

Genetic Analysis of Pooled Variation and Heritability in Maize Inbred Lines and Hybrids

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Abstract: Genetic variability is of greatest interest as it plays a vital role in framing successful breeding programme. Improvements in yield can be achieved by selection for grain yield, 1000 grain weight, plant height, ear height information helps a plant breeder to ensure efficient cultivar selection and screening of available sources of maize germplasm i.e. maize inbreds and hybrids involving two or more characters simultaneously for desirable attributes. The present study was therefore initiated to screen out different maize inbreds and hybrids for variability of yield and yield components. The experiment was carried out involving a set of 60 crosses along with 19 parents and three checks for estimating variability and heritability for yield and its attributing traits at three locations during *kharif* 2012, rabi 2012-13 and *kharif* 2013. The mean values of parents, hybrids and standard checks for eleven characters pooled over three locations are presented character wise. Wide range of variation was recorded for various traits indicating immense scope of selection for improvement. Genotypes in pooled analysis recorded a general mean of 51.10 days with a range of 44.89 to 60.22 days for days to 50 per cent tasseling. The mean number of days to maturity varied from 79.11 to 97.00 days with a mean of 86.03 days. The ear length in pooled analysis ranged from 9.22 to 20.33 cm with a general mean of 16.37 cm. The parents ranged from 9.22 to 18.22 cm while that of hybrids ranged from 14.89 to 20.33 cm. The grain yield of parents ranged from 36.00 to 126.78 g while for crosses, it varied from 108.44 to 170.67 g. High narrow sense heritability recorded for days to 50 per cent silking, days to 50 per cent tasseling, days to maturity, ear height, number of kernels per row and 100-seed weight indicated that these traits are predominantly under the control of additive gene action and can be improved by selection.

Keywords: maize, variability, heritability

I. INTRODUCTION

Maize (*Zea mays* L.) belonging to family gramineae is an annual, short day, cross pollinated, photosynthetically more active (C4) and is grown extensively in temperate, subtropical and tropical regions world over. It is widely grown in India suggesting its wide adaptability and has assumed a place of prominence owing to its varied uses. A wide range of genetic variation is observed in this crop giving immense scope of selection to the plant breeders for its improvement.

Genetic variability is of greatest interest as it plays a vital role in framing successful breeding programme. The hybrids involving the parents with more diversity are expected to exhibit higher amount of heterotic expression and broad

spectrum of variability in segregating generations. The narrowing of genetic diversity in modern maize varieties emphasizes the importance of conserving genetic traits for future plant breeding. Heritability of a metric character is a parameter of particular significant to the breeder as it measures the degree of resemblance between the parents and the off-springs and its magnitude indicates the heritability with which a genotype can be identified by its phenotypic expression.

Among the various other characteristics, grain yield in maize is the most important and complex quantitative character controlled by numerous genes. Improvements in yield can be achieved by selection for grain yield, 1000 grain weight, plant height, ear height (Prodhon and Rai, 1997). The additive genetic variance component is the most important component of genetic variability for all traits. All this information helps a plant breeder to ensure efficient cultivar selection and screening of available sources of maize germplasm i.e. maize inbreds and hybrids involving two or more characters simultaneously for desirable attributes. The present study was therefore initiated to screen out different maize inbreds and hybrids for variability of yield and yield components.

II. MATERIAL AND METHODS

The present investigation for studying variability estimates for grain yield and yield contributing characters in fifteen inbred lines of maize was carried out during *kharif* 2012, rabi 2012-13 and *kharif* 2013 at Agricultural Research Station, Madhira Agricultural Research Station (ARS), Tandur, Rangareddy district and Regional Agricultural Research Station (RARS), Warangal, respectively. The mean values of parents, hybrids and standard checks for eleven characters pooled over three locations are presented character wise.

Genotypes in pooled analysis recorded a general mean of 51.10 days with a range of 44.89 to 60.22 days for days to 50 per cent tasseling. This trait for parents ranged from 46.89 (MRC 1176) to 60.22 days (BML 5) while for hybrids the range varied from 44.89 (MRC 1544 X BML 14) to 55.11 days (MRC 1604 X BML 13). The checks, DHM 117, 30 V 92 and 900 M Gold recorded 53.66, 55.00 and

56.33 days for days to 50 per cent tasseling, respectively (Table 1).

