www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(7): 397-400

www.thepharmajournal.com
Received: xx-05-2021
Accepted: xx-06-2021

Tupaki Lokya
Department of Soil Science and Agriculture Chemistry, Dr. PDKV, Akola, Maharashtra, India

DV Mali
Department of Soil Science and Agriculture Chemistry, Dr. PDKV, Akola, Maharashtra, India

VV Gabhane
Department of Soil Science and Agriculture Chemistry, Dr. PDKV, Akola, Maharashtra, India

PR Kadu
Department of Soil Science and Agriculture Chemistry, Dr. PDKV, Akola, Maharashtra, India

Corresponding Author:
Tupaki Lokya
Department of Soil Science and Agriculture Chemistry, Dr. PDKV, Akola, Maharashtra, India

Effect of different levels of potassium on yield, chemical properties, nutrient status and nutrient uptake by soybean crop in vertisols

Tupaki Lokya, DV Mali, VV Gabhane and PR Kadu

Abstract
The field experiment was conducted to assess Effect of different levels of potassium on yield, chemical properties, nutrient status and nutrient uptake by soybean crop in vertisols. The experiment comprised four treatments and six replications as six farmer's laid out in Randomized Block Design. The treatments comprised of 30:75:00 kg NPK ha^{-1} (T_1), 30:75:30 kg NPK ha^{-1} (T_2), 30:75:60 kg NPK ha^{-1} (T_3) and 30:75:90 kg NPK ha^{-1} (T_4). The results of the present experiment indicated that the soil chemical properties *viz*., pH, EC and organic carbon were significantly improved with the application of 30:75:90 kg NPK ha^{-1} followed by 30:75:60 kg NPK ha^{-1}.The available N, P and K were improved significantly with the application of 90 kg K_2O ha^{-1} along with recomended dose of N and P. Application of 30:75:90 kg NPK ha^{-1} resulted significant improvement in grain (17.21 q ha^{-1}) and straw (27.04 q ha^{-1}) yield of soybean. The uptake of N, P and K were increased with the increase in the levels of K. The higher uptake of N (134.12 kg ha^{-1}), P (16.37 kg ha^{-1}) and K (44.67 kg ha^{-1}) was recorded with the application of 30:75:90 kg NPK ha $^{-1}$.

Keywords: Potassium, farmer's field, soybean, soil fertility status

Introduction
Soybean (*Glycine max*. L.) is one of the important oil seed as well as leguminous crop. It is originated in Eastern Asia/China. It is second largest oilseed crop in India after groundnut. Soybean is a miracle "Golden bean" of the 21st century mainly due to its high protein (40%) and oil (20%). In India, it is mainly grown as oil seed as well as pulse crop. It is the cheapest and richest source of high quality protein. It supplies most of the nutritional constituents essential for human health. Soybean occupies an intermediate position between legumes and oilseeds.
Soybean is also called as `Gold of soil' due to its various qualities such as ease in cultivation, less requirement of fertilizer and labour. It builds up the soil fertility by fixing atmospheric nitrogen through nodules. Soybean fixes nitrogen symbiotically and leaves about 25% for succeeding crop. All these qualities have made it an ideal for crop rotation.
Potassium is well known equality nutrient essential for improving quality of produce particularly oilseed crops. The requirement of K to for different crops is varied. In view of the varying response among crops, the present experiment was under taken to study the effect of various levels of potassium on yield of soybean and soil nutrient status on farmer's field in vertisols.

Material and Methods
Field experiment on soybean was conducted on farmer's field at Kanehri, Tq. Barshitakli, Dist. Akola. The experiment comprised four treatments and six replications laid out in Randomized Block Design. The treatments comprised of 30:75:00 kg NPK ha^{-1} (T_1), 30:75:30 kg NPK ha^{-1} (T_2), 30:75:60 kg NPK ha^{-1} (T_3) and 30:75:90 kg NPK ha^{-1} (T_4).
The representative soil samples from the farmer`s field were collected by using soil auger. The soil samples were air dried in shade and ground to passed through 2 mm sieve. The processed samples were well mixed and stored in clean cloth bags with proper labels for subsequent analysis.
The pH of a soil was measured by a glass electrode pH meter after equilibrating soil with water in the ratio of 1:2.5 soil water suspensions for 30 minutes with occasional stirring (Jackson, 1973) [8]. The electrical conductivity of the clear supernatant extract obtained from

