



## **Effect of intercrops on growth, yield and economics of irrigated cotton based intercropping system**

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**Abstract :** Field experiment was conducted at (TNAU) Cotton Research Station, Srivilliputtur, under winter irrigated condition during September 2020 to February 2021 to identify better inter cropping system in cotton *Bt* hybrid Jadoo under paired row planting. The experiment was carried out in a randomized block design with three replications. The treatments consisted of control ( $T_1$  - Sole cotton), two rows of intercrop small onion with paired row planting of cotton ( $T_2$ ), two rows of cluster bean with cotton ( $T_3$ ), two rows of coriander with cotton ( $T_4$ ), one row onion + one row cluster bean with cotton ( $T_5$ ), one row cluster bean + one row coriander with cotton ( $T_6$ ), one row coriander + one row onion with cotton ( $T_7$ ), one row each onion + cluster bean + coriander with cotton ( $T_8$ ), normal spacing of cotton + 2 rows black gram ( $T_9$ ), normal spacing of cotton + 2 rows green gram ( $T_{10}$ ). The results revealed that all the inter crops had increased the seed cotton yield slightly indicating the complimentary effect of intercropping. Among the intercrops, the performance of cluster bean (pod yield of 3136 kg/ha) and onion (bulb yield 1810 kg/ha) were found to be better. The total seed cotton equivalent yield was the highest with intercropping of one row each of onion and cluster bean with cotton (3749 kg/ha) followed by two rows of cluster bean (3697 kg/ha) and two rows of onion (3689 kg/ha) as compared sole cotton (2395 kg/ha), cotton + black gram (2554 kg/ha) and cotton + green gram intercropping system (2564 kg/ha). All the intercropping indices (Relative Production Efficiency, Land Equivalent Ratio, Relative Economic Efficiency and Diversification Index) were also favourable with intercropping system than sole cropping. Higher gross return (189919 Rs./ha) and net return (103513 Rs./ha) were associated with one row of onion and cluster bean each with cotton followed two rows of cluster bean with cotton (gross return 187313 Rs./ha and net return 96919 Rs./ha). However benefit cost ratio was higher with two rows of cluster bean (2.24) followed two rows of onion (2.07) with cotton. It can be concluded from the study that the combination of intercrops cluster bean and onion of each one row or two rows of cluster bean intercropping were found to be highly suitable for *Bt* cotton.

**Keywords :** Cotton, economics, intercropping, seed cotton yield

Cotton also known as “White Gold” and “King of Fibre Crops” is an important fibre cum cash crop of India and Tamil Nadu as well. India has the largest area (41.3%) of cotton in the world, but, due to its lower productivity, it’s share to the total world cotton production is only 25.4per cent. In Tamil Nadu, cotton is cultivated in an area of 1.55 lakh ha during 2020-2021 with a production of 5.0 lakh bales and productivity of 548 kg/ha, which is below the world average yield of 768 kg/ha (Anonymous, 2021). In order to meet the demand and to satisfy the native mill requirement of cotton, the productivity should be increased. Intercropping has been recognized as potentially beneficial and economic system of crop production. It is the only way to increase the

cropping intensity and resource utilization for efficient management of inputs. The main objective of intercropping is to obtain an additional yield or to realize higher total economic returns and also to minimize the risk. As cotton is a relatively longer duration and its slow growth during earlier stage offer vast scope for intercropping. The inter space between two rows of wide spaced cotton can be efficiently utilized by growing short duration intercrops including vegetables. Selection of suitable intercropping system is paramount importance to realize higher productivity and economic benefits. Keeping in view, an experiment was conducted to identify proper intercrops in *Bt* cotton based intercropping system.