In pooled analysis, the range of days to 50 per cent silking was from 47.78 to 63.11 days with a mean of 54.00 days. For parents, the days to 50 per cent silking ranged from 50.00 (MRC 1176) to 63.11 days (BML 5), while in hybrids, the range varied from 47.78 (MRC 1544 X BML 14) to 57.67 days (MRC 1604 X BML 13). The checks DHM 117, 30 V 92 and 900 M Gold recorded 56.88, 57.88 and 59.22 days respectively.

In pooled analysis, the mean number of days to maturity varied from 79.11 to 97.00 days with a mean of 86.03. Parents showed a range of 79.11 (MRC 1179) to 97.00 days (BML 7), while the hybrids ranged from 81.67 (MRC 1556 X BML 14) to 89.11 days (MRC 1601 X BML 7 and MRC 1561 X BML 13). The checks DHM 117, 30 V 92 and 900 M Gold recorded 88.66, 89.00 and 87.99 days respectively.

The plant height in pooled analysis ranged from 67.78 to 218.00 cm with a mean of 164.17 cm. The mean height for parents ranged from 67.78 (BML 7) to 156.56 cm (MRC 1582). The hybrids ranged from 146.67 (MRC 1601 X BML 14) to 218.00 cm (MRC 1176 X BML 7). The plant height of checks DHM 117, 30 V 92 and 900 M Gold found 216.89, 193.33 and 184.11 cm, respectively.

In pooled analysis, the ear height of genotypes ranged from 28.11 to 144.89 cm with a general mean of 78.67 cm. The mean ear height of parents ranged from 28.11 (BML 7) to 79.00 cm (MRC 1179). In case hybrids the ear height ranged from 63.67 (MRC 1564 X BML 14) to 144.89 cm (MRC 1176 X BML 7). The checks DHM 117, 30 V 92 and 900 M Gold recorded 106.88, 89.22 and 86.66 cm of ear height respectively.

The ear length in pooled analysis ranged from 9.22 to 20.33 cm with a general mean of 16.37 cm. The parents ranged from 9.22 (BML 14) to 18.22 cm (MRC 1176) while that of hybrids ranged from 14.89 (MRC 1601 X BML 14) to 20.33 cm (MRC 1123 X BML 13). The checks DHM 117, 30 V 92 and 900 M Gold recorded 17.11, 17.66 and 15.33 cm respectively.

In pooled analysis, the ear girth ranged from 8.67 to 16.22 cm with a general mean of 14.01 cm. The mean ear girth of parents ranged from 8.67 (BML 5) to 15.30 cm (MRC 1544). Among hybrids, the cross MRC 1358 X BML 14 recorded the lowest value of 12.67 cm and highest value of 16.22 cm was recorded by cross MRC 1123 X BML 13. The checks DHM 117, 30 V 92 and 900 M Gold recorded 15.88, 14.89 and 15.00 cm respectively (Table 2).

The mean number of kernel rows per ear in pooled analysis was 14.53 with a range of 8.78 to 17.11. The kernel rows of parents ranged from 8.78 (BML 5) to 16.22 (MRC 1604) while that of crosses varied from 13.11 (MRC 1176 X BML 14) to 17.11 (MRC 1601 X BML 7 and MRC 1123 X

BML 5). The check, DHM 117 was found to have 15.77, 30 V 92 was found to have 15.22, while 900 M Gold recorded mean of 16.22 kernel rows per ear.

In pooled analysis, the mean number of kernels per row was 31.74 with a range of 10.56 to 41.67. The number of kernels per row of parents varied from 10.56 (BML 13) to 34.67 (MRC 1112). The range of crosses was from 26.56 (MRC 1601 X BML 14) to 41.67 (MRC 1561 X BML 5). While the checks DHM 117, 30 V 92 and 900 M Gold recorded 35.00, 35.22 and 35.33 kernels per row respectively.

