



Effect of legume intercropping on competition indices and returns of *Bt* cotton

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ABSTRACT : A field experiment was conducted during *khari*f, 2015 under rainfed conditions at Agricultural College Farm, Bapatla to study the bio economic efficiency of different cotton based intercropping systems. Competition functions like competition ratio, land equivalent ratio and area time equivalent ratio were calculated for the assessment of benefits of intercropping. LER and ATER was highest in cotton + blackgram (1.51 and 1.12) intercropping. Intercropping decreased the seed cotton production. Higher net field benefits was obtained from cotton + blackgram than sole cotton. Farmers with small land holdings, seriously constrained by low crop income can adopt the practice of intercropping of blackgram in cotton.

Key words : Blackgram, competition functions, intercropping, legumes, returns

In India, dry lands occupy 74 per cent of total cropped area and are mainly owned by small and marginal farmers. They have a poor resource base and it is increasingly realized that, to bring 100 per cent efficiency in cropping system followed in dryland, there is need for increasing cropping intensity through intercropping. Risk of uncertainty imposed by changing climate could be managed by adoption of location specific diversified intercropping systems in small farms (Sankaranarayanan *et al.*, 2010) due to better interception and infiltration of rainfall (Gokhale *et al.*, 2011). Cotton is ideally suitable for inter or mixed cropping because of its wide spacing with initial slow rate of growth. It offers good scope for intercropping with short duration pulses and oil seeds.

Intercropping cotton with short duration legumes offers good scope for stability in production and profit besides offering domestic food and fodder requirement. Hence, the present trial was conducted to study the effect of intercropping legumes in *Bt* cotton.

The study was conducted under rainfed conditions of Agricultural College Farm, Bapatla during *khari*f, 2015. Soil of the experimental site was neutral with a pH of 7.3, low in available nitrogen (190.3 kg/ha), medium in phosphorus (23.0 kg/ha) and high in potassium with 294.6 kg/ha. The experiment was laid out in randomized block design with four replications. The experiment consisted of nine treatments, *viz.*, T₁- Sole cotton; T₂- Cotton + greengram; T₃- Cotton + blackgram; T₄ - Cotton + cowpea; T₅- Cotton + soybean; T₆- Sole greengram; T₇- Sole blackgram; T₈- Sole cowpea; T₉- Sole soybean. Cotton was sown at 90 × 60 cm and two rows of intercrops (at 30cm spacing) were sown in between the lines of cotton. Cotton was fertilized with 120:60:60 kg/ha NPK kg/ha where entire phosphorus was applied as basal in the form of SSP. Nitrogen as urea and potassium as MOP were applied in three equal splits at 30,60 and 90 DAS by pocketing method. Recommended dose of NPK kg/ha were applied to legumes as basal *viz.*, greengram and blackgram-20:50,

cowpea-20:50:25 and soybean-30:60:40. Other production aspects such as intercultivation and weeding for cotton remained same in all the treatments. A total rainfall of 646.4 mm (33 rainy days) was received during the crop growth period. Different competition functions were calculated by the following formulae.

$$\text{Land Equivalent Ratio } (L_a + L_b) = \frac{(Y_{ab}|Y_{aa})}{Y_{aa}} + \frac{(Y_{ba}|Y_{bb})}{Y_{bb}}$$

$$\text{Competition Ratio} = \frac{\frac{Y_{ab}}{Y_{aa} \times Z_{ab}}}{\frac{Y_{ba}}{Y_{bb} \times Z_{ba}}}$$

$$\text{Area Time Equivalent Ratio} = \frac{(R_{yc} \times t_c) \times (R_{yp} \times t_p)}{T}$$

Where;

Y_{aa} = pure stand yield of crop 'a'

Y_{ab} = intercrop yield of crop 'a'

Y_{bb} = pure stand yield of crop 'b'

Y_{ba} = intercrop yield of crop 'b'