## MATERIALS AND METHODS

Field experiment was conducted at (TNAU) Cotton Research Station, Srivilliputtur, Tamil Nadu, India under winter irrigated condition during September, 2020 to February, 2021 to identify better inter cropping system in cotton *Bt* hybrid Jadoo under paired row planting. The experiment was carried out in a randomized block design with three replications. The treatments consisted of control (T<sub>1</sub> - Sole cotton), two rows of intercrop small onion with paired row planting of cotton (T<sub>2</sub>), two rows of cluster bean with cotton (T<sub>3</sub>), two rows of coriander with cotton (T<sub>4</sub>), one row onion + one row cluster bean with cotton (T<sub>5</sub>), one row cluster bean + one row coriander with cotton (T<sub>6</sub>), one row coriander + one row onion with cotton (T<sub>7</sub>), one row each onion + cluster bean + coriander with cotton (T<sub>8</sub>), normal spacing of cotton + 2 rows black gram (T<sub>9</sub>), normal spacing of cotton + 2 rows green gram (T<sub>10</sub>). The sowing of experimental crop was taken up on 02.09.2020. The soil of the experimental field was clay loam with a pH of 8.26 dSm/m. The available soil nutrient status was low in N (196 kg/ha). High in P (40 kg/ha) and also high in K (496 kg/ha). The varieties used for the intercrops were CO 5 (small onion), CO 1 (cluster bean), CO 4 (coriander), VBN 8 (black gram), CO 8 (green gram). A spacing of 120 x 60 cm in control (sole crop) and black gram (T<sub>9</sub>) and green gram (T<sub>10</sub>) intercropping and for other treatments, paired row planting of 80 x 60 cm for cotton and 50 x 10 cm for 2 rows intercropping and 40 x 10 cm for three rows of intercropping were followed. A fertilizer recommendation of 120 : 60 : 60 kg NPK/ha was applied for all the treatments and no additional fertilizers or pesticides were applied to intercrops. Irrigations were also given to main crop of cotton only in both sole cotton and intercropping systems. Two hand hoeing on 15- 20 DAS and 35-40 DAS were practiced for all the treatments. Observations on growth, yield attributes and seed cotton yield and yield of intercrops were recorded. Economics were also worked out.

## RESULTS AND DISCUSSION

### Growth and yield attributes

The results on the effect of different intercrops on growth and yield attributes are furnished in Table.1. The results showed that there was no significant influence on all the growth and yield attributes of cotton due to intercropping. However there was a slight increase in all the parameters studied *i.e.*, plant height, monopodia, sympodia, bolls/plant and boll weight was observed indicating noncompetition for resources between component crops in intercropping system. This might be ascribed to all the intercrops completed their life cycle about 75–80 days before the active and development stage of cotton. As all the intercrops were harvested within 80 DAS, the active growth and development of main crop, there was statistically similar growth and yield attributes were observed. Similar non significant response of different intercrops *viz.*, green gram and black gram (Satish *et al.*, 2012), cluster bean (Ravindrakumar *et al.*, 2017), coriander and cluster bean (Sankaranarayanan *et al.*, 2012) on growth and yield attributes of cotton were in accordance with the results of present study.

### Seed cotton yield

The influence of various intercropping system on seed cotton is presented in Table 2. The seed cotton yield was also not influenced by different treatments. However, all the inter crops studied had increased the seed cotton yield slightly indicating the complimentary effect without competition during the growth and development of main crop. Among them, intercropping of onion, cluster bean, coriander at one row each with *Bt* cotton recorded highest seed cotton yield (2460 kg/ ha) followed by that of one row each of onion and cluster bean (2449 kg/ ha) and intercropping of two rows of cluster bean (2443 kg/ha). Similar result of non significant response between pure cropping and intercropping of cotton was reported by Sankaranarayanan *et al.*, (2012)

