

INTERCROPPING STUDY IN BT. COTTON UNDER RAINFED CONDITION OF KUTCH REGION OF GUJARAT (*Gossypium hirsutum* L.)

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Abstract: A field experiment was conducted at Agricultural Research Station, Sardarkrushinagar Dantiwada Agricultural University Kothara Dist: Kutch (Gujarat) during *khariif* seasons of 2010-11, 2015-16 and 2016-17 to study the effect intercropping on yield and economics on Bt, cotton. The trial was laid out in randomized block design with three replications, assigning 10 treatments of inter cropping i.e. T₁: Bt. Cotton + Greengram (1:1), T₂: Bt. Cotton + Blackgram (1:1), T₃: Bt. Cotton + Moth bean (1:1), T₄: Bt. Cotton + Greengram (1 : 2), T₅: Bt. Cotton + Blackgram (1: 2), T₆: Bt. Cotton + Moth bean (1 : 2), T₇: Bt. Cotton sole 120 cm, T₈: Greengram sole 45 cm T₉: Blackgram sole 45 cm and T₁₀: Moth bean Sole 45 cm. The results revealed that sowing of sole moth bean at 45 cm or inter cropping of Bt. cotton + moth bean (1:2) gave higher cotton equivalent yield as well as monetary returns in intercropping system on medium black soil of Kutch region under rainfed condition

Keywords: Bt. Cotton, Rainfed, Green gram, Blackgram, Moth bean and Intercropping.

INTRODUCTION

In general cotton is grown as a mono crop, which is being risky and sometimes leads to complete failure due to inadequate, erratic and uneven distribution of rainfall as well as water logging condition in dryland agriculture. Cotton being a long duration, wide spaced crop and slow initial growth it offers a great scope for growing of a short duration crops and thereby, helps to harvest the potential productivity and minimize the risk involved in dry land agriculture. Intercropping of short duration pulses/oilseed crops like mothbean, greengram, blackgram, sesamum etc. also help in the stabilizing soil fertility status in soil. Since, the dryland crop's productivity is further comparatively less because of low and erratic rainfall and poor adoption of improved technologies. To viaduct this gap, the crop diversification is required for increasing the productivity and profitability per unit area and per unit time where intercropping systems amuse an important responsibility in subsistence and food production (Ramachandrappa, *et al.* 2016). Intercropping is also an efficient strategy that can be

followed with desirable outcomes in the present climate change scenario (Venkateswarlu and Shankar, 2009). In cropping system approach to agriculture, complementary arise due to better utilization of resources (below ground and above ground) both in temporal and spatial dimensions as in case of intercropping. The benefits in terms of enhanced produce per unit area and time accrue due to duration differences, rooting systems and crop canopy/stature variations in intercropping system as opposed to sole cropping. In order to avoid risk involved in dry land agriculture and better use of resources like moisture, nutrients and soil. Hence, this experiment was undertaken to stabilize the income for farmers of the region.

MATERIALS AND METHODS

The experiment was conducted at Agricultural Research Station, Sardarkrushinagar Dantiwada Agricultural University Kothara Dist: Kutch (Gujarat) during kharif seasons of 2010-11, 2015-16 and 2016-17 to find out suitable intercrop in cotton for maximum benefits per unit area and work out optimum land utilization by intercropping. The soil of experimental field was medium black in texture, alkaline in reaction (pH 8.2), low in organic carbon content (0.31 %) and available nitrogen (180.0 kg/ha), while, medium in available phosphorus (36.48 kg/ha) and high in available potash (285 kg/ha). The trial was laid out in Randomized Block Design (RBD) with three replications and 10 treatments of inter cropping i.e. T₁ : Bt. Cotton + Greengram (1:1), T₂ : Bt. Cotton + Blackgram (1:1), T₃ : Bt. Cotton + Moth bean (1:1), T₄ : Bt. Cotton + Greengram (1 : 2), T₅ : Bt. Cotton + Blackgram (1 : 2), T₆ : Bt. Cotton + Moth bean (1 : 2), T₇ : Bt. Cotton sole 120 cm, T₈ : Greengram sole 45 cm T₉: Blackgram sole 45 cm and T₁₀ : Moth bean Sole 45 cm. In intercropping, Cotton was sown with the spacing of 120cm × 30 cm whereas, intercrops were was sown in between two rows of cotton by different row ratio as per treatments. Recommended dose of nitrogen and phosphorus fertilizers (80: 00 kg/ha for cotton and 20:40 kg/ha for inter crops) was applied to the respective crops through urea and diammonium phosphate. The nitrogen was applied to cotton crop in two equal splits; first at the time of sowing and second at 40-50 days after sowing while, whole quantity of nitrogen and P₂O₅ was applied to inter crops in a single dose as basal at the time of sowing. The observations were recorded on seed and stalk/stover yields as well as economics of cotton and inter crops after harvest. Other cultural operations and plant protection measures were applied as per recommendation of the region.

