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Growth, yield and quality of cotton in cotton based intercropping system under organic and rainfed condition

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Abstract

The field experiment was conducted at Agronomy Farm, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (MS) during 2018-19 in randomized block design with seven treatment and replicated thrice. The experiment resulted that plant height recorded significantly higher in treatments of cotton + greengram for grain purpose (1:1). Other growth attributes viz. number of functional leaves plant⁻¹ (68.97), leaf area plant⁻¹ (29.83 dm²), LAI plant⁻¹ (3.31) and total dry matter accumulation plant⁻¹ (52.52 g) were recorded significantly higher in sole cotton and found at par with other treatments and seed cotton yield were recorded significantly higher in sole cotton and found at par with treatments of cotton + greengram for vegetable purpose (1:1), cotton + greengram 50% vegetable and 50% grain purpose (1:1) and cotton + cowpea for vegetable purpose (1:1), cotton + cowpea 50% vegetable and 50% grain purpose (1:1).

Keywords: Seed cotton yield, LAI, intercropping system, organic, rainfed

Introduction

Cotton (*Gossypium sp.*) is most important cash crop for fibre in kharif season in Indian context. It is known as 'king of fibre', 'white gold' and belongs to *malvaceae* family. It plays an important role in supporting the country's economy. India is the only country to grow all four species of cultivated cotton viz., *G. hirsutum*, *G. barbadense*, *G. herbaceum* and *G. arboreum* are growing commercially under diversified ecosystem. India is second largest cotton producing country in the world. It stand first in area (12.44 M ha) and second in production (37 M bales) with productivity of 505.46 kg ha⁻¹ in 2017-18, (Anonymous 2018). Cotton is a long duration (150- 180 days) crop. Being a wider space crop and its slow initial growth offers abundant scope for raising intercrops (short duration legumes) in between the rows of cotton. Intercropping has been identified as the most profitable and productive method of crop production for enhancing the resource utilization and cropping intensity (Harisudan *et al.* 2009) [2]. Being wider spaced, cotton provides an opportunity for introducing a short duration pulses crop like cowpea and greengram as an intercrops in additive series. Though cowpea and greengram are reported to have better potential than many of pulse, cowpea and greengram also grown as vegetable crop in India since it fetches good prices in market. At present due to mono cropping, erratic rainfall, poor soils and soil management practices, continuous use of chemical fertilizers without application of organic manures, other agrochemicals and increased sucking pests cotton cultivation become risky and less profitable especially under rainfed condition. Thus, to overcome these problems and increase the productivity and profitability of cotton based cropping systems are possible through better agronomic management practices with the help of organic nutrient management and intercropping with legumes. Cotton intercropped with legumes not only gave extra benefit by increasing system production but also it improve the soil fertility by adding crop biomass i.e. helpful to increasing organic matter in soil and also helps in biological nitrogen fixation.

Materials and Methods

The study was conducted during *kharif* season of 2018 under rainfed condition at organic field of Agronomy farm of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola in a randomized block design and replicated thrice on medium black cotton soil. Soil was neutral in reaction. The soil of experiment plot having pH (8.1) which is nearly neutral, medium organic carbon (OC) (0.54%), electrical conductivity (EC) (0.21 dsm⁻¹), available nitrogen (156.21 kg ha⁻¹) available phosphorus (20.16 kg ha⁻¹) and available potassium (244.22 kg ha⁻¹).

Seven treatments combination *viz.* T₁- sole cotton, T₂- cotton + greengram for vegetable purpose (1:1), T₃- cotton + greengram for grain purpose (1:1), T₄- cotton + greengram 50% for vegetable and 50% for grain purpose, T₅- cotton + cowpea for vegetable purpose (1:1), T₆- cotton + cowpea for grain purpose (1:1), T₇- cotton + cowpea 50% for vegetable and 50% for grain purpose (1:1) were used at experiment plot. Cotton and intercrops were sown at spacing of 90 x 10 cm into 1:1 row proportion.

Nutrients (N:P:K) were applied by 5 tonne FYM ha⁻¹ at the time of sowing in row zone of cotton and intercrops. To protect crops from sucking pest organic pesticides were applied in experiment plot. Genotypes used for cotton, greengram and cowpea were AKA-07 (*G. arboreum*), Utkarsha and Divya-2, respectively.

