Biological Forum – An International Journal **15(2): 220-229(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Path of Productivity among Stay Green and High RGR Heterotic Group derived F_1s of Cotton (*Gossypium hirsutum* L.)

Nikhila[1*] and S.S. Patil[2]

[1]Ph.D. Scholar, Department of Genetics and Plant Breeding, University of Agricultural Sciences, Dharwad (Karnataka), India.
[2]Emeritus Scientist, Department of Genetics and Plant Breeding, University of Agricultural Sciences, Dharwad (Karnataka), India.

(Corresponding author: Nikhila)*
(Received: 15 December 2022; Revised: 27 January 2023; Accepted: 06 February 2023; Published: 09 February 2023)
(Published by Research Trend)

ABSTRACT: Path of productivity is an approach that helps in the identification of the traits that are responsible for the productivity of the top genotypes. The ten top potential-derived F_1s and ten least potential-derived F_1s were considered as two groups and their means for each character were expressed as per cent deviation from the overall mean of the derived hybrids. These per cent deviation values help in identifying the important yield contributing traits responsible for high productivity seen in top potential genotypes as well as low productivity seen in least potential genotypes. In the top potential genotypes, the yield-attributing traits showed a positive per cent deviation from the group mean and in the ten least potential genotypes the yield-attributing traits showed a negative per cent deviation from the group mean.

Keywords: Derived F_1s, genotypes, path of productivity, per cent deviation.

INTRODUCTION

Cotton is a crop of global importance and is a source of fiber, cattle feed and edible oil. Cotton is also popularly called as white gold. Cotton belongs to the family *Malvaceae*, genus *Gossypium* having 50 different species of which 46 are wild type and 4 are cultivated type. These 4 species comprise of both diploids and tetraploids with chromosome numbers of 2n=26 and 2n=52 respectively. Among these *G. arboreum* L., *G. herbaceum* L. belongs to the diploid group (old world cotton) whereas *G. hirsutum* L. (American cotton) and *G. barbadense* L. (Egyptian cotton) belong to the tetraploids also known as new world cotton. *G. hirsutum* L. is popularly grown worldwide because of its fine fiber quality with higher productivity levels.

Cotton as a self-pollinated crop is a unique example where heterosis has been commercially exploited and GM technology is added to these commercial hybrids. Though over 90% of the area is under hybrids and intra-hirsutum hybrids reveal a lion's share in the cultivation of cotton, the methods of developing hybrids and the aspects of enhancing heterosis have not been researched upon. On examining the literature, it is evident that such studies are lacking even in maize and other crops where hybrids are cultivated exhaustively. After the development of the superior hybrids, the path of productivity helps to determine the role of different productivity traits contributing to yield *i.e.*, the ten top potential-derived F_1s and ten least potential-derived F_1s were considered as two groups and their means for each character were expressed as per cent deviation from overall mean of the derived hybrids. These per cent deviation values help in identifying the important yield contributing traits responsible for high productivity seen in top potential genotypes as well as low productivity seen in least potential genotypes. Similar works were also conducted by Deepak (2002); Lavanya (2004); Mahantesh Shastri (2004); Nataraj (2005); Gururaj (2006); Hanamaraddi (2010); Pranesh (2014); Rajeev *et al.* (2016); Vinayak and Patil (2017); Rajeev (2018); Kiran (2020); Ashok Kumar (2021).

MATERIAL AND METHODS

In the present investigation, twenty DC F_4 lines of the Stay Green group were crossed to two selected reciprocal parents RGR 2572 (RGR T3), RCR-4 (RGR T4), an additional compact tester DSC 75-8 (Ca T5) and with two common testers SSG2 (CM T1) and RCR-178 (CM T2) producing hundred derived F_1s. Similarly, twenty DC F_4 lines of the High RGR group were crossed to two reciprocal parents SG-102 (SG T3), SG 109 (SG T4), an additional tester DSC 27-4 (Cb T5) and with two common testers SSG2 (CM T1) and RCR-178 (CM T2) producing hundred derived F_1s. These hundred derived F_1s were evaluated and the top ten potential genotypes with the ten least potential genotypes were considered for calculating the path of productivity in both stay green and high RGR heterotic groups.

