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Effect of various levels of potassium on yield of soybean and soil nutrient status on farmer's field in Vertisols

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Abstract
The field experiment was conducted to assess theeffect of various levels of potassium on yield of soybean and soil nutrient status on farmer's field in Vertisols at Kanehri, Tq. Barshitakli, Dist. Akoladuring Kharif 2015-16.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 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 $^{-1}$. 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.

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 theeffect 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 during Kharif 2015-16 on effect of various levels of potassium on yield of soybean and soil nutrient status on farmer's field in vertisols.The experiment comprised four treatments and six replications laid out in Randomized Block Design. The treatments comprised of30:75:00 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, 14]. Available nitrogen was determined by alkaline permanganate method using micro processor based automatic distillation system (Subbiah and Asija, 1965) [21]. 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) [13, 14]. Available potassium was determined by neutral normal ammonium acetate method using flame photometer (Knudsen and Peterson, 1982) [10].

The treatment wise plant samples were selected randomly from each net plot at harvesting stage. The plant samples were dried in shade and then placed in oven at 65 ^{0}C till the constant weight obtained. The oven dried weights were recorded. These plant samples were ground in electrically operated stainless steel blade grinder (Willey mill) up to maximum fineness.

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 was added and digested on microprocessor based (KES-12L) digester. After completion of digestion (clear white) the extract was diluted and filtered through Whatman 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 Disscussion

Effect of different levels of potassium on soybean yield

The results revealed that 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}) was recorded 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 which was found to be on par with each other indicating response to 60 kg applied K. 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 withabsolutely no application of K along with recommended dose of N and P.

The results are in consonance with Deshmukh *et al.* (1994) [6], Mandal and Pramanik (1996) [12] and Farhad *et al.* (2010) [7] they reported that increasing levels of potassium significantly increased the grain and straw yield of soybean.

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}.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} recorded 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} and found to be on par with each other. The lowest N uptake i.e. 101.76 kg ha^{-1} was recorded with the application of 30:75:00 kg NPK ha^{-1}.

The application of 30:75:90 kg NPK ha^{-1} resulted 31.8% increase in total N over 30:75:00 kg NPK ha^{-1}followed by the application of 30:75:60 kg NPK ha^{-1} which was increasedto 25.2% as compared to the 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] they reported that uptake of nitrogen increased significantly with the application of various levels of potassium.

Phosphorus uptake

The P uptake ranged between 12.14 to 16.37 kg ha^{-1}.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}) was registered with the application of 30:75:00 kg NPK ha^{-1}.The application of 30:75:90 kg NPK ha^{-1} resulted in increase 34.8% increase in total phosporus over 30:75:00 kg NPK ha^{-1}followed by the application of 30:75:60 kg NPK ha^{-1} which was increased to 25.8% as compared to the 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] they reported that uptake of phosphorus increased significantly with the application of various levels of potassium.

Potassium uptake

The potassium uptake ranged between 26.32 to 44.67 kg ha^{-1}.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} recorded maximum potassium uptake which 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}) was registered with the application of 30:75:00 kg NPK ha^{-1}.

The application of 30:75:90 kg NPK ha^{-1} resulted 69.7% higher over 30:75:00 kg NPK ha^{-1} whereas, the application of 30:75:60 resulted 48.7% higher uptake as compared to 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] they reported that uptake of potassium increased significantly with the application of various levels of potassium.

Effect of different level of potassium on chemical properties of soil

pH and Electrical conductivity

The effect of different level of potassium was found to be non-significant in respect of soil pH. The pH value ranged from 7.78 to 7.92 indicating slight variation. The effect of different level of potash on electrical conductivity was found to be non-significant. The electrical conductivity value ranged from 0.28 to 0.33 dS m^{-1} for various treatments indicating slight variation among various potassium levels and 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}.Among the various treatments, significantly higher organic carbon content (5.67 g kg^{-1}) was recorded with the application of 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 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 increase in organic carbon under 30:75:90 kg NPK ha^{-1} was registered to the extent of 3.09% higher over 30:75:00 kg NPK ha^{-1} and 2.53% higher over 30:75:30 kg NPK ha^{-1}. 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}. The highest content of available N (196 kg ha^{-1}) was recorded 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}) was recorded with the application of 30:75:00 kg NPK ha^{-1}.

The application of 30:75:90 kg NPK ha^{-1} increased the availability of nitrogen by 7.1% higher and whereas, the application of 30:75:60 kg NPK ha^{-1}increased availability of N by 4.9% as compared 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] they reported that application of higher levels of K significantly increased the available N status over relatively lower levels of potash.

Available P

The effect of potassium levels on availability of phosphorus was found to be non-significant. The available P ranged between 11.75 to 12.96 kg ha^{-1}. However, the higher phosphorus content (12.96 kg ha^{-1}) was recorded in the treatment receiving 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] they reported that application of higher levels of K increased the available P status over relatively lower levels of potash.

Available K

Available K content in soil was significantly influenced with the different levels of potassium. The available K content in soil at harvest ranged between 369 to 412 kg ha^{-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}.

The application of 30:75:90 kg NPK ha^{-1} significantly increased the status available K by 11.6% over 30:75:00 kg NPK ha^{-1} whereas, application of 30:75:60 kg NPK ha^{-1} significantly increased the available K by 6.5% as compared with the application 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] who reported that application of higher levels of K significantly increased the available K status over relatively lower levels of potash.

Table 1: 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

Table 2: 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	NS	27.27

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 plantstands 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, 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 Ariculture 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 AR *et al*. Nutrient status of soil under different nutrient and crop management practices. Karnataka J Agric. Sci. 2012; 25(2):193-198.