

## Original Research Article

### **Standard Heterosis for grain yield and its attributing traits in early maturing maize hybrids**

**Running title:** Heterosis studies in maize

#### **Abstract**

The present study was conducted at the Research Farm of Dryland Agriculture Research Station, SKUAST-Kashmir during kharief -2019. Range of heterosis was calculated over standard check. The most suited cross combination viz., KDM-440 x KDM-914A (-5.879), KDM-440 x V-335 (-4.468), KDM-930 x V-351(-4.165), KDM-927A x V-335 (-3.986), CML-470 x KDM-914A (-3.808) for Days to maturity, KDM-347 x V-351 (4.967) CML-470 x KDM-914A (4.610), CML-474 x V-351(-4.396), KDM-927 A x V-351 (-3.110), KDM-930 x V 335 (2.896) for Number of kernels rows per cob, KDM-347 x V-351(-7.544), KDM-440 x V-351 (6.438), KDM-916A x KDM-914 A(6.117), CML-470 x V-351(5.992), CML-474 x V-335 (5.274) for Number of kernels per row, KDM-340 x V-351 (3.966), KDM340 x KDM-914A (3.150), KDM-930 x V-351(3.165), KDM-440 x KDM-914 (3.556), KDM-347 x V-351(3.324) for 100-grain weight, KDM-347 x V351 (34.197), KDM-440 x V335 (28.933), CML470 x KDM-914A (29.380), KDM-895 x KDM914A (25.383), KDM927A x KDM-914A (19.549) for grain yield per plant were observed in the present study. The range of heterosis over standard check ranged for one of a kind traits like for days to maturity ranged from -3.796 (CML-425 x KDM-914A) to (2.414) CML-474 x KDM-914A. The Extent of heterosis for number of kernel rows per ear over standard check ranged from CML-470 x V-335(28.576) to KDM-916A x V -335(-2.143), for quantity of kernels per row maximum well known heterosis ranged from CML-470 x V-351 (19.079) to KDM-347 x V-351 (-15.132), for 100- grain weight, Extent of heterosis extended from CML-470 x KDM-914 A(22.321) to KDM-916A x V-335 (-3.464). For grain yield per plant, heterosis extended from CML-470 x K DM-914 A(61.923) to KDM916A x V-335(9.321). Heterosis (CML -470 x KDM-914 A, CML-474 x V-351, KDM-440 x V-335) should be tested for multilocation to arrive valid conclusion related to their use in commercial maize cultivation.

**Comment [U1]:**

**Comment [U2]:** Give a summary of study major objective + a brief on methodology before you go straight to results.

**Comment [U3]:** This is an abstract, select a few most interesting hybrids (germoplasm under study) and remove the rest, we shall see them in the body (results)

**Comment [U4]:** What do u mean?? Re-write this

**Key words:** Heterosis, hybrids, yield and yield attributes, early maturing, maize

## **Introduction**

Heterosis is the hybrid vigour which is generally represented as performance of offspring over parents (ref-). Charles Darwin had achieved lot of experiments in order to check his concept of origin of species, ~~in-It~~ which comparison of inbred lines with open pollinated maize was once compared (ref). From this they concluded that cross pollinated vegetation has gained 25 percentage higher than offspring of self pollinated crops and in addition had super cold tolerance (ref). Later in 1876 it was concluded from these experiments that hybrids outshined in discipline because of “great innate constitutional vigour” (Darwin *et al.*, 1989 too old, browse for recent refs). Meanwhile two very eminent scientists of time laid foundations for new maize breeding methods, Scientist describe hybrid vigour as it was very important to have some term for it so “Shull” was the first person who marked the “heterosis” term for the rationalization of hybrid vigour. “East and Shull” working independently in 1908 had rediscovered phenomena of inbreeding depression and hybrid vigour in maize, consequently hybrids as soon as identified would possibly be reproduced year after year except a change. In maize hybrids can be developed with the aid of de tasselling of one of the inbred and pollination is carried from different inbred lines planted in close by adjacent blocks.

Heterozygosis is accountable for diversity which makes the crosses to range from each other. Where as homozygosis is diminished mechanically due to inbreeding (Dar *et al* 2017). Generally F<sub>1</sub> hybrids of “outcrossed” inbred strains show a incredible increase in vigour and viability. Even if the inbred lines, are degenerated due to inbreeding and there will be decrease of vigour. This phenomenon is termed heterosis or hybrid vigour. So, for assessment in deciding the parents, crosses and any future breeding programme.