The approach of determining the path of productivity was followed to determine the role of different productivity traits contributing to yield. The top few potential derived F_1s and the least few potential derived F_1s were considered as two groups and their means for each character were expressed as per cent deviation from the overall mean of the derived hybrids. These per cent deviation values help in identifying the important yield contributing traits responsible for high productivity seen in top potential genotypes as well as low productivity seen in the least potential genotypes. The path of productivity analysis was done separately for both sets of crosses (Rajeev *et al.* 2016; Vinayak and Patil 2017). And the formula used for the calculation is:

$$\text{Per cent deviation} = \frac{\text{Mean of top/least performing genotypes} - \text{overall mean}}{\text{Overall mean}} \times 100$$

RESULTS AND DISCUSSION

Path of productivity analysis was done separately for Stay Green group derived F_1s (Set I) and High RGR group derived F_1s (Set II) and are presented as below.

Path of productivity of derived F_1s of Stay Green heterotic group (Set I). The percent deviation of ten top potential and ten least potential derived F_1s over group mean for thirteen different characters are presented in Table 1. The top ten derived F_1s showed positive deviation from the group mean for all the characters except for inter-boll distance. The major yield-contributing traits responsible for the superiority of the top ten hybrids are seed cotton yield (31.54 %), lint yield (35.55 %), boll weight (33.36 %) and the number of bolls (25.43 %). Characters like plant height, number of monopodia, number of sympodia, sympodial length, inter-branch distance, Seed index, ginning outturn and lint index showed positive per cent deviation from the overall mean of the derived hybrids and this indirectly affected the productivity of the superior derived F_1s. Inter boll distance showed negligible negative per cent deviation from the overall mean of the derived hybrids.

The ten least potential derived F_1s showed negative deviation from the group mean for all the characters except for the number of monopodia. The major yield contributing traits responsible for the inferiority of the ten least potential derived F_1s are seed cotton yield (-39.32%), lint yield (-42.06 %), boll weight (-10.89 %) and the number of bolls (-28.87 %). The negative per cent deviation from the group mean was also observed for the characters like plant height, number of sympodia, sympodial length, inter boll distance, inter-branch distance, seed index, ginning outturn, lint index and number of monopodia showed positive per cent deviation from overall mean of the derived hybrids. Similar results of positive per cent deviation for the characters like seed cotton yield, lint yield, boll weight and number of bolls in the top ten derived F_1s were observed by Lavanya (2004); Mahantesh Shastri (2004); Nataraj (2005); Hanamaraddi (2010); Rajeev (2018); Kiran (2020); Ashok kumar M (2021). Positive per cent deviation for the characters like seed cotton yield, lint yield and the number of bolls was observed by Deepak (2002); Rajeev *et al.* (2016); Vinayak and Patil (2017). Positive per cent deviation for the characters like plant height, and the number of monopodia was observed by Gururaj (2006); Pranesh (2014).

Path of productivity of derived F_1s of High RGR heterotic group (Set II). The percent deviation of ten top potential and ten least potential derived F_1s over group mean for thirteen different characters are presented in Table 2. The top ten derived F_1s showed positive deviation from the group mean for most of the characters except for the number of monopodia, sympodial length, inter boll distance, seed index, ginning outturn and lint index. The major yield-contributing traits responsible for the superiority of the top ten hybrids are seed cotton yield (25.24 %), lint yield (24.75 %), number of bolls (22.62 %) and boll weight (31.03 %). The character *i.e.,* the number of monopodia (-11.48 %) showed a negative deviation from the group mean which might be responsible for the superiority of derived F_1s. The positive per cent deviation from the group mean was observed among the characters like plant height, number of sympodia, and inter-branch distance. The negative per cent deviation from the group mean was observed among the characters like sympodial length, inter boll distance, seed index, ginning outturn and lint index which had a negligible effect on the superiority of the hybrids.

The ten least potential-derived F_1s showed negative deviation from the group mean for all the characters under study. The major yield contributing traits responsible for the inferiority of the ten least potential derived F_1s are seed cotton yield (-33.20 %), lint yield (-34.16 %), boll weight (-13.86 %) and the number of bolls (-19.37 %) which showed negative per cent deviation from the group mean. The negative per cent deviation from the group mean was observed among all the characters like plant height, number of monopodia, number of sympodia, sympodial length, inter boll distance, inter-branch distance, seed index, ginning outturn, and lint index. Similar results of positive per cent deviation for the characters like seed cotton yield, lint yield, boll weight and number of bolls in the top ten derived F_1s were observed by Lavanya (2004); Mahantesh Shastri (2004); Nataraj (2005); Hanamaraddi (2010); Rajeev (2018); Kiran (2020); Ashok kumar (2021). Positive per cent deviation for the characters like seed cotton yield, lint yield and the number of bolls was observed by Deepak (2002); Rajeev *et al.* (2016); Vinayak and Patil (2017). A negative per cent deviation for the number of monopodia was observed by Hanamaraddi (2010); Rajeev (2018); Kiran (2020) which contributes to the superiority of derived hybrids.