In pooled analysis, the mean 100-seed weight was found to be 27.85 g with a range of 20.33 to 38.33 g. Among the parents, the lowest and highest values were 20.33 g (BML 14) and 38.33 g (MRC 1582). While the values of crosses varied from 22.89 (MRC 1176 X BML 14 and MRC 1179 X BML 14) to 32.44 g (MRC 1123 X BML 13). The check DHM 117 recorded 28.22 g, while 30 V 92 recorded 27.00 g for 100-seed weight whereas, 900 M Gold recorded 24.89 g.

In pooled analysis grain yield per plant showed a range of 36.00 to 170.67g with a general mean of 121.83g. The grain yield of parents ranged from 36.00 (BML 13) to 126.78g (MRC 1176). The crosses varied from 108.44 (MRC 1179 X BML 14) to 170.67g (MRC 1123 X BML 13). The checks DHM 117, 30 V 92 and 900 M Gold recorded 128.44, 122.11 and 115.67 of grain yield per plant respectively.

The overall means of parents and crosses revealed that hybrids registered superior performance than parents with respect to days to 50 per cent tasseling, days to 50 per cent silking, days to maturity, plant height (cm), ear height (cm), ear length (cm), ear girth (cm), number of kernel rows per ear, number of kernels per row, 100-seed weight (g) and grain yield per plant (g). Further, the hybrids in general were tall and high yielding over parents.

The hybrids, MRC1123 X BML 13 (170.67 g), MRC1358 X BML 13 (158.78 g), MRC1123 X BML 14 (153.56 g), MRC 1123 X BML7 (153.22) and MRC1176 X BML7 (152.44 g) recorded high grain yield per plant compared to check, DHM-117 (128.44 g) over three locations. These hybrids need to be further tested in multi location and on farm trials prior to commercial exploitation.

In pooled analysis high narrow sense heritability estimates were recorded for days to 50 per cent silking (75.44%) followed by days to 50 per cent tasseling (72.61%), 100-seed weight (62.45%), days to maturity (53.93%), ear height (53.46%), number of kernels per row (45.53%), ear length (44.25%), ear girth (43.19%), number of kernel rows per ear (42.62%), plant height (37.51%) and grain yield per plant (28.18%) (Table 3). Similar results were reported by Yadav *et al.* (2002) , Muhammad Rafique *et al.* (2004), Seanski *et al.* (2005), Mohammad Akbar *et al.* (2006), Sofi and Rather (2007) and Ali *et al.* (2010), Bello (2012) , Abdel-Moneam *et al.* (2014) and Agrawal *et al.* (2014) .

In the present investigation high narrow sense heritability estimates were recorded in days to 50 per cent silking followed by days to 50 per cent tasseling, 100-seed weight, days to maturity, ear height and number of kernels per

row. Thus these traits are predominantly under the control of additive gene action and hence, these characters can be improved by selection.

Table 1: Mean performance of parents, crosses and standard checks for various yield attributes pooled over locations in maize

