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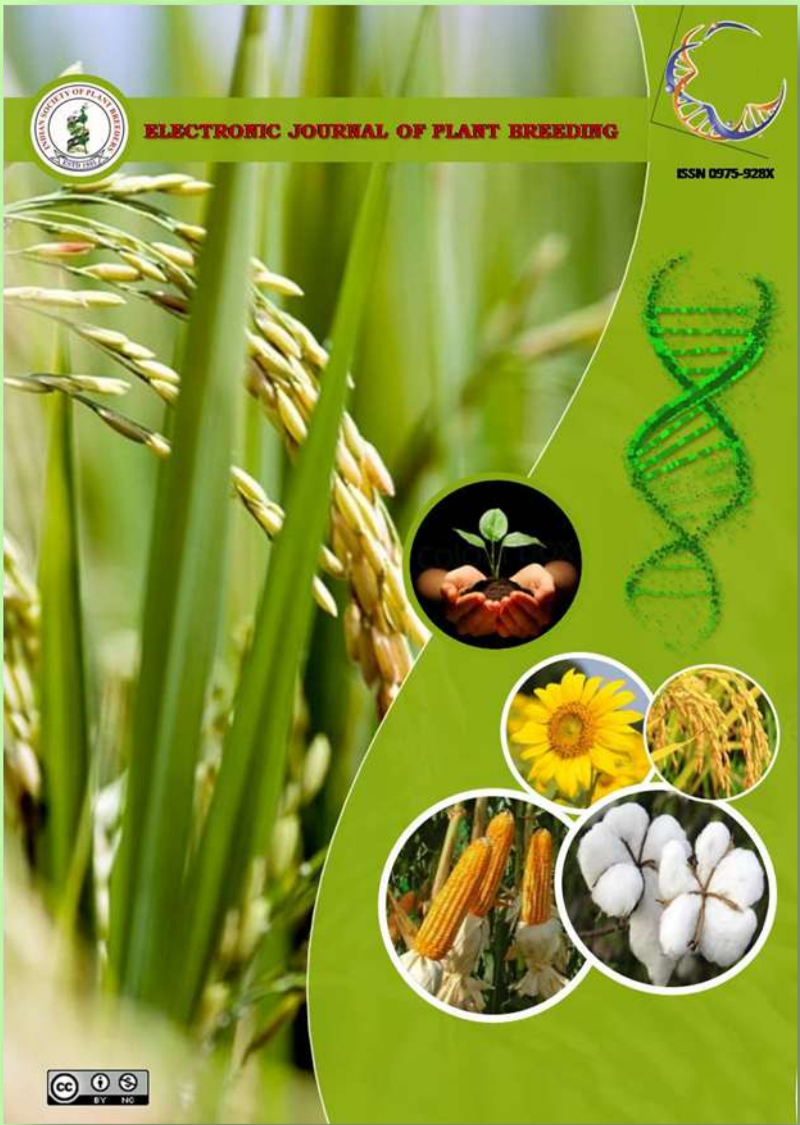

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Research Article

Genetic investigation on compact cotton (*Gossypium hirsutum* L.) using its segregating population (F_2)

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Abstract
In all over the World during last three decades, cotton breeders have been revolving to evolve high yielding compact genotypes to have uniform harvesting of bolls. Based on the data analysed using 54 F_1hybrids synthesized using 6 female and 9 male parents, nine better yielding compact hybrids were selected and used for this study. These were categorized into three distinct groups based on single plant yield *viz*., low (Group I), medium (Group II) and high (Group III). Mean comparison between the overall yield of F_1 and F_2 population derived from each of this group was found to be narrowing down from F_1 to F_2, even though significant number of high yielders were presented in F_2 population. The cross combinations viz., 343-1-1 x TCH1716 (Group I), 343-1-1 x RB602 &TCH1926 x RAH1070 (Group II) and TCH1819 x RB602 (Group III) were identified as elites as they had superior individual mean yield. Overall performance of Group-I in F_2 generation was observed to be better than its F_1 generation. This result was not observed in other two groups inferring that high yielding cross (Group III) rarely shows progress in yield as generation advances and low yielding crosses shouldn't be always neglected considering its early generation performance. Continuing selection in such crosses (Group I) to further generations may reveal its full genetic potential.