Table 1: Path of Productivity of top ten potential and bottom ten least potential derived hybrids of Stay green F_4 lines against High RGR and other testers (Set I).

Sr. No.	Derived hybrids	Plant height (cm)	Number of monopodia	Number of sympodia	Number of bolls	Boll weight (g)	Sympodial length (cm)	Inter boll distance (cm)	Inter branch distance (cm)	Seed index (g)	Ginning outturn (%)	Lint index (g)	Seed cotton yield (kg ha^{-1})	Lint yield (kg ha^{-1})
Top ten potential derived hybrids														
1.	SG 17 × CM T1	152.50	3.63	24.38	26.38	6.30	51.63	7.09	13.13	7.50	39.05	4.81	2260.15	883.25
2.	SG 14 × RGR T4	150.50	3.13	24.00	29.13	4.15	33.88	7.01	13.50	10.00	40.73	6.87	2172.64	882.44
3.	SG 10 × CM T1	127.88	1.38	20.88	24.00	6.35	42.25	10.86	11.88	10.00	39.73	6.59	2140.88	850.33
4.	SG 14 × CM T1	140.63	2.38	23.75	27.50	5.25	35.13	7.89	13.38	8.50	39.09	5.44	2125.32	832.46
5.	SG 9 × CM T1	155.00	3.00	23.25	19.63	6.10	44.88	9.37	13.25	9.50	38.61	5.96	2123.38	823.04
6.	SG 10 × RGR T3	142.88	1.88	23.88	21.38	5.70	38.25	7.88	13.00	8.50	40.27	5.72	2119.49	849.73
7.	SG 7 × CM T1	132.50	3.63	20.38	24.38	5.35	35.38	7.81	11.88	8.50	37.66	5.13	2101.34	788.99
8.	SG 18 × RGR T4	137.25	2.13	20.13	26.25	5.05	33.50	8.00	12.63	10.50	37.21	6.22	2066.33	768.02
9.	SG 4 × RGR T3	163.63	2.75	21.88	24.88	5.00	56.38	9.20	15.25	8.50	36.16	4.85	2020.96	729.76
10.	SG 2 × CM T1	162.13	1.75	26.25	24.50	4.70	55.75	11.93	12.38	9.50	40.26	6.39	2009.94	809.53
Mean of top ten		146.49	2.56	22.88	24.80	5.40	42.70	8.70	13.03	9.10	38.88	5.80	2114.04	821.76
Overall Mean		137.88	2.13	21.47	19.77	4.05	42.40	8.74	12.36	8.70	37.54	5.25	1607.14	606.26
% Deviation		6.24	20.16	6.56	25.43	33.36	0.71	-0.36	5.41	4.66	3.56	10.51	31.54	35.55
Bottom ten least potential derived hybrids														
1	SG 6 × RGR T3	136.75	2.50	25.75	15.88	2.90	51.13	8.97	13.13	8.50	37.89	5.25	1153.47	430.92
2	SG 14 × RGR T3	137.13	3.38	17.13	16.75	2.80	45.38	8.27	13.00	9.00	35.10	4.89	1128.93	400.11
3	SG 6 × CM T2	158.25	2.25	25.63	15.38	4.45	39.25	7.36	9.88	8.00	36.11	4.52	1067.43	385.16
4	SG 10 × RGR T4	128.88	2.88	22.38	12.00	3.15	41.75	8.63	12.63	8.50	36.22	4.82	998.08	361.83
5	SG 20 × CM T2	144.38	2.63	22.50	13.88	3.10	49.75	10.75	15.25	9.00	35.28	4.94	965.02	341.44
6	SG 15 × Ca T5	96.50	0.75	22.25	12.63	5.35	41.88	9.66	7.63	7.00	37.26	4.11	916.40	337.72
7	SG 9 × RGR T3	130.25	2.38	19.75	14.75	3.45	42.38	7.34	14.38	8.00	38.55	5.03	907.97	348.20
8	SG 20 × CM T1	135.00	3.00	20.13	12.50	3.65	33.75	7.09	12.13	7.00	31.92	3.28	905.38	288.79
9	SG 2 × Ca T5	116.50	1.13	17.00	13.88	3.80	30.00	8.34	10.88	7.00	38.00	4.30	859.11	327.70
10	SG 6 × CM T1	129.63	2.63	19.25	13.00	3.40	36.38	7.79	11.63	7.50	34.17	3.90	849.63	290.62
Mean of bottom ten		131.33	2.35	21.18	14.06	3.61	41.16	8.42	12.05	7.95	36.05	4.50	975.14	351.25
Overall Mean		137.88	2.13	21.47	19.77	4.05	42.40	8.74	12.36	8.70	37.54	5.25	1607.14	606.26
% Deviation		-4.76	10.20	-1.36	-28.87	-10.89	-2.92	-3.63	-2.48	-8.57	-3.98	-14.20	-39.32	-42.06

Table 2: Path of Productivity of top ten potential and bottom ten least potential derived hybrids of High RGR F_4 lines against Stay green and other testers (Set II).

