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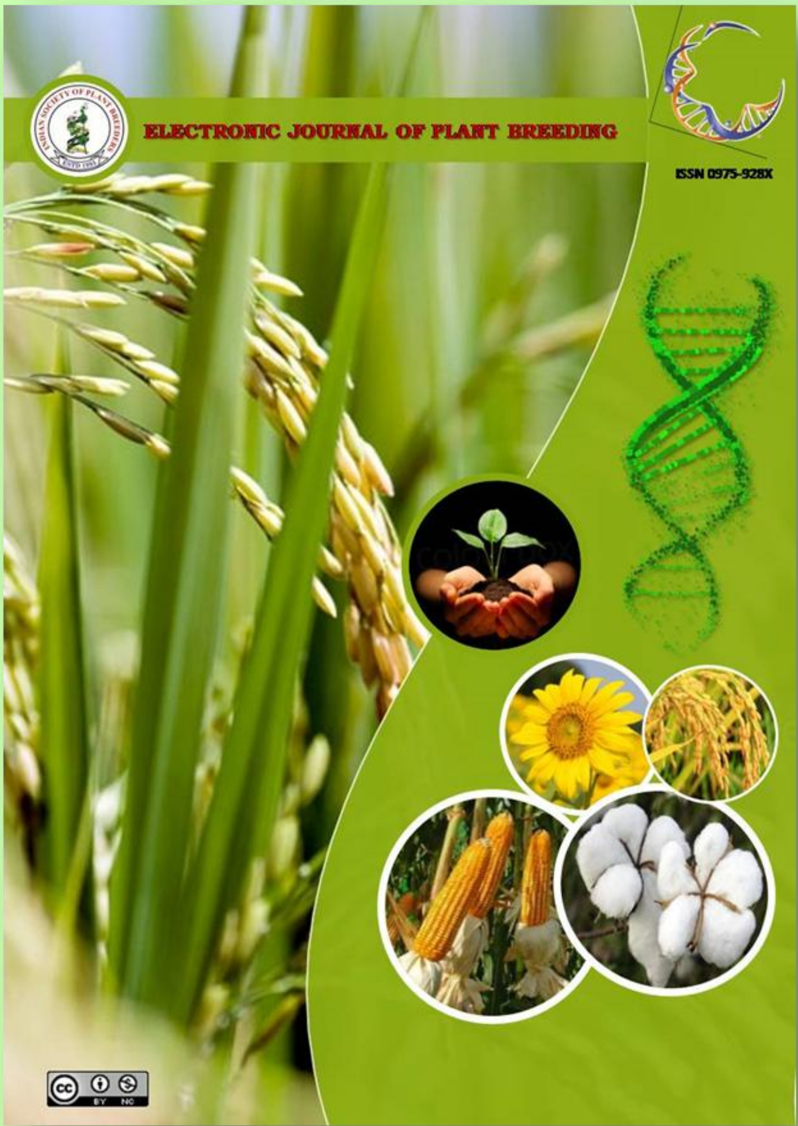

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Research Article

Study on *per se* performance and heterosis for kernel yield and its attributing traits in maize [*Zea mays* (L.)]

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Abstract
The phenomenon of heterosis has provided the most important genetic tools in improving yield of crop plants. Identification of specific parental combination capable of producing the highest level of heterotic effects in F_1 has immense value for commercial exploitation of heterosis. The experimental material comprised of eight parental lines, 28 F_1 hybrids with one standard check (GAYMH-1). On the basis of *per se* values, the parents CML 338, VL-1032 and BLD-11 were recorded maximum kernel yield per plant, while in case of hybrids, CBE-98 × BLD-11, CBE-98 × MRCN-3 and CBE-26 × BLD-11 were best for kernel yield per plant. The population mean for kernel yield per plant was 99.74 gm. Among the 28 hybrids, 4 hybrids *i.e.* CBE-26 × MRCN-3, CBE-26 × VL-109178, VL-109178 × MRCN-3 and CBE-98 × MRCN-3 manifested significant and desirable heterosis over mid parent, better parent and economic heterosis over check (GAYMH-1) for kernel yield per plant and other component traits *viz.*cob weight, cob length, cob girth, 100-kernel weight, number of kernel row per cob and number of kernel per row.