Key words
Cotton - F_1, F_2 Population - Mean yield.

Introduction

Cotton (*Gossypium hirsutum* L) is a splendiferous fibre crop known to human beings for more than 1000 years use primary source for global natural fibre needs. More than millions of people's lifeline either directly & indirectly depends on the production of cotton. Indian cotton hybrids and varieties have excessive vegetation, number of monopodial branches which lead to more space utilization for planting, unwanted energy diversion, inefficient utilization of solar energy, prolonged days to maturity, extensive labour cost for manual picking and limits adopting mechanization.

To overcome such issues in cotton production, new concept of developing compact cotton emerged. A plant which has zero monopodia and shorter sympodial length is defined as compact cotton (Gunasekaran *et al*., 2014). The compact genotype of cotton which is presently being adopted to fit in High-Density Planting System (HDPS) has shorter sympodial branches with reduced internode length giving a morphological appearance of compressed nature of plant with clustered boll habit. In high-density planting system, cotton canopy arrangement is very closer and it reduces soil evaporation (Paslawar *et al* .,2015)

Compact genotypes can utilize three-dimensional space area in a better manner and have better access for picking the bolls. (Tamilselvam *et al*., 2013). Compact genotypes are high yielders as they had significantly more number of bolls, number of sympodia and boll weight per unit area. Compact genotype shows a highly positive correlation for seed cotton yield, internode length, lint index and uniformity ratio. (Preetha and Raveendran, 2007). In all over the World during the last three decades, cotton breeders have been revolving to develop high yielding compact genotypes to strengthening cotton production.

Materials and Methods

The present study was conducted in an experimental plot at Department of Cotton, (CPBG), Tamil Nadu Agricultural University, Coimbatore under irrigated condition during *Kharif* season (2018-2019) by using segregating materials obtained from compact and non-compact genotype's crosses. (Table 1) The compactness and genetic variability studies on F_1 material have been done during the *Kharif* season of 2017 (Monisha *et.al*.,2018).

Based on the data analysis for compactness with yield potential in 54 F_1 hybrids, nine better compact hybrids were selected for this study. (Table 2) These nine crosses were categorized into three distinct groups *viz*., Compactness with low yield (55.13-74.82 g/plant, Group-I), compactness with medium yield(87.46-99.08 g/plant, Group-II) and compactness with high yield (123.12 -167.17 g/plant, Group -III).The F_2 population from each of these crosses were generated and used for this study. Single plant yield observations taken from 100 plants in each of the crosses were subjected to analysis (Table 3).

Results and Discussion

In low yielder group-I, 343-1-1 x TCH1716 cross had better yield in both F_1 (74.82g) and F_2 (80.27g) generations than other two crosses as this cross had 71 plants which recorded single plant yield more than its F_1 group mean yield (67.01g).Moreover, 15 plants exceeded overall F_1 population mean. This cross had second maximum value (191g) of single plant yield among overall F_2 population. The cross 343-1-1 x CCH15-1 was found to be the second potential yielder of this group as it has 67 superior plant with better yield than F_1 population and single plant yield of 14 individuals exceeded the overall F_1 population mean. The cross 343-1-1 x BGDS1055 was observed to be low productive cross as mean single plant yield was only 64.65g.

In group II, the cross 343-1-1 x RB602 yielded more number of superior plants (40 nos) whose single plant yield exceeded the F_1 group mean (91.62g) and had 19 individuals whose single plant yield exceeded the overall F_1 population mean (103.16g). The second highest mean single plant yield of 83.94g with a maximum of 150.99g in F_2 generation was observed in this cross. The cross TCH1926 x RAH1070 had the highest single plant yield mean (84.40g) in the F_2 generation and had the second highest number of superior individuals (38 nos) surpassing F_1 population group mean and with 19 individuals having single plant yield exceeding the overall F_1 population mean. TCH1926 x GISV310 cross was observed to be a poor single plant yielder (72.74g) in this group and had lower number of superior plants (23nos) surpassing its F_1 population group mean. Both 343-1-1 x RB602 and TCH1926 x RAH1070 crosses of this group can be considered as potential yielder as they had more plants in F_2 generation with high yield.