Sr. No.	Derived hybrids	Plant height (cm)	Number of monopodia	Number of sympodia	Number of bolls	Boll weight (g)	Sympodial length (cm)	Inter boll distance (cm)	Inter branch distance (cm)	Seed index (g)	Ginning outturn (%)	Lint index (g)	Seed cotton yield (kg ha^{-1})	Lint yield (kg ha^{-1})
Top ten potential derived hybrids														
1.	RGR 9 × SG T3	144.13	1.63	23.38	26.13	6.75	40.25	6.74	12.25	8.50	36.22	4.87	2272.99	813.14
2.	RGR 15× CM T1	132.25	2.38	18.00	22.25	5.50	38.50	9.77	13.25	10.50	36.84	6.12	2255.14	832.01
3.	RGR 14 × Cb T5	112.00	0.63	16.38	28.38	5.75	33.25	6.95	9.88	11.00	34.83	5.88	2240.51	779.48
4.	RGR 18 × SG T4	157.88	1.00	24.50	23.13	6.15	43.38	7.75	13.88	9.00	39.36	5.87	2231.80	874.49
5.	RGR 19 × SG T4	147.38	1.50	22.13	25.13	6.35	46.25	10.92	12.25	11.50	38.76	7.27	2214.48	858.64
6.	RGR 18 × CM T2	120.00	1.75	19.25	26.00	5.20	41.13	9.09	10.88	7.50	37.33	4.48	2200.27	819.70
7.	RGR 6 × SG T4	130.25	1.63	23.63	25.00	5.65	40.00	8.85	11.75	9.00	35.72	5.00	2199.83	788.27
8.	RGR 18 × Cb T5	111.00	0.50	17.25	23.50	5.95	34.13	6.81	9.75	7.50	38.33	4.69	2196.94	844.68
9.	RGR 5 × SG T3	123.50	1.50	14.63	26.88	6.00	31.75	7.84	11.50	7.00	40.34	4.74	2193.38	882.38
10.	RGR 16 × CM T2	123.50	3.50	19.25	25.13	5.95	46.88	8.49	11.75	8.50	27.33	3.19	2185.39	598.18
Mean of top ten		130.19	1.60	19.84	25.15	5.93	39.55	8.32	11.71	9.00	36.51	5.21	2219.07	809.10
Overall Mean		129.56	1.81	19.65	20.51	4.52	42.68	9.11	11.22	9.46	36.59	5.48	1771.89	648.58
% Deviation		0.48	-11.48	0.95	22.62	31.03	-7.34	-8.64	4.37	-4.81	-0.24	-4.99	25.24	24.75
Bottom ten least potential derived hybrids														
1.	RGR 16 × SG T3	128.50	1.88	18.88	16.75	4.10	35.75	9.11	11.88	9.00	37.83	5.48	1332.55	504.04
2.	RGR 20 × CM T1	132.13	1.50	17.38	19.25	4.35	56.63	8.59	9.88	10.00	34.16	5.16	1291.07	443.19
3.	RGR 2 × Cb T5	104.50	0.38	19.88	15.88	3.60	39.88	8.82	9.38	7.50	33.67	3.80	1280.70	435.01
4.	RGR 8 × SG T3	127.25	1.75	21.25	15.75	4.45	40.75	7.31	12.25	10.50	37.83	6.38	1258.18	476.47
5.	RGR 20 × Cb T5	107.88	0.88	20.00	18.88	3.85	42.38	8.19	9.00	9.00	36.67	5.21	1208.74	441.27
6.	RGR 16 × Cb T5	108.38	0.88	17.13	15.13	3.20	33.13	7.93	8.13	9.50	32.83	4.64	1173.74	387.47
7.	RGR 5 × Cb T5	113.25	1.13	19.38	16.13	3.35	28.63	8.56	10.50	9.00	35.17	4.89	1164.67	407.54
8.	RGR 19 × SG T3	115.38	1.63	20.13	17.38	4.35	44.63	8.50	12.00	9.50	35.75	5.29	1153.82	412.62
9.	RGR 10 × Cb T5	99.00	0.88	20.63	15.75	4.40	38.00	7.47	9.75	8.50	37.50	5.11	1035.20	387.87
10.	RGR 20 × CM T2	119.75	2.25	20.38	14.50	3.30	35.75	7.09	10.75	9.00	40.17	6.01	937.14	374.91
Mean of bottom ten		115.60	1.31	19.50	16.54	3.90	39.55	8.16	10.35	9.15	36.16	5.20	1183.58	427.04
Overall Mean		129.56	1.81	19.65	20.51	4.52	42.68	9.11	11.22	9.46	36.59	5.48	1771.89	648.58
% Deviation		-10.77	-27.39	-0.77	-19.37	-13.86	-7.34	-10.43	-7.77	-3.23	-1.19	-5.25	-33.20	-34.16

