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SHORT RESEARCH ARTICLE

Influence of G x E interaction on heterobeltiosis, combining ability and stability of multiple cross derivatives of cotton (*Gossypium hirsutum* L.) amenable for HDPS

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Abstract

An experiment was conducted in three different locations using 42 crosses derived by crossing six lines and seven testers in Line x Tester design to identify stable cotton genotypes amenable to a high-density planting system. The heterozygotes were found more stable due to individual buffering capacities over homozygotes. Strong association between heterobeltiosis and specific combining ability (sca) was shown by the hybrids MC 4-3 x MC 3-2, MC 4-3 x MC 22-2, MC 4-3 x NH 630, MC 5-1 x MC 11-1 and MC 5-1 x NH 630 while MC 17-6 x MC 17-1, MC 4-3 x MC 3-2, MC 16-3 x MC 17-2 had out yielded homozygous parents in poor environments and exhibited heterosis and sca effects in desirable direction for short compact characters.

Cotton (*Gossypium hirsutum* L.) is considered as a primary source of natural fibre worldwide. It is an important cash crop of global importance forming a basis for the textile industry and showing a higher magnitude of genotype x environment interaction in the field (Campbell and Jones 2005). Recently concerted efforts were made to develop varieties/hybrids amenable for high-density planting system (Pradeep and Murthy 2019). The effect of environment on yield stability and other quantitative traits depends on their heterozygous or homozygous nature as they differ in individual buffering capacities (Cole et al. 2009) besides affecting combining ability (Dwivedi et al. 1999). Therefore, in the present study an attempt was made to elucidate the association of environment with heterosis, combining ability for yield under high density planting system (HDPS). The compact plant traits, buffering capacities of homozygotes and heterozygotes, stability of hybrids and parents, were considered of immense value in identifying stable genotypes.

Six lines (MC 4-3, MC 5-1, MC 9-1, MC 16-3, MC 17-6 and MC 23-2) and seven testers (NH 630, MC 3-2, MC 17-1, MC 19-2, MC 22-2, MC 11-1, MC 17-6) possessing vertical and horizontal compactness (Pradeep and Sumalini 2005) were crossed in a line x tester mating design (Kempthorne 1957) during *rabi* 2013-14. The resulted crosses and parents were evaluated during the raining season of 2014-15 at three different locations *viz*., Aswaraopet (E1), Warangal (E2) and Adilabad (E3). The material was planted at a spacing of 60 cm x 30 cm in Randomized Block Design replicated thrice. The data were recorded on 13 traits and mean values were subjected to analysis of variance (ANOVA) for pooled as well as individual environments. The differences in heterobeltiosis were estimated on better parent, the general combining ability (GCA) and specific combining ability (SCA) were estimated as per line x tester analysis, while the stability parameters were calculated as per Eberhart and Rusell (1966) model.

All the traits except, days to first boll bursting, earliness index, boll weight and harvest index exhibited higher range of heterobeltiosis in poor and moderate environments (data not shown) due to the physiological response of crosses in these environments (Cole et al. 2009; Patil et al. 2017). The GCA:SCA ratio for yield and other characters was found less than unity (data not shown), indicating non-additive effects in controlling the stability of characters under poor

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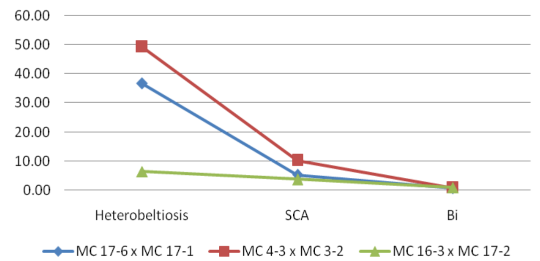

Fig. 1. Best crosses identified based on heterobeltiosis, sca and stability

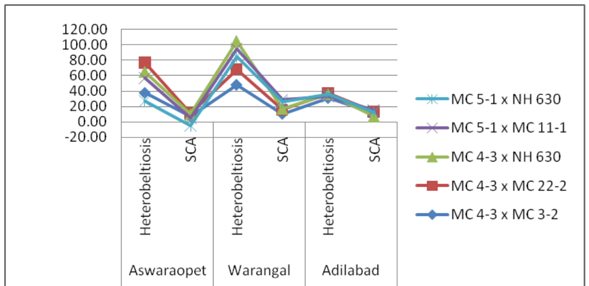

Fig. 2. Association between heterobeltiosis and sca effects

environment (Patil et al. 2017). The results also revealed a positive association between heterobeltiosis and non-additive gene action for the characters viz., days to 50% flowering, plant height, number of sympodial branches, length of the sympodial branches, leaf area, boll weight, 100 seed weight, harvest index but not for all (Patil et. al. 2017). The study indicated the importance of linear and non-linear components in determining the interaction of the genotypes with environments, as reported earlier (Patel et al. 2013; Verma et al. 2013: Riaz et al. 2013; Killi and Harem 2006), however, it was found to be deviating from the findings of Patil et al. (2017) and Devdar (2013). Further, the performance of heterozygotes is greater than that of homozygotes due to individual buffering capacities (Cole et al. 2009) that leads to increased yields and stability of hybrids than parents (Patil et al. 2017, Shahzad et al. 2019). High better parent heterosis combined with high sca effects for the compact traits and yield in the desired direction demonstrated the presence of reasonable genetic diversity among the parents (Moll et al. 1965). The parents MC 5-1, MC 16-3, MC 17-2 and crosses MC 4-3 x MC 3-2, MC 17-6 x MC 17-1 and MC 16-3 x MC 17-2 (Fig. 1) were found to be stable and could be exploited for development of varieties/hybrids amenable for HDPS. On contrary, the hybrids MC 4-3 x 3-2, MC 4-3 x MC 22-2 and MC 5-1 x MC 11-1, MC 5-1 x NH 630 (Fig. 2) exhibited heterobeltiosis and sca effects in the desired direction for compact traits, stable performance under poor, moderate (E1, E2) and better environment (E3), respectively.

Thus the present study also reiterated that in hybrids the stability was due to superior performance over the parents in low-yielding environments. Hence, the use of selected hybrids under diverse environments and high-density planting system is suggested.

Authors' contribution

Conceptualization of research (KM, TP); Designing of experiments (KM, TP); Contribution of experimental material (TP); Execution of field / lab experiments and data collection (KM); Analysis of data and interpretation (KM, TP); Preparation of manuscript (KM, TP).

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