

## Heterosis for Forage Yield and its Attributing Traits in Sorghum [*Sorghum Bicolor* (L.) Moench]

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### Abstract

The present investigation was carried out to study per se performance and magnitude of heterosis in sorghum [*Sorghum bicolor* (L.) Moench]. The 28 hybrids were generated by L x T fashion during early summer, 2019 at Centre for Millets Research, Sardar Krushinagar Dantiwada Agricultural University, Deesa using seven females (DS 1142, DS 1147, DS 1135, DS 193, DS 187, SPV 2445 and DS 171) and four male parents (CSV 21F, GFS 06, GFS 04 and GAFS 12). The resultant 28 hybrids were evaluated along with eleven parents and one check CSV 32F in randomized block design with three replications during kharif 2019. Perusal of per se performance of parents and their hybrids for different traits evinced that DS 1147 among the females, GFS 06 among the males and DS 1147 x CSV 21F, DS 1142 x GFS 04, DS 1142 x GFS 06 and DS 1142 x CSV 21F among the hybrids exhibited higher overall mean performance for green fodder yield per plant and some of the yield contributing traits. For earliness, female DS 187, male GFS 04 and hybrid DS 171 x CSV 21F were found superior as they exhibited lower values for days to flowering. Significant heterosis over better parent and best standard check (CSV 32F) was observed in many hybrids for various traits. The hybrids DS 1147 x CSV 21F (57.31%) and (33.03%), DS 1142 x GFS 04 (52.74%) and (31.39%) and DS 1142 x GFS 06 (28.57%) and (28.59%) and DS 1142 x CSV 21F (48.07%) and (27.37%) manifested significant positive heterosis over better parent and standard check respectively for green fodder yield per plant. While in case of dry fodder yield, the hybrid DS 1147 x GFS 06 (58.84%) and (51.43%), DS 1147 x CSV 21F (59.66%) and (51.30%) and DS 1135 x GFS 06 (46.50%) and (39.66%) exhibited significant and desirable heterosis over better parent and over standard check respectively.

**Key words :** Per se performance, heterobeltiosis, standard heterosis, yield.

Sorghum [*Sorghum bicolor* (L.) Moench] has been classified under family Poaceae, sub-family Panicoideae, tribe Andropogoneae and genus Sorghum having  $2n = 20$  chromosomes. Sorghum has a significant role in livestock production, particularly in tropical zone where feed stuffs could not meet animal requirements due to many factors such as poor soil fertility and drought. To obtain better animal performance,

forage sorghum should be nutritionally superior i.e., better in palatability, high in protein, digestibility and low in toxic constituents (Pholsen and Suksri, 2007). In order to make forage sorghum as an enterprising and remunerative crop, there is an urgent need to initiate research to develop varieties and hybrids having faster growth, early to medium maturity and higher fodder yield with good quality parameters like juiciness, resistant to leaf spot disease, sweetness high protein content and minimum toxic constituents like HCN content. To develop such fodder varieties/hybrids of sorghum, knowledge of heterosis, combining ability and stability across the environments are necessary.

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Heterosis is expressed as per cent increase or decrease of hybrid performance over the parental value (Mutazing, 1945). Since, the better parent may fall on either extreme depending upon the traits; heterosis may result in any one of the two directions, positive and negative. The utilization of heterosis or hybrid vigour as a means of maximizing the yield of agricultural crops has become one of the most important techniques in plant breeding. Knowledge of the magnitude of heterosis for various characters is essential to decide better combinations and exploit them through heterosis breeding. The economic heterosis rather than mid parent heterosis and heterobeltiosis, reflects the actual superiority over the best existing cultivar to be replaced and appears to be more relevant and practical. Therefore, the present investigation is undertaken in Line x Tester mating design for yield and its components traits in forage sorghum with the objective to estimate the nature and magnitude of heterosis over better parents and standard check

### **Materilas and Methods**

The experimental material comprised of forty genotype including fertile counterparts of seven female line, four male line, twenty-eight hybrid and one check CSV 32F were grown in a randomized block design replicated thrice during kharif, 2019 at Centre for Millets Research, Sardar Krushinagar Dantiwada Agricultural University, Deesa (District: Banas kantha). Each genotype was represented by a single row plot of 3.0metre length. The inter row distance was 30 centimetres. Five competitive plants were randomly selected and tagged from each plot of entry for recording observations and average value per plant was computed. The observations were recorded on days to flowering, plant height (cm), number of leaves per plant, stem diameter (cm), leaf length (cm), leaf width (cm), leaf: stem ratio, green fodder yield per plant (g), dry fodder

yield per plant (g) and quality characters like brix (%) and crude protein content (%). The replication-wise mean values for all the characters were subjected to statistical analysis. The analysis of variance was carried out as per the procedure suggested by Panse and Sukhatme (1978). Heterosis was estimated as per cent increase or decrease in the mean value of  $F_1$  hybrid over better parent i.e., heterobeltiosis (Fonseca and Patterson, 1968) and over standard check i.e., standard heterosis (Meredith and Bridge, 1972) for each character.

