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RESEARCH ARTICLE :

Split application of nitrogen, phosphorus and potassium for enhancing yield of soybean on inceptisol

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SUMMARY : The field experiment on soybean grown on Inceptisol was laid out in a Randomized Block Design with the nine treatments and three replications at Central Research Farm of Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri – 413 722 Dist – Ahmednagar during *Kharif* 2012. The results revealed that, the growth parameters *viz*., root nodule counts (19) were observed in treatment T_6 (application of 50:75:25 kg ha^{-1} in two splits-50% N,P_2O_5 and K_2O at sowing and 30 DAS)which was at par with treatment T_7.The treatment T_7 (application of 50:75:50 kg ha^{1} in two splits-50% N,P_2O_5 and K_2O at sowing and 30 DAS) were recorded the highest number of pods per plants (51.73), grain yield (34.53 q ha^{-1}) and stover yield (44.04 q ha^{-1}) which was at par with treatment T_6. The total uptake of NPK by soybean and available of nutrient in soil were significantly influenced by the split application of NPK and maximum total uptake and available of NPK in soil at harvest was observed in the treatment T_7 and it was at par with treatment T_6. Thus, application of 50:75:25 kg NPK ha^{-1} in two splits - 50% NPK at sowing and 50% NPK at 30 DAS was proved to be profitable for soybean cultivation on Inceptisol.

KEY WORDS :
Inceptisol, Spilt application of NPK, Soybean yield

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BACKGROUND AND OBJECTIVES

Soybean is important source of protein and oil for human and animal feed. It typically contains 20 per cent oil and 38 per cent protein (Imas and Magen, 2007). At present, soybean crop is becoming more popular in Maharashtra which is second largest producing state for soybean in India. The average productivity of soybean in Maharashtra is 10.58 q ha^{-1} which is low as compare international average productivity of 22 q ha^{-1} (FAO STAT, 2012). Yield constrains analysis indicated that unbalanced nutrition is one of the important reasons for low productivity of soybean in the country (Sharma *et al.*, 1996 and Tiwari, 2001). Under nutrition management, split application of nutrients *i.e.* right source, rate, time and place are most crucial aspects for achieving the highest economical yield of crops with an increase in nutrient use efficiency is advocated by Flannery (1986). Gervais and Paual (2009)

reported that split application of nitrogen and phosphorus to soybean showed positive response for enhancing yield of soybean. Keeping in view this fact, the present investigation was undertaken to study the nutrient requirement of soybean and effect of split application of NPK on soybean yield, soil fertility status and nutrient uptake by soybean.

RESOURCES AND METHODS

A field experiment was conducted at the Post Graduate Research Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri during *Kharif* 2012. The soil from the experimental site was medium black with soil pH 8.42, EC 0.34 dSm^{-1} Organic Carbon 0.48 %, available N 178.62 kg ha^{-1}, available P_2O_5 13.90 kg ha^{-1} and available K_2O 278 kg ha^{-1}. Before conduct of main experiment, maize crop was grown as an exhaust crop for development of uniform fertility gradient. The field experiment was laid out in Randomized Block Design with nine treatments *viz.*, absolute control, application of 50:75:00, 50:75:25, 50:75: 50 N,P_2O_5 ,K_2O kg ha^{-1} at sowing, application of 50:75:00, 50:75:25, 50:75: 50 N, P_2O_5, K_2O kg ha^{1} in two equal splits at sowing and 30 days after sowing and application of 50:75:25, 50:75: 50 N,P_2O_5, K_2O in two splits -100 % N at sowing, 50% P_2O_5 and K_2O at sowing and 30 days after sowing.

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Nodulation, yield and yield contributing parameters of soybean :

The data on number of root nodules, number of pods/ plant, grain and stoveryield as influenced by different treatments was presented in Table 1. The significant variation in number of root nodules, number of pods/ plants, grain and stover yield were observed due to various treatments of split application of NPK to soybean.

The highest mean number of root nodules (19) were observed in two treatments *viz.*, T_6 and T_7 and these are at par with treatments T_9 (18.56); T_8 (16.89) and T_5 (16.78). Similar results were also reported by Sorawgi *et al*. (1988) in which he found that the growth of nodulation and yield were higher with application of 60 kg N ha^{-1} if applied in two splits along with 30 kg P_2O_5 ha^{-1}.

The significantly highest mean number of pods $plant^{-1}$ (51.73) was noticed in treatment T_7 *i.e.* application of 50:75:50 kg ha^{1} in two splits-50% N,P_2O_5 and K_2O at sowing and 30 DAS which was at par with treatment T_6 *i.e.* application of 50:75:25 kg ha^{-1} in two splits- at sowing and 30 DAS (51.60).