In group -III, high number of superior individuals (12 nos) surpassing the respective F_1 population group mean was found in TCH1819 x RB602 cross and low number (2 nos) was observed in TCH1926 x RB602 . Compared to the F_1 population group mean, both crosses recorded severe yield reduction in overall F_2 mean. The cross TCH1819 x TCH1716 was found to be the second highest single plant yielder and had 9 number of superior individuals. Considering yield of nine crosses, maximum yield (205.62g), higher F_2 population mean yield (99.36g) with 12 superior individuals surpassing respective F_1 population group mean were observed in TCH1819 x RB602.

Mean comparison between the overall yield of F_1 and F_2population pooling all the nine crosses revealed that yield narrows down from F_1 to F_2 population (Table 4). Even though the yield of the F_2 population mean found to be as low and couldn't exceed the F_1 population mean, the significant number of high yielding individuals (137 nos) were found in the F_2population that could surpass F_1 population mean. Among the 900 observed individuals of F_2, nearly one-third of the population (307 individuals) was observed as high yielders whose single plant yield exceeded its respective group mean. From 307 superior individuals, 137 plants performance was found to be excellent with exceeding performance indicating presence of transgressive segregants in F_2 population.

In spite of transgressive segregation, overall mean yield of the F_2 population was found to be low than F_1 population. Single plant yield reduction was found to be higher in group III, medium in group II with no reduction in group I. Among the 307 superior individuals isolated in F_2 population, maximum number of individuals (183 nos), nearly half of superior individuals belonged to the group I and low number of superior individuals (23 nos) were observed in group III .

This study revealed the following: Low yielding compact cross (Group I) had lower mean single plant yield in F_1 and F_2 compared to medium (Group II) & high yielding (Group III) crosses. Substantial reduction in F_2 population mean was observed in group III compared to group II with a better improvement in yield in group I. This indicates that low performing crosses could release more amount of variation in later generation. Moreover high yielding crosses fail to recombine better in subsequent generation as witness by the lesser number of individual plants in group III surpassing the respective population mean. Hence it could be appropriate to practice recombination breeding even in low performing crosses (Group I) while medium & high yielding crosses can be directly exploited through heterosis breeding. This study leaves a message that proceeding with high yielding crosses for generations may not yield more desirable recombinants as expected.

References

Gunasekaran, M., Vindhiyavarman, P., Thangaraj, K., and Balu, P. A. (2014). TCH 1822–a zero monopodia and short sympodial *G. hirsutum* cotton genotype suitable for high-density planting system., *Electronic Journal of Plant Breeding*., **5**(4), 858-861.

Preetha, S., and Raveendran, T. S. (2007). Genetic variability and association analysis in three different morphological groups of cotton (*Gossypium hirsutum* L.). *Asian Journal of Plant Sciences*, **6**(1), 122-128.

Paslawar, A. N., Deotalu, A. S., andNemade, P. W. (2015).High-density planting of cotton variety AKH–081 under rainfed condition of Vidharbha. *Plant Archives*,**15**(2), 1075-1077.

Monisha, K., Premalatha, N., Sakthivel, N., and Kumar, M. (2018).Genetic variability and correlation studies in upland cotton (*Gossypium hirsutum.*L). *Electronic Journal of Plant Breeding.*, **9**(3), 1053-1059.

Tamilselvam, G., Rajendran, R. and Anbaras, K. (2013). Comparison of robust and compact *hirsutum* cotton types: A search for ideal plant type. *Internation Journal of Agricultural and Food Science*.,**3**(2), 64-68.

Table 1. Details of compact and non compact genotypes, used as parents for crossing

S. No	LINES	S. No	TESTERS
	Compact plant type	1.	RB602
1.	C10-8	2.	BGDS1055
2.	TCH1926	3.	TCH1716
3.	343-1-1	4.	CCH15-1
4.	TCH1819	5.	RAH1070
	Non compact	6.	GISV310
5.	SVPR3	7.	RHC 1202
6.	CSH 5640	8.	DSC 1501
		9.	LHDP-1

