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Study of Heterosis for Grain Yield and its Components Traits in Single Cross Derivatives of Maize (*Zea mays* L.)

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ABSTRACT

The 45 F_1 hybrids obtained by crossing in line x tester fashion were evaluated in three different environments along with parents and checks for grain yield traits and its component to harness the heterotic information over better parent and standard check. the number of hybrids depicted significant positive heterobeltiosis and relative heterosis on pooled basis were 38 and 40 respectively, for grain yield per plant. The estimates of standard heterosis for grain yield and its attributing traits showed that hybrid $L_{14} \times T_3$ exhibited maximum estimates of significant positive standard heterosis suggesting that hybrid may be exploited before commercial release for confirmation of its superiority.

Key words: *Heterosis, Relative hetrosis, Maize, Hetrobeltosis, Economic hetrosis*

Introduction

Globally maize (*Zea mays L.*; 2n=20, native to South America), has emerged as third most important cereal crop followed by rice and wheat. It is grown during the rainy (*Kharif*), winter *Rabi*, and spring seasons, but the *Kharif* rainy season is the most productive. It has diversified utilization pattern because an array of products are developed from the maize like food for humans, bioenergy feedstock for livestock, and raw material for industries. It has immense genetic potential and is therefore, called the "miracle crop". Maize has an advantage over the other cultivated crops due to its higher production potential, wider adaptability, fast-growing nature and excellent fodder quality free from toxicants (Sumalini *et al.*, 2020). Selection of parents based on mean performance does not necessarily lead to wanted results (Rai and Asati, 2011). As a result, developing a strong breeding plan to boost this crop's productivity is critical.

The understanding of the heterosis phenomenon, the development of hybrid breeding technology, and the successful commercial exploitation of heterosis in maize are regarded as significant achievements and landmarks in the biological sciences over the last century, as hybrids play a significant role in increased maize production and food security, particularly through single cross maize hybrids. The breeding strategy for exploitation of heterosis in maize through single cross hybrid cultivation is primarily based on the development and identification of high per se performing diverse, vigorous, and productive inbred lines with good seed quality, as well as their subsequent evaluation for combining ability in cross combinations to identify single

crosses with high heterotic effects (Prasad and Singh, 1986; Makumbi *et al.,* 2011; Keimeso *et al.,* 2020 and Maphumulo *et al.,* 2021). It has estimated that the use of hybrids increased the yield nearly by 15% per annum in maize. For improving the genetic yield potential of the varieties and hybrids, the choice of suitable parents for evolving better hybrids is a matter of great concern to the plant breeders.

Materials and Methods

The 45 hybrids were developed through line x tester breeding method. These 45 hybrids along with parents (15 lines and 3 testers) with three checks PHM-3, DKC-7074 and DHM-121 were evaluated in three different environments viz., E_1 (*Kharif* 2017-18) at Instructional farm, Rajasthan College of Agriculture, E_2 (*Rabi* 2017-18) Instructional farm, Rajasthan College of Agriculture and E_3 (*Rabi* 2017-18) at Instructional Farm, CTAE, MPUAT, Udaipur in three replication in Randomized block design (RBD). Each treatment was sown in single row plot of 4 meter length maintaining crop geometry of 60 x 25 cm row to row and plant to plant spacing, respectively. Observations were taken on thirteen traits during the experiment viz., days to 50% tasseling, days to 50% silking, anthesis-silking interval (ASI), 75% brown husk, plant height, ear height, ear length, ear girth, number of grain row/ear, number of grains/row, 100-seed weight, grain yield per plant, harvest index.

Results and Discussion

The estimates of standard heterosis for grain yield and its attributing traits showed that hybrid $L_{14}\times T_3$ (15.49%) exhibited maximum estimates of significant positive economic heterosis for grain yield per plant on pooled basis (15.49%) followed by hybrids viz., L_{14} x T_2(12.64%), L_3 x T_3(11.51%),L_7 x T_2 (11.18%) and L_9x T_3 (8.43%). In Table 1 has showed the significant economic heterosis , per se performance, specific combining ability and significant association of traits on the basis of economic heterosis The hybrid $L_{14}\times T_3$ hybrid also possessed significant estimates of economic heterosis for ear length (20.57%) ear girth (15.67%), 100 grain weight(6.55%) on pooled basis and negative significant estimates of economic heterosis for plant height (-2.49%) and ear height (-1.89%) as dwarf plant are desirable for high grain yield, maximum photosynthate efficiently translocate from source to sink (grains). This hybrid also exhibited negative significant economic heterosis for days to 50% tasseling (-2.25%) that suggested earliness for maturity. Similar results were found by Adebayo *et.al.,* (2017), Chaurasia *et al.,* (2020), and Iseghohi *et al.,* (2020)