Parents	Days to 50 % tasseling	Days to 50 % silking	Days to maturity	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear girth(cm)	Number of kernel rows per ear	Number of kernels per row	100 seed Weight (gm)	Grain yield per plant (g)
MRC 1112	50.44	53.44	85.22	149.67	53.67	14.11	13.22	13.00	34.67	30.78	121.22
MRC 1123	51.11	54.11	86.56	130.78	46.89	14.00	11.22	12.78	27.00	29.33	103.22
MRC 1176	46.89	50.00	79.56	151.67	62.00	18.22	14.11	15.78	33.33	35.67	126.78
MRC 1179	50.22	53.22	79.11	155.44	79.00	17.00	13.67	13.89	30.00	33.33	122.78
MRC 1209	54.11	57.11	89.78	118.44	48.33	15.56	10.56	11.78	20.44	30.00	87.89
MRC 1271	49.44	52.56	85.56	140.56	49.00	15.56	12.11	12.44	25.00	27.00	88.00
MRC 1358	50.00	53.22	80.33	129.89	51.33	13.11	10.89	12.11	29.67	22.67	77.00
MRC 1544	50.00	53.00	82.67	135.33	60.67	16.67	15.33	13.89	30.22	37.33	125.33
MRC 1556	49.78	52.78	83.00	138.33	59.00	15.78	13.33	12.11	30.33	34.33	121.00
MRC 1561	57.78	60.78	94.22	131.78	74.33	15.44	13.11	13.89	28.33	33.67	121.11
MRC 1564	49.44	52.44	84.11	135.67	74.44	14.56	13.33	14.56	27.67	34.00	122.56
MRC 1582	50.78	53.78	86.22	156.56	63.33	16.78	13.00	13.67	27.00	38.33	123.33
MRC 1601	48.78	52.11	79.89	113.78	49.67	15.00	12.89	12.56	31.00	28.56	110.33
MRC 1604	56.78	59.78	91.00	125.00	72.33	14.11	14.44	16.22	28.00	34.00	123.67
MRC 1661	48.78	51.78	80.44	136.44	47.78	14.67	13.56	12.22	28.44	30.00	108.67
BML5	60.22	63.11	92.22	110.89	49.67	11.78	8.67	8.78	13.33	20.44	42.22
BML7	58.22	61.33	97.00	67.78	28.11	9.44	9.11	9.11	11.22	25.00	49.67
BML13	53.56	56.56	92.44	122.33	51.33	10.11	10.56	9.11	10.56	24.33	36.00
BML14	58.44	61.44	94.56	75.89	39.67	9.22	9.78	10.56	12.44	20.33	44.33
Mean of parents	52.35	55.39	86.52	127.69	55.82	14.27	12.26	12.55	25.19	29.95	97.64
Range of parents	46.89 to 60.22	50.00 to 63.11	79.11 to 97.00	67.78 to 156.56	28.11 to 79.00	9.22 to 18.22	8.67 to 15.33	8.78 to 16.22	10.56 to 34.67	20.33 to 38.33	36.00 to 126.78
Crosses											
MRC1112 X BML5	48.56	51.22	84.78	167.89	80.44	18.33	14.78	16.22	33.56	26.33	125.00
MRC1112 X BML7	51.89	54.33	87.78	172.89	92.22	17.67	14.22	15.89	35.56	25.33	133.33
MRC1112 X BML13	52.56	55.33	86.44	160.22	76.89	18.56	14.67	15.89	36.22	27.44	137.22
MRC1112 X BML14	46.56	49.56	82.78	162.89	75.11	17.33	13.56	15.00	31.33	24.56	125.89
