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Effect of intercropping on growth, yield and economics of cotton under rain fed condition

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ABSTRACT

An experiment was conducted in cotton growing area barind tract at Chapainawabganj during July 2021 to February 2022 for maximum benefit of cotton production with blackgram intercropping. For this experiment, a randomized complete block design with three replications were used to test the performance of six different intercroppping, including T_1 = cotton + jute, T_2 = cotton + blackgram, T_3 = cotton + spinach, T_4 = cotton + radish, T_5 = cotton + okra, and T_6 = sole cotton. The results revealed that the highest seed cotton 3134.40 kg ha^{-1} was produced in sole cotton growing field. Blackgram as an intercrop was given the highest gross return (354738 taka ha^{-1}), net profit (214238 taka ha^{-1}) and benefit cost ratio (2.52) as compared with other intercrops. Therefore, intercropping of black gram with cotton may be more economical for a good idea for farmers who grow only sole cotton in order to increase their economic return.

Keywords: Intercropping, Cotton, Blackgram, Jute seed, Spinach, Radish and Okra.

INTRODUCTION: Cotton (*Gossypium hirsutum* L.) is an important cash crop for farmers as well as the main raw materials for the textile industry. The area and production of cotton in the country are limited compared to its annual demand (8.2 million bales) in 2021 (BTMA, 2022). Due to the country's limited land resources, vertical expansion rather than horizontal expansion is the best choice for meeting demand. Intercropping is tried and true methods of vertical cotton expansion that can assist farmers secure both subsistence and disposable income (Singh and Jodha, 1989).

Cotton intercropping has recently been recognized as a potentially advantageous and cost-effective crop production strategy (Tomar, 1994). Similarly, intercropping (Harisudan *et al*., 2009) is one of the techniques to boost cropping intensity and resource usage. When component crops are grown together, they can complement each other and make better use of resources, resulting in a yield advantage. Long duration with initially slow growing cotton and short duration fast maturing mungbean appeared to be the most compatible companion crops in the intercropping system (Tabib *et al.,* 2014; Rao, 1991) and also been proved to be productive and economic in the tropical countries (Sayampot and Changsalak, 1997). The overall productivity in terms of cotton equivalent yield was generally higher in intercropping system than in sole crop (Maitra *et al.,* 2000). The productivity and efficiency of intercropping system depends, to a large extent, on the nature and extent of plant competition (Harper, 1977) and the spatial arrangement and densities of the component crops revealed that paired row cotton seemed well compared to single row cultivation for easy harvesting and handling of intercrop without any damage to the base crop cotton (Natarajan, 1990; Aasim *et al*., 2008). The information of intercropping with cotton was unavailable. Therefore, the view of intercropping with cotton was a time needed researchable issue in Bangladesh.

OBJECTIVE: This experiment was executed to observe the effect of other crops intercropping with cotton field on cotton productivity as well as economy. It was offered that intercropping in cotton field will be more economical for cotton production.

MATERIAL AND METHODS: The experiment was arranged in a randomized complete block design with three replications during July 2021 to February 2022. The area of unit plot was 16.2 m^2 maintaining row to row distance 90 cm and plant to plant distance 40 cm with 1.0 m distance between two plots and 2.0 m wide space between two blocks. The treatments were T1 = cotton with jute seed, T2 = cotton with black gram, T3 = cotton with spinach, T_4 = cotton with radish, T_5 = cotton with okra and T_6 = sole cotton (Figure 1a, 1b, 1c, 1d, 1e and 1f, respectively). The experimental plot was partitioned into unit blocks and each block into unit plots in accordance with the design of the experiment.

Field preparation and seedling transplanting: The field selected for conducting the experiment was opened at 5 July 2021 with a tractor and cross-ploughed several times followed by laddering to obtain good tillage. The seedlings of cotton were transplanting at 12 August 2021 and the intercrop seeds were sown as same time in a single line between two rows of cotton.

Investigation of agronomic parameters: For the measurements of the traits, five representative plants were selected randomly from each plot and later they marked with labels for recognition. The recorded data were estimated for days to 50% squaring (DS), days to 50% flowering (DF), sympodial branches plant^{-1} (SBP), number of bolls plant^{-1} (NB), single boll weight (SBW), ginning out turn (GOT%), seed cotton yield (SCY), cotton equivalent yield (CEY), gross return, net profit and benefit cost ratio (BCR).

Data analysis: R-Studio statistical software was used for the analysis of variance (ANOVA) technique and the least significant difference was considered for comparing the treatment means. The mean square at the error were estimated as Johnson *et al.*

(1955). Means were separated using Duncan's multiple range tests at a 5% level of significance.

RESULTS AND DISCUSSIONS: Sympodial branches plant^{-1}of cotton: Sympodial branches plant^{-1} was not significantly different by the intercropping treatment of cotton. However, the maximum number of sympodial branches plant^{-1} (16.47) was recorded in sole cotton followed by intercropping cotton with spinach (16.33) and cotton with blackgram (16.30). On the other hand, the minimum sympodial branches plant^{-1} (11.76) was observed in cotton when intercropping with okra (Table 1). Tabib *et al.* (2014) reported that highest numbers of sympodial branches were found in sole cropping and higher number of branches plant^{-1} in sole cotton. Oad *et al.* (2007) was also reported same results under cotton + pigeon pea intercropping system. Mahatale *et al.* (2008); Jayakumar and Surendran (2017a) was observed higher number of branches plant^{-1} in cotton based intercropping system.

