). The mean total available nitrogen, phosphorous and potassium after harvest of soybean in the soil was 237.85, 23.15 and 329.35 kg ha^{-1}, respectively. The available residual nitrogen, phosphorous and potassium was highest in 50 kg N+ 75 kg P_2O_5 + 50 kg K_2O + 5 t FYM ha^{-1} (237.32, 26.30 and 337.03 kg ha^{-1}) and it was at par with 50 kg N+ 75 kg P_2O_5 + 50 kg K_2O + 2.5 t FYM ha^{-1}(236.50, 25.73 and 336.32 kg ha^{-1}). Lowest available N,P and K (208.40, 18.66 and 310.12 kg ha^{-1}, respectively) were foound in control. Similar findings were reported by Duraisingh and Gopalswamy (1991).

REFERENCES

A.O.A.C. (1992). Method of Analysis of Association of official Agricultural Chemists. Edn.9 Horomitz, W(Ed). Association of official Agricultural Chemists, Washington D.C.

Bharadauj, V. and Omanwar, P.K. (1994). Impact of long term fertility treatment on bulk density, water content and microbial population of soil. *J. Indian Soc. Soil Sci.,* **42** : 387.

Chandel, A.S. (1989). Soybean productivity constraints in north Indian plain. An Agronomist view, world soybean Research Conference, held in Beunos Aires, Argentina, during 5-9 March 1989, **1** : 672-676.

Duraisingh, R.and Gopalswamy, N. (1991). Effect of plant geometry and levels of nitrogen and phosphorous on productivity of soybean. *Indian J. Agron.,* **36**(4): 545-548.

Jackson, M.L. (1973). *Soil chemical analysis*. Prentice hall of India Pvt. Ltd, New Delhi. pp. 373-389.

Kumar, Rakesh and Singh, K.P. (1996). Long term effects of fertilizer, lime and FYM on yield, nutrient uptake by soybean and soil properties. *J. Res. Bass.,* **8** (2)115-118.

Nelson, W.L. (1989). Determining soybean fertility needs. Soybean World Research Conference, **4**: 615-620.

Patel, S.R and Chandravanshi, B.R. (1996). Nitrogen and phosphorous nutrition of soybean (*Glycine max*) grown in vertisol. *Indian J. Agron.,* **41**(4):601-603.

Shapira, C.A., Peterson, T. A. and Flowerday, A. D. (1987). Irrigation methods, composted manure, variety and foliar fertilization effect on soybean. III *Fertilizer Issue*, **4** (4): 122-129.

Tiwari, S.P. (2001). Shattering the production in soybean based cropping system. *Res. J., Jawaharlal Nehru Krishi Vishwa Vidyalaya,* **35** : 1-10.

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