MRC 1123 X BML5	51.22	54.00	86.33	168.00	70.78	19.33	15.33	17.11	34.44	28.78	144.33
MRC 1123 X BML7	51.78	54.78	88.11	177.78	98.89	17.33	15.56	16.22	36.78	31.11	153.22
MRC 1123 X BML13	53.78	56.44	86.44	192.00	103.44	20.33	16.22	16.44	38.89	32.44	170.67
MRC 1123 X BML14	49.44	52.22	84.33	172.67	76.56	18.67	15.67	16.56	32.56	28.56	153.56
MRC 1176 X BML5	52.44	55.44	85.67	174.22	87.44	16.89	14.67	14.11	35.56	24.89	119.00
MRC 1176 X BML7	54.33	57.00	88.00	218.00	144.89	18.44	16.00	15.89	38.44	30.22	152.44
MRC 1176 X BML13	53.67	56.78	88.33	201.33	109.22	19.00	15.78	15.33	38.00	30.11	149.56
MRC 1176 X BML14	50.44	53.44	83.33	169.22	83.44	15.89	13.67	13.11	33.56	22.89	119.22
MRC 1179 X BML5	50.78	53.56	85.78	165.89	73.11	16.78	14.22	15.33	33.89	24.78	108.67
MRC 1179 X BML7	52.33	54.89	87.67	178.67	90.33	15.33	14.89	16.11	33.67	26.00	124.11
MRC 1179 X BML13	51.44	54.22	86.78	148.33	76.00	18.56	15.33	15.67	37.22	28.11	131.78
MRC 1179 X BML14	48.78	51.67	83.78	161.89	68.11	15.78	13.33	14.56	30.67	22.89	108.44
MRC 1209 X BML5	51.44	54.33	84.22	163.22	77.56	17.67	14.11	14.56	33.00	27.67	128.44
MRC 1209 X BML7	51.56	54.56	86.33	183.56	87.78	17.67	15.67	14.67	37.56	25.44	129.44
MRC 1209 X BML13	50.78	53.67	86.44	167.56	84.89	17.22	14.56	15.11	35.44	28.11	130.56
MRC 1209 X BML14	49.44	52.22	82.44	158.11	73.56	17.00	13.11	13.56	32.33	25.78	127.33
MRC 1271 X BML5	48.67	51.33	85.11	177.78	80.22	17.00	14.67	15.11	32.22	28.89	124.78
MRC 1271 X BML7	50.89	53.78	84.11	188.22	90.78	16.33	14.78	14.78	33.67	27.56	123.33
MRC 1271 X BML13	50.33	53.22	85.56	185.00	91.33	17.89	14.78	14.67	33.89	30.78	143.33
MRC 1271 X BML14	46.67	49.56	83.22	173.89	75.11	16.00	13.67	14.11	30.22	27.00	124.56
MRC 1358 X BML5	49.67	52.44	85.00	175.00	79.33	17.56	13.78	15.22	32.67	26.11	118.67
MRC 1358 X BML7	54.56	56.89	85.89	187.78	86.33	15.11	15.33	14.78	33.89	28.44	126.78
MRC 1358 X BML13	51.78	54.22	85.89	207.56	94.89	19.22	15.22	15.67	36.33	31.67	158.78
MRC 1358 X BML14	47.67	50.56	82.78	170.00	75.44	16.56	12.67	14.11	30.67	24.33	118.56
MRC 1544 X BML5	46.89	49.89	84.00	156.11	71.33	16.67	14.11	15.44	31.11	26.33	120.67
MRC 1544 X BML7	48.78	51.56	84.89	176.00	94.67	16.56	14.78	16.44	34.22	28.11	140.44
MRC 1544 X BML13	49.56	52.44	85.56	182.00	92.44	18.22	14.56	15.11	34.00	29.56	132.78

