Electronic Journal of Plant Breeding, 1(4): 685-688 (July 2010)

Research Article

Heterosis Studies in GMS Based Diploid Cotton

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Abstract

A study of heterosis over better parent and checks was carried out during 2005-06. GMS based hybrids were generated by utilizing 18 genetic male sterile lines of *G. arboreum* and 3 testers of *G. herbaceum*. The hybrids exhibited high heterosis over better parent and varietal check Rahs-14, while they also exhibited considerable heterosis over standard check, Chamtkar-222 and varietal check, DLSa-17, for seed cotton yield (kg/ha). The two hybrids, Million-GMS × Jayadhar and GAKA-423 × H-221 which were recorded significant positive heterosis for seed cotton yield(kg/ha) over standard check Chamatkar-222 also have significant positive heterosis for yield component trait like boll number and fibre quality traits like, 2.5 per cent span length and fibre strength over all the checks. Only few hybrids recorded significant positive heterosis for economic traits like seed index, lint index and ginning outturn, while many hybrids recorded significant positive heterosis for fibre quality traits like 2.5 per cent span length and fibre strength over standard check, Chamatkar-222 and varietal check Rahs-14. The hybrids, GMS-4 × DDhC-11, GAKA-8614 × DDhC-11 and GMS-4 × DDhC-11 recorded significant positive heterosis over standard check, Chamatkar-222 and varietal check Rahs-14 for 2.5 per cent span length and fibre strength.

Key word: GMS based hybrids, Heterosis, diploid cotton, economic traits

Introduction

Heterosis breeding is mainly responsible for increased production of cotton. Hybrid cover about 45% of the total cotton area, which contributed 55 per cent of the total cotton production and about 44 per cent of area is covered by tetraploid hybrids and hardly 1 per cent is covered by diploid hybrids (Tuteja *et al.*, 2005).

In heterosis breeding programme, the selection of parents or hybrids based on their morphological diversity is very important in producing superior hybrids. The main constraint for increase in the area under hybrids of diploid cotton is the cost of hybrid seed production which is about 15 to 20 times higher than the varieties. Hence, the conventional hybrids are beyond the reach of poor farmers.

Cotton being an often cross pollinated crop is amenable for heterosis breeding. In case of cotton the system of male sterility is of great significance in practical, as it avoids laborious process of emasculation and it can aid in production of hybrid seed. Diploid cottons are inherently low yielders. So, there is lot of scope to improve their genetic potential for yields. The area under diploid cotton is about 20 lakh hectares, in which diploid hybrids cover only about 0.5 lakh hectares (Mayee and Rao, 2002). This is mainly because of uneconomical hybrid seed production due to low boll setting through conventional method of hybrid seed production. The low boll setting may be attributed to small size of flowers and close adherence of brittle nature of staminal column in flowers, which easily breaks during emasculation. Therefore, genetic male sterlity was thought to be a best, economical and alternative method for hybrid seed production technique in cotton and especially in diploid cotton to release higher yields.

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Material and Methods

Fifty four hybrids involving eighteen male sterile lines of *G. arboreum* and three testers of *G. herbaceum* were evaluated for heterosis along with parents and checks (Chamatkar-222 (standard check), DLSa-17 and Rahs-14 (varietal checks) of *G. arboreum* and *G. herbaceum,* respectively) in randomized block design with two replications at Agricultural Research Station, Dharwad during 2007-08. Each entry had two rows of 5.4 m spaced at 90 × 30 cm. Observations on plant height, number of monopodia per plant, number of

sympodia per plant, number of bolls, boll weight, seed cotton yield per plant (g), seed cotton yield (kg/ha), seed index, lint index, ginning outturn, halo length, 2.5 per cent span length, fibre strength, micronaire value, uniformity ratio and maturity coefficient were recorded. The data were recorded on five competitive plants in each plot, averaged and analyzed according to the method outlined by Kempthrone (1957).

Results and Discussion

The results and discussion of 16 quantitative traits are grouped into plant morphological traits, yield and yield attributing traits, economic traits and fibre quality parameters.

Plant morphological traits

Plant height is an important morphological character in cotton which provides the seat for nodes and internodes ultimately determining total yielding potential of a genotype. There were two hybrids, RGMS-2 × Jayadhar and SGMS-4 × Jayadhar which recorded significant positive heterosis over better parent, standard check (Chamatkar-222) and varietal checks (DLSa-17 and Rahs-14), respectively. The present findings are in agreement with the studies of Bhatade *et al.* (1992).

The hybrids, GMS-8401 × Jayadhar and GAKA-423 × Jayadhar exhibited significant negative heterosis over better parent and varietal check Rahs-14 for number of monopodia per plant. A total of four hybrids, GAK-15A × H-221, RGMS-3 × Jayadhar, GMS-4 × DDhC-11 and 8401-GMS × H-221 recorded significant positive heterosis over the checks, Chamatkar-222 and Rahs-14 respectively for this trait. The results of heterosis are in conformity with the reports of Neelima (2002).