Akola (Maharashtra) is situated at latitude 22°42' North and longitude 77°02' East and at an altitude 307.41 meter above mean sea level. The total rainfall (from 22th MW to 52nd MW) at Akola centre was 835.5 mm in 42 rainy days in *kharif* season of 2018. The normal mean monthly maximum temperature is 42.5 °C during the hottest month (May) while the normal mean monthly minimum temperature is 10.6 °C in the coldest month (December). The mean daily evaporation reaches as high as 16.8 mm in the month of May and as low as 4.3 mm in the month of August. The mean wind velocity varies from 4.7 km hr⁻¹ during October to 17.6 km hr⁻¹ during June. Relative humidity peaks during the southwest monsoon (74–87%) and lows during the summer months (30–40%).

Results and Discussion

Growth attributes of cotton

In this study, cotton is grown with green gram and cowpea. Crop showed that plant height, functional leaf number, leaf area, LAI and total dry matter accumulation plant⁻¹ were influenced significantly by various treatments of cotton associated with greengram and cowpea.

Plant height at harvest recorded significantly higher in treatments of cotton intercropped with greengram and cowpea. Data (Table 1) revealed that the treatments of cotton + greengram for grain purpose (1:1) *i.e.* 83.6 cm followed by cotton + cowpea for grain purpose (1:1) 83.17 cm recorded significantly higher plant height and found at par with other treatments. It might be associated with the competition for growth resources (light, moisture, nutrient and space) with intercrops increase the efficiency of crops for resource utilization. Similarly (Ravindra *et al.* 2017) [5] reported that tallness of cotton plants in the plots of intercrops and then in sole cotton was might be associated with competitive effect for space, moisture, nutrient and light (due to annidation process) further accelerated the phototropism and thereby increased plant height of cotton. Number of functional leaves plant⁻¹ (68.97), leaf area plant⁻¹ (29.83 dm²), LAI plant⁻¹ (3.31) and total dry matter accumulation plant⁻¹ (52.52 g) were recorded significantly higher in sole cotton and found at par with other treatments. Because there is no competition for

growth resources to produce more no. of functional leaves resulted more leaf area and leaf area index plant⁻¹. This also contributes to increased dry matter plant⁻¹. The increases in growth attributes in sole cotton might be associated with cotton have no competition for above and below ground resource utilization when grown in sole condition. (Shrivastava *et al.* 2010) [7] Revealed that, leaf area and leaf area index were the highest under sole cotton than intercropping system. The increase in growth attributes in sole cotton was confirmed by some earlier findings of (Satish *et al.* 2012) [6] (Ravindra *et al.* 2017) [5] and (Singh *et al.* 2017) [8].

Yield attributes and yield of cotton

Yield attributes *viz.* no. of picked bolls plant⁻¹ and seed cotton yield plant⁻¹ at harvest was influenced significantly by various treatments of cotton grown with greengram and cowpea (Table 2). Sole cotton produced significantly higher no. of picked bolls (5.49) plant⁻¹ and seed cotton yield (12.01 g) plant⁻¹ over the rest of the treatments and found at par with the rest of the treatments except the treatments of cotton + greengram for grain purpose (1:1) and cotton + cowpea for grain purpose (1:1). Boll weight of cotton was not influenced significantly by different treatments. The seed cotton yield (1112 kg ha⁻¹), stalk yield (1358 kg ha⁻¹) and biological yield (2474 kg ha⁻¹) of cotton recorded significantly higher in sole cotton and found at par with treatment of cotton + greengram for vegetable purpose (1:1), cotton + greengram 50% vegetable and 50% grain purpose (1:1) and cotton + cowpea for vegetable purpose (1:1), cotton + cowpea 50% vegetable and 50% grain purpose (1:1). Average harvest index of cotton was 44.59 percent. Treatments of sole cotton and cotton + greengram and cotton + cowpea (1:1) intercropping system for vegetables, 50% for vegetables and 50% for grain purpose as well as for grain purpose were found non-significant.

This might be due to under sole condition cotton utilized environmental and ground resources in more without any competition for growth resources for the production of these parameter. Intercropping system has significant effect on seed cotton yield because early harvested intercrops in treatments of cotton recorded significantly higher seed cotton yield. By analyzing the earlier studies and the current study indicated that duration of the intercrop, uptake pattern of intercrop and decomposition potential of these intercrop remains will have a strong influence on the cotton yield. Similar results also reported by (Mankar and Nawlakhe 2009) [4], (Khargkharate *et al.* 2014) [3], (Vekariya *et al.* 2015) [9], (Ravindra *et al.* 2017) [5] and (Singh *et al.* 2017) [8].

Quality studies of cotton

Quality parameters of cotton like Ginning percentage, seed index, lint index and earliness index were not affected by different treatments of cotton intercropped with greengram and cowpea (Table 3).