## **MATERIAL AND METHODS**

Ten diverse maize inbred lines viz., KDM-340, KDM-440, KDM-916, KDM-927A, KDM-895, CML-470, CML-474, CML-425, KDM-347, KDM-930 and three widely adapted testers V-351, V-335, KDM-914A were crossed while using line x tester mating design in order to obtain set of thirty crosses during Rabi-2018 at Winter Nursery, Agricultural centre of Research Institute, Rajendranagar, Hyderabad, ~~then~~ F<sub>1</sub> ~~hybrids were~~ ~~was~~ evaluated at Dryland Agriculture Research Station Srinagar during kharief -2019 using ~~in~~ randomized block design with three replications

**Comment [U5]:** I would suggest your introduction to have the following flow;  
-maize production/productivity and its impotence on globe scale and narrow it down to your region or country  
-heterosis in maize + other crops (comparson)  
-heterosis and production  
-research gap  
-study rational

DON'T WRITE AS YOU ARE PREPARING LECTURE NOTES

with experimental plot of 75 x 20 cm. The data was recorded on morphological, maturity, yield and yield attributing traits viz., ~~D~~Days to 50% ~~per cent~~ tasseling, ~~D~~Days to 50% ~~per cent~~ silking, ~~D~~Days to maturity (Seed to seed), ~~P~~Plant height (cm), ~~e~~Ear height (cm): ~~e~~Ear length (cm), ~~e~~Ear diameter (cm), ~~No. number~~ of kernel rows ear<sup>-1</sup>, ~~numberNo.~~ of kernels row<sup>-1</sup>, ~~p~~Prolificacy index: ~~g~~Grain yield plant<sup>-1</sup> (g). Combining ability procedure was done according to Kempthorne (1957).

## RESULTS AND DISCUSSIONS

~~Heterosis is regarded as the ideal performance of offspring over its parents and is the effect of variances. Its set up as a primary tool for enhancement of manufacturing of crops. Plant breeders have extensively used and exploited heterosis in analyzing yield of numerous plants in particular cross-pollinated crop species. Therefore, the heterotic studies can supply the groundwork for the utilization of precious hybrid mixtures in the future breeding programmes and their profitable utilization. The presence of sufficient hybrid vigour is an full size pre-requisite for triumphing manufacturing of hybrid varieties. In the cutting edge reading, preferred heterosis viz., parental heterosis for each trait were computed. The consequences confirmed a wide array of patterns of heterosis for maturity the traits underneath study (Table 1). Maximum amount of heterosis was~~

once calculated for general check for maturity traits. Out of thirty cross combinations, noteworthy heterosis over standard check (SMH 2) was recorded in KDM-440 x KDM-914A (-5.879), KDM-440 x V-335 (-4.468), KDM-930 x V-351(-4.165), KDM-927 x V-335 (-3.986), CML-470 x KDM-914A (-3.808) for Days to maturity. KDM-347 x V-351 (4.967), CML-470 x KDM-914A (4.610), CML-474 x V-351(-4.396), KDM-927 x V-351 (-3.110), KDM-930 x V-335(2.896) for wide variety of kernels rows per cob, KDM-347 x V-351(-7.544), KDM-440 x V-351(6.438), KDM-916A x KDM-914A (6.117), CML-470 x V-351 (5.992), CML-474 x V-335(5.274) for Number of kernels per row, KDM-340 x V-351 (3.966), KDM340 x KDM-914 A (3.150), KDM-930 x V-351(3.165), KDM-440 x KDM-914 A(3.556), KDM-347 x V-351(3.324) for 100 grain weight, KDM-347 x V351 (34.197), KDM-440 x V335(28.933), CML470 x KDM-914A (29.380), KDM-895 x KDM914A (25.383), KDM927A x KDM-914 (19.549) for Grain yield per plant. Significant heterosis for yield and yield related constituent qualities and most flowering traits have been said by way of a variety of people (Jain and Bharadwaj, 2014; Rajesh *et al.*, 2014; Alam *et al.*, 2008; Amiruzzaman *et al.*, 2010; Amanullah *et al.*, 2011; Jawaharlal *et al.*, 2012; Ali *et al.*, 2012; Abauli *et al.*, 2012; Izhar and Chakraborty, 2013 and Singh *et al.*,

**Comment [U6]:** The following results are expected;

- 1)-Table for ANOVA
- 2)-Table for means + other descriptive STATs of your choice, could be graphs, charts, etc)
- 3)- Table for specific combining ability (SCA)
- 4)- Table for general combining ability (GCA), where possible.

**Comment [U7]:** GO STRAIGHT TO STUDY RESULTS

**Comment [U8]:** READ A FEW MORE ARTICLES TO IMPROVE ON WRITING SKILLS, you are almost there.

2013).

