

## **Studies on *kharif* legume intercropping with *Bt* cotton under rainfed conditions**

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**ABSTRACT :** A field experiment was conducted for three years in *kharif*, 2007-2008 to 2009-2010 at Cotton Research Station, Nanded to identify remunerative *Bt* cotton based intercropping system under rainfed conditions. Legumes *viz.*, pigeonpea, soybean, greengram, blackgram clusterbean were evaluated for their intercropping benefits. Significant reductions in boll weight, yield/plant as well as seed cotton yield/ha were recorded due to all intercropping treatments over sole cotton. However, it was compensated by intercrop yields. Cotton + soybean (1:1) recorded highest seed cotton equivalent yield (2946 kg/ha) closely followed by cotton + greengram (1:3) under paired row and cotton + pigeonpea (4:2). Highest gross and net monetary returns were received from cotton + soybean (1:1) intercropping (Rs. 81,419 and Rs. 40,878/ha, respectively). Cotton + soybean and cotton + pigeonpea were most remunerative intercropping systems in terms of B:C ratio (1.97).

**Key words :** *Bt* cotton, intercropping, land equivalent ratio, paired row planting, yield

Cotton is an important fibre crop of India and is mostly grown as rainfed in Maharashtra. Monocropping, erratic rains, poor soils, continuous use of inorganic fertilizers without addition of organic manures, increased sap sucking pest attacks reduced its productivity and profitability. In this circumstances, to ward off these problems incur heavy expenses and farmers often get indebted. An option to this tragedy is to grow compatible intercrops to best utilize the wide space between cotton crop (Ramanjaneyalu and Reddy, 2002). These are a common component of an intercrop and their ability to fix nitrogen often assists the productivity of the intercrop or subsequent crop. With this background, an effort was made to evaluate the possibility of intercropping advantages of *kharif* legumes in *Bt* cotton under rainfed condition.

### **MATERIALS AND METHODS**

A field experiment was conducted at Cotton Research Station, Nanded to identify *Bt* cotton based remunerative intercropping system under rainfed conditions for consecutive three years (2007-2008, 2008-2009 and 2009-2010). The soil of experimental site was clay loam and was neutral to slightly alkaline having pH 7.85. The organic carbon content was low (0.24%), and

was medium in phosphorus (14.58 kg/ha) and high in potassium (670 kg/ha) content. The experiment was laid out in randomized block design with 8 treatments replicated thrice on 8<sup>th</sup> July, 2007, 20<sup>th</sup> July, 2008 and 8<sup>th</sup> July, 2009 with *Bt* cotton hybrid Bunny. *Bt* cotton was evaluated for its compatibility with 5 intercrops, *viz.*, pigeonpea (*Cajanus cajan*), soybean (*Glycine max* (L) Merr.), greengram (*Phaseolous radiates* (L) Wilezek), clusterbean (*Cyamposis tetragonaloba*) and black gram (*Phaseolous mungo* (L) Hepper). Paired row planting of *Bt* cotton (60 -120 cm) intercropped with greengram (1:3) was also evaluated and compared with regular planted *Bt* cotton (90 cm row spacing) intercropped in 1:1 proportion. Sole crop of *Bt* cotton was tested in regular as well as paired row planting. Fertilizers were scheduled to supply 100:50:50 kg/ha N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O. A total rainfall (from onset of monsoon till December end) of 791 mm (37 rainy days), 648 mm (37 rainy days) and 724 mm (41 rainy days) was received during 2007, 2008 and 2009, respectively. Cotton equivalent yield was calculated by converting the intercrop yield into seed cotton equivalent yield on the basis of selling prices of respective crops in each year. Monetary returns were calculated to judge the remunerative performance of intercropping systems.

**Table 1.** Mean yield attributing characters, seed cotton yield, intercrop yield, seed cotton equivalent and LER as influenced by different treatments

