Biological Forum – An International Journal **14(1): 147-150(2022)**

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

Triallel Analysis for Ginning Outturn in Inter and Intra Specific Cotton Hybrids

Y. Prashanth[1*], T. Pradeep[2], A. Sudarshanam[3], D. Saida Naik[4] and B. Ramprasad[3]

[1]Deportment of Genetics and Plant Breeding, College of Agriculture, Rajendranagar, (Telangana), India.
[2]Seed Research & Technology Centre, Rajendranagar, (Telangana), India.
[3]Regional Agricultural Research Station, Warangal, Telangana, (Telangana), India.
[4]Deportment of Crop physiology, College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad, (Telangana), India.

(Corresponding author: Y. Prashanth)*
(Received 14 October 2021, Accepted 08 December, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Ginning outturn, is one of the economically important trait to enhance lint yield. It showed that high GOT % is good for devising strategy for fiber quality improvement also. Genetical improvement of this complex trait had created attention of conventional plant breeders, any plant breeding technique has to be decided based on the gene action involved for expression trait. Triallel analysis provides information on all types of gene actions *viz.*, additive, dominance and epistatic components besides giving information on order of parents in three-way cross combinations for obtaining superior hybrids transgressive segregants. In the present study an attempt was made to obtain information on gene action controlling the trait ginning outturn of cotton in 60 inter and intra specific three way cross hybrids. The result revealed that, role of additive as well as non-additive gene action in the expression of this trait. Suggested, improvement would be possible by adopting special breeding methods like inter mating in early segregating generations for two to three generations with step by step improvement followed by pedigree method of breeding or special breeding methods like biparental selection scheme and recurrent selection schemes.

Keywords: Ginning outturn, triallel analysis, inter specific cotton hybrids.

INTRODUCTION

Cotton is an important global fibre crop and its fibre having prime source for world textile industry, it is cultivated across the world about 80 countries in an average area of 31.4 million hectares with 111.7 million bales (420 lb) of production with productivity of 775 kg lint per hectare. The lint yield considerably depends on ginning outturn of growing hybrid or cultivars, GOT is the percentage of ginned lint obtained from seed cotton and is used for measure of saleable commodity. This trait associated with a number of other characters such as number of fibres per seed, fibre weight, seed weight etc., high ginning percentage may result from lighter seed index, increased number of fibres per seed and heavy weight of individual fibre or from any combination of these character (Christidis and Harrison 1955). Approaches to enhance lint yield by increasing GOT should help breeders to break the productivity barriers in response to global competition. It has been reported that yield can be boosted 3% with 1% rise in ginning outturn (Saleem *et al.* 2010). Further, Sezener *et al*. (2006) also showed that high GOT % is good for devising strategy for fibre quality improvement. The two cultivated tetraploid cotton species *Gossypium hirsutum* L. and *Gossypium barbadense* L. are included in this study for development of cotton hybrids having high GOT coupled with broad genetic base and good fibre quality.

MATERIALS AND METHODS

The experimental materials were utilized in this study comprised of 60 three-way cross hybrids developed from 6 cotton genotypes. Four genotypes of *G. hirsutum* L. [Adilabad kapas-1(1), ADB-39 (2), ARBC-64(5) and CNH 115 (6)] and two genotypes of *G. barbadense* L. [Suvin (3) and Phule rukhmai(4)] received from cotton scheme, Agricultural Research Station, Adilabad were crossed in half diallel fashion (Griffing 1956) and obtained fifteen single crosses. Later these hybrids were involved in all possible combinations such that no parent appeared twice in the same cross and obtained 60 three-way crosses. All these 60 crosses were evaluated in two replications and triallel analysis was carried out as per Rawlings and Cokerhams (1962a). Each genotype was sown in 2 rows of 10 hills by maintaining a spacing of 120 × 60 cm, the plot size was 2.4 m × 6.0 m. Then a random sample of 300 g seed cotton from each hybrid and the lint obtained was utilized to estimate the ginning out-turn with the following manner

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

RESULTS AND DISCUSSION

Analysis of variance and genetic component of variances. Mean data on ginning out-turn from sixty three-way crosses were subjected to triallel analysis and the analysis of variance (Table 1) and combining ability for the trait revealed highly significant differences among genotypes for 1-line general effect for first and second kind, 2-line specific effect for first kind and second kind, and 3-line specific effects. The results also suggested that preponderance significant additive and non additive genetic effects.

