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Quality parameters of cotton as influenced by intercropping unconventional green manures

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ABSTRACT

Field experiments were conducted at Agricultural Research Station, Bhavanisagar, Tamil Nadu Agricultural University during summer 2003 and winter 2003-2004 to evaluate the effect of un conventional green manuring of marigold, sesame and sunnhemp on cotton yield and various quality characters. Four cropping systems *viz.*, sole cotton, cotton + marigold, cotton + sesame and cotton + sunnhemp were tested (Factor A) in single and double rows (Factor B) incorporating them on 30 and 40 DAS (Factor C). The treatments were laid out in a factorial Randomized Block Design replicated thrice. The results indicated that intercropping marigold in two rows in between cotton rows and intercropping it *in situ* on 30 DAS had contributed ultimately more kapas and lint yield securing higher yield advantage in both summer and winter crops. Cotton quality in terms of seed and lint indices improved with marigold intercropping followed by sunnhemp. Sesamum had less effect on various quality parameters.

Key words : Unconventional green manuring, Cotton yield, Quality parameters, Intercropping.

INTRODUCTION

Green manuring is a practice of turning green biomass in the soil to improve soil physical, physico-chemical as well as biological properties suitable for plant growth. It is a convenient mean to furnish higher amount of nitrogen to the beneficiary crops than any other system of organic manuring. The growing and turning of green manure crops has been an ancient practice. Exclusive symposiums have been held on green manuring. The publication of IRRI (1988) on the proceedings of a symposium on sustainable agriculture under the title "Green manure in rice farming" reveals the significance attached to green manuring. While renewal in research on green manures is seen, the practice of green manuring by the farmers has been for ages and in China it goes back to 1134 B.C. (Joffee, 1955). Still earlier Pieters (1927) wrote in his book "Green manuring principles and practice" that much is known of what goes in the soil when organic manure is added but much still remains to be learned.

There are still processes within plants that we do not understand. From the past to the present findings, there is a research gain. Bouldin *et al*. (1988) reports showed the advances in green manuring research. They reported two N fractions. One which decomposes rapidly is named as 'Fast N' and the other named as 'Slow N'. Fast N accounts for 50-80 per cent of total N. It is incorporated to increase organic matter content, maintain soil structure, reduce loss of nutrients particularly N, provide a source of N for the succeeding crop and reduce soil erosion, increases soil organic carbon and improves physical properties like infiltration rate, bulk density and water content at field capacity and thereby increase the production of crops. With these ideas in view, field experiments were conducted to find out the effect of unconventional green manures as intercrops on the yield of associate hybrid cotton and the quality parameters

MATERIALS AND METHODS

Field experiments were conducted at Agricultural Research Station, Bhavanisagar in order to find out the effect of unconventional green manures as intercrops on the yield and quality parameters of associate hybrid cotton (TCHB 213) during the year 2003 to 2004. Four cropping systems *viz.*, sole cotton, cotton + marigold, cotton + sesame and cotton + sunnhemp were tested (Factor A) in single and double rows (Factor B) incorporating them on 30 and 40 DAS (Factor C). The treatments were laid out in a factorial Randomized Block Design replicated thrice. The soil of the experimental fields was well drained sandy clay loam of Irugur series. Sesame and sunnhemp were solid rows in the interspace *i.e.*, 60 cm in between two cotton rows for single row spacing. For two rows, they were sown at 40cm interval in the interspace. In a similar way, marigold seedlings were planted keeping 10 cm intra row spacing, cotton was earthed up simultaneously at the respective incorporation timings.