Table 2. Three categorizes of nine selective compact crosses

	Cross details
Group-I	343-1-1 x BGDS1055
	343-1-1 x TCH1716
	343-1-1 x CCH15-1
Group-II	343-1-1 x RB602
	TCH1926 x RAH1070
	TCH1926 x GISV310
Group -III	TCH1926 x RB602
	TCH1819 x RB602
	TCH1819 x TCH1716

Table 3. Single plant yield of all F_2 individuals with respective groups

	Single plant yield of all F_2 individuals of Group I			Single plant yield of all F_2 individuals of Group II			Single plant yield of all F_2 individuals of Group III		
Plant	343-1-1 X BGDS1055	343-1-1 X TCH1716	343-1-1 X CCH15-1	343-1-1 X RB602	TCH1926 X RAH1070	TCH1926 X GISV310	TCH1926 X RB602	TCH1819 X RB602	TCH1819 X TCH1716
1	26.50	81.00	127.30	57.17	56.70	60.05	88.22	88.63	39.50
2	37.39	60.39	89.10	66.02	68.09	55.94	44.38	117.61	88.66
3	77.18	165.43	74.33	73.35	88.56	94.13	64.69	76.53	76.02
4	87.93	89.06	57.11	98.71	102.62	104.80	48.41	96.14	81.94
5	13.54	69.11	73.96	110.94	91.84	59.82	57.84	62.99	33.18
6	31.21	40.95	49.67	78.66	77.30	158.00	84.98	74.00	96.63
7	78.77	36.55	107.54	106.64	65.20	77.18	64.50	42.28	88.53
8	47.47	94.20	109.10	150.99	77.95	50.09	51.98	161.00	95.99
9	21.68	46.59	51.22	43.28	84.87	50.09	52.46	120.00	138.39
10	87.80	76.35	75.51	122.00	136.66	128.00	102.15	135.41	109.00
11	24.01	67.60	87.86	54.24	160.00	45.04	89.35	72.37	120.00
12	34.98	50.61	75.86	94.97	60.30	91.73	92.89	98.02	99.54
13	43.00	77.58	84.79	88.90	131.17	92.77	94.55	134.00	60.57
14	34.92	40.37	50.23	71.92	72.85	111.36	74.00	65.85	45.01
15	112.01	69.59	85.08	98.48	52.00	38.21	96.73	69.53	67.44
16	49.72	60.01	133.21	58.12	111.73	63.85	81.47	93.16	80.55
17	71.90	83.26	46.37	95.68	85.23	43.50	77.01	70.93	76.55
18	85.57	82.43	119.55	68.34	85.23	63.80	88.24	123.27	93.44
19	82.42	50.42	83.85	46.14	96.88	99.70	60.74	50.20	44.98
20	30.10	65.87	62.94	85.68	99.25	46.04	45.85	68.64	63.40
21	53.71	86.15	120.01	77.16	86.39	105.00	74.93	72.17	60.71
22	99.61	84.89	54.44	130.10	64.00	52.82	61.74	76.57	126.00
23	70.10	35.10	110.83	46.22	41.03	79.60	97.85	58.08	90.24
24	25.94	74.00	59.47	75.25	101.11	60.49	53.87	91.50	78.37
25	47.50	52.20	46.86	97.75	62.40	42.60	42.24	73.35	82.71
26	72.65	82.85	79.76	101.42	97.76	35.01	71.44	52.80	50.90
27	71.16	50.79	54.74	32.95	87.76	79.02	33.36	83.70	152.06
Plant	343-1-1 X BGDS1055	343-1-1 X TCH1716	343-1-1 X CCH15-1	343-1-1 X RB602	TCH1926 X RAH1070	TCH1926 X GISV310	TCH1926 X RB602	TCH1819 X RB602	TCH1819 X TCH1716
29	128.00	78.05	88.13	85.00	58.48	57.67	83.05	69.68	52.55
30	80.00	60.29	34.59	127.78	94.05	91.88	78.83	108.23	95.70
31	100.00	100.00	42.51	73.20	98.88	89.66	154.72	74.41	130.88
32	161.00	72.05	63.18	123.68	86.69	75.63	135.60	189.00	44.35
33	106.19	102.54	76.32	56.10	101.28	62.42	130.00	92.60	68.52
34	53.11	81.52	46.63	64.16	68.16	46.58	156.84	43.43	82.80
35	70.00	112.54	55.98	71.60	118.90	33.93	55.01	65.37	33.72
36	49.36	45.94	68.85	48.25	85.78	74.02	85.08	85.05	77.67
37	40.00	79.01	60.54	112.36	70.65	67.88	39.70	81.02	64.24
38	28.50	85.88	36.63	99.67	79.25	40.29	30.50	77.03	94.21
39	60.07	90.78	75.88	81.88	75.17	94.12	65.58	76.46	109.90
40	62.96	134.65	104.19	65.44	64.72	96.46	40.95	205.62	143.00
41	114.65	59.44	68.25	71.76	62.00	71.05	54.50	130.00	90.98
42	60.00	99.05	100.00	98.23	102.00	114.46	79.83	96.90	79.29
43	102.00	85.17	90.00	78.41	82.30	58.67	41.88	85.86	69.17
44	90.00	140.90	88.57	62.87	65.50	98.79	60.26	131.22	60.91
45	74.00	84.27	90.23	74.24	90.86	47.52	121.53	105.73	108.00
46	96.10	88.35	51.45	102.05	79.00	79.71	62.05	64.19	36.12
47	60.05	61.87	73.10	82.33	78.85	83.54	44.23	81.93	158.00
48	97.28	55.27	102.70	121.00	70.40	53.93	36.01	137.00	58.28
49	59.10	70.78	81.91	51.33	93.86	41.95	75.06	138.11	45.73
50	74.71	78.82	36.12	82.52	100.54	45.59	90.29	153.00	154.00
51	57.02	94.38	121.18	80.47	120.14	41.92	77.91	154.00	75.50
52	68.15	147.38	81.12	92.05	113.00	75.26	105.60	102.00	84.90
53	62.23	150.27	70.09	84.37	66.84	73.69	122.13	75.00	45.51
54	110.50	98.80	75.78	101.15	78.81	63.13	62.01	117.68	118.04
55	85.39	126.60	86.88	106.80	106.17	43.61	39.62	63.59	73.57