suspension used for pH was utilized for the electrical conductivity measurement (Jackson, 1973) [8]. Organic carbon was determined by modified Walkley and Black rapid titration procedure (Nelson and Sommer, 1982) [13]. Available nitrogen was determined by alkaline permanganate method using micro-processor based automatic distillation system (Subbiah and Asija, 1965). Available phosphorus was determined by Olsen's method using 0.5 M sodium bi-carbonate as an extractant using UV based double beam spectrophotometer (Olsen and Sommers, 1982) [14]. Available potassium was determined by neutral normal ammonium acetate method using flame photometer (Knudsen and Peterson, 1982) [10]. The plant samples dried in shade and then placed in oven at 65 ^{0}C till the constant weight obtained. The oven dried weights were recorded. Finely ground and well mixed plant samples were weighted accurately (0.2 g) and transferred into micro digestion tube and 5 ml di-acid mixture added and digested on microprocessor based (KES-12L) digester. After completion of digestion (clear white color) the extract was diluted and filtered through What-man filter paper No. 42. These extracts were used for determination of phosphorus and potassium (Piper, 1966) [15]. Total nitrogen was determined by digesting the plant sample in microprocessor based digestion system (KES-12L) using conc. H_2SO_4 and salt mixture (Micro - Kjeldahl's method) (Chapman and Pratt, 1961) [5] followed by distillation with automatic distillation system.

Results and Discussion

Effect of different level of potassium on chemical properties of soil

pH and electrical conductivity

The pH value ranged from 7.78 to 7.92 (Table 1) indicating slight alkali soils. The electrical conductivity value ranged from 0.28 to 0.33 dS m^{-1} for the soil is free from salinity and alkalinity.

Organic carbon

The impact of various levels of potassium on the magnitude of soil organic carbon revealed that the organic carbon content ranged between 5.50 to 5.67 g kg^{-1} (Table 1). Among the various treatments, significantly higher organic carbon content (5.67 g kg^{-1}of soil with the application of 30:75:90 kg NPK ha^{-1} followed by application of 30:75:60 kg NPK ha^{-1} which found to be on par with each other. The lowest value of organic carbon (5.50 g kg^{-1}) was recorded with the application of 30:75:00 kg NPK ha^{-1}.

The increase in organic carbon with higher levels of potassium is associated with the better crop growth which added sufficiently higher quantity of biomass, ultimately resulted in maintaining higher levels of organic carbon over rest of the treatments. The similar results were also given by Bansal and Jain (1988) [2].

Effect of different level of potassium on fertility status of soil

Available N

The available N content ranged between 183 to 196 kg ha^{-1} (Table 1). The highest content of available N (196 kg ha^{-1}) with the application of 30:75:90 kg NPK ha^{-1} followed by 30:75:60 kg NPK ha^{-1}. The lowest content of available N (183 kg ha^{-1}) of soil with the application of 30:75:00 kg NPK ha^{-1}.

The increase in N status with increased levels of K may be due to better crop growth and resultant biomass production, which on mineralization converted into mineral N, which ultimately resulted into improvement in the N status of soil. The higher value of available N might be due to synergistic effect of potassium on availability of nitrogen. Similar synergistic results were reported by Tisdale and Nelson (1975) [22], Bansal *et al.* (1980) [3], Katkar *et al.* (2002) [9] and Rajashekarappa *et al.* (2013) [16].

Available P

The available P ranged between 11.75 to 12.96 kg ha^{-1} (Table 1). The higher phosphorus content (12.96 kg ha^{-1}) of soil with the application of 30:75:60 kg NPK ha^{-1}. The lower phosphorus content (11.75 kg ha^{-1}) was registered in the treatment receiving 30:75:00 kg NPK ha^{-1}.Similar results were reported by Agrawal *et al.* (1987) [1], Regar *et al.* (2009) [18], Vidyavathi *et al.* (2012) [23] and Rajashekarappa *et al.* (2013) [16].

Available K

The available K content in soil at harvest ranged between 369 to 412 kg ha^{-1} (Table 1). Significantly higher available K (412 kg ha^{-1}) was recorded with the treatment receiving 30:75:90 kg NPK ha^{-1} followed by application of 30:75:60 kg NPK ha^{-1} which was found to be on par with each other. The lowest content of available K (369 kg ha^{-1}) was recorded with the treatment of 30:75:00 kg NPK ha^{-1}. Similar results were reported by Shirale and Khating (2009) [19], Vidyavathi *et al.* (2012) [23] and Rajashekarappa *et al.* (2013) [16].