CONCLUSION

The deviation of positive or negative would reflect on the nature of genes ultimately contributing towards the yield. Two sets of genotypes differing in their paths to productivity can be used in hybridization to bring together the different genes responsible for higher yields that are present in them. Superior segregants can be isolated later from such a cross. With the comparison of both the top and bottom crosses, we may say that there is a modified path of productivity for the superiority and inferiority of genotypes.

FUTURE SCOPE

This approach helps to determine the role of different productivity traits contributing to yield. Superior segregants can be isolated later from the crosses with a positive per cent deviation from the group mean values and can also be used in breeding programs.

REFERENCES

Ashok Kumar, M. (2021). Use of broad based populations for exploiting heterotic group in cotton (*Gossypium hirsutum* L.). *Ph.D.* (*Agri.) Thesis*, University of Agricultural Sciences, Dharwad, Karnataka, India.

Deepak (2002). Genetic studies on potentiality of *herbaceum* cotton genotypes in diverse situations. *M. Sc.* (*Agri.*) *Thesis*, University of Agricultural Sciences, Dharwad, Karnataka, India.

Gururaj (2006). Genetic studies on compact and robust plant types of cotton (*Gossypium hirsutum* L.). *M. Sc. (Agri.) Thesis*, University of Agricultural Sciences, Dharwad, Karnataka, India.

Hanamareddi (2010). Genetic investigation in cotton (*Gossypium hirsutum* L.). *M. Sc. (Agri.) Thesis*, University of Agricultural Sciences, Dharwad, Karnataka, India.

Kiran, N. (2020). Exploitation of broad based heterotic populations for improving hybrid performance in cotton (*Gossypium hirsutum* L.). *Ph.D.* (*Agri.*) *Thesis*, University of Agricultural Sciences, Dharwad, Karnataka, India.

Lavanya, K. K. R. (2004). Genetic studies on plant types of cotton (*Gossypium hirsutum* L.) *M. Sc.* (*Agri.*) *Thesis*, University of Agricultural Sciences, Dharwad, Karnataka, India.

Mahantesh Shastri (2004). Genetic evaluation of diverse cotton (*Gossypium hirsutum* L.) plant types and their segregating generations. *M. Sc. (Agri.) Thesis*, University of Agricultural Sciences, Dharwad, Karnataka, India.

Nataraj, S. (2005). Genetic evaluation of cotton species under protective irrigation, rainfed and saline situations. *M. Sc.* (*Agri.*) *Thesis*, University of Agricultural Sciences, Dharwad, Karnataka, India.

Pranesh, K. J. (2014). Exploiting heterotic groups through reciprocal recurrent selection for combing ability to improve performance of cotton hybrids. *Ph. D. Thesis*, University of Agricultural Sciences, Dharwad, Karnataka, India.

Rajeev, S. (2018). Exploiting concept of *Gossypium hirsutum* L. vs *Gossypium barbadense* L. heterotic groups through reciprocal selection for combining ability in cotton. *Ph.D.* (*Agri.) Thesis*, University of Agricultural Sciences, Dharwad, Karnataka, India.

Rajeev, S., Srivalli, P., Patil, S. S. and Manjula, S. M. (2016). Determining the path of productivity for seed cotton yield in upland cotton (G*ossypium hirsutum* L.). *Advances in Life Sciences*, *5*(19), 8361-8365.

Vinayak, E. and Patil, S. S. (2017). Determining path of productivity in double cross F_1 populations belonging to within and between heterotic group crosses in cotton (*Gossypium hirsutum* L.). *Journal of Farm Sciences*, *30*(1), 12-15.

How to cite this article: Nikhila and S.S. Patil (2023). Path of Productivity among Stay Green and High RGR Heterotic Group derived F_1s of Cotton (*Gossypium hirsutum* L.). *Biological Forum – An International Journal, 15*(2): 225-229.