Nitrogen as urea (46 per cent), phosphorus as super phosphate (16 per cent P_2O_5) and potassium as muriate of potash (60 per cent K_2O) were applied at the rate of

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120: 60: 60 kg N, P_2O_5 and K_2O ha^{-1}, respectively. Full dose of P and K and ½ N were applied as basal. Remaining N was applied in equal splits at the time of incorporation of green manure and at 60 DAS. Fertilizers were applied to cotton rows alone. The seed cotton harvested from five sample plants were pooled, cleaned, ginned and the fibre quality parameters *viz*., Bartlett's earliness index, ginning percentage, seed index, lint index, mean fibre fineness, mean fibre length, maturity coefficient and bundle strength were analyzed. The influence of treatment on the crop earliness was estimated through Bartlett's index (BI) by using the following formula of Bartlett (1947).

$$BI = \frac{P_1 + (P_1 + P_2) + (P_1 + P_2 + P_3) + (P_1 + P_2 + \ldots P_n)}{(P_1 + P_2 + P_3 + \ldots\ldots P_n) \; X \; n}$$

where, BI = Bartlett's Index, P_1, P_2, P_3 ……. Pn are the seed cotton yield at the first, second, third and n^{th} pickings, respectively. n = number of pickings

Ginning percentage was calculated by using the formula suggested by Santhanam (1976).

$$\text{Ginning percentage} = \frac{\text{Weight of lint (g)}}{\text{Weight of seed cotton (g)}} \times 100$$

The weight of hundred seeds obtained after ginning was weighed and expressed in grams (Santhanam, 1976). The lint obtained from ginning of hundred seed cotton was weighed and expressed in grams (Santhanam, 1976). Mean fibre length was determined by 'Baer sorter' and expressed in mm (Sundaram, 1979). Mean fibre fineness, a measure of fibre weight per unit length of fibre (g/inch) was analyzed with the help micronaire tester (Sundaram, 1979).It is a ratio of breaking strength of a bundle of fibres to its weight. It was measured in stelometer and expressed in tenacity at 1/8 gauge.

RESULTS AND DISCUSSION

Kapas and lint yield:

The positive effect of intersowing and *in situ* incorporation of green manures reflected on kapas yield in both the seasons (Table 1) having thus higher yield than sole cotton (without intercropping any green manure). The yield increase was by 28.2 and 25.0 per cent due to green manuring in summer and winter seasons, respectively as compared to sole cotton. Winter season crop yielded more kapas.

As regards sources of green manures, marigold out yielded other sources and the difference was clear in winter crop. It was followed by sunnhemp. The marigold as compared to sole cotton had nearly 35.0 per cent higher kapas yield in summer 2003 crop and 39.7 per cent in winter crop. The sunnhemp had 31.0 and 24.9 per cent higher yield, respectively. The increase in kapas yield due to sesame green manuring was marginal as compared to sole cotton. In both the seasons, double row intersowing / interplanting of green manures produced more kapas yield than single row and similarly earlier incorporation on 30 DAS had favourable effect. The interactive effect was significant and consistent with respect to row ratio and their incorporation timing. In both the years, double row of sowing / planting with early incorporation resulted in distinctly higher kapas yield. Single row and early incorporation resulted in low yield in both the seasons. The effect of green manure sources, row ratio and duration of green manures had similar effect on lint yield and this is in line with the fact that lint yield is a function of kapas yield. Similar results were obtained by Satheeshkumar (1999) reported higher values for many of the cotton yield attributes due to intercropping and *in situ* incorporation of sunnhemp. Mahendran *et al*. (1997) reported improvement in sugarcane yield attributes due to intercropping of daincha. Selvi (2001) reported positive impact on rice yield due to intercropping of daincha. The present study goes in line with their observations.

Table 1 : Effect of unconventional green manuring on kapas and lint yield of cotton

Treatments	Kapas yield ($Kgha^{-1}$)		Lint yield ($Kg\ ha^{-1}$)	
Stages	Summer	Winter	Summer	Winter
Inter crop				
I_1 – Marigold	1515	1988	485.3	621.3
I_2 – Sesamum	1334	1633	407.6	492.2
I_3 – Sunnhemp	1470	1778	463.2	541.3
S.E.±	45.4	57.9	7.94	20.6
C.D. (P=0.05)	93.7	119.5	16.4	42.6
Row ratio				
R_1 – Single row	1376	1713	422.9	515.8
R_2 – Double row	1504	1887	481.1	587.4
S.E.±	37.1	47.3	6.5	16.9
C.D. (P=0.05)	76.5	97.6	13.4	34.8
Days of incorporation				
D_1 – 30 DAS	1488	1855	475.3	573.1
D_2 – 40 DAS	1393	1744	428.7	530.1
S.E.±	37.1	47.3	6.5	16.9
C.D. (P=0.05)	76.5	97.6	13.4	34.8
Cropping system				
Without GM (S_1)	1123	1423	331.3	406.0
Overall mean of GM (S_2)	1440	1779	452.0	551.6
S.E.±	66.8	85.2	11.7	30.4
C.D. (P=0.05)	137.9	175.9	24.1	62.7

