INTEGRATED PHOSPHORUS MANAGEMENT IN SOYBEAN - SUNFLOWER CROPPING SYSTEM

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Summary

Soybean-sunflower sequential cropping is one of the most important systems in which sunflower is cultivated in India. Both soybean and sunflower have high P requirements. The studies were, therefore, carried out to optimize P requirement in soybean-sunflower system through integrated P management.

The field experiment was carried out in permanent plots under the All India Coordinated Sunflower Improvement Project at three locations *viz.*, Coimbatore (Tamil Nadu State), Akola and Latur (Maharashtra State). The soil types were Alfisol at Coimbatore, and Vertisol at Akola and Latur which had medium available P status at the beginning. There were 10 treatments comprising application of 100% recommended P to both crops and reducing P application to 50 or 0% to either of the crops with other the crop getting recommended P. When soybean received 100% P, phosphorus solubilizing bacteria (PSB) and farm yard manure (FYM) were included either singly or in combination for sunflower along with 0 or 50% P. The treatments were arranged in randomized block design with three replications. The study was initiated during 1995-96 at Coimbatore and Akola and 1996-97 at Latur.

Average data of three years indicated that on Alfisol at Coimbatore and Vertisol at Akola, application of 100% P to both crops resulted in highest yield of both crops although it was possible to substitute 50% P to sunflower with PSB or FYM or both without any significant adverse effect on productivity. On Vertisol at Latur, application of PSB alone could substitute 100% P for sunflower. System productivity and net returns also showed similar trend. Available soil P after three years cropping was highest in the treatment when both crops in the system received 100% of recommended P.

Introduction

Soybean-sunflower sequential cropping is one of the popular systems in which sunflower is cultivated in central southern regions of India. Both soybean and sunflower have high P requirement (Hegde, 1998) and any economy in P use of either of the crops goes a long way in increasing the profitability of this important system. As hardly less than 30% of applied P is taken up by the current crop, there is great scope to make use of residual P fertility by the succeeding crop by employing biological/organic amendments to increase P availability. The present studies were, therefore, carried out to economize P use of soybean-sunflower system through integrated P management.

Materials and Methods

The experiment was conducted in permanent plots under the All India Coordinated Sunflower Improvement Project at three locations, *viz.*, Coimbatore (Tamil Nadu State), Akola and Latur (Maharashtra State). The study was initiated during 1995-96 at Coimbatore and Akola and 1996-97 at Latur. The soil types were sandy loam Alfisol at Coimbatore and clay Vertisol at Akola and Latur. The soils at three sites had pH of 7.6, 8.0 and 7.2; available N content of 278, 151 and 128 kg/ha; available P content of 12.7, 14.3 and 12.1 kg/ha and available K content of 378, 450 and 411 kg/ha, respectively.

There were 10 treatments (Table 1) comprising application of 100% recommended P to both soybean and sunflower and reducing P application to 50 or 0% to either of the crops with the other crop receiving recommended P. When soybean received 100% recommended P, PSB and FYM (5 t/ha) were included either singly or in combination for sunflower along with 0 or 50% recommended P. The treatments were arranged in randomized block design with three replications.

The recommended fertilizer level for soybean were 30:80:50 at Coimbatore and 30:75:30 at Akola and Latur, N:P_2O_5:K_2O kg/ha. Soybean was planted during second fortnight of June or first fortnight of July at all locations with a spacing of 30x10cm. The cultivars used were Co-1, PKV-1 and PK-472 at Coimbatore, Akola and Latur respectively. All the fertilizers were applied before planting. The crop was irrigated only at Coimbatore. Soybean was harvested in October and seed yields were recorded on air-dry basis.

Land was prepared for planting succeeding sunflower without disturbing the bands between plots. Sunflower was planted during second fortnight of October or first fortnight of November at different locations with a spacing of 60x30cm. Sunflower hybrids BSH-1 (variety Co-4 for 1996-97 and 1997-98), PKVSH-27 and PAC-36 were used at Coimbatore, Akola and Latur respectively. The recommended fertilizer level for sunflower were, 60:80:40 at Coimbatore and 40:60:40 at Akola and Latur, N:P_2O_5:K_2O kg/ha. Full dose of P as per the treatment and K and half of N was applied before planting and the remaining half N was topdressed 30 days later. The PSB (2 kg/ha) and FYM (5 t/ha) as per the treatment were applied during land preparation. Sunflower was raised under irrigation. Crop was harvested during February and seed yield was recorded on air-dry basis.

Soil samples from 0-15cm layer was collected after sunflower harvest during 1997-98 and analysed for available P (Olsen, 1954). Yield data were pooled over years and treatment

means were compared at 5% level of significance using least significant difference. To compare total system productivity, the average soybean yield was converted to sunflower equivalents based on the market price and added to sunflower yields. Net returns from different treatments were also calculated based on input cost and output value.