Table 1: Plant height (cm), no. of monopodial branches, no. of sympodial branches, no. of functional leaves, leaf area (dm²), leaf area index and total dry matter accumulation (g) plant⁻¹ of cotton as influenced by different treatments.

Treatments	Plant height (cm)	No. of monopodial branches	No. of sympodial branches	No. of functional leaves	Leaf area (dm ²)	Leaf area index	Total dry matter accumulation (g)
T ₁ - Sole cotton	80.47	2.00	7.53	68.97	29.83	3.31	52.52
T ₂ - Cotton + greengram for vegetable purpose (1:1)	81.67	2.30	7.33	64.73	26.83	2.98	50.77
T ₃ - Cotton + greengram for grain purpose (1:1)	83.60	2.17	6.67	64.60	27.90	3.10	49.03
T ₄ - Cotton + greengram 50% for vegetable and 50% for grain purpose (1:1)	78.72	2.00	7.07	65.97	27.37	3.04	49.71
T ₅ - Cotton + cowpea for vegetable purpose (1:1)	79.19	2.13	7.33	65.73	27.77	3.09	50.63
T ₆ - Cotton + cowpea for grain purpose (1:1)	83.17	2.03	7.13	61.20	27.53	3.06	50.22
T ₇ - Cotton + cowpea 50% for vegetable and 50% for grain purpose (1:1)	79.23	2.20	7.20	64.07	27.37	3.04	49.24
S.E.(m) ±	2.653	0.208	0.325	3.618	2.136	0.237	1.737
C.D. at 5%	8.174	NS	NS	11.146	6.581	0.731	5.352

Table 2: No. of picked bolls plant⁻¹, boll weight (g), seed cotton yield plant⁻¹, seed cotton yield (kg ha⁻¹), stalk yield (kg ha⁻¹), biological yield (kg ha⁻¹) and harvest index (%) as influenced by different treatments.

Treatments	Numbers of picked bolls plant ⁻¹	Boll weight (g)	Seed cotton yield plant ⁻¹	Seed cotton yield (kg ha ⁻¹)	Stalk Yield (Kg ha ⁻¹)	Biological Yield (Kg ha ⁻¹)	Harvest Index (%)
T ₁ - Sole cotton	5.49	2.11	12.01	1112	1358	2474	45.06
T ₂ - Cotton + greengram for vegetable purpose (1:1)	5.22	2.1	11.11	1040	1261	2301	45.08
T ₃ - Cotton + greengram for grain purpose (1:1)	4.14	2.1	9.06	807	1125	1932	41.77
T ₄ - Cotton + greengram 50% for vegetable and 50% for grain purpose (1:1)	5.19	2.11	11.08	1012	1226	2238	45.10
T ₅ - Cotton + cowpea for vegetable purpose (1:1)	4.99	2.14	10.83	1002	1228	2230	44.95
T ₆ - Cotton + cowpea for grain purpose (1:1)	4.71	2.1	10.29	937	1113	2050	45.71
T ₇ - Cotton + cowpea 50% for vegetable and 50% for grain purpose (1:1)	5.2	2.11	11.07	1038	1293	2331	44.49
S.E.(m) ±	0.23	0.43	0.56	55	50	97	0.99
C.D. at 5%	0.77	NS	1.53	170	155	300	NS

Table 3: Ginning percentage, seed index, lint index and earliness index of cotton as influenced by different treatments

Treatment	Ginning Percentage (%)	Seed Index (g)	Lint Index	Earliness Index
T ₁ - Sole cotton	42.72	7.09	5.28	0.61
T ₂ - Cotton + greengram for vegetable purpose (1:1)	42.60	7.08	5.25	0.57
T ₃ - Cotton + greengram for grain purpose (1:1)	42.79	7.07	5.29	0.56
T ₄ - Cotton + greengram 50% for vegetable and 50% for grain purpose (1:1)	42.15	7.08	5.16	0.56
T ₅ - Cotton + cowpea for vegetable purpose (1:1)	42.87	7.08	5.31	0.61
T ₆ - Cotton + cowpea for grain purpose (1:1)	42.48	7.07	5.22	0.60
T ₇ - Cotton + cowpea 50% for vegetable and 50% for grain purpose (1:1)	42.50	7.07	5.23	0.61
S.E.(m) ±	0.21	0.08	0.01	0.05
C.D. at 5%	NS	NS	NS	NS

Conclusion

Sole cotton recorded significantly higher number of leaves, leaf area and dry matter accumulation plant⁻¹, yield attributes like number of picked bolls plant⁻¹, seed cotton yield plant⁻¹ and seed cotton yield.

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