Table 2 : Fibre length, bundle strength, maturity co efficient, uniformity ratio and bartlett's earliness index of cotton as influenced by green manure intercropping

Treatment	Fibre length (mm)		Bundle strength (tenacity at 1/8 gauge)		Maturity co-efficient		Uniformity ratio (%)		Bartletts earliness index	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Inter crop										
I_1 – Marigold	32.31	26.51	26.72	26.43	0.67	0.65	43.18	46.00	0.54	0.52
I_2 – Sesamum	30.66	26.48	26.12	26.72	0.65	0.61	40.49	45.72	0.50	0.54
I_3 – Sunnhemp	31.39	26.84	26.45	27.06	0.66	0.62	40.56	46.58	0.52	0.56
S.E. ±	0.82	0.30	0.29	0.21	0.11	0.04	1.91	2.43	0.03	0.02
C.D. (P=0.05)	NS	NS	NS	0.42	NS	NS	NS	NS	NS	NS
Row ratio										
R_1 – Single row	29.53	26.29	26.37	26.58	0.65	0.59	40.79	47.35	0.49	0.51
R_2 – Double row	33.38	26.93	26.49	26.90	0.66	0.65	42.03	44.85	0.55	0.57
S.E. ±	0.67	0.24	0.23	0.17	0.01	0.03	1.56	1.98	0.03	0.01
C.D. (P=0.05)	1.38	0.50	NS	NS	NS	0.06	NS	NS	0.05	0.02
Days of incorporation										
D_1 – 30 DAS	31.91	27.01	26.59	26.92	0.66	0.64	42.73	45.77	0.53	0.55
D_2 – 40 DAS	30.99	26.46	26.27	26.30	0.65	0.60	40.09	46.43	0.51	0.53
S.E. ±	0.67	0.17	0.23	0.24	0.01	0.03	1.56	1.98	0.03	0.02
C.D. (P=0.05)	NS	0.35	NS	0.50	NS	NS	NS	NS	NS	NS
Cropping system										
Without GM	30.69	23.56	26.39	26.56	0.63	0.65	40.48	48.09	0.46	0.48
Overall mean of GM	31.45	26.74	26.43	26.61	0.66	0.62	41.41	46.10	0.52	0.54
S.E. ±	1.20	0.30	0.42	0.44	0.02	0.05	2.82	3.57	0.05	0.03
C.D. (P=0.05)	NS	0.62	NS	0.91	NS	NS	NS	NS	NS	NS

NS-Non significant

Fibre length, bundle strength, maturity co-efficient, uniformity ratio, bartlett earliness index and micronaire value:

Intersowing and *in situ* incorporation of green manures, by and large, did not affect the quality of cotton as measured by fibre length, bundle strength, maturity co-efficient, uniformity ratio and Bartlett's earliness index (Table 2). Green manure sources and incorporation timing had no influence on micronaire value. The row ratio had, however, influence on the fibre quality with intersowing two rows of green manures improving these quality parameters as compared to single row sowing. To be precise, the sources, row ratio and incorporation timing of intercrop green manures had no influence on almost all fibre quality parameters.

Cotton quality characters:

Both lint and seed indices results show that intercropping green manures and their *in situ* incorporation in the interspace of cotton is advantageous in producing more quantity of lint per seed (lint index) and seed weight (seed index). The advantage is more pronounced with marigold intercropping followed by sunnhemp. Sesamum had less effect on these quality parameters. The treatments effect on ginning percentage had the same trend. Other quality parameters were not influenced much. Higher lint production per seed (lint index) and higher seed weight (seed index) might explain well the higher seed cotton yield and lint yield due to green manure intercropping (S_2) in general as compared to sole cotton (S_1) and marigold (I_1) in particular. Similar were observed by Satheeshkumar (1999).