### **Result and Discussion**

The analysis of variance revealed significant mean square due to genotypes, parents, females, males, females vs. males, parents vs. hybrids and hybrids revealed that all the characters under study were significantly differed except parents, females and males for number of leaves per plant. Males for stem diameter, leaf width and dry fodder yield, female vs. male for number of leaves, leaf width, leaf: stem ratio, brix per cent and crude protein content. In case of parents vs. hybrids all the characters were significantly differ except plant height. The hybrids were significant for all the characters, which suggested that there was a presence of considerable amount of variability.

The per se performance of parents and hybrids for yield and their traits is presented in Table no. 2 evinced that none of the parents (i.e., female or male) show consistent good performance for all the traits. The female DS 1147 was top ranking for number of leaves, leaf length, leaf width, leaf: stem ratio and dry fodder yield. The female DS 187 recorded better per se performance for earliness. Minimum stem diameter recoded by parent SPV 2445. The female parent DS 171 showed maximum plant height. The female parent DS 1142 recoded maximum green fodder yield. While in respect of quality parameter, parent DS 1142 for brix

and parent DS 193 for crude protein content recorded highest per se performance.

Among the male parents, GFS 04 recorded minimum days for flowering, stem diameter, dry fodder yield and brix. Parent GFS 06 recorded highest plant height (cm), leaf width (cm), leaf: stem ratio and green fodder yield. The parent CSV 21F showed better per se performance for number of leaves per plant.

In case of hybrids, none of the hybrids was exhibited superior per se performance for all the traits. The hybrid DS 171 x CSV 21F recorded minimum days to flowering (62.00). The cross DS 1142 x CSV 21F exhibited its superiority for highest plant height (405.68 cm), broad leaf width (10.93 cm) and maximum brix (10.39 %). The hybrid DS 1147 x CSV 21F recorded maximum number of leaves per plant (13.73) leaf length (94.37 cm), leaf: stem ratio (0.54), highest green fodder yield per plant (493.03 g) and dry fodder yield per plant (207.56 g). The cross DS 1135 x GFS 06 recorded minimum stem diameter (3.33 cm) while cross DS 1135 x CSV 21F show better per se performance for crude protein content (9.33 %).

In practical plant breeding, the heterosis measured over better parent and popular check variety is more practical and realistic. Hence in present study, the heterosis is measured over better parent and standard check i.e., CSV 32F. In present study, 16 hybrids recorded significant and positive heterobeltiosis, while 10 hybrids recorded superior over standard check CSV 32F for green fodder yield per plant. The wide range of heterosis for green fodder yield per plant over better parent i.e., -17.33 to 60.04 per cent (heterobeltiosis) and over standard check was recorded i.e., -33.43 to 33.03 per cent. For green fodder yield, the hybrid DS 1147 x CSV 21F (57.31%) and (33.03%), DS 1142 x GFS 04 (52.74%) and (31.39%) and DS 1142 x GFS

06 DS 1142 x CSV 21F (28.57%) and (28.59%) manifested significant positive heterosis over better parent and standard check, respectively. The low to high estimates of heterobeltiosis and standard heterosis for green fodder yield per plant were also reported by Prakash *et al.* (2010), Patel *et al.* (2018) and Parmar *et al.* (2019). In case of dry fodder yield, eight and seven hybrids exhibited significant and positive heterosis over better parent and standard check CSV 32F. The wide spectrum of heterosis over better parent and standard check was recorded i.e., -27.85 to 59.66 per cent (heterobeltiosis), -34.07 to 51.43 per cent standard heterosis over CSV 32. The hybrid DS 1147 x GFS 06 (58.84 %) and (51.43 %), DS 1147 x CSV 21F (59.66 %) and (51.30 %), DS 1135 x GFS 06 (46.50 %) and (39.66 %) exhibited significant and desirable heterosis over better parent and over standard check for dry fodder yield (Table 5). Similar results were also reported by Patel *et al.* (2020), Patel *et al.* (2017), Tariq *et al.* (2014), Tariq *et al.* (2012) and Desai *et al.* (2000).

A comparative study of best heterotic hybrid, DS 1147 x CSV 21F, DS 1142 x GFS 04, DS 1142 x GFS 06 and DS 1142 x CSV 21F for green fodder yield per plant manifested positive and significant heterosis over both better parent and standard check. These hybrids also exhibited significant and positive heterosis over better parent or standard check for various component traits viz., days to flowering, plant height, number of leaves per plant, leaf length, leaf: stem ratio, dry fodder yield per plant, stem diameter and leaf width (Table 4).

## Conclusion

The analysis of variance revealed that significant differences among the parents for most of the traits. The female DS 1147 was ranked top for number of leaves, leaf length (cm), leaf width (cm), leaf: stem ratio and dry

fodder yield (g). In case of male parent, GFS 06 was found superior for plant height (cm), leaf width (cm), leaf: stem ratio and green fodder yield (g). The hybrids DS 1147 x CSV 21F, DS 1142 x GFS 04, DS 1142 x GFS 06 and DS 1142 x CSV 21F for green fodder yield per plant manifested positive and significant heterosis over both better parent and standard check.

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