Table 1: Analysis of and genetic component of variances.

Source	D.F.	Mean squares	Genetic component of variances	
Replications	1	54.45**	Variances	Value
1 line order	5	22.42**	Var(A)	1.07
1 line general effect of first kind (hi)	5	21.46**	Var(D)	-23.99
1 line general effect of second kind (gi)	5	20.53**	Var(AA)	0.2
2 line order	9	10.58**	Var(AD)	86.56
2 line specific effect of first kind (dij)	9	12.85**	Var(DD)	-6.56
2 line specific effect of second kind (sij)	19	9.56**	Var(A)	1.07
3 line specific (tijk)	21	5.50*		
Crosses	59	10.37**		
Error	59	2.58		

General combining ability effects of grandparent (h_i), parent (g_i) and two-line specific effects of first kind d_{ij} and second kind S_{ij}. 1-line general effect of first kind (hi) and second kind (gi) and two line specific effect of first kind are presented in Table 2 while 2-line specific effect of second kind is in Table 3. Among the parents, Adilabad kapas-1 and Phule rukhmai had significant and positive 1-line general effect of first kind (hi) and second kind (gi) respectively, clearly indicating the fact that both the parents were good general combiners for this character when used as a grandparent and immediate parent in any of three-way crosses. Two line specific effect of first kind (dij) was positive in eight crosses (1 × 3, 1 × 4, 1 × 5, 1 × 6, 2 × 5, 2 × 6, 3 × 4 and 3 × 5) the cross 2 × 6 was exhibit high (2.30)and significant, hence these crosses are good specific combiners as grandparent in three-way crosses. 2-line specific effect of second kind (sij) was positive in eight crosses (1 × 3, 1 × 4, 2 × 5, 3 × 4, 3 × 5, 4 × 5, 4 × 6 and 5 × 6) the cross 3 × 4 was found to be high (2.04) and significant, hence these crosses can be considered as good specific combiner as half parents.

Table 2: General combining ability effects as grandparent (h_i), as parent (g_i), two-line specific effects of first kind dij.

Line	General line effects		Two-line specific effects of first kind dij					
	h_i	g_i	1	2	3	4	5	6
1	1.17*	0.31		-1.92*	0.32	0.74	0.23	0.63
2	-0.58	0.50			-1.16	-0.37	1.15	2.30**
3	-0.89	-0.06				0.88	0.5	-0.55
4	0.8	1.35*					-0.37	-0.88
5	0.24	-1.76*						-1.5
6	-0.73	0.66						
SE	0.27	0.35		0.48				
CD P=0.05%	0.99	1.26		1.54				
CD P=0.01%	1.56	1.97		2.22				

1-Adilabad kapas-1, 2-ADB-39, 3-Suvin, 4- Phle Rukhmai, 5-ARBC-64 and 6-CNH 115

Table 3: Two line specific effect of second kind (i as half parent and j as parents).

Two-line specific effects of second kind s_{ij}					
Lines	S_{ij}	Lines	S_{ij}	Lines	S_{ij}
12	-0.96	23	-0.43	35	0.64
13	0.39	24	-0.08	36	-0.45
14	0.92	25	0.16	45	0.4
15	-0.01	26	-0.19	46	0.02
16	-0.34	34	2.04*	56	0.96
12	-0.96	23	-0.43	35	0.64
SE (**S_{ij}**); 0.42, CD (P=0.05%); 1.25 and CD (P=0.01%)1.71					

Three-line specific effects (T_{ijk}). Three line specific effects (T_{ijk}) were found to be positive in twenty seven crosses (Table 4). Among them, triplet (1 × 5) × 2 has shown the significant and high performance (2.14) in which the parents 1 and 5 are the best general combiners for production of potential three way crosses. The alternate triplet 1 × 2 × 5 (-0.26) or 2 × 5 × 1 (-0.29) have negative T_{ijk} effects. It is clearly emphasizing the order effect of parents in which crossing has to be effected to produce significant triplets. Similar results were reported by Rajamani *et al.* (2015) 60 three-way crosses.