MRC 1544 X BML14	44.89	47.78	82.00	151.56	66.33	15.67	13.33	14.44	29.11	24.44	120.56
MRC 1556 X BML5	48.11	50.89	83.67	172.33	75.00	16.11	15.11	16.44	34.44	26.33	128.11
MRC 1556 X BML7	52.00	55.11	88.56	165.78	88.78	15.78	14.67	15.78	35.56	25.22	127.22
MRC 1556 X BML13	51.33	54.33	87.11	177.33	83.89	18.56	15.11	14.44	35.78	25.11	119.56
MRC 1556 X BML14	46.11	48.89	81.67	167.22	70.00	15.11	14.11	15.67	32.89	24.22	128.22
MRC 1561 X BML5	51.00	54.11	86.78	176.22	99.11	18.44	15.44	15.56	41.67	27.89	145.44
MRC 1561 X BML7	52.11	54.56	86.22	188.22	99.33	15.78	14.56	14.56	33.00	26.67	114.00
MRC 1561 X BML13	52.89	56.00	89.11	204.67	105.56	17.44	14.78	14.33	35.44	27.00	130.22
MRC 1561 X BML14	49.44	52.56	84.44	172.33	93.89	17.11	14.44	14.67	39.67	26.22	144.11
MRC 1564 X BML5	50.44	53.89	85.89	158.22	68.78	16.67	14.22	14.78	33.78	27.33	117.22
MRC 1564 X BML7	51.11	54.22	85.56	184.44	94.11	16.22	14.56	14.67	34.22	31.11	134.11
MRC 1564 X BML13	52.00	54.78	87.33	167.00	81.44	16.33	13.89	13.11	32.78	28.78	119.56
MRC 1564 X BML14	48.44	51.89	83.89	153.11	63.67	15.67	13.22	13.78	31.78	25.56	118.22
MRC 1582 X BML5	50.44	52.89	86.67	173.89	77.11	17.00	13.89	14.56	31.11	28.56	118.44
MRC 1582 X BML7	52.00	55.33	88.00	161.11	74.78	16.44	14.11	14.56	30.89	27.22	110.11
MRC 1582 X BML13	51.89	54.89	87.78	172.33	77.78	18.22	14.22	13.89	32.56	29.67	124.56
MRC 1582 X BML14	48.44	50.78	84.67	170.00	72.00	16.00	13.00	13.56	29.11	26.56	117.22
MRC 1601 X BML5	50.22	53.33	87.22	152.78	76.44	16.00	14.33	16.44	28.56	25.67	113.78
MRC 1601 X BML7	52.44	55.67	89.11	177.11	84.00	15.67	14.56	17.11	32.11	25.67	128.33
MRC 1601 X BML13	53.56	56.33	88.78	166.33	83.56	17.11	15.22	15.78	32.33	29.44	138.44
MRC 1601 X BML14	48.22	51.44	85.22	146.67	69.78	14.89	13.56	15.78	26.56	23.89	112.56
MRC 1604 X BML5	49.11	51.89	85.78	189.89	100.56	17.22	15.11	14.89	37.22	29.67	147.22
MRC 1604 X BML7	52.33	55.11	86.89	194.44	98.00	18.00	14.67	14.44	38.78	29.78	141.33
MRC 1604 X BML13	55.11	57.67	86.11	189.44	103.44	18.33	14.11	13.22	34.33	28.22	133.33
MRC 1604 X BML14	48.11	50.89	84.00	184.56	95.56	16.56	14.56	15.00	35.22	27.78	145.00
MRC 1661 X BML5	50.44	52.89	86.22	170.11	80.89	16.67	14.67	15.89	30.78	27.22	123.56
MRC 1661 X BML7	51.67	54.33	88.67	167.56	87.56	15.33	14.56	16.00	28.11	26.11	118.89
MRC 1661 X BML13	49.89	53.11	86.22	178.11	98.11	17.11	15.22	15.00	31.11	28.22	121.44
MRC 1661 X BML14	48.44	50.78	84.22	165.00	75.78	15.56	13.67	14.89	28.67	25.11	123.44
Mean of crosses	50.51	53.36	85.76	174.02	85.13	17.03	14.51	15.10	33.65	27.25	129.49
Range of crosses	44.89 to 55.11	47.78 to 57.67	81.67 to 89.11	146.67 to 218.00	63.67 to 144.89	14.89 to 20.33	12.67 to 16.22	13.11 to 17.11	26.56 to 41.67	22.89 to 32.44	108.44 to 170.67
Checks											
DHM-117	53.66	56.88	88.66	216.89	106.88	17.11	16.00	15.66	35.00	28.22	128.44
30 V 92	55.00	57.88	89.00	193.33	89.22	17.66	15.00	15.00	35.22	27.00	122.11
900 M Gold	56.33	59.22	87.99	184.11	86.66	15.33	15.00	15.33	35.33	24.89	115.67
Mean of checks	54.99	57.99	88.54	198.10	94.25	16.7	15.33	15.33	35.18	26.70	122.07

Table 2: Heritability (narrow sense) for grain yield and yield component in maize pooled over three locations

Character	Heritability narrow sense (%)			
	Tandur	Warangal	Madhira	Pooled
Days to 50% tasseling	85.77	81.90	62.45	72.61
Days to 50% silking	85.67	78.86	69.17	75.44
Days to maturity	74.84	73.60	60.29	53.93
Plant height (cm)	32.16	43.76	65.01	37.51
Ear height (cm)	57.05	44.10	77.13	53.46
Ear length (cm)	35.86	63.52	63.42	44.25
Ear girth (cm)	57.46	42.36	50.82	43.19
Number of kernel rows per ear	43.86	61.41	35.77	42.62
Number of kernels per row	50.52	58.39	47.24	45.53
100-seed weight (g)	65.50	57.46	67.14	62.45
Grain yield per plant (g)	39.18	31.13	35.20	28.18

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