

Nutrient management in cotton (*Gossypium hirsutum*)-based cropping systems

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ABSTRACT

A field experiment was conducted on clayey soils during the rainy seasons of 1999–2003 at Parbhani, to study nutrient management in cotton (*Gossypium hirsutum* L.)-based intercropping systems. Sole cotton recorded significantly higher seed-cotton yield than cotton + blackgram (*Phaseolus mungo* L.) and cotton + soybean [*Glycine max* (L.) Merr.] intercropping systems. However, highest and significant cotton-equivalent yields were recorded in cotton + blackgram intercropping, followed by cotton + soybean than sole crop of cotton. Further, yield of seed cotton, intercrop and cotton equivalent were enhanced significantly with every higher fertilizer level and highest values were recorded with 100% recommended dose of fertilizer (RDF). The performance of cotton + blackgram (1:1) with 100% RDF was better than all the treatments for cotton-equivalent yield and net monetary returns. The uptake of NPK by cotton was significantly more under sole cotton and cotton intercropped with blackgram than the cotton intercropped with soybean. Application of 100% RDF recorded significantly higher NPK uptake by cotton than 75% and 50% RDF.

Key words : Cotton + blackgram/soybean intercropping, Cotton-equivalent yield

Cotton is an important cash crop of Maharashtra, ranking first in acreage and production in the country. However, the productivity is very low because entire area is rainfed (96–97% area) poor soil fertility (Blaise and Prasad 2005) and heavy infestation of bollworms during peak square, flowering and boll-development stages. Therefore farmers grow different intercrops in cotton to maximize returns and minimize risks. Intercropping is commonly practised in different parts of the Maharashtra under rainfed situations. Cotton intercropped with blackgram gives higher monetary returns than sole cotton (Birajdar *et al.*, 1987; Tomar and Kushwaha, 1991). Similar trend was noticed for cotton intercropped with soybean by Tomar *et al.* (1994) and Wankhede *et al.* (2002). Though the intercropping with these crops become popular, information on fertilizer management to intercropping systems is meagre. Keeping this in view, an attempt was made to find out a profitable cropping system and economical fertilizer level for cotton-based intercropping system.

MATERIALS AND METHODS

A field experiment was conducted at Parbhani during the rainy (*kharif*) seasons of 1999–2003. The soil was Typic Haplusterts (Vertisol) having available N 167.5 kg/ha, available phosphorus (P_2O_5) 27.4 kg/ha and available potassium (K_2O) 388.6 kg/ha, and pH 8–8.2. The experiment was laid out in randomized block design (factorial),

consisting of 9 combinations of 3 cropping systems [sole cotton (C), cotton intercropped with 1 row of blackgram (C+B, 1:1) and cotton intercropped with 1 row of soybean (C+S, 1:1)] and 3 fertilizer levels [recommended dose of NPK of both the crops on area basis (100% RDF), 75% of the recommended dose of NPK of both the crops on area basis (75% RDF) and 50% recommended dose of NPK of both the crops on area basis (50% RDF)]. The treatments were replicated thrice. Cotton hybrid 'PHH 316' ('Ganga'), blackgram cv. 'TAU 1' and soybean cv. 'JS 335' were used in the investigation. The cotton crop was planted with a spacing pattern of 90 cm × 60 cm. The recommended dose of NPK used for cotton, blackgram and soybean was 100:50:50 kg/ha, 25:50:0 kg/ha and 30:60:0 kg/ha respectively. Complete dose of P, K and half dose of N was applied as basal dose to cotton crop at the time of sowing by ring method and complete dose of N and P to intercrops by drilling method just before sowing as per treatments. The sowing was done on 7, 2 and 21 July in 1999–2000, 2000–01 and 2002–03 respectively. The precipitation received during the respective crop seasons was 934, 1,029 and 793.9 mm in 47, 46 and 41 rainy days respectively. The experiment was vitiating during 2001–02 due to poor precipitation.

RESULTS AND DISCUSSION

Effect of cropping systems and fertilizer levels

Seed-cotton yield: Sole crop of cotton with 100% rec-

ommended dose of fertilizer (RDF) recorded significantly higher cotton yield over all the treatments during 1999–2000 and in pooled results and was on a par with its 75% RDF during 2000–01 and 2002–03 (Table 1). Cotton + blackgram with 100% RDF was next best and was at par with its 75% RDF. Seed-cotton yield was significantly reduced by cotton + soybean treatments at all the levels of fertilizer.

Intercrop yield: Soybean as an intercrop with 100% RDF recorded significantly higher seed yield than all the treatments, which was followed by its 75% RDF and 50% RDF. The production potential of soybean was better than blackgram, whereas prevailing rates of commodities made blackgram were more remunerative than soybean.

Cotton-equivalent yield: Cotton + blackgram with 100% RDF recorded significantly more cotton-equivalent yield than rest of the treatments during 1999–2000 and 2000–01. During 2002–03, cotton + soybean with 100% RDF recorded significantly more cotton-equivalent yield than rest of the treatments. It clearly indicated that intercropping of cotton with either blackgram or soybean with 100% RDF seems to be beneficial than reduced fertilizer levels.

Effect of cropping

Seed-cotton yield: Seed-cotton yield was influenced significantly by different intercropping systems. The highest seed-cotton yield was obtained from sole crop of cotton which was significantly higher than cotton + blackgram and cotton + soybean intercropping systems. Amongst intercropping systems, cotton + blackgram recorded significantly more seed-cotton yield than cotton + soybean intercropping system. It clearly indicated that soybean variety 'JS 335' when taken as an intercrop in cotton hybrid 'PHH 316' ('Ganga') affected the cotton growth and ultimately yield compared to blackgram variety 'TAU 1'.