R_{yc} = Relative yield of crop c,

R_{yp} = Relative yield of crop p,

t_c = Duration (days) for crop c,

t_p = Duration (days) for crop p,

T = Duration (days) for the whole system

Z_{ab} and Z_{ba} = sown proportions of crop 'a'

and 'b' in intercropping system L_a and

L_b are LER for individual components of system,

Highest seed cotton yield was recorded with sole cotton which was statistically comparable with cotton + blackgram (Table 1). Among, the different intercropping treatments, cotton + blackgram recorded the highest seed cotton yield of 1917 kg/ha which was *on par* with cotton + greengram (1807 kg/ha), cotton + cowpea (1736 kg/ha) and cotton + soybean (1690 kg/ha). Ramanjaneyulu and Buchareddy (2002) also confirmed that the intercropped soybean

competed, lowering the yield of cotton. The reduction in seed cotton yield when intercropped with soybean, cowpea, greengram and blackgram was 21.54, 19.40, 16.10 and 11.00 per cent, respectively as compared to sole cotton.

Highest seed yield of legumes was recorded with sole soybean followed by sole cowpea and sole greengram which were significantly superior over the yield of sole blackgram. Similar is the case in intercropping situation also.

Land equivalent ratio (LER) : The Land Equivalent Ratio is an important indice to measure the yield advantage in intercropping system. Normally, the LER values in intercropping systems are always higher than that of sole cropping (Table 1). The land equivalent ratio of the system tested ranged from 1.51 to 1.40 indicating the advantage of intercropping. Highest mean land equivalent ratio (LER) was found to be 1.51 which indicated that 51 per cent yield advantage was observed when blackgram was grown as intercrop with cotton compared to sole cotton crop or cotton with greengram, cowpea and soybean. Intercropping of greengram with cotton reduced the LER to 1.40. However, LER in intercropping treatments compared with monocropping of cotton can be ascribed to better utilization of natural (land and light) and added (fertilizer and water) resources. These results are in accordance with those reported Nawlakhe *et al.*, (2009).

Competition ratio (CR) : The data pertaining to competition ratio is presented in Table 1. Competition ratio is an important way to know the degree with which one crop competes with the other. Among different intercropping treatments the highest competition ratio of 2.96 was seen in case of cotton + greengram. That

Table 1. Competition indices and net returns as influenced by different intercrops

Treatment	Seed cotton yield (kg/ha)	Intercrop yield (kg/ha)	Land equivalent ratio	Competition ratio	Area time equivalent ratio	Net returns (Rs/ha)
Sole cotton	2154	-	-	-	-	51849
Cotton + greengram	1807	508	1.40	2.96	1.04	55773
Cotton + blackgram	1917	488	1.51	2.83	1.12	59463
Cotton + cowpea	1736	575	1.44	2.53	1.11	44054
Cotton + soybean	1690	616	1.45	2.32	1.11	50921
Sole greengram	-	898	-	-	-	22320
Sole blackgram	-	778	-	-	-	17482
Sole cowpea	-	901	-	-	-	4803
Sole soybean	-	915	-	-	-	12364
SEm±	100.9	37.8	-	-	-	-
CD (p=0.05)	310	111	-	-	-	-
CV (%)	10.8	10.7	-	-	-	-

means the cotton produced 2.96 times as much as expected yield and is 2.96 times as competitive. Same was found with cotton + groundnut intercropping in 1:3 row ratio at IARI, New Delhi in sandy loam soils (Singh and Ahlawat2011).

Area time equivalent ratio (ATER) : The ATER provides a more realistic comparison of the yield advantage of intercropping over that of sole cropping than LER as it considers variation in time taken by the component crops of different intercropping systems. In all the treatments, the ATER values were smaller than LER values (Table 1) indicating the over estimation of resource utilization in the latter. All the intercropping systems recorded higher ATER, indicating advantage of intercropping over sole *Bt* cotton. Maximum ATER (1.12) was recorded from *Bt* cotton intercropped with blackgram in 1:2 row ratio.

Cotton + blackgram resulted in highest net returns (Rs. 59,463/ha). This might be due to good yields and better price of blackgram intercrop with lesser reduction in cotton yield.

It can be concluded that higher LER, ATER and net returns was obtained from cotton + blackgram than sole cotton and the competition ratio was highest in cotton + greengram.

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