Effect of different levels of potassium on soybean yield

The increasing levels of potassium significantly increased the grain and straw yield of soybean. Among the various treatments, significantly higher grain yield (17.21 q ha^{-1}) and straw yield (27.04 q ha^{-1}) with the higher levels of potassium *viz.*, 30:75:90 kg NPK ha^{-1} followed by application of 60 kg K_2O ha^{-1} along with recommended dose of N and P (Table 2). In view of the initial very high K status and low requirement of K particularly by soybean as per general recommended dose, it is essential to re-examine the response of applied potassium to soybean in swell-shrink soil of vidarbha region. The lower grain yield (14.19 q ha^{-1}) and straw yield (21.02 q ha^{-1}) was recorded with absolutely no application of potassium along with recommended dose of N and P. The similar results are given by Deshmukh *et al.* (1994) [6], Mandal and Pramanik (1996) [12] and Farhad *et al.* (2010) [7].

Effect of different levels of potassium on nutrient uptake by soybean

Nitrogen uptake

The N uptake ranged between 101.76 to 134.12 kg ha^{-1} (Table 2). Result indicates that the N uptake by soybean increased significantly with the application of different levels of potassium along with recommended dose of N and P. The application of 30:75:90 kg NPK ha^{-1} give the maximum nitrogen uptake (134.12 kg ha^{-1}) followed by application of 30:75:60 kg NPK ha^{-1} which was 127.43 kg ha^{-1}. The lowest N uptake 101.76 kg ha^{-1} potassium with the application of 30:75:00 kg NPK ha^{-1}. Similar results were reported by Krishnan and Alourduraj (1997) [11], Singh *et al.* (2004) [20] and Raskar (2006) [17].

Phosphorus uptake

The P uptake ranged between 12.14 to 16.37 kg ha^{-1} (Table 2). Result indicates that the P uptake by soybean increased significantly with the application of different levels of potassium. The application of 30:75:90 kg NPK ha^{-1} recorded maximum phosphorus uptake (16.37 kg ha^{-1}) followed by application of 30:75:60 kg NPK ha^{-1} i.e. 15.28 kg ha^{-1} and found to be on par with each other. Minimum P uptake (12.14 kg ha^{-1}) by soybean crop with the application of 30:75:00 kg NPK ha^{-1}. Similar results were reported by Basith *et al.* (1995) [4], Krishnan and Alourduraj (1997) [11], Singh *et al.* (2004) [20] and Raskar (2006) [17].

Potassium uptake

The potassium uptake ranged between 26.32 to 44.67 kg ha^{-1} (Table 2). Result indicates that the potassium uptake by soybean increased significantly with the application of different levels of potassium. The application of 30:75:90 kg NPK ha^{-1} give the maximum potassium uptake by soybean crop was 44.67 kg ha^{-1} followed by application of 30:75:60 kg NPK ha^{-1} (39.14 kg ha^{-1}). Least uptake (26.32 kg ha^{-1}) by soybean crop with the application of 30:75:00 kg NPK ha^{-1}. Similar results were reported by Basith *et al.* (1995) [4], Krishnan and Alourduraj (1997) [11], Singh *et al.* (2004) [20] and Raskar (2006) [17].

Table 1: Effect of different levels of potassium on chemical properties and soil nutrient status

Treatments	pH (1:2.5)	EC (dS m-1)	Organic carbon (g kg-1)	Available nutrients (kg ha-1)		
				N	P	K
30:75:00 kg NPK ha-1	7.80	0.28	5.50	183	11.75	369
30:75:30 kg NPK ha-1	7.78	0.30	5.53	187	12.48	381
30:75:60 kg NPK ha-1	7.83	0.32	5.63	192	12.96	393
30:75:90 kg NPK ha-1	7.92	0.33	5.67	196	12.90	412
SE(m) ±	0.03	0.01	0.03	0.66	0.32	9.05
CD at 5%	NS	NS	0.09	1.98	0.19	27.27

Table 2: Effect of different levels of potassium on yield and nutrient uptake by soybean

Treatments	Yield (q ha-1)		Nutrient uptake (kg ha-1)		
	Grain	Straw	N	P	K
30:75:00 kg NPK ha-1	14.19	21.02	101.76	12.14	26.32
30:75:30 kg NPK ha-1	15.76	25.06	117.81	14.16	33.44
30:75:60 kg NPK ha-1	16.56	26.37	127.43	15.28	39.14
30:75:90 kg NPK ha-1	17.21	27.04	134.12	16.37	44.67
SE(m) ±	0.27	0.64	1.975	0.313	0.933
CD at 5%	0.82	1.93	9.192	1.458	4.34

Conclusion

It can be concluded that, application of 90 kg K_2O ha^{-1} along with recommended dose of N and P_2O_5 resulted improvement in the nutrient status as well as grain and straw yield of soybean.