Days to 50% squaring and flowering (days) of cotton: The days to 50% squaring and flowering were statistically significant by the intercropping system of cotton. In Table 1, the results showed the minimum days required for 50% squaring (46.33 days) and flowering (59.67 days) in sole cotton but the maximum days required 52.00 and 66.00 days when cotton intercropping with jute and okra, respectively. Similarly, Shah *et al.* (2010) reported that early and rapid squaring and flowering combined with a shorter boll maturation period and the low node number of first sympodial branches combined with a lower number of main stem nodes. Likewise, Baloch and Veesar (2007) also found that earliness was measured in terms of the flowering time of cotton from 49 to 68 days for flower.

Number of bolls plant^{-1}of cotton: Number of bolls plant^{-1} of cotton was significantly varied among the intercropping treatments. The sole cotton represents the highest number of bolls plant^{-1} (29.33) which was statistically similar with intercropping of black gram (27.53) and the lowest bolls plant^{-1} (7.87) was found intercropping of okra in cotton, respectively (Table 1). Our findings were similarly with Tabib *et al.* (2014) and Oad *et al*. (2007) who obtained higher number of bolls plant^{-1} under sole cotton cropping system.

Single boll weight (g) and seed Cotton yield (kg ha^{-1}) of Cotton*:* Boll weight and seed yield of cotton was significantly affected by the intercropping practice of cotton. The highest seed cotton yield (3134.40 kg ha^{-1}) was produced in sole cotton which was statically similar with intercropping of black gram (2821.30 kg ha^{-1}) may be due to highest boll weight (5.30 g) and as a leguminous crop add available nutrient in soil (Table 1). Jayakumar and Surendran (2017a) reported the increase in nitrogen use efficiency was mainly due to the higher yield obtained under this treatment. On the other hand, the lowest seed cotton yield (797.40 kg ha^{-1}) was produced cotton intercropping with okra due to lowest boll weight (4.43 g). Seed cotton yield was reduction due to intercrops association. The findings are agree with Tabib *et al*. (2014); Sanjay *et al.* (2003); Basavarajappa *et al.* (2003); Khan *et al.* (2001); Junior *et al.* (2003) observed increasing plant density from 6 to 10 and 14 plants/m^{-2}, reduced lint percentage and bolls weight (table 1).

Treatment	Sympodial branches plant^{-1}	Days to 50% squaring	Days to 50% flowering	Bolls plant^{-1}	SBW (g)	Seed cotton yield (kg ha^{-1})
T_1	15.73	52.00 a	65.67 ab	8.20 c	4.70 bc	820.00 b
T_2	16.30	49.00 ab	61.33 c	27.53 a	5.30 a	2821.30 a
T_3	16.33	46.33 b	62.67 bc	20.00 b	4.87 b	2372.60 a
T_4	15.13	47.00 b	61.67 c	22.27 ab	4.63 bc	2146.00 a
T_5	11.76	50.67 ab	66.00 a	7.87 c	4.43 c	797.40 b
T_6	16.47	46.33 b	59.67 c	29.33 a	4.93 ab	3134.40 a
$LSD_{(0.05)}$	6.7884ns	4.5984*	3.0623**	7.3091**	0.3753**	1169.30**
CV(%)	24.33	5.21	2.68	20.93	4.29	31.89

Table 1: Effect of intercropping on sympodial branches plant^{-1}, days to 50% squaring, days to 50% flowering, bolls plant^{-1}, single bolls weight (g) and seed cotton yield (kg ha^{-1}) of cotton. Here, T_1 = cotton + jute seed, T_2 = cotton + blackgram, T_3 = cotton + spinach, T_4 = cotton + radish, T_5 = cotton + okra and T_6 = sole cotton.

Treatment	CEY (kg ha^{-1})	Gross return (Tk. ha^{-1})	Net Profit (Tk. ha^{-1})	BCR
T_1	1737.50 b	230174 bc	89674 bc	1.63
T_2	1120.30 c	354738 a	214238 a	2.52
T_3	205.76 d	232051 bc	91551 bc	1.65
T_4	0.00 d	193139 c	52639 c	1.37
T_5	2743.5 a	318682 ab	178182 ab	2.26
T_6	0.00 d	282096 abc	141596 abc	2.00
$LSD_{(0.05)}$	456.57**	108387*	108387*	-
CV (%)	25.93	22.19	46.55	-

Table 2: Effect of intercropping on CEY (Kg ha^{-1}), gross return (Tk. ha^{-1}), net profit (Tk. ha^{-1}) and benefit cost ratio (BCR) of cotton. Here, T_1 = cotton + jute seed, T_2 = cotton + blackgram, T_3 = cotton + spinach, T_4 = cotton + radish, T_5 = cotton + okra and T_6 = sole cotton. CEY = Cotton equivalent yield, BCR = Benefit cost ratio.

Cotton equivalent yield (CEY), gross return (Tk. ha^{-1}), net profit (Tk. ha^{-1}) and benefit cost ratio (BCR) of cotton: Intercropping treatments was significantly affected for cotton equivalent, gross return, net profit and benefit cost ratio. The results revealed that, the highest CEY (2743.50 kg ha^{-1}) was recorded in okra, second highest value of CEY (1737.50 kg ha^{-1}) was found in jute seed and third highest value of CEY (1120.30 kg ha^{-1}) was obtained from blackgram in intercropping system.

On the other hand, the lowest CEY (205.76 kg ha-1) was recorded in spinach intercropping with cotton (table 2).

CONCLUSIONS: Based on the results of the present study was concluded that intercrop cotton with blackgram was the best combination in relation to equivalent yield, economic returns and benefit cost ratio.

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