Keywords
Maize, *per se* performance, heterobeltiosis, standard heterosis, kernel yield

Introduction

Maize (*Zea mays* L.; 2n=20) is one of the most important economic cereal crops of the world. It was domesticated over the past 10,000 years from the grass teosinte in Central America (Doebley *et al*, 2006) and has been subject to cultivation and selection ever since. It ranks one of the three important cereal crops in the world as well as in India after wheat and rice for production and consumption. It occupies a place of a pride among the coarse cereal crops in India. There is no cereal on the earth, which has such enormous potential as maize and hence, it resides in the vital place as 'Queen of Cereals'. Maize belongs to the grass family *Poaceae* (*Gramineae*) and tribe *Maydeae*, the maize is the only cultivated and economically important species of genus *Zea*. Maize grain contains about 70% starch, 9.9% protein, 4% oil and 2.7% crude fiber. Normal maize is a good source of basic dietary requirement, but the lack of two essential amino acids lysine and tryptophan (Nelson 1969), poses a problem to meet the daily balanced protein requirement. In India, it is grown round the year in an area of 8.69 million hectares with the production of 21.81 million tonnes and 2509 kg/ha productivity (Anonymous, 2016).

Heterosis breeding has been a potential method of increasing yield in most of the cross-fertilizing crops. The choice of the right type of parents to be used in hybridization program is a difficult task for the plant breeder. The use of parents of known superior genetically worth ensures much better success. It requires extensive and detailed genetical assessment of existing germplasm as well as newly evolved promising lines, which could be used in future breeding program, or could be directly released as cultivars after proper evaluation.

Material and Methods

The material for experimentation consisted of eight parents (CBE-15, CBE-98, CBE-26, MRCN 3, CML 338, BLD-11, VL-1032 and VL-109178), their 28 half-diallel crosses and one check GAYMH-1. The seed of 28 hybrids were produced during *rabi*2016 at Department of Seed Technology, S.D. Agricultural University, Sardarkrushinagar (Gujarat) The seed of inbred lines were maintained by sibbing.A set of 37 genotypes comprising of eight parents and their 28 F_1hybrids with single check (GAYMH-1) were sown in Randomized Block Design (RBD) with three replications, during *kharif* 2017. Each entry sown in 3m length row and it was 75 cm away from another row and maintained 20 cm distance between plants within row. The recommended agronomical practices and plant protection measures were adopted for raising a good crop. The observations were recorded both as visual assessment (days to tasseling, days to silking, Anthesis-silking interval (ASI) and days to dry husk) and measurement on randomly selected five competitive individual plants (plant height, cob height, cob weight, cob length, cob girth, number of kernel rows per cob, number of kernels per row, 100-kernel weight, kernel yield per plant, shelling percentage, protein content and starch content). The replication wise mean values of each entry for the sixteen traits were analysed using Randomized Block Design (RBD) as suggested by Sukhatme and Amble (1985) as well as estimation of relative heterosis, heterobeltiosis and economic heterosis as per the method given by Turner (1953), Fonseca and Peterson (1968) and Meredith and Bridge (1972), respectively.The data were analyzed statistically using the software WINDOSTAT version 8.1.

Results and Discussion

The analysis of variance from the mean data was carried out as per Randomized Block Design of the field experiment. The results (Table 1) revealed significant differences due to genotypes for all the traits under study. This indicated that parents and their hybrids under study had sufficient genetic variability for different traits. Further, partitioning of mean sum of square due to genotypes indicated that the differences among parents were significant for all the traits except plant height, cob height, number of kernels per row, protein content and starch content. The significant differences among parents indicated greater diversity in the parental lines. In case of hybrids, significant differences were found for all the traits except anthesis-silking interval (ASI) and number of kernel rows per cob indicating varying performance of cross combinations. Mean sum of squares due to parents *Vs* hybrids were significant for all the traits except protein content and starch content, which shows that considerable amount of heterosis was reflected in crosses.

The *per se* performance of parents revealed that the, parent CML 338 was top ranking for kernel yield per plant and cob weight as well as some of the yield components, *viz.*, days to tasseling, plant height and cob girth. The parent, CBE-98 was good for number of kernel rows per cob and number of kernels per row. The parent, BLD-11 was best for seed index (100-kernel weight) and shelling percentage. The parent, MRCN-3 was found better for protein content and starch content(Table 2.).

The *per se* performance of hybrids revealed that none of the hybrids were found superior for all the characters under study. The hybrids CBE-98 × BLD-11, CBE-98 × MRCN-3 and CBE-26 × BLD-11 recorded maximum kernel yield per plant. In case of cob weight, hybrids CBE-98 × MRCN-3, CBE-26 × BLD-11 and VL-109178 × BLD-11 were found superior(Table 2).