RESULTS AND DISCUSSION

Cotton Equivalent yield:

Cotton equivalent yield was influenced significantly due to different treatments in individual year as well as in pooled (Table 1). Intercropping of Bt. Cotton + Moth bean (1: 2) had recorded the highest cotton equivalent yield during all the years of experimentation as well as in pooled except in the year of 2010 and 2016. In pooled results, this treatment had showed significantly superiority in terms of cotton equivalent yield (714 kg/ha) over the rest of the treatments except moth bean Sole sown at 45 cm between two rows. Significantly, the lowest cotton equivalent yield was recorded when Bt. cotton sole 120 cm. Yield of sole cotton was recorded statistically less as compared to intercropping, which indicated that under rainfed situation, sole cropping of cotton is not as good as than its intercropping with short duration pulses. The higher cotton equivalent yield with intercrops was due to higher additional seed and Stover yields of pulses. These results are in agreement with the findings of Ramachandrappa *et al.* (2016) and Manoj *et al.*, (2013).

Rain water use efficiency (RWUE):

In pooled results, the maximum RWUE of 1.16 kg/ha.mm was recorded in sole moth bean sown at 45 cm spacing. The higher rain water use efficiency in sole moth bean might be due to higher cotton equivalent yield recorded with same amount of rain water received in all the plots. Similar results were observed by Rao *et al.* (2010) in sorghum and Ramachandrappa *et al.* (2016) in castor.

Economics:

In pooled results, the maximum net income (Rs. 27485/ha) and B:C ratio (3.59) were recorded in sole moth bean sown at 45 cm spacing, while maximum gross income (Rs. 35361/ha) was recorded in intercropping of Bt. Cotton + Moth bean (1 : 2). The corresponding rise in net return was due to higher in yield of sole moth bean sown at 45 cm spacing, which resulted to bring out better use of natural resources *viz.*, sunlight, land and water. The results are in conformity with the findings of Patel *et al.*, (2007).

From the results of three years of experimentation it is concluded that sowing of sole moth bean at 45 cm or inter cropping of Bt. cotton + moth bean (1 : 2) should be done for getting higher cotton equivalent yield as well as monetary returns on medium black soil of Kutch region of Gujarat under rainfed condition.

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Table 1 : Yield and economics of different cotton based inter cropping system (2010, 2015 and 2016)										
Treatments	Mean yield (kg/ha)		Cotton Equivalent yield (kg/ha)				Gross income (Rs/ha)	Net Income (Rs/ha)	B : C ratio	RWUE (kg/ha/mm)
	Seed cotton	Intercrop seed	2010	2015	2016	Pooled				
T ₁ : Bt. Cotton + Greengram (1:1)	197	273	433	415	486	445	22017	5317	0.32	0.92
T ₂ : Bt. Cotton + Blackgram (1:1)	232	224	486	460	497	481	23812	7112	0.43	1.00
T ₃ : Bt. Cotton + Moth bean (1:1)	192	347	444	473	711	542	26840	10140	0.61	1.12
T ₄ : Bt. Cotton + Greengram (1:2)	186	471	530	553	762	615	30444	13744	0.82	1.28
T ₅ : Bt. Cotton + Blackgram (1:2)	197	301	566	545	483	531	26295	9595	0.57	1.10
T ₆ : Bt. Cotton + Moth bean (1:2)	176	533	497	615	1031	714	35361	18661	1.12	1.48
T ₇ : Bt. Cotton sole 120 cm	247	-	318	322	102	247	12235	3185	0.35	0.51
T ₈ : Greengram sole 45 cm	-	601	395	414	831	546	27047	19397	2.54	1.13
T ₉ : Blackgram sole 45 cm	-	419	506	437	457	467	23097	15047	1.87	0.97
T ₁₀ : Moth bean Sole 45 cm	-	703	412	488	1229	710	35135	27485	3.59	1.47
S. Em±			16.3	29	61	23.4				
C.D.(0.05)			48.4	86.2	184	66.4				
C.V (%)			6.2	10.6	16.3	13.3				