Treatments	Bolls/ plant	Boll weight (g)	Yield/ plant (g)	Seed cotton yield (kg/ha)	Intercrop yield (kg/ha)	SCEY (kg/ha)	Mean LER	GMR (Rs/ha)	NMR (Rs/ha)	B:C ratio
Sole <i>Bt</i> cotton	39.25	3.84	145.45	2552	-	2552	1.00	71582	31001	1.76
Cotton + pigeonpea (4:2)	32.65	3.32	109.50	1849	930	2893	1.13	81419	40060	1.97
Cotton + soybean (1:1)	35.41	3.41	120.69	2156	1143	2946	1.16	82749	40878	1.97
Cotton + greengram (1:1)	35.54	3.58	124.17	2291	348	2720	1.07	76384	35112	1.85
Sole cotton - paired row (60:120 cm)	38.74	3.68	141.34	2493	-	2493	0.98	69935	29344	1.72
Paired row cotton + greengram (1:3)	35.64	3.52	121.13	2249	550	2909	1.14	81726	39984	1.96
Cotton + clusterbean (1:1)	35.72	3.39	122.02	2215	1888	2717	1.07	76283	33914	1.80
Cotton + blackgram (1:1)	34.41	3.36	116.10	2146	434	2593	1.02	72932	30915	1.74
SE +	1.61	0.07	5.15	57.1	-	67	-	1903	1971	-
P=0.05	4.90	0.24	15.62	158.1	-	185.4	-	5267	5456	-
CV (%)	7.80	4.93	7.14	7.60	-	7.36	-	7.45	16.82	-
<b>Selling prices (Rs/q)</b>										
<i>Year</i>	<i>Cotton</i>	<i>Pigeonpea</i>	<i>Soybean</i>	<i>Greengram</i>	<i>Clusterbean</i>	<i>Blackgram</i>				
2007-2008	2650	2550	1850	2400	600	2100				
2008-2009	2800	3000	1800	3400	800	3200				
2009-2010	3000	3500	2000	4500	850	3500				

## RESULTS AND DISCUSSION

**Yield attributes :** Different intercropping systems were found to effect significantly on yield attributes (Table 1). Significantly highest boll weight (3.84 g) and yield /plant (145.45 g) were found in sole *Bt* cotton treatment in regular planting and was followed by sole *Bt* cotton in paired row planting. Cotton + soybean (1:1) intercropping recorded significantly lower bolls and yield / plant than sole cotton. Lowered yield attributes in cotton + soybean intercropping might be due to increased competition between main crop and intercrop for longer duration. Among all intercropping, cotton + greengram (1:1) recorded highest boll weight (3.58 g) and yield / plant (124.17 g).

**Seed cotton yield :** Seed cotton yield (SCY) of sole cotton in regular planting treatment was highest during all the years of experimentation and after pooled analysis (2552 kg/ha) and was followed by sole cotton in paired row. Seed cotton yield in all intercropping were found lower than that of sole cotton. Similar results of yield reduction in cotton due to intercropping were also reported by Sree Rekha *et al.*, (2008) and Giri *et al.*, (2006). Among intercropping systems, cotton + green gram (1:1) out yielded highest seed cotton yield (2291 kg/ha). This might be due to less competition in greengram due to short crop duration.

**Seed cotton equivalent yield :** Total productivity of the system indicated in terms of seed cotton equivalent yield (Table 1) revealed that cotton + soybean (1:1) was the most productive intercropping during first two years and on pooled mean basis (2946 kg/ha). Good yields and better prices of soybean influenced to increase the seed cotton equivalent yield in the cotton + soybean intercropping system. In year 2009-2010, cotton + pigeonpea (4:2) strip cropping recorded highest SCEY. Sole *Bt* cotton in paired row was the lowest productive in terms of SCEY (2493 kg/ha) followed by sole cotton in regular planting (2552 kg/ha). On pooled mean basis, cotton + soybean (1:1) was followed by cotton +

greengram (1:3) in paired row planting (2909 kg/ha) for SCEY.

**Land equivalent ratio :** All the intercroppings were found efficient in terms of land equivalent ratio (Table 1). Highest mean land equivalent ratio (LER) was recorded in cotton + soybean intercropping (1.16) closely followed by cotton + greengram in paired row (1.14) and cotton + pigeonpea strip cropping (1.13).

**Economics :** Intercropping systems increased mean gross monetary returns by Rs.1,350/ha to Rs.11,167/ha (Table 1). Cotton + soybean (1:1) treatment recorded highest gross monetary returns (Rs.82,749/ha) and net monetary returns (Rs.40,878/ha). It was found *on par* with cotton + pigeonpea (4:2) and cotton + greengram (1:3) in paired row planting for gross and net monetary returns. Cotton + soybean, cotton + pigeonpea and cotton + greengram in paired row were found significantly profitable for GMR and NMR over sole cotton. Asewar *et al.*, (2008) reported increase in GMR due to cotton + soybean over sole cotton. Cotton + cluster bean (1:1) and cotton + blackgram (1:1) were found statistically similar for monetary returns. Pulses intercropped with cotton were also noticed to by Maitra *et al.*, (2001) to give higher returns.

Cotton + soybean (1:1) and cotton + pigeonpea (4:2) were most remunerative intercropping for B:C ratio (1.97 each) closely followed by cotton + greengram (1:3) in paired row (1.96).

Cotton + soybean (1:1) was the most profitable intercropping system and was efficient system for land utilization followed by intercropping of cotton + greengram (1:3) in paired row and cotton + pigeonpea (4:2) in strip cropping.

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