Lint index:

The lint obtained from unit number of cotton seeds (100 seed) was 28.6 per cent higher on an average in green manured cotton than that of sole cotton (without green manuring) (S_2 vs. S_1) during summer 2003. It was 30.0 per cent in winter 2003-04 crop. Marigold and sunnhemp green manured treatments (I_1 and I_2) had comparable performance in lint production per seed. Sesamum intercropping and *in situ* incorporation in cotton rows (I_2) had low lint yield per seed in both seasons. Increase in intercrop green manure rows from one to two in the interspace of cotton and *in situ* incorporation contributed higher values of lint index in both summer 2003 and winter 2003-04 crops. Incorporation timings (D_1 and D_2) did not influence the lint index (Table 3).

Table 3 : Lint index, seed index, ginning (%) and micronaire value of cotton as influenced by green manure intercropping

Treatment	Lint index (g)		Seed index (g)		Ginning (%)		Micronaire value (10^{-6} g inch^{-1})	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Inter crop								
I_1 – Marigold	5.67	5.71	9.13	9.02	32.08	30.94	3.48	3.58
I_2 – Sesamum	5.21	5.16	8.50	8.43	30.88	29.97	3.36	3.50
I_3 – Sunnhemp	5.32	5.73	8.76	9.08	31.39	30.55	3.36	3.50
S.E. ±	0.16	0.18	0.21	0.22	0.55	0.37	0.12	0.04
C.D. (P=0.05)	0.33	0.37	0.44	0.45	NS	0.74	NS	NS
Row ratio								
R_1 – Single row	5.23	5.19	8.55	8.38	30.95	30.01	3.37	3.49
R_2 – Double row	5.57	5.88	9.05	9.31	31.95	30.96	3.43	3.56
S.E. ±	0.13	0.22	0.17	0.25	0.45	0.29	0.10	0.03
C.D. (P=0.05)	0.27	NS	0.36	NS	0.93	0.61	NS	NS
Days of incorporation								
D_1 – 30 DAS	5.42	5.70	9.01	9.10	31.92	30.73	3.42	3.55
D_2 – 40 DAS	5.38	5.37	8.59	8.59	30.97	30.24	3.38	3.50
S.E. ±	0.13	0.22	0.17	0.25	0.45	0.29	0.10	0.03
C.D. (P=0.05)	NS	NS	0.36	NS	NS	NS	NS	NS
Cropping system								
Without GM	4.20	4.30	7.60	7.63	29.50	28.50	3.17	3.38
Overall mean of GM	5.40	5.53	8.84	8.84	31.45	30.49	3.40	3.51
S.E. ±	0.24	0.39	0.31	0.45	0.81	0.53	0.18	0.06
C.D. (P=0.05)	0.49	0.81	0.65	0.93	1.68	1.09	NS	NS

Seed index:

Seed index, which is the test weight of unit number of seed (100 seed), was higher in cotton green manured by intercropping (S_2 vs. S_1). The green manure intercrops *viz.*, marigold and sunnhemp had comparable seed index values, while sesamum had less effect on the seed index in both seasons. Increase in intercrop green manure rows from one to two and *in situ* incorporation resulted in more values of seed index. Similarly early incorporation of green manures (D_1) increased the seed index as compared to incorporation on 40 DAS (D_2). This was the trend in both seasons (Table 3).

Ginning percentage:

Intercropping and *in situ* incorporation of green manures (S_2) had higher outturn of lint to the tune of 31.45 and 30.49 per cent in summer and winter crops as against 29.50 and 28.50 per cent, respectively in sole cotton (S_1). Marigold followed by sunnhemp intercropping had higher ginning percentage, while sesamum did not benefit much. Increase in number of green manure rows improved the ginning percentage (Table 3).

Conclusion:

The results indicated that intercropping marigold in two rows in between cotton rows and intercropping it *in situ* on 30 DAS had contributed ultimately more kapas and lint yield securing higher yield advantage in both summer and winter crops. Cotton quality in terms of seed and lint indices improved with marigold intercropping followed by sunnhemp. Sesamum had less effect on various quality parameters. None of the green manures had any influence on almost all fibre quality parameters.

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