References

1. Agrawal S, Singh TA, Bharadwaj V. Inorganic soil phosphorus fractions and available P as effected by long term fertilization and cropping pattern in Naintal Turai. J Indian Soc. Soil Sci 1987;34:305-308.
2. Bansal KN, Jain SC. Forms of potassium in Vertisol as influenced by long term intensive cropping and fertilizer use. J Potassium Res 1988;4(3):104-109.
3. Bansal SK, Omanwar PK, Bhardwaj V. Effect of intensive cropping and fertilization on organic carbon and total and available nitrogen in a soil from Pantnagar. J Indian Soc. Soil. Sci 1980;57(3):373-377.
4. Basith MA, Satyanarayana V, Latchanna A, Prasad PV. Response of groundnut genotypes to levels of potassium and plant stands in rainy season. J Pot. Res 1995;11(3&4):385-388.
5. Chapman HD, Pratt PF. Methods of Analysis for Soils, Plants and Waters, Divisions of Agricultural Science, University of California, Berkeley, U.S.A 1961.
6. Deshmukh VN, Rangacharya RP, Rewatkar SS, Solanke BU. Response of soybean to phosphorus and potassium application in Vertisol. J Pot. Res 1994;10(4):332-337.
7. Farhad ISM, Islam MN, Hoque S, Bhuiyan MSI. Role of potassium and sulphur on the growth, yield and oil content of soybean (*Glycine max* L.). Academic Journal of Plant Sciences 2010;3(2):99-103.
8. Jackson ML. Soil Chemical Analysis (Edn. 2) Prentice Hall of India Pvt. Ltd., New Delhi 1973, 69-182.
9. Katkar RN, Turkhede AB, Solanke VM, Wankhade ST, and Patil MR. Effect of integrated management of organic manures and fertilizer on soil properties and yield of cotton. J Cotton Res. Dev 2002;16(1):89-92.
10. Knudsen D, Peterson GA. In: Methods of Soil Analysis, Part II, Chemical and Microbiological Methods by Page, A.L., R.H. Miller and D.R. Keeney (eds.), Agronomy Monograph No. 9 (2nd edition). American Society of Agronomy and Soil Science Society of America, Madison, Wisconsin, USA 1982, 228-231.
11. Krishnan PK, Alaurduraj. Different levels, time and method of application of N and K on the uptake of nutrients and soil nutrients status in cotton. Madras Agric J 1997;84(6):330-334.
12. Mandal SS, Pramanik CK. Integrated fertilizer management with potassium in soybean and sesame under different systems. J Pot. Res 1996;12(3):298-304.
13. Nelson DW, Sommers LE. Total carbon, organic carbon and organic matter. In: Methods of soil analysis Part-II. A.L. (Ed.). Am. Soc. Of Agron. Inc. Soil Sci. Am. Madison, Wisconsin, USA 1982, 539-577.
14. Olsen SR, Sommer LE. In: Methods of Soil Analysis, Part II, Chemical and Microbiological Methods by Page, A.L., R.H. Miller and D.R. Keeney (eds.), Agronomy Monograph No. 9 (2nd edition) American Society of Agronomy and Soil Science Society of America, Madison, Wisconsin, USA 1982, 421-422.
15. Piper CS. Soil and Plant Analysis. Asian Report. Hans,

Publisters, Bombay. Potassium in Agriculture. American Society of Agronomy, Madison, WI 1966, 363.

16. Rajashekarappa KS, Basavarajappa BE, Puttaiah ET. Effect of different organic mulches and *in situ* green manuring on soil properties and yield and economics of maize in south-eastern dry zone of Karnataka. Global Journal of Biology Agriculture and Health Science 2013;2(3):236-240.
17. Raskar BS. Effect of irrigation methods fertilizer levels and green manuring on yield and Nutrient balance in summer cotton. Res and Dev 2006;20(1):70-72.
18. Regar PL, Rao SS, Vyas SP. Crop residue management for sustainable production of Indian mustard (*Brassica juncea*) in arid and semi-arid region. Indian J Soil Con 2009;37(2):118-122.
19. Shirale ST, Khating LE. Effect of organic and inorganic nutrients on yield, nutrient uptake and balance in different cropping systems in Vertisol. Ann. Plant Physiol 2009;23(1):83- 85.
20. Singh A, Rathod A, Pathak D. Effect of foliar application of inorganic nutrients on yield of American cotton. J cotton res. Development 2004;19(1):18-12.
21. Subbaih BV, Asjia GL. A rapid procedure for determination of available nitrogen in soils. Current Sciences 1965;25:258-260.
22. Tisdale SL, Nelson WL. Soil fertility and fertilizer, MacMillan and Co. London 1975.
23. Vidyavathi GS, Dasog HB, Babalad NS, Hebsur SK, Gail SG, Patil *et al*. Nutrient status of soil under different nutrient and crop management practices. Karnataka J Agric. Sci 2012;25(2):193-198.