The data on grain and stover yield of soybean revealed that, the significantly highest grain yield (34.53 q ha^{-1}) of soybean was registered by the treatment T_7 (application of 50:75:50 kg ha^{1} in two splits-50% N,P_2O_5 and K_2O at sowing and 30 DAS) and it was at par with

Table 1 : Effect of split application of NPK on nodulation, yield and yield contributing parameters of soybean

Treatments		No. of root nodules $plant^{-1}$ at 50 % flowering	No. of pods $plant^{-1}$	Grain yield (q ha^{-1})	% increase in grain yield over recommended treatment	Stover yield (q ha^{-1})
T_1:	Absolute control	10.11	32.07	19.88	--	25.45
T_2:	Application of 50:75:00 N,P_2O_5 and K_2O kg ha^{-1} at sowing	14.45	35.73	24.04	--	30.63
T_3:	Application of 50:75:25 N,P_2O_5 and K_2O kg ha^{-1} at sowing	14.78	36.73	24.90	--	32.04
T_4:	Application of 50:75: 50 N,P_2O_5 and K_2O kg ha^{-1} at sowing	15.89	36.80	27.73	--	35.75
T_5:	Application of 50:75:00 kg ha^{-1} in two splits -50% N, P_2O_5 and K_2O at sowing and 30 DAS	16.78	41.20	25.07	4.28	32.24
T_6:	Application of 50:75:25 kg ha^{-1} in two splits-50% N, P_2O_5 and K_2O at sowing and 30 DAS	19.00	51.60	34.30	42.67	43.34
T_7:	Application of 50:75:50 kg ha^{-1} in two splits-50% N, P_2O_5 and K_2O at sowing and 30 DAS	19.00	51.73	34.53	43.63	44.04
T_8:	Application of 50:75:25 kg ha^{-1} in two splits -100% N at sowing, 50% P_2O_5 and K_2O at sowing and 30 DAS	16.89	41.53	27.35	13.76	34.83
T_9:	Application of 50:75: 50 kg ha^{-1}in two splits -100% N at sowing, 50 % P_2O_5 and K_2O at sowing and 30 DAS	18.56	42.33	27.92	16.13	35.20
	S.E.±	1.20	1.57	0.84	--	1.15
	C.D. (P=0.05)	3.61	4.72	2.52	--	3.46

Table 2 : Effect of split application of NPK on total uptake and available NPK in soil after harvest of soybean

		Total uptake of NPK (kg ha^{-1})			Available NPK after harvest (kg ha^{-1})		
		N	P	K	N	P	K
T_1 :	Absolute control	163.44	26.90	57.98	144.89	7.17	203.07
T_2 :	Application of 50:75:00 N,P_2O_5 and K_2O kg ha^{-1} at sowing	176.53	32.38	68.49	148.78	8.12	220.43
T_3 :	Application of 50:75:25 N,P_2O_5 and K_2O kg ha^{-1} at sowing	182.88	33.35	72.72	150.19	8.37	258.38
T_4 :	Application of 50:75: 50 N,P_2O_5 and K_2O kg ha^{-1} at sowing	194.81	33.43	81.14	150.46	8.52	264.65
T_5 :	Application of 50:75:00 kg ha^{-1} in two splits -50% N,P_2O_5 and K_2O at sowing and 30 DAS	186.22	30.37	73.22	149.43	9.56	223.03
T_6 :	Application of 50:75:25 kg ha^{-1} in two splits-50% N,P_2O_5 and K_2O at sowing and 30 DAS	210.23	43.75	100.16	152.69	9.59	287.92
T_7 :	Application of 50:75:50 kg ha^{-1} in two splits-50% N,P_2O_5 and K_2O at sowing and 30 DAS	212.93	44.41	100.84	153.11	9.86	309.18
T_8 :	Application of 50:75:25 kg ha^{-1} in two splits -100% N at sowing, 50% P_2O_5 and K_2O at sowing and 30 DAS	192.83	32.97	79.85	151.17	9.48	295.12
T_9 :	Application of 50:75: 50 kg ha^{-1} in two splits -100% N at sowing, 50 % P_2O_5 and K_2O at sowing and 30 DAS	193.88	36.88	81.62	150.22	9.70	308.90
	S.E. ±	3.69	2.21	2.26	1.16	0.14	8.62
	C.D. (P=0.05)	11.04	6.62	6.78	3.48	0.43	25.86

treatment T_6 (application of 50:75:25 kg ha^{1} in two splits-50% N, P_2O_5 and K_2O at sowing and 30 DAS) (34.30 q ha^{-1}).

In general 43.63, 42.67, 16.13, 13.76 and 4.28 per cent increase in grain yield of soybean were observed in split application of nutrient treatments *viz.*, T_7, T_6, T_9, T_8 and T_5, respectively, over the recommended dose of fertilizer application to soybean T_2 : Application of 50:75:00 NPK kg ha^{1} at sowing. It was also documented in the literature that application of potassium to soybean in split enhanced the yield of soybean (Bansal *et al.,* 2001); Singh and Singh (1994); Imas and Magen (2004) and Megan (1997).

Similar trend was also observed in stover yield of soybean due to split application of NPK. The split application of NPK in treatment T_7 recorded significantly the highest straw yield (44.04 q ha^{-1}) and it was at par with treatment T_6 (43.34 q ha^{-1}).

It can be concluded that split application of recommended dose of fertilizer with potassium *i.e.* 50 : 75 : 25 N, P_2O_5 and K_2O kg ha^{-1} was found beneficial for enhancing the grain and stover yield of soybean.

Uptake and available nutrient at harvest of soybean:

The data in respect of total uptake of NPK by soybean and available nutrient at harvest was presented in Table 2. The data revealed that significant increased in total uptake of NPK was observed in treatment T_7 (212.93, 44.41 and 100.84 N, P, K, respectively) and T_6 (210.23, 43.75 and 100.16 N, P, K, respectively) over rest of all the treatment. However, the treatment T_6 and T_7 were at par with each other. The similar trend in respect of soil available NPK at harvest were observed. Similar type of observations and probable reasons for the highest uptake of NPK by soybean due to split application of NPK to soybean were reported by Deol *et al.* (2010) and Rathod *et al.* (2012).

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