## REFERENCES

- Abadi, J.M., S.K. Khorasani, B. S. Sar, S. Movafeg and M. Golbashy. 2011. Estimation of combining ability and gene effects in forage maize (*Zea mays* L.) using line  $\times$  tester crosses. *Journal of Plant Physiology and Breeding* 1(1): 57-67.
- Abuali, A.I., A.A. Abdelmulla, M.M. Khalafalla, A.E. Idris and A.M. Osman. 2012. Combining ability and heterosis for yield and yield components in maize (*Zea mays* L.). *Australian Journal of Basic and Applied Sciences* 6(10): 36-41.
- Amanullah, Jehan, S., Mansoor, M. and Khan, M. A. 2011. Heterosis studies in diallel crosses of maize. *Sarhad Journal of Agriculture* 27(2): 207-211.
- Amiruzzaman, A.I., M.A. Islam, L. Hasan M. Kadir and M.M. Rohman. 2013. Heterosis and combining ability in a diallel among elite inbred lines of maize (*Zea mays* L.). *Emirates Journal of Food and Agriculture* 25(2): 132-137.
- Amiruzzaman, M., M.A. Islam, L. Hassan. and M.M. Rohman. 2010. Combining ability and heterosis for yield and component characters in maize. *Academic Journal of Plant Sciences* 3(2): 79-84.
- Dar, S. A., G. Ali, A.G. Rather and M.N. Khan. 2017. Combining ability for yield and maturity traits in elite inbred lines of maize (*Zea mays* L.) *International Journal of Agricultural Sciences* 3(2): 290-293.
- Dar, Z.A., A.A. Lone, B.A. Alaie, S.A. Dar, G. Ali, I. Abidi, R.A. Lone, S. Gulzar and N. Yousuf. 2017. Genetic variation in maize inbred lines under temperate conditions. *Journal of Experimental Biology and Agriculture Sciences* 5(2): 215-219
- Dar, Z.A. A.A. Lone, B.A. Alaie, A. Gowhar, G. Asima, and I. Abidi. 2015. Estimation of combining ability involving quality protein maize (QPM) inbreds under temperate conditions. *The Bioscan* 10(2): 863-867.
- Dar, Z.A., A.A. Lone, N.S. Khuroo, G. Ali, I. Abidi, M.A. Ahangar, M.A. Wani, A.B. Yasin, A. Gaza, R.A. Lone, N. Yousuf and S. Gulzar. 2017. Line  $\times$  tester analysis in maize (*Zea mays* L.) for various morpho-agronomic traits under temperate conditions. *International Journal of Current Microbiology and Applied Sciences* 6(7): 1430-1437.
- Izhar, T. and M. Chakraborty. 2013. Combining ability and heterosis for grain yield and its

components in maize inbreds over environments (*Zea mays* L.). African Journal of Agricultural Research 8(25): 3276-3280.

Jain, R. and D.N. Bharadwaj. 2014. Heterosis and inbreeding depression for grain yield and yield contributing characters in quality protein maize. Agricultural communications 2(1): 8-16

Rajesh, V., S.S. Kumar, V.N. Reddy, and A.S. Sankar. 2014. Heterosis studies for grain yield and its component traits in single cross hybrids of maize (*Zea mays* L.). International Journal of Plant, Animal and Environmental Sciences 4(1): 304-306.

**Table 1: Estimation of heterosis over standard check for days to maturity, yield & yield attributing traits in maize (*Zea mays* L.)**

Crosses	Days to maturity	Kernel rows cob <sup>-1</sup>	Number of kernels row <sup>-1</sup>	100- grain weight(g)	Grain yield plant <sup>-1</sup> (g)
CML470 × V-351	-3.793*	14.286*	19.079*	19.321*	51.154*
CML470 × KDM-914 A	1.690	15.195*	18.421*	22.321*	61.923*
CML470 × V335	0.992	28.576*	19.316*	6.071*	41.50*
CML474 × V351	-0.172*	10.714*	12.500*	14.821*	58.077*
CML474 × KDM-914A	-2.414*	3.571*	15.132*	10.250	50.769*
CML474Xv335	-3.241	7.143*	9.868*	13.143*	39.231*
KDM-916A xV335	-2.052*	-2.234	-5.921	-3.464	9.231
KDM-347x V351	-0.517*	9.700	-15.132	9.607*	13.462
KDM-347x KDM-914 A	-1.897*	-3.571	6.579*	12.214*	22.692*
KDM-347 xV335	2.241	5.809	5.921*	17.321*	48.462*
KDM-895 × V351	3.103	-3.670	4.605*	7.250*	33.846*
KDM-895 × KDM-914A	4.276	14.286*	11.842*	15.536*	45.769*
KDM-895 × V335	4.897	5.122*	-1.316	11.607*	18.077*
KDM-440 xV351	-1.962*	19.245*	15.789	6.964*	28.846*
KDM-440 × KDM914A	9.034	12.700	-10.526	11.443*	53.462*
KDM-440 xV335	1.823	8.571*	11.421*	9.571*	31.154*
KDM-930A × V351	-4.991*	6.243*	12.500*	12.500*	24.615*
KDM -930A × KDM914A	1.552	12.234*	5.550*	14.718*	37.308*
KDM930AxV335	-4.203*	7.183*	2.921*	10.107*	25.769*
KDM-340 × V351	2.241	2.193*	17.763*	14.821*	13.846
KDM-340 × KDM-914A	-0.142*	6.445*	24.652*	15.000*	36.215*
KDM-340 × V335	-0.163*	4.700	7.895*	18.893*	26.992*