Yield and yield attributing characters

The seed cotton yield of diploid cotton is generally contributed by boll number and boll weight in intraspecific hybrids and number of bolls in interspecific hybrids (Singh *et al.*, 1975 and Bhatade, 1983). Hence in the present study, the results of three traits viz., seed cotton yield, number of bolls and boll weight are discussed here under.

The hybrids, GAKA-423 × H-221 and GAK-09A × H-221 exhibited significant positive heterosis over better parent, standard check, Chamatkar-222 and varietal checks DLSa-17 and Rahs-14. The findings of heterosis are in agreement with the results of Reddy (2001). The hybrids, GMS-4-1 × DDhC-11, GAK-26A × DDhC-11, SGMS-4× Jayadhar, GAK-09A × Jayadhar, GAKA-423 × H-221 and GAK-09A × H-24 recorded significant positive heterosis over better parent, standard check, Chamatkar-222 and varietal checks, DLSa-17 and Rahs-14 for seed cotton yield per plant. The findings of heterosis are in agreement with reports of Neelima (2002) and Potdukhe (2002).

The hybrids, GMS-4-1 × DDhC-11, GAK-26A × DDhC-11, SGMS-4 × Jayadhar, GAK-09A × Jayadhar,GAK-09A × H-221 and GAKA-423 × H-221 recorded significant positive heterosis over better parent standard check,Chamatkar-222 and varietal checks, DLSa-17 and Rahs-14 for boll number.

The two best crosses in the present study were Million-GMS × Jayadhar and GAKA-423 × H-221 based on seed cotton yield (kg/ha). The hybrids GAKA-423 × H-221 exhibited significant positive heterosis over better parent and all the checks in present study for boll number. In addition, the two hybrids also possessed better fibre properties like 2.5 per cent span length and fibre strength in comparison with all the checks in the present study.

Economic traits

The economic traits included in the present study are seed index, lint index and ginning outturn. Among these three economic traits, ginning outturn per cent primarily depends upon seed weight and lint weight. Lint index represent the absolute weight of lint produced per seed and this trait is more important in breeding work than ginning outturn as it is highly correlated with the lint yield.

The cross, GMS-7 × Jayadhar recorded significant positive heterosis over better parent for seed index while, three hybrids viz., 8401-GMS × DDhC-11, 8401-GMS × Jayadhar and GMS-1 × DDhC-1 recorded significant positive heterosis over better parent for lint index.Similar findings were also reported by Reddy (2001) and Karande *et al.* (2004). In addition, for ginning outturn the hybrid GMS-7 × DDhC-11 was recorded significant positive heterosis over Rahs-14. The results of heterosis are in agreement with the reports of Reddy (2001).

Fibre properties

In recent years, more emphasis is laid on quality traits apart from seed cotton yield. In present investigation, six fibre property traits are included viz., halo length, 2.5 per cent span length, fibre

strength, micronaire value, uniformity ratio and maturity coefficient.

For halo length as many as eight hybrids over better parent, all the 54 hybrids over standard check, Chamatkar-222 and 24 hybrids over Rahs-14 recorded significant positive heterosis, which indicated that hybrids generally possessed better halo length than parents and checks. These findings are in accordance with the results of Kajjidoni (1984 and 1997) and Ansingkar (1996). The hybrids, GMS-4-1 × DDhC-11, GAKA-8614 × DDhC-11 and SGMS-4 × DDhC-11 recorded significant positive heterosis over standard check, (Chamatkar-222) and Rahs-14 for 2.5 per cent span length and fibre strength in desirable direction. The results of heterosis are in conformity with the reports of Reddy (2001), Neelima (2002) and Tuteja *et al*. (2005).The two best hybrids identified in the present based on seed cotton yield and fibre properties (Table.1) are Million-GMS × Jayadhar and GAKA-423 × H-221.

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Table 1: Mean performance of top two hybrids and checks for sixteen quantitative characters in cotton of rainfed condition

Characters	Crosses		Checks		
	Million-GMS × Jayadhar	GAKA-423 × H-221	Ch-222	DLSa-17	Rahs-14
Plant height (cm)	163.05	157.20	149.65	133.60	128.60
Number of monopodia per plant	2.70	3.30	2.80	3.10	3.80
Number of sympodia per plant	27.50	28.00	26.20	25.60	28.40
Number of bolls per plant	20.85	28.25	13.30	20.45	5.85
Boll weight (g)	2.40	2.20	3.70	2.25	1.76
Seed cotton yield per plant (g)	49.95	60.25	49.65	44.70	7.80
Ginning outturn (%)	30.92	33.71	40.65	34.39	32.04
Lint index (g)	2.68	2.53	4.90	3.18	3.32
Seed index (g)	5.95	5.89	7.03	6.06	7.02
Halo length (mm)	21.87	19.91	18.2	28.44	21.35
2.5% span length (mm)	26.10	25.30	22.90	25.20	22.90
Fibre strength (g/tex)	22.80	20.90	15.50	20.20	17.60
Micronaire value (µg/inch)	4.80	5.20	7.10	4.60	4.80
Uniformity ratio	49.00	49.00	52.0	49.00	48.00
Maturity coefficient	0.86	0.90	1.05	0.84	0.86
Seed cotton yield per ha (kg)	929.00	780.61	652.80	513.37	290.08