A REVIEW | *International Journal of Plant Sciences*, (January to June, 2010) Vol. 5 Issue 1 : 369-372

Heterosis and combining ability studies in maize (*Zea mays* L.)

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Accepted : August, 2009

Key words : Maize, Heterosis, Combining ability, Gene action, Yield

Maize (*Zea mays* L.) is one of the important food and forage crops with abundant natural diversity. The exploitation of heterosis is possible only when the parents involved in the crosses differ in their combining ability. Generally high heterosis values are desirable for grain yield in maize. The combining ability analysis facilitates the partitioning of genotypic variation of the hybrids into variation due to general combining ability (main effects) and specific combining ability (interactions), which indicates about a measure of additive and non-additive gene action. For exploiting hybrid vigour, *per se* performance, *sca* effects and the extent of heterosis of hybrids are important.

Maize is the third most important cereal next to wheat and rice in both area and productivity. India occupies an area of 7,400,000 ha with an average productivity of 1,959 kg/ha. (FAO, 2004). Maize is used as human food, animal feed and industrial raw material. The grain is used for food and feed for cattle and poultry. Green leaves, stems are used as fodder for cattle. Grain is also used to produce starch, corn oil, syrups, beverages, vitamins and amino acids. Maize oil is used as cooking oil. It is also used with linseed oil for paints. Maize is a highly cross pollinated crop and the scope for the exploitation of hybrid vigour will depend on the direction and magnitude of heterosis, biological feasibility and the type of gene action involved. The exploitation of heterosis is possible only when the parents involved in the crosses differ in their combining ability. An attempt has been made to review the available literature relevant to heterosis and combining ability in maize.

Heterosis:

Heterosis is defined as the percentage of hybrid over the parental mean and generally high heterosis values are desirable for grain yield in maize.

Gupta *et al*. (1994) reported that 16 out of 23 double cross hybrids showed high degree of heterosis for grain yield than the best standard. Shweta Kumar (1995) reported that eight out of 25 hybrids showed high degree of heterosis for grain yield per plant and earliness. Nagda *et al*. (1995) studied 20 F_1 hybrids and reported that 15 crosses exhibited significant positive heterosis for grain yield over best check and revealed significant negative heterosis for days to silking, plant height and ear height in all crosses except one cross. Ling *et al*. (1996) confirmed that mean heterotic effect was the highest for grain yield per plant followed by grain weight and ear thickness. Saha and Mukherjee (1996) reported that there was significant positive heterosis for grains per ear and the crosses with highest heterosis for 100-grain weight and grain yield per plant had high negative heterosis for percentage grain conversion. Ling *et al.* (1999) noted that the 100-grain weight of all hybrids was greater than the female parents. But heterosis of mid parental value differed according to the relative grain weight of parents. Nagesh Kumar *et al*. (1999) observed heterosis for grain yield which ranged from 26.31 to 37.30 per cent over better parent. Chiduaa *et al*. (1999) reported a high degree of heterosis for grain yield in the hybrids, Stojokovic *et al*. (1999) reported that the partial or complete dominance of dominant alleles with additive effects were the main contributors to yield heterosis in maize. Netaji *et al*. (2000) observed significant and positive heterosis and heterobeltiosis for grain yield in more than 20 hybrids and expression of heterobeltiosis was most evident for grain yield per plot, followed by test weight, ear length, ear height, plant height and number of seed rows per ear. Shahwani *et al.* (2001) noticed positive and significant heterosis in 17 hybrids, while 11 hybrids showed heterobeltiosis for ears per plant. Saleh *et al.* (2002) reported high estimates of heterosis for grain yield, ear weight, grain weight per ear, moderate estimates for plant and ear height, shelling percentage, ear diameter, number of kernel rows per ear, number of kernels per ear row and grain weight. Singh (2003) reported highly significant negative heterobeltiosis and standard heterosis for early silking.

Combining ability and gene action:

The combining ability analysis facilitates the partitioning of genotypic variation of the hybrids into

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