The data from table 3 for kernel yield per plant (g)revealed that all the hybrids under study manifested significant and positive heterosis over mid parent, better parent and standard check (GAYMH-1). The estimates of relative heterosis for kernel yield per plant ranged from 38.85 per cent (CBE-15 × CML 338) to 136.46 per cent (CBE-26 × MRCN-3).The effects of heterobeltiosis varied from 17.71 per cent (CBE-15 × CML 338) to 126.78 per cent (CBE-26 × MRCN-3). The cross CBE-26 × MRCN-3 was depicted the highest significant and positive relative heterosis (136.46 %) and heterobeltiosis (126.78%) effects. The standard heterosis varied between 6.42 per cent (CBE-15 × CML 338) to 46.05 per cent (CBE-98 × BLD-11). Out of 28 hybrids, CBE-98 × BLD-11, CBE-98 × MRCN-3 and CBE-26 × BLD-11 were exhibited maximum significant and positive values of standard heterosis, medium to high heterobeltiosis (BP) and standard heterosis (SH) for kernel yield per plant in maize has also reported by Patel (2007), Singh and Gupta (2009), Avinashe (2011), Soni (2012), Singh *et al.* (2013), Lahane*et al.* (2015), Swarnalathadevi*et al.* (2016), Gami *et al.* (2018[a]) and Gami *et al.* (2018[b]).

A comparative study of most heterotic crosses for kernel yield per plant (Table 4) revealed that the hybrid CBE-26 × MRCN-3 expressed the highest heterobeltiosis (BP). This hybrid also manifested significant positive heterobeltiosis for cob weight, cob length, cob girth, number of kernel rows per cob, number of kernels per row. while, CBE-98 × BLD-11 expressed highest standard heterosis for kernel yield per plant. This hybrid also revealed significant positive standard heterosis for cob weight, cob length, cob girth, number of kernels per row, 100-kernel weight, shelling percentage. Significant and desirable heterobeltiosis and standard heterosis for component traits were earlier reported in maize by Soni (2012), Singh *et al.* (2013), Lahane *et al.* (2015), Swarnalatha devi *et al.* (2016) Gami *et al.* (2018[a]) and Gami *et al.* (2018[b]).

Among the 28 hybrids, 4 hybrids manifested significant and desirable heterosis for kernel yield and other component traits over mid parent, better parent and economic heterosis over check (GAYMH-1) these four heterotic hybrids in plunging order were CBE-26 × MRCN-3, CBE-26 × VL-109178, VL-109178 × MRCN-3 and CBE-98 × MRCN-3.The desirable heterosis also observed in the cross combinations of CBE-26 × MRCN-3 for different component traits, *viz.*, days to tasseling, days to silking, cob weight, cob length, cob girth, number of kernel rows per cob, number of kernels per row; CBE-26 × VL-109178 for days to tasseling, days to silking, cob weight, cob length, cob girth, number of kernel rows per cob, number of kernels per row and 100-kernel weight; VL-109178 × MRCN-3 for days to silking, cob weight, cob length, cob girth, number of kernel rows per cob, number of kernels per row and CBE-98 × MRCN-3 for days to tasseling, days to silking, cob weight, cob length, cob girth, number of kernel rows per cob, number of kernels per row and 100-kernel weight in desirable direction.A perusal of *per se* performance and heterosis indicated that hybrids CBE-26 × MRCN-3, CBE-26 × VL-109178, VL-109178 × MRCN-3, CBE-98 × MRCN-3 and CBE-98 × BLD-11were found promising for commercial exploitation.

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Table 1. Analysis of variance for sixteen traits in maize

Sources of variation	df	Days to tasseling	Days to silking	ASI	Days to dry husk	Plant height	Cob height	Cob weight	Cob length
Replications	2	3.20	5.29	0.01	3.25	8.94	9.01	44.38	0.70
Genotypes	36	29.20**	30.75**	1.23*	4.65**	2035.83**	510.94**	3552.12**	10.64**
Parents	7	37.81**	23.99**	3.52**	3.14*	2.61	2.82	251.31**	1.20**
Hybrids	27	6.41**	7.62**	0.53	4.55**	18.46**	38.17**	759.47**	1.04**
Parents *Vs* Hybrids	1	596.89**	708.48**	4.78*	21.67**	72772.71**	16942.77**	105646.80**	346.09**
Error	**72**	**1.62**	**1.90**	**0.71**	**1.39**	**8.06**	**5.96**	**37.52**	**0.32**