Table 4: Three-line specific effects (T_{ijk}).

Cross	T_{ijk}	Cross	T_{ijk}	Cross	T_{ijk}	Cross	T_{ijk}
(12)3	-0.14	(15)6	-0.76	(25)4	1.86	(36)2	-0.29
(12)4	-0.9	(16)2	-0.16	(25)6	-0.34	(36)4	0.08
(12)5	-0.26	(16)3	-0.6	(26)1	0.52	(36)5	0.94
(12)6	1.3	(16)4	0.63	(26)3	0.63	(45)1	0.64
(13)2	0.83	(16)5	0.13	(26)4	-0.68	(45)2	0.38
(13)4	1.15	(23)1	0.86	(26)5	-0.46	(45)3	-0.12
(13)5	-0.57	(23)4	-0.28	(34)1	-0.34	(45)6	-0.9
(13)6	-1.4	(23)5	0.22	(34)2	0.74	(46)1	0.79
(14)2	-2.81**	(23)6	-0.8	(34)5	-0.6	(46)2	1.7
(14)3	1.24	(24)1	-1.09	(34)6	0.2	(46)3	-1.88
(14)5	0.7	(24)3	0.75	(35)1	0.22	(46)5	-0.61
(14)6	0.87	(24)5	0.5	(35)2	-1.27	(56)1	-0.57
(15)2	2.14*	(24)6	-0.17	(35)4	-0.95	(56)2	-1.25
(15)3	-0.5	(25)1	-0.29	(35)6	2.00*	(56)3	1.85
(15)4	-0.88	(25)3	-1.24	(36)1	-0.73	(56)4	-0.03
SE (S_{tijk}) 0.67, CD P=0.05% 1.98, CD P=0.01% 2.69							

1-Adilabad kapas-1, 2-ADB-39, 3-Suvin, 4- Phle Rukhmai, 5-ARBC-64 and 6-CNH 115.

Estimation of genetic components of variances. Estimation of genetic component revealed that (Table 5), the magnitude of additive genetic variance (σ^2A) was positive and larger than the dominance genetic variance (σ^2D). These results indicated the predominance of additive genetic variances (σ^2A) in the inheritance of this trait. With regard to epistatic variances, additive by additive genetic variance (σ^2AD) showed positive value and considerable magnitude. Whereas, variances additive by additive genetic variance (σ^2AA) and dominance by dominance genetic variance (σ^2DD) showed negative value It could be concluded that the trait mainly controlled by σ^2A and σ^2AD epistatic variances. Rajamani *et al.* (2015) also reported that additive × dominance gene action played a major role for this character. Laxman and Ganesh (2003) observed predominance of non fixable epistatic interaction (additive × dominant followed by dominance × dominance) for this trait which is in partial agreement with the present findings on the contrary, Ramalingam (1996) reported prevalence of dominance × dominance component followed by additive gene action governing the character. These results were in common agreement with the results obtained by many authors among them Abd El-Bary *et al*. (2008), El-hoseiny (2009); Abd El-Bary, (2013); Darweesh (2010); El-Feki *et al*. (2012) who were reported both additive as well as non additive/epistatic gene action controlling the trait ginning outturn.

Table 5: Estimation of genetic components of variances.