56	62.72	85.02	88.25	110.80	103.21	80.00	80.36	78.26	97.00
57	60.32	82.77	106.18	69.90	46.41	68.80	40.27	77.40	91.32
58	68.31	70.03	46.33	144.26	39.67	79.54	94.09	65.27	98.08
Plant	343-1-1 X BGDS1055	343-1-1 X TCH1716	343-1-1 X CCH15-1	343-1-1 X RB602	TCH1926 X RAH1070	TCH1926 X GISV310	TCH1926 X RB602	TCH1819 X RB602	TCH1819 X TCH1716
59	153.00	60.34	135.90	77.13	85.51	65.47	80.05	77.34	89.53
60	75.58	61.65	75.41	64.56	120.00	116.84	40.81	137.00	84.05
61	92.24	110.44	58.60	95.02	128.00	70.08	44.45	57.15	76.04
62	110.11	74.24	53.71	79.75	90.00	60.30	88.30	114.21	157.00
63	52.95	44.01	85.37	56.76	120.00	39.04	49.47	71.42	74.77
64	45.18	56.09	98.59	97.74	96.80	64.00	117.60	157.00	84.67
65	90.59	40.00	42.84	52.78	123.00	55.28	59.39	119.00	77.72
66	73.54	48.14	79.23	86.84	95.02	48.08	51.00	130.00	44.56
67	110.00	67.88	80.91	115.22	79.65	92.08	105.00	59.34	134.00
68	69.31	191.00	41.49	77.54	65.12	47.87	116.38	106.50	83.45
69	35.78	46.04	40.34	71.46	57.06	58.65	60.51	126.00	72.73
70	34.78	50.10	98.55	88.02	114.60	83.00	82.30	85.65	62.81
71	55.00	78.00	60.18	60.00	40.00	65.40	21.53	151.00	68.69
72	51.69	74.78	80.10	70.01	122.00	121.34	106.42	95.62	113.30
73	24.09	75.28	46.78	111.96	56.70	52.47	94.01	79.53	96.26
74	31.41	79.00	60.10	81.34	89.00	57.17	53.34	44.96	153.00
75	23.74	71.85	81.34	96.61	95.00	84.66	47.54	181.00	168.00
76	45.22	50.00	90.03	61.46	66.91	148.00	43.96	97.50	95.87
77	43.19	81.62	72.69	64.50	52.85	80.00	75.52	167.00	78.45
78	32.93	78.66	55.13	86.22	95.76	56.21	37.55	137.00	52.64
79	55.67	78.50	91.52	55.24	75.00	105.77	98.04	76.00	103.76
80	110.00	69.00	54.97	61.32	105.05	68.75	93.02	123.01	47.01
81	62.08	75.57	75.16	106.20	57.10	105.77	111.13	82.87	93.96
82	59.00	47.69	53.76	53.82	79.56	83.39	80.10	95.60	60.63
83	30.78	107.40	98.83	100.39	56.72	97.40	88.16	96.10	66.80
84	59.02	83.24	71.51	73.98	48.40	45.95	64.33	74.65	63.10
85	42.36	104.60	105.71	98.40	72.61	64.29	57.16	205.00	75.34
86	80.27	86.14	71.86	59.00	83.61	70.01	137.80	106.00	74.66
87	39.08	72.28	70.70	93.24	67.41	71.38	66.46	120.11	50.81
88	78.43	73.00	72.44	137.38	66.01	74.70	107.68	120.52	150.92
Plant	343-1-1 X BGDS1055	343-1-1 X TCH1716	343-1-1 X CCH15-1	343-1-1 X RB602	TCH1926 X RAH1070	TCH1926 X GISV310	TCH1926 X RB602	TCH1819 X RB602	TCH1819 X TCH1716
89	50.48	51.97	138.10	92.24	99.79	87.72	86.16	80.00	136.00
90	14.86	58.64	70.25	98.10	110.00	100.95	89.35	75.00	48.99
91	77.30	79.77	69.78	111.53	37.58	40.25	39.36	75.25	75.59
92	81.80	96.17	68.47	123.00	51.23	79.00	36.56	114.69	42.15
93	43.80	92.85	45.61	96.00	65.76	77.24	33.68	110.11	66.99
94	97.86	37.34	87.54	115.60	70.36	54.49	88.46	166.27	91.93
95	55.76	140.91	46.69	70.93	97.00	70.15	103.33	97.72	96.85
96	74.49	120.54	78.17	57.44	103.11	84.71	73.42	98.54	104.00
97	24.50	91.60	87.36	63.47	116.00	80.01	34.65	57.69	75.70
98	67.40	150.75	89.82	92.09	81.73	80.01	76.76	154.00	125.83
99	46.17	72.28	43.08	62.73	97.93	40.35	44.08	91.02	153.88
100	62.88	81.44	110.90	76.50	85.00	78.70	93.56	79.00	158.66