*** P ≤ 0.05, ** P ≤ 0.01 where ASI= Anthesis silking interval**

Sources of variation	df	Cob girth	Number of kernel row per cob	Number of kernel per row	100-kernel weight	Kernel yield per plant	Shelling percentage	Protein content	Starch content
Replications	2	0.53	1.56	0.40	1.92	18.17	29.81	0.03	0.10
Genotypes	36	5.12**	1.91**	60.20**	12.74**	1601.15**	109.55**	0.05**	0.68**
Parents	7	0.78**	1.33**	1.07	8.62**	341.58**	65.60**	0.03	0.25
Hybrids	27	0.47*	0.65	8.44**	4.95**	365.37**	71.79**	0.05**	0.82**
Parents *Vs* Hybrids	1	165.37**	31.81**	1835.68**	205.50**	44898.63**	1230.07**	0.03	0.66
Error	**72**	**0.26**	**0.43**	**1.26**	**2.11**	**9.72**	**10.82**	**0.01**	**0.26**

*** P ≤ 0.05, ** P ≤ 0.01**

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Table 2.*Per se* performance of the parents and their hybrids for sixteen traits in maize

Sr. No.	Parents/hybrids	Days to tasseling	Days to silking	ASI	Days to dry husk	Plant height (cm)	Cob height (cm)	Cob weight (g)	Cob length (cm)
Parent:									
1.	CBE-15	60.00	61.67	1.67	82.67	94.08	34.81	71.09	11.48
2.	CBE-98	59.67	62.33	2.66	83.67	95.65	35.23	76.03	11.96
3.	CBE-26	66.33	68.33	2.00	84.66	94.70	34.51	62.73	12.29
4.	VL 1032	58.00	62.00	4.00	82.00	95.60	37.37	83.40	13.07
5.	CML 338	55.00	60.00	5.00	82.66	93.68	36.04	89.38	12.82
6.	VL-109178	55.67	59.00	3.33	83.67	96.13	35.48	69.07	11.66
7.	BLD-11	57.00	60.66	3.66	84.33	93.72	34.96	79.10	13.03
8.	MRCN-3	57.67	61.00	3.33	82.00	94.98	36.53	65.42	11.84
	Parental mean	58.67	61.88	3.21	83.21	94.82	35.62	74.53	12.27
Hybrids:									
9.	CBE-15 × CBE-98	54.67	57.33	2.67	83.33	155.98	64.19	136.72	17.20
10.	CBE-15 × CBE-26	51.33	54.00	2.67	83.00	154.41	63.55	132.57	15.26
11.	CBE-15 × VL-1032	51.33	54.33	3.00	82.00	155.15	63.22	127.13	16.82
12.	CBE-15 × CML-338	51.33	53.67	2.33	81.33	155.36	61.98	137.56	16.71
13.	CBE-15 × VL-109178	50.67	53.33	2.67	81.00	155.66	63.87	132.48	17.23
14.	CBE-15 × BLD-11	52.33	55.67	3.33	82.67	158.09	60.52	126.22	16.73
15.	CBE-15 × MRCN-3	52.00	54.00	2.00	79.33	156.87	59.92	129.08	15.33
16.	CBE-98 × CBE-26	55.33	59.00	3.67	82.33	156.63	61.12	130.37	15.78
17.	CBE-98 × VL 1032	54.33	57.33	3.00	82.00	159.47	63.97	168.41	16.91
18.	CBE-98 × CML 338	56.33	59.33	3.00	84.67	156.92	63.30	134.24	16.21
19.	CBE-98 × VL-109178	54.33	56.33	2.00	82.67	161.63	70.23	163.11	16.83
20.	CBE-98 × BLD-11	54.00	56.67	2.67	82.33	160.73	69.57	169.81	17.10
21.	CBE-98 × MRCN-3	53.67	56.67	3.00	84.00	154.26	70.67	182.26	17.56
22.	CBE-26 × VL 1032	54.33	57.00	2.67	82.67	160.53	71.20	157.79	16.81
23.	CBE-26 × CML 338	54.00	57.00	3.00	81.67	159.97	65.65	142.20	16.31
24.	CBE-26 × VL-109178	52.67	55.67	3.00	83.67	161.56	72.62S	156.25	16.97
25.	CBE-26 × BLD-11	54.33	56.33	2.00	82.67	161.22	67.48	177.65	16.82
26.	CBE-26 × MRCN-3	53.33	56.00	2.67	81.67	159.78	69.43	151.07	16.18
27.	VL-1032 × CML 338	51.67	55.00	3.33	80.67	155.36	67.01	155.50	16.88
28.	VL-1032 × VL-109178	53.00	56.00	3.00	80.67	157.85	67.45	146.08	16.35
29.	VL-1032 × BLD-11	53.00	55.67	2.67	82.67	154.70	66.31	144.21	16.71
30.	VL-1032 × MRCN-3	52.00	54.33	2.33	81.33	159.08	69.39	166.89	16.65
31.	CML 338 ×VL-109178	51.00	53.33	2.33	79.67	154.73	63.95	152.26	16.57
32.	CML 338 × BLD-11	51.33	53.67	2.33	81.00	155.38	64.52	150.95	15.64
33.	CML 338 × MRCN-3	51.33	54.00	2.67	81.67	156.89	60.64	149.29	16.27
34.	VL-109178 × BLD-11	53.33	56.33	3.00	83.00	155.79	63.24	172.20	17.29
35.	VL-109178 × MRCN-3	53.67	56.00	2.33	83.00	155.25	66.79	150.09	15.87
36.	BLD-11 × MRCN-3	53.67	56.00	2.33	83.00	154.01	69.13	150.99	17.16
37.	GAYMH-1 (Check)	56.66	60.00	3.33	83.00	142.98	70.77	132.56	16.14
	Hybrid mean	53.01	55.71	2.70	82.13	157.26	65.75	149.76	16.58
	S.Em±	0.75	0.80	0.49	0.68	1.64	1.41	3.53	0.32
	CD at 5%	2.11	2.24	1.37	1.92	4.62	3.97	9.97	0.92
	CV %	2.38	2.41	29.84	1.43	1.98	4.11	4.60	3.60