Results and Discussion

Seed yield. The average data of three years indicated that on Alfisol at Coimbatore, application of 100% recommended P to both soybean and sunflower resulted in highest yield of both crops (Table 1). Any reduction in P application to either of the crops had adverse effect on productivity. However, application of PSB and FYM along with 50% recommended P could result in as much sunflower yield as with 100% recommended P. The system productivity also showed similar trend and clearly indicated the possibility of substituting 50% recommended P for sunflower with PSB and FYM without any significant adverse effect on productivity. More or less similar results were obtained at Akola on Vertisol except that application of PSB or FYM or both along with 50% recommended P resulted in sunflower yield which was at par with that obtained with application of 100% recommended P. On Vertisol at Latur, application of PSB alone could substitute the entire amount of P to sunflower without any significant adverse effect on productivity. However, application of FYM had no significant beneficial effect. Sunflower equivalent yields of the system also followed similar trend. The role of PSB in converting fixed P into soluble forms and help to reduce P supply has been well documented (Rokade and Patil, 1992).

Net returns. Both at Coimbatore and Akola, highest net returns from the system were obtained when both soybean and sunflower received 100% of recommended P (Table 2). However, at Latur, application of PSB or PSB + FYM along with 50% recommended P to sunflower and 100% P to soybean recorded higher net returns than with application of 100% recommended P to both crops.

Available soil P. Level of P application to soybean had no marked influence on soil P (Table 2). However, both at Coimbatore and Akola, application of 100% recommended P to both soybean and sunflower resulted in highest available soil P.

This study clearly shows the possibility of substituting 50-100% P requirement of sunflower in soybean-sunflower sequential cropping system by PSB or PSB+FYM without any adverse effect on system productivity in different soil types.

References

Hegde, D.M. 1998. Integrated nutrient management for production sustainability of oilseeds - A review. *Journal of Oilseeds Research*, **15**(1):1-17.

Olsen, S.R., Cole, C.V., Watanabe, F.S. and Dean, LA. 1954. *Estimation of available phosphorus in soils by extraction with sodium bicarbonate.* USDA Cir. 934.

Rokade, S.D. and Patil, P.L. 1992. Phosphate solubilizing micro-organisms - a review. Journal of Maharashtra Agricultural Universities, **17**(3):458-65.

Table 1. Effect of P management on the productivity of soybean-sunflower sequence

Treatment		Average seed yield (kg/ha)								
Soybean	**Sunflower**	Coimbatore			Akola			Latur		
		Soybean	Sunflower	Sunflower equivalent	Soybean	Sunflower	Sunflower equivalent	Soybean	Sunflower	Sunflower equivalent
100% P	100% P	1441	1225	2522	2258	1302	3334	1660	1396	2890
50% P	100% P	1182	1205	2269	1785	1281	2887	1226	1384	2487
No P	100% P	993	1188	2082	1469	1262	2584	891	1418	2220
100% P	50% P	1405	954	2218	2117	1095	3000	1635	1088	2559
100% P	50% P + PSB	1400	1009	2269	2161	1179	3124	1702	1426	2958
100% P	50% P + 5t/ha FYM	1402	1090	2352	2203	1243	3226	1723	1180	2731
100% P	50% P + PSB + 5t/ha FYM	1405	1152	2416	2243	1276	3295	1762	1402	2988
100% P	PSB	1389	863	2113	2105	947	2841	1744	1328	2898
100% P	5t/ha FYM	1412	970	2241	2129	1095	3011	1724	1076	2628
100% P	PSB+5t/ha FYM	1392	1040	2293	2137	1206	3129	1741	1271	2838
	LSD (P=0.05)	113	194	291	280	158	274	174	165	248

Table 2. Effect of P management on net returns and available soil P in soybean-sunflower sequence

Treatment		Net returns (Rs/ha)			Available soil P (kg/ha)	
Soybean	**Sunflower**	Coimbatore	Akola	Latur	Coimbatore	Akola
100% P	100% P	20832	23641	24248	13.8	22.4
50% P	100% P	19422	18893	20730	12.9	23.8
No P	100% P	18557	16100	18078	12.9	22.4
100% P	50% P	19001	19512	21126	12.6	10.4
100% P	50% P + PSB	19222	21532	25370	12.5	11.9
100% P	50% P + 5t/ha FYM	19608	20532	22740	12.7	13.4
100% P	50% P + PSB + 5t/ha FYM	19936	21354	25439	12.9	14.9
100% P	PSB	18813	18457	24998	12.1	10.4
100% P	5t/ha FYM	19371	17911	21787	12.6	8.9
100% P	PSB+5t/ha FYM	19600	19834	24481	12.6	13.4

Rs. 43.40 = 1 US$