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Performance of cotton genotypes intercropped with pearl millet and greengram

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ABSTRACT: There is a direct need to increase crop productivity per unit area and per unit time. Cotton with the relatively longer life cycle (150-175 days), wider space and its skimpy initial growth keeps the inter row space remain as vacant from sowing to 60-75 days. It gives ample scope for raising short duration pulse, cereal and vegetable as intercrops. The experiment was conducted during *kharif* season of 2016 at Cotton Research Area of CCS Haryana Agricultural University, Hisar. Treaments with different intercropping systems were *desi* cotton + Pearlmillet (1:1), *Desi* cotton + Pearlmillet (1:2), *Desi* cotton + Greengram (1:1), *Desi* cotton + Greengram (1:2), *Bt.* Cotton + Pearlmillet (1:1), *Bt.* cotton + Pearlmillet (1:2), *Bt.* Cotton +Greengram (1:1), *Bt.* Cotton +Greengram (1:2), sole *Desi* cotton and sole *Bt.* cotton. Laid out in randomised block design (RBD) with three replications. Higher number of sympodial branches, boll weight, number of bolls and seed cotton yield was observed with *Bt.* Cotton + Greengram (1:2). Highest land equivalent ratio (1.70) and crop equivalent yield (5028 kg/ha) was also recorded in *Bt.* Cotton + Greengram (1:2).

Key words: Cotton, greengram, intercropping, pearlmillet, productivity

Cotton popularly known as “King of fiber “and “White Gold” is a major fiber crop of the world and is used by about 75 per cent of world’s population for textile purposes. Its fiber is used universally as a textile raw material. In India, it is an important cash and commercial crop valued for its fiber and vegetable oil and also a source for earning the valuable foreign exchange by providing employment to millions of people, hence plays significant role in national economy. The diverse products obtained from cotton include textile raw material, cotton seed is a major source of vegetable oil and cotton cake as a rich source of high quality protein for livestock feed.

Current agriculture is facing a situation with formidable problems of stagnating production due to decline in factor productivity, degrading soil health, inefficiency of current production practices, scarcity of resources, and high cost of cultivation and low returns to the farmers as ill effects of green revolution which concentrates on maximum output but overlooks input efficiency. The only way to increase crop productivity on per unit area basis is possible through intercropping. Thus to meet out the challenges imposed by over use of natural resources and to sustain productivity level improved crop management through inclusion of legume crops in crop rotations and intercropping of legumes with cereals have many potential benefits as compared to sole cropping systems (Venkateswarlu and Sarkar, 2009).

Intercropping is an age old practice in India, especially under rainfed conditions, which aims to increase total productivity per unit area and to equitably and judiciously utilize land resources and farming inputs including labour. Development of feasible and economically viable intercropping systems largely depends on selection of compatible crops and adoption of proper planting geometry. Although research is still ongoing, there is strong evidence that intercropping can substantially increase the yield from a given area of land. As well, intercrops may require lower levels of costly inputs through increased resource-use efficiency. Besides supplementing to productivity per unit area and time, these intercrops serve as an insurance

against menace of pest and disease and vagaries of weather to which monocroped cotton is usually subjected to. The introduction of leguminous intercrops in cotton will helps to maintain the soil fertility level.

In cotton growing region, cotton based intercropping system are popular because the short duration intercrop will help farmer to realize the income needed interimly to meet the domestic food and fodder requirement. The short duration compact crops like green gram, black gram, pearlmillet, onion and other vegetables when grown as intercrop in cotton has little or no adverse effect on the growth and development of cotton (Satish *et al.,* 2012 and Khan *et al.*, 2001).

For getting higher return per unit land area intercropping appears to be one of the important aspect. Taking into consideration the above facts it has become imperative to find out the suitable crops and optimum row ratio for higher productivity. Therefore, the experiment entitled "Performance of Cotton genotypes intercropped with Pearl millet and Greengram." was planned for execution during *kharif* season of 2016 at Cotton Research Area of CCS Haryana Agricultural University, Hisar.

The seed bed was prepared after pre sowing irrigation at field capacity. Two harrowing followed by ploughing with cultivator after that planking was done as preparatory tillage for the entire plot. The main crop of cotton was sown by dibbling method after layout at a spacing of 67.5 x 30.0 cm for desi cotton and 67.5 x 60.0 cm for Bt. cotton. Both intercrops greengram (MH-421) and pearlmillet (HBB 67 i) was sown by hand plough with 1:1 and 1:2 row ratios, respectively.

The five tagged plant of cotton from each plot were selected for counting number of monopods and sympods at final picking. Average number of monopods and sympods were used for statistical analysis. The seed cotton obtained from five tagged plants was weighed and divided with number of bolls picked to get average boll weight. A composite seed sample was drawn from the individual plot seed cotton yield and 100 seeds of cotton were counted and their weight was taken. The weight was taken in gram (g).

Two pickings were done and the seed cotton of each picking from each plot was weighed separately. The total of both the pickings together with yield of five tagged plants was taken as seed cotton yield plot^{-1} and was calculated hectare^{-1} basis.

Land equivalent ratio (LER) : Land equivalent ratio of the different intercropping systems was calculated by the following formula given by Willey (1979).

$$LER = \sum_{i}^{m} \frac{Y_i}{Y_{ij}}$$

Y_i = Individual crop yield under intercropping system

Y_{ij} = Individual crop yield under sole cropping system

Crop equivalent yield : Yield of different intercrops are converted into equivalent yield of any one crop based on price of the produce. It is calculated by the following formula :

$$CEY = \sum_{i=1}^{m} (Y_i \, xe_i)$$

Where, Y_i = yield of i^{th} component

e_i = equivalent factor of i^{th} component or price of i^{th} crop.