Intercrop yield: Soybean as an intercrop recorded significantly higher yield than blackgram and proved its more production potential capacity than blackgram.

Cotton-equivalent yield: The differences in cotton-equivalent yield were significant due to cropping system. During early 2 years cotton + blackgram system resulted in highest cotton-equivalent yield which was significantly more than cotton + soybean system as well as sole crop of cotton, whereas during 2002–03 cotton + soybean system has recorded highest cotton-equivalent yield which was significantly more than cotton + blackgram system

Table 1. Effect of nutrient management on yield of seed cotton, intercrop and cotton equivalent in cotton-based intercropping system

Cropping system	Fertilizer level	Seed-cotton yield (q/ha)			Intercrop yield (q/ha)			Cotton-equivalent yield (q/ha)			Pooled net monetary return (Rs/ha)
		1999–2000	2000–2001	2002–2003	1999–2000	2000–2001	2002–2003	1999–2000	2000–2001	2002–2003	
Cotton (sole)											
	RDF	7.34	6.07	6.35				7.34	6.07	6.35	11.87
	75%	6.69	5.55	5.78				6.69	5.55	5.78	7.03
	50%	6.14	4.65	5.51				6.14	4.65	5.51	2.73
Cotton + blackgram (1:1)											
	RDF	5.28	4.48	5.96	8.71	5.77	3.26	11.30	9.17	7.78	55.53
	75%	4.94	4.17	5.28	7.94	5.14	3.02	10.43	8.35	6.96	46.59
	50%	4.15	3.84	4.99	7.19	4.46	2.69	9.12	7.46	6.49	36.71
Cotton + soybean (1:1)											
	RDF	4.62	3.03	5.32	15.14	10.74	5.98	10.69	7.43	8.59	37.99
	75%	4.02	2.73	4.97	13.40	9.77	5.35	9.39	6.74	7.90	28.62
	50%	3.42	2.19	4.66	11.98	8.51	4.77	8.22	5.67	7.26	11.55
CD (P=0.05)		0.53	0.57	0.57	0.66	0.84	0.26	0.53	0.79	0.50	6.34
Cropping system											
Cotton (sole)		6.72	5.42	5.88				6.72	5.42	5.88	7.21
Cotton + blackgram		4.79	4.16	5.41	7.95	5.12	2.99	10.28	8.33	7.08	46.28
Cotton + soybean		4.02	2.65	4.98	13.50	9.67	5.37	9.43	6.61	7.92	28.39
CD (P=0.05)		0.31	0.33	0.33	0.38	0.48	0.15	0.31	0.46	0.29	4.11
Fertilizer level											
	100%	5.75	4.53	5.88	11.93	8.26	4.62	9.78	7.56	7.57	35.13
	75%	5.22	4.15	5.34	10.67	7.46	4.19	8.84	6.88	6.88	24.08
	50%	4.57	3.56	5.05	9.59	6.49	3.73	7.82	5.93	6.42	17.00
CD (P=0.05)		0.31	0.33	0.33	0.47	0.59	0.18	0.31	0.46	0.29	4.11

as well as sole crop of cotton. The performance of sole crop of cotton was significantly poorer than both the treatments.

Effect of fertilizer levels

Yield of seed cotton, intercrop and cotton equivalent was enhanced significantly with every higher fertilizer level and highest values were recorded with 100% RDF.

Net monetary returns

Cropping systems: Cotton intercropped with blackgram was found most profitable than cotton intercropped with soybean and sole cotton. Cotton + soybean system proved the next best profitable cropping system than sole cotton. Tomar *et al.* (1994) and Wankhede *et al.* (2000) also reported higher monetary return with cotton + blackgram system. Our results confirm these findings. Thus, cotton + blackgram intercropping system proved most profitable, followed by cotton + soybean intercropping than sole cotton.

Fertilizer levels: Application of recommended dose of fertilizer of both the crops on area basis proved most profitable than 75% and 50% RDF. Further, application of 75% RDF also proved profitable than application of 50% RDF.

Table 2. Nutrient uptake by cotton under different treatments (mean data of 3 seasons)

Treatment	Nutrient uptake (kg/ha)		
	N	P	K
<i>Cropping system</i>			
Cotton	65.0	16.60	69.30
C+B (1:1)	60.3	15.00	65.57
C+S (1:1)	54.3	13.20	62.33
CD (P=0.05)	5.6	1.67	3.90
<i>Fertilizer level</i>			
100% RDF	65.4	16.41	68.47
75% RDF	59.1	15.05	65.65
50% RDF	54.1	13.33	63.08
CD (P=0.05)	5.6	1.67	3.90

C, Cotton; B, blackgram; S, soybean; RDF, recommended dose of fertilizer

Cropping systems and fertilizer levels: Cotton intercropped with blackgram with 100% RDF recorded significantly higher net monetary returns than all the treatment combinations. It clearly indicated that recommended dose of fertilizer (NPK) of both the crops (cotton + blackgram) on area basis seems to be essential for harvesting maximum net returns.

Uptake of NPK: In pooled results, NPK uptake by cotton was significantly higher in sole cotton and blackgram intercropped cotton than cotton intercropped with soybean (Table 2). Further, an application of 100% RDF increased the NPK uptake in cotton significantly than 75% and 50% RDF which were at par with each other for N and K uptake, whereas P uptake was significantly more in 75% RDF than 50% RDF. The nutrient uptake obtained in the present study confirm the results obtained for this location (Singh *et al.*, 2004).

It was concluded that cotton + blackgram and cotton + soybean intercropping systems are highly beneficial than growing of sole cotton, and application of 100% RDF to cotton + blackgram intercropping proved highly profitable.

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