**Table 1.** Growth and yield characters and seed cotton yield as influenced by inter cropping in *Bt* cotton

Treatments	Plant height (cm) at harvest	Monopodia at harvest	Sympodia at harvest	Bolls/m <sup>2</sup>	Boll weight (g)	Seed cotton yield (kg/ha)	
T <sub>1</sub> Sole <i>Bt</i> cotton	124.5	1.67	17.13	71.43	5.36	2395	
T <sub>2</sub> Paired row planting of <i>Bt</i> cotton with two rows onion	128.3	1.67	17.22	72.62	5.46	2422	
T <sub>3</sub> Paired row planting of <i>Bt</i> cotton with two rows cluster bean	126.9	1.70	17.61	73.70	5.75	2443	
T <sub>4</sub> Paired row planting of <i>Bt</i> cotton with two rows coriander	127.5	1.67	17.43	72.34	5.67	2431	
T <sub>5</sub> Paired row planting of <i>Bt</i> cotton with one row onion + one row cluster bean	126.6	1.70	17.37	72.78	5.53	2449	
T <sub>6</sub> Paired row planting of <i>Bt</i> cotton with one row cluster bean + one row coriander	127.1	1.63	17.62	72.61	5.72	2443	
T <sub>7</sub> Paired row planting of <i>Bt</i> cotton with one row coriander + one row onion	126.7	1.67	17.34	71.80	5.52	2434	
T <sub>8</sub> Paired row planting of <i>Bt</i> cotton with one row row onion + one row cluster bean + one row coriander	128.5	1.70	17.56	73.72	5.68	2460	
T <sub>9</sub> Normal spacing of <i>Bt</i> cotton with 2 rows black gram	126.1	1.67	17.38	71.63	5.45	2415	
T <sub>10</sub> Normal spacing of <i>Bt</i> cotton with 2 rows greengram	126.3	1.67	17.40	71.54	5.52	2420	
	SEd	6.51	0.74	1.44	2.86	0.29	89.5
	CD (0.05)	NS	NS	NS	NS	NS	NS

**Table 2 :** Seed cotton equivalent yield and economics as influenced by inter cropping in *Bt* cotton

Treatments	Intercrop yield (kg/ha)	Seed cotton equivalent yield (kg/ha)	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	BCR
T <sub>1</sub> Sole <i>Bt</i> cotton	—	2395	69000	122145	53145	1.77
T <sub>2</sub> Paired row planting of <i>Bt</i> cotton with two rows onion	Onion - 1810	3689	90200	186872	96672	2.07
T <sub>3</sub> Paired row planting of <i>Bt</i> cotton with two rows cluster bean	Cluster bean - 3136	3697	83800	187313	103513	2.24
T <sub>4</sub> Paired row planting of <i>Bt</i> cotton with two rows coriander	Coriander - 1130	2838	72800	144321	71521	1.98
T <sub>5</sub> Paired row planting of <i>Bt</i> cotton with one row onion + one row cluster bean	Onion - 1008 Cluster bean - 1487	3749	93000	189919	96919	2.04
T <sub>6</sub> Paired row planting of <i>Bt</i> cotton with one row cluster bean + one row coriander	Cluster bean - 1379 Coriander - 611	3215	80200	163171	82971	2.03
T <sub>7</sub> Paired row planting of <i>Bt</i> cotton with one row coriander + one row onion	Onion - 853 Coriander - 558	3232	86200	164033	77833	1.90
T <sub>8</sub> Paired row planting of <i>Bt</i> cotton with one row row onion + one row cluster bean + one row coriander	Onion - 737 Cluster bean - 1145 Coriander - 456	3598	95200	183063	87863	1.92
T <sub>9</sub> Normal spacing of <i>Bt</i> cotton with 2 rows black gram	Black Gram - 126	2554	72300	130095	57795	1.80
T <sub>10</sub> Normal spacing of <i>Bt</i> cotton with 2 rows greengram	Green Gram - 131	2564	72300	130625	58325	1.81

and Maitra *et al.*, (2001). In the present study, the reason for slightly higher yield of cotton under all the intercrops might be due to growing

of legumes (cluster bean, green gram, blackgram) was beneficial soil health and soil fertility as evident from higher uptake of N, P and K nutrient

as reported by Sankaranarayanan *et al.*, (2010) and Rao *et al.*, (2009). The results of cluster bean (1:1) intercropping system recorded higher seed cotton yield than cotton + black gram (1:1) and cotton + green gram (1:1) intercropping system as reported by Ravindrakumar *et al.*, (2017) was also in line with the present investigation.