Table 4. Mean comparison of F_1 and F_2 population for single plant yield

	Cross details	F_1 Population	F_2 Population				
		SPY	**SPY**	**MIN**	**MAX**	**NI**	**NII**
	343-1-1 x BGDS1055	55.13	64.65	13.54	161.00	45	10
	343-1-1 x TCH1716	74.82	80.27	35.10	191.00	71	15
Group	343-1-1 x CCH15-1	71.09	76.00	34.59	138.10	67	14
I	Mean	**67.01**	**73.64**	SUM		**183**	**39**
	343-1-1 x RB602	99.08	83.94	32.95	150.99	40	19
	TCH1926 x RAH 1070	88.33	84.40	37.58	160.00	38	19
Group	TCH1926 x GISV 310	87.46	72.74	33.93	158.00	23	12
II	Mean	**91.62**	**80.36**	SUM		**101**	**50**
	TCH1926 x RB602	123.12	73.82	21.53	156.84	2	15
	TCH1819 x RB602	162.24	99.36	42.28	205.62	12	19
Group	TCH1819 x TCH1716	167.17	87.24	33.18	168.00	9	14
III	Mean	**150.84**	**86.81**	SUM		**23**	**48**
	Over all mean	**103.16**	**80.27**	SUM		**307**	**137**

SPY - Single Plant Yield (g) .
NI - Number of individuals of F_2 population whose single plant yields are better than respective F_1 population group mean .
NII - Number of individuals of F_2 population whose single plant yields are better than overall mean of F_1 population .

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