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Research Paper

Effects of N, P and K on productivity and soil fertility in Soybean (*Glycine max* L. Merril)-Wheat (*Triticum aestivum*) cropping system

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ABSTRACT

A field experiment was conducted on cultivators' field during *Kharif* and *Rabi* seasons of 2008-09 on medium black soils in the scarcity zone of Ahmednagar district in Maharashtra in order to study the effect of fertilizer levels on yield and uptake of nutrients in soybean (*Glycine max* L. Merril) + wheat (*Triticum aestivum*) cropping sequence. The field experiment was laid out on permanent site in Randomized Block Design with six replications and five treatments. The fertility level increased the yield and up take of nutrients by soybean-wheat cropping Sequence. The grain yield of soybean and wheat were high with combined use of fertilizers. The maximum productivity, improvement in fertility status and chemical properties of soil could be possible from soybean-wheat cropping with application of 100 % RDF in the respective crops. A significant increase in the grain and straw yield of soybean-wheat cropping sequence was observed with balanced fertilizer application as per RDF in soybean-wheat yield. The highest productivity was recorded in the treatment consisting recommended dose of fertilizers with adequate supply of irrigation water in soybean-wheat cropping sequence.

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Key words : Cropping system, Soybean-wheat, Soil fertility, Productivity, Levels of NPK

INTRODUCTION

Soybean-wheat cropping sequence has gained popularity in scarcity zone of Maharashtra with high yielding and fertilizer responsive cultivators of these two staple food crops. There has been growing interest in cropping sequence as a potential tool in improving and sustaining soil health as well as productivity. Cropping sequence is traditionally a low cost input agriculture system. Information on nutrient management on individual crops is available, while cropping system, it is lacking. Moreover, the single nutrient approach has been replaced by multinutrient to proved balanced nutrients to boost up crop productivity and nutrient use efficiency. Beside nutrient management in cropping system is more efficient and judicious than individual crop, as following crop take care of the residual effects of nutrients N, P and to some extent K. Keeping these considerations in view, the present field investigation was undertaken.

MATERIALS AND METHODS

A field experiment was conducted for two consecutive seasons (2008-2009) on medium black soil in scarcity zone of Maharashtra. The soils were moderate in organic carbon (0.60 per cent), low in available nitrogen (176 kg ha^{-1}) and available phosphorus (14 kg ha^{-1}) and very high in available potassium (475 kg ha^{-1}). The field experiment was laid out on permanent site in Randomized Block Design with six replications and five treatments. The treatments were comparised of recommended dose of N, recommended dose of NP, recommended dose of NK, recommended dose of NPK and absolute control. The soybean (cv. *Phule Kalyani*) in *Kharif* and Wheat (cv. *Tyambak*) were the experimental crops. The recommended dose for soybean and wheat were 50:75:25 and 120.60.40 kg N: P: K ha^{-1} applied, respectively as per the treatments. Biofertilizers *viz., Rhizobium, Azotobactor* and PSB were used for seed treatment with respect of crops. Initial and after harvest soil samples

were collected and analyzed for pH, EC, organic cabon and available nutrients by following standard methods (Black *et al.,* 1965 and Jackson, 1973). The plant samples were collected after harvest and analyzed for total NPK for uptake studies (Parkinson and Alien, 1975 and AOAC, 1990). The statistical analysis was carried out as per method suggested by Panse and Sukhatme (1967).The grain and straw yields were recorded after harvest of both the crops.

RESULTS AND DISCUSSION

The results obtained from the present investigation have been discussed in the following sub heads :

Response of soybean to N, P_2O_5 and K_2O:

Application of N, P_2O_5 and K_2O had positive and significant influence on seed and straw yield of soybean (Table 1). The seed yield of soybean increased significantly with increasing levels of N up to 50kg/ha. Application of 50 kg ha^{-1} N increased the seed yield by 2.97 q ha^{-1} over absolute control. These findings were confirmed with the results of Hile *et al.* (2007). Application of P was effective however, marked response was observed on application of 75 kg P_2O_5 ha^{-1}. The application of recommended N and P_2O_5 recorded an increase of 5.77 q ha^{-1} seed yield of soybean over the control. This might be attributed to more P fixing capacity of soil of experimental plot. It was observed that the treatment comparising recommended N and K_2O resulted an increase of 7.7 q ha^{-1} over the control. This might be due to sufficient potash reserve and high potash buffering capacity of experimental plot. The application of RDF + biofertilizers recorded significantly higher grain yield of soybean (19.78 q ha^{-1}) and straw yield (23.73 q ha^{-1}), followed by the treatment involving application of recommended N, K_2O + biofertilizers. Similar results were also reported by Rao *et al.* (1998), Hile *et al.* (2007) and Gunjal (2006).