In case of maturity traits, as earliness is desirable trait the significant negative economic heterosis exhibited by $L_4\times T_2$ (-2.39%) for days to 50 percent tasseling, $L_3\times T_1$ (-40.00 %) for ASI and $L_{13}\times T_1$ (-7.26 %) for days to 75 per cent brown husk on pooled basis. For the maturity traits earlier workers also reported significant negative economic heterosis *viz*., Praveen Kumar *et al.* (2014), Attia *et al.* (2015) for early tasseling and silking, Matin *et al.* (2017), Chaurasia *et al.* (2020) for (Anthesis-silking Interval).

Heterobeltiosis and relative heterosis are significant attributes because they reflect the information about the existence of dominance and over-dominance type of gene actions in the expression of different characters. In the current study, for yield and yield contributing traits, the number of hybrids showing significant positive heterobeltiosis and relative heterosis on pooled basis were 38 and 40 respectively, for grain yield per plant. Results observed by

Table 1. Hybrids with high grain yield per plant showing significant and positive economic heterosis over the best check PHM-3, *per se* performance, specific combining ability (SCA) effects on pooled basis with their desirability for other traits in maize.

S. No.	Hybrids	Economic Heterosis	Grain yield per plant (g)	SCA effects	Trait showing desirable and significant Ecomomic heterosis
1	L_{14} x T_3	15.49	159.42	3.21*	Days to 50% tasseling, plant height,ear height, ear length, ear girth, 100 grain weight,
2	L_{14} x T_2	12.64**	149.63	7.33*	Ear length, ear girth, 100 grain weight
3	L_3 x T_3	11.51**	148.13	14.56**	Ear girth, harvest index, 100 grain weight
4	L_7 x T_2	11.18**	148.76	9.56**	Ear length, 100 grain weight
5	L_9x T_3	8.43**	144.04	20.35**	100 grain weight, harvest index

Chaurasia *et al.* (2020) are also in support with the present experimental findings for significant positive heterobeltiosis and relative heterosis on pooled basis for grain yield per plant.

For agromorphological traits, heterobeltiosis and relative heterosis on pooled basis, all hybrids in case of plant height and 43 (heterobeltiosis) and all hybrids (relative heterosis) for ear height, 15 and 22 (for ear length), 24 and 36 (for ear girth) and 27 and 33 (for no. of grain rows per ear), 29 and 36 (for 100-grain weight) and 39 and 14 (for harvest index) respectively. In case of maturity related traits, the number of hybrids depicting significant negative heterobeltiosis and relative heterosis on pooled basis were 4 and 6 (for days to 50 per cent tasseling), 4 and 5 (for days to 50 per cent silking), 9 and 4 (for ASI) and 2 and 7 (for days to 75 per cent brown husk), respectively.

The above stated statements are in agreement with results reported by researchers *viz*., Bisen *et al.* (2017), Adebayo *et al.* (2017) and Chaurasia *et al.* (2020) for grain yield and yield contributing traits and maturity related traits in maize. Similar findings for mid parent heterosis for physiological and quality traits in maize were also reported by Tesfaye *et al.* (2019); Chaurasia *et al.* (2020) and Iseghohi *et al.* (2020).

Conclusion

The majority of the hybrids for grain yield and yield contributing traits exhibited positive significant relative heterosis, thereby depicting that for these traits the genes with positive effect were dominant. The $L_{14}\times T_3$ exhibited maximum estimates of significant positive economic heterosis for grain yield per plant over the better check PHM-3. The hybrids viz., $L_4\times T_2$, $L_3\times T_1$ and $L_{13}\times T_1$expressed significant negative heterosis of earliness traits thereby suggesting that for these traits the genes with negative effect were dominant. It has suggested that before it is commercially exploited, these crosses may be further evaluated in a variety of environments and seasons to further confirm its superiority.

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