Variance	Values
Var (A)	226.27
Var (D)	-1204.48
Var (AA)	-431.68
Var (AD)	4927.11
Var (DD)	-1033.53

CONCLUSION

Finally from this study, computation of genetic variances gave an indication of significant amount of both additive and non additive. Positive significant of 1 line general effect of first kind (hi) and second kind (gi) indicated preponderance of additive gene action. The three-way cross having parental lines in the order of (Adilabad kapas-1 × ARBC-64) × ADB-39 exhibited high positive three line effect compared to alternate triplet (Adilabad kapas-1 × ADB-39) × ARBC-64 or (ADB-39 × ARBC-64) × Adilabad kapas-1 that have negative T_{ijk} effects. This clearly indicated the importance order effects of parents in production of potential three-way cross hybrids. The cross ADB-39 × CNH-115 was identified as better combination for SCA among all other. The character was predominantly governed by additive and additive × dominance epistatic component of gene action. Therefore, these findings suggested that, trait improvement would be possible by adopting special breeding methods like inter mating in early segregating generations for two to three generations with step by step improvement followed by pedigree method of breeding or special breeding methods like biparental selection scheme and recurrent selection schemes.

Acknowledgements. The authors gratefully acknowledge Deportment of Genetics and Plant Breeding, College of Agriculture, Professor Jayashankar Telangana State Agricultural University, Hyderabad to permit to this study and Agricultural Research Station, Adilabad for specialties provided during study.

Conflict of Interest. None.

REFERENCES

Abd El-Bary, A. M. R. (2013). Improving Egyptian cotton using f2 triallel crosses. *J. Plant Production, Mansoura Univ., 4*(6): 943 – 956.

Abd El-Bary, A. M. R., Soliman, Y. A. M., Hamoud, H. M. E. and Abou El-Yazied, M. A. (2008). Triallel analysis for yield components and fiber traits in (*Gossypium barbadense* L.). *J. Agric. Sci. Mansoura Univ*., *33*(2): 1189-1201.

Christidis, B. G. and Harrison, G. J. (1955). In Cotton Growing Problems, pp. 22-26.

Darweesh, A. H. M. (2010). Genetical studies on triallel crosses in cotton. M. Sc. Thesis, Faculty of Agriculture, Tanta University, Cairo, Egypt.

El-Hoseiny, H. A. (2009). Improving Egyptian cotton using double crossing technique. Ph.D. Thesis, Faculty of Agriculture. Al-Aaher. University, Egypt.

El-Feki, T. A, H. A. El-Hoseiny, Aziza, Sultan, M. and Orabi, M. H. M. (2012). Improving Egyptian cotton using F_2 triallel crosses. *J. Agric. Sci. Mansoura Univ*., *3*(2): 229-239.

Griffing, B. (1956). Concept of general and specific combining ability in relation to diallel crossing system. *Australian Journal of Biological Sciences*, *9*(4): 463-493.

Laxman, S. and Ganesh, M. (2003). Combiing ability for yield components and fibre charecters in cotton (*Gossypium hirsutum* L.). *Jour. Res. Acharya N.G. Ranga Agril. Uni., 31*: 19-23.

Rajamani, S., G. M. V., Prasada Rao and Ratna Kumari, S. (2015). Genetics of seed cotton yield and its attributing characters in cotton (*Gossypium hirsutum* L.). Paper presented at the National Symposium on Future Technologies: Indian Cotton in the Next Decade. Guntur, pp. 228-238.

Ramalingam, A. (1996). Genetics of seed cotton yield and its components in upland cotton (*Gossypium hirsutum* L.) vs Diallel and triallel analysis. Ph. D. Thesis submitted to Tamil Nadu Agricultural University.

Rawlings, J. O. and Cockerham, C. C. (1962a). Triallel analysis. *Crop Science, 2:* 228-31.

Saleem, M. F., Bilal, M. F., Awais, M., Shahid, M. Q. and Anjum, S. A. (2010). Effect of nitrogen on seed cotton yield and fiber qualities of cotton (*Gossypium hirsutum* L.) cultivars. *The Journal of Animal & Plant Sciences, 20*(1): 23-27.

Sezener, V., Kabakci, Y. I., and Aydin, U. (2006). A clustering study on selection of parents in cotton breeding. *Asian Journal of Plant Sciences*, *5*(6): 1031-1034.

How to cite this article: Y. Prashanth, T. Pradeep, A. Sudarshanam, D. Saida Naik and B. Ramprasad (2022). Triallel Analysis for Ginning Outturn in Inter and Intra Specific Cotton Hybrids. *Biological Forum – An International Journal*, *14*(1): 147-150.