The experiment was conducted in RBD design along with three replications. All the tests of significance were made at 5 per cent level of significance.

RESULTS AND DISCUSSION

The monopodial and sympodials branches plant^{-1} were higher under sole *Bt.* cotton (3.66 and 22.20) as compared to sole desi cotton. But with greengram intercropping these values were 3.7 (1:1) and 22.6 with (1:2) indicating a increase monopodial and sympodials branches/plant respectively (Table 1). Previous literature showed

contrasting results. Investigation of Sheoran and Malik (1986) that the monopolial branches were un affected by intercropping greengram, whereas Rao (1982) confirmed present investigation that the monopolial and sympodial branches were significantly reduced by intercropping greengram. These variable responses in different investigations could probably be partly due to the magnitude of competition in the intercropping system grown in variable geometry and varieties of crops with varying competitive ability. The decrease in number of sympodial branches had a definite impact on the productions of seed cotton yield because they are the main fruit bearing branches and are more in number compared to monopodials. The results of Deoche *et al.*, (2004) also corroborated with the present findings.

The bolls/plant and boll weight were maximum under *Bt* cotton with greengram (1:2) (Table 1). *Bt* cotton with greengram produced maximum bolls/plant (45) and with pearlmillet the boll number reduced upto 29.0. *Bt* cotton intercropped with greengram (1:2) produced more bolls weight (4.9 g) than sole crop (4.6 g). *Bt* cotton intercropped with greengram (1:2) produced maximum seed cotton yield of 4663 kg/ha. More bolls/plant coupled with increased boll weight was the reason for maximum seed cotton yield kg/ha under intercropped crop of cotton. This might be due to less competition in greengram due to short duration crop. Greengram as intercrop shows synergistic effect on *Bt.* cotton yield by fixing atmospheric nitrogen and providing better nutrition to the cotton plant. There was definite increase in these parameters by intercropping cotton with greengram. Increase in seed cotton yield due to intercropping of greengram was earlier reported by several research workers (Prasad *et al.*, 1993, Wankhade, 1994, Ramesh Babu *et al.*, 1996, Sanjay *et al.*, 2003, Doeche *et al.*, 2004, SreeRekha *et al.*, 2008, Reddy and Mohemmad, 2009 and Satish *et al.*, 2012). Intercrop, greengram shared resources with cotton and offered a stiff competition thereby hindering the optimum growth and development of monopodial, sympodial branches and thereby number of bolls and reduced the recovery of seed cotton yield/plant and ultimately seed cotton yield hectare^{-1}.

Cotton intercropped with pearlmillet give significantly lower seed cotton yield as compared to sole cotton or cotton intercropped with greengram. Similar results were observed by Singh and Singh (2015).

Bt cotton intercropped with greengram (1:2) had higher land equivalent ratio as compared to all other treatments (Table 2). Similar results also found by Singh *et al.*, (2014). Crop equivalent yield was also highest when *Bt* cotton was intercropped with green gram (1:2) followed by *Bt* cotton intercropped with green gram (1:1). *Desi* cotton intercropped with

Table 1. Effect of different intercropping systems on yield attributes and seed cotton yield

Treatments	Monopods plant	Sympods plant	Bolls plant	Boll weight (g)	Seed index	Seed cotton yield (kg/ha)
T_1 *Desi* cotton + Pearlmillet (1:1)	1.62	9.10	13.3	1.7	8.86	1059
T_2 *Desi* cotton + Pearlmillet (1:2)	1.44	8.00	13.0	1.8	8.86	1093
T_3 *Desi* cotton + Greengram (1:1)	1.77	11.00	27.3	1.9	8.63	2533
T_4 *Desi* cotton + Greengram (1:2)	1.88	13.50	27.0	2.4	8.51	3138
T_5 *Bt* Cotton + Pearlmillet (1:1)	2.60	19.30	30.0	4.7	9.43	3438
T_6 *Bt* Cotton + Pearlmillet (1:2)	2.80	20.30	29.0	4.7	10.00	3230
T_7 *Bt* Cotton + Greengram (1:1)	3.70	21.10	44.0	4.9	9.80	4550
T_8 *Bt* Cotton + Greengram (1:2)	3.60	22.60	45.0	4.9	9.50	4663
T_9 Sole *Desi* cotton	2.00	16.11	29.0	2.5	8.80	3200
T_{10} Sole *Bt* Cotton	3.66	22.20	43.0	4.6	9.60	4300
SE(m) ±	0.26	1.40	2.4	0.1	0.55	223
CD (p=0.05)	0.66	4.30	7.0	0.5	NS	669

Table 2. Effect of different treatments on intercropping indices

Treatments	Land equivalent ratio	Crop equivalent yield (kg/ha)
T_1 *Desi* cotton + Pearlmillet (1:1)	0.90	1491
T_2 *Desi* cotton + Pearlmillet (1:2)	0.95	1546
T_3 *Desi* cotton + Greengram (1:1)	1.23	2849
T_4 *Desi* cotton + Greengram (1:2)	1.55	3560
T_5 *Bt* Cotton + Pearlmillet (1:1)	1.35	3774
T_6 *Bt* Cotton + Pearlmillet (1:2)	1.39	3623
T_7 *Bt* Cotton + Greengram (1:1)	1.48	4795
T_8 *Bt* Cotton + Greengram (1:2)	1.70	5028
T_9 Sole *Desi* cotton	1.00	3200
T_{10} Sole *Bt* cotton	1.00	4300

pearlmillet in both ratios (1:1, 1:2) yield lowest crop equivalent yield among all the treatments.

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