Response of wheat to N, P_2O_5 and K_2O:

Application of N, P_2O_5 and K_2O had positive and significant influence on seed and straw yield of wheat (Table 1). The yield of wheat increased significantly with increasing levels of N, and a linear response to N was observed up to 120 kg ha^{-1} in all the treatments except control. Application of 120 N kg ha^{-1} alone increased yields by 3.45 q ha^{-1} over absolute control. Grain yields of 7.74 q ha^{-1} and 11.99 q ha^{-1} were recorded over the control with application of recommended P_2O_5 and K_2O along with recommended N, respectively. The application of RDF + biofertilizers recorded significantly higher grain yield of wheat (36.67 q ha^{-1}) and straw yield (54.94 q ha^{-1}), followed by the treatment involving application of recommended N, K_2O + biofertilizers. The results are in conformity with Rao *et al.* (1998), Hile *et al.* (2007) and Gunjal (2006)

Table 1 : Grain and straw yield and total nutrient uptake in soybean-wheat cropping sequence

Treatment details	*Kharif* –soybean		*Rabi*- wheat		*Kharif* –soybean uptake kg ha^{-1}			*Rabi*- wheat uptake kg ha^{-1}		
	Grain yield	Straw yield	Grain yield	Straw yield	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Absolute control	8.98	10.77	15.99	23.98	47.34	7.92	19.32	24.45	5.98	21.81
Recommended N	11.95	14.34	19.44	29.16	65.45	10.73	25.92	36.09	7.67	27.23
Recommended N and P_2O_5	14.75	17.70	23.76	35.36	81.36	13.34	23.46	46.97	10.51	33.30
Recommended N and K_2O	16.68	20.01	27.98	41.98	102.59	15.32	39.36	55.32	12.52	41.37
Recommended N, P_2O_5 and K_2O	19.78	23.73	36.67	54.94	123.35	19.42	49.04	81.19	17.73	63.65
S.E.±	0.30	0.36	1.03	1.54	-	-	-	-	-	-
C.D. (P=0.05)	0.89	1.07	3.04	4.56	-	-	-	-	-	-

Table 2 : Initial and residual fertility status of soil

Treatment details	pH (1:205)	EC (dSm^{-1})	OC (%)	Available nutrients (Kg ha^{-1})		
				N	P_2O_5	K_2O
Absolute control	8.10	0.94	0.61	162	12	463
Recommended N	8.08	0.63	0.69	189	15	483
Recommended N and P_2O_5	8.09	0.63	0.73	192	17	488
Recommended N and K_2O	8.11	0.60	0.71	195	16	498
Recommended N, P_2O_5 and K_2O	8.15	0.68	0.76	209	19	505
Initial status	8.04	0.94	0.60	176	14	475

Uptake of N, P_2O_5 and K_2O :

The result on nutrients uptake by soybean and wheat crop indicated that the uptake of total nitrogen (123.35 kg ha^{-1}), total phosphorus (19.42 kg ha^{-1}) and total potassium (49.04 kg ha^{-1}) was recorded higher where all three recommended sources of nutrients were applied in treatment T_5 in the *Kharif* season (Table 1). The similar trend was observed in *Rabi* season and nutrient uptake was 81.19 kg ha^{-1} total nitrogen, 17.73 kg ha^{-1} total phosphorus and 63.65 kg ha^{-1} total potassium (Table 1). The lowest total nutrient uptake was recorded in the absolute control. Similar results were also reported by Bisht *et al.* (1996).

Soil fertility status:

The data on soil fertility status after harvest of the crop are presented in Table 2. The highest available nitrogen (209 kg ha^{-1}), phosphorus (19 kg ha^{-1}), potassium (505 kg ha^{-1}),organic carbon (0.76 per cent) content was observed after harvest of crop due to application of 100 % RDF + biofertilizers. In general, wherever there was inclusion of organic source either biofertilizer, the improvement in the chemical properties of soil was observed more pronouncely as compared to use of only inorganic source. This trend is in conformity with the findings of Patel (1994). In general residual organic carbon, available nitrogen, available phosphorus and available potassium content was increased due to application of FYM, biofertilizers and chemical fertilizers after completion of crop cycle. This was because of beneficial effects of FYM and biofertilizers. This is in conformity with the research findings of Varlakhmi *et al.* (2005).

Thus, it could be possible to achieve maximum productivity and improvement in soil fertility status from soybean - wheat cropping system with the application of RDF + biofertilizers to both the crops.

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