### **Yield of intercrops**

The results showed that, among the intercrops, the performance of cluster bean was better than other intercrops (Table 2). Two rows of cluster bean intercropping with *Bt* cotton registered a pod yield of 3136 kg/ha. The second best intercropping was two rows of onion which recorded a bulb yield of 1810 kg/ha. The intercrops green gram and black gram yielded low grain yield of 131 and 126 kg/ha only. The variation in the yield of intercrops was due to different in duration and their growth habit. Superiority of cluster bean (Ravindrakumar *et al.*, (2017) and onion inter cropping (Jayakumar and Surendran, 2016 and (Lamlom *et al.*, 2018) than black gram and green gram intercropping with cotton are in favour of present study. Similar beneficial effect of vegetable intercropping in *Bt* cotton also documented by Sudhir *et al.*, (2018) and Sankaranarayanan *et al.*, (2012).

### **Seed cotton equivalent yield (SCEY)**

The total productivity in terms of seed cotton equivalent yield (SCEY) increased when cotton was intercropped with all the intercrops studied (Table 2). Among them, the total SCEY was the highest with intercropping of one row each of onion and cluster bean with cotton (3749 kg/ha) followed by two rows of cluster bean (3697 kg/ha) and two rows of onion (3689 kg/ha). The next higher total SCEY was observed with intercropping of three crops (onion, cluster bean and coriander) as one row each with *Bt* cotton (3598 kg/ha). The higher SCEY than pure cotton under these intercropped treatments were due to additional yield of intercrops obtained and also prevailing remunerative market price. The lesser

total SCEY under pulses intercropping was a result of lower grain yield of pulses than vegetables. The findings of higher SCEY under cotton intercropped with cluster bean (Ravindrakumar *et al.*, (2017), Velmurugan *et al.*, (2012) and Sankaranarayanan *et al.*, (2012)), Onion (Maitra *et al.*, 2001), Coriandar (Sankaranarayanan *et al.*, 2012) than sole cotton were in agreement with the present study. Similar results of yield advantage of cotton + pulse inter cropping as reported by Pandagale *et al.*, (2019), Khagkharate *et al.*, (2014) and Maitra *et al.*, (2001) were also in conformity with the findings of present investigation.

### **Economics**

The economic analysis (Table 2) indicated that though the total cost of cultivation was higher, all the intercropping system showed improvement in economic benefits than sole cropping. Higher gross return of Rs 189919/ha was associated with one row of onion and cluster bean each followed two rows of cluster bean (Rs 187313/ha) and two rows of onion (Rs 186872/ha). Higher net income and BC ratio were observed in the order of intercropping two rows of cluster bean (Rs 103513/ha and 2.24 respectively), two rows of onion (Rs. 96972/ha and 2.07, respectively) and one row of onion and cluster bean each (Rs. 96919/ha and 2.04, respectively). Higher economic benefits obtained the above intercrops systems were due to the resultant effect of additional intercrops yield realized. Among the intercrops system, lesser economic returns were noticed with the intercrops of coriander green gram and black gram. Sole cotton registered the least economic returns. Similar results of enhanced economic benefits of intercrops in cotton were reported by Sankaranarayanan *et al.*, (2012) (cluster bean and coriander), Venkatraman 2008 (onion and cluster bean), Seema Sepat and Ahlawat (2010), Pandagale *et al.*, 2019 (black gram and green gram) and Singh and Ahlawat (2011) (ground nut).

It can be concluded from the study that

the combination of intercrops cluster bean and onion of each one row or two rows of cluster bean intercropping were found to be more productive and remunerative system and hence highly suitable for Btcotton.

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