Table 2 conti….

Sr. No.	Parents/hybrids	Cob girth (cm)	Number of kernel row per cob	Number of kernel per row	100-Kernel weight(g)	Kernel yield per plant (g)	Shelling percentage	Protein content (%)	Starch content (%)
Parent:									
1.	CBE-15	11.54	10.53	15.66	34.63	54.60	76.95	10.36	61.89
2.	CBE-98	12.19	11.86	17.13	34.23	61.81	81.31	10.24	61.78
3.	CBE-26	11.51	10.56	15.33	32.00	48.55	77.33	10.32	62.05
4.	VL 1032	11.48	10.93	15.63	34.40	70.88	85.01	10.19	61.63
5.	CML 338	12.76	11.73	15.96	35.50	78.50	87.81	10.27	61.76
6.	VL-109178	11.74	10.00	15.93	34.43	54.77	79.37	10.15	61.82
7.	BLD-11	12.64	11.60	16.13	38.06	70.72	89.40	10.33	62.03
8.	MRCN-3	11.87	10.80	16.73	35.50	52.88	80.33	10.45	62.57
	Parental mean	11.97	11.00	16.07	34.85	61.59	82.25	10.29	61.95
Hybrids:									
9.	CBE-15 × CBE-98	15.34	11.87	24.83	37.52	95.11	69.62	10.44	61.64
10.	CBE-15 × CBE-26	15.52	12.40	22.90	37.20	95.67	72.74	10.48	61.96
11.	CBE-15 × VL-1032	15.68	11.47	24.67	39.73	95.52	75.13	10.30	62.46
12.	CBE-15 × CML-338	14.96	12.80	25.23	37.00	92.41	67.24	10.30	62.54
13.	CBE-15 × VL-109178	15.43	12.13	23.97	37.60	102.83	77.71	10.24	61.90
14.	CBE-15 × BLD-11	15.44	12.27	23.87	38.97	99.06	78.50	10.50	61.77
15.	CBE-15 × MRCN-3	15.05	11.73	22.60	37.03	95.55	74.01	10.25	61.75
16.	CBE-98 × CBE-26	14.30	12.27	25.47	36.43	95.98	73.64	10.47	62.02
17.	CBE-98 × VL 1032	15.61	12.27	26.43	40.10	101.55	60.32	10.11	62.23
18.	CBE-98 × CML 338	14.86	12.53	24.90	37.73	100.04	74.64	10.14	61.15
19.	CBE-98 × VL-109178	14.98	12.00	25.80	38.87	115.13	70.63	9.97	62.16
20.	CBE-98 × BLD-11	14.75	12.67	27.70	38.10	126.81	74.69	10.23	61.89
21.	CBE-98 × MRCN-3	15.08	13.20	25.27	38.10	126.61	69.64	10.28	61.56
22.	CBE-26 × VL 1032	14.39	11.33	28.73	38.07	117.11	74.22	10.35	62.73
23.	CBE-26 × CML 338	14.88	12.50	27.73	37.50	122.22	85.92	10.26	62.12
24.	CBE-26 × VL-109178	14.43	12.17	27.40	38.57	119.16	76.26	10.45	62.74
25.	CBE-26 × BLD-11	14.70	12.27	28.93	36.53	125.64	70.82	10.33	61.81
26.	CBE-26 × MRCN-3	15.45	12.93	27.13	36.17	119.93	79.39	10.31	62.34
27.	VL-1032 × CML 338	14.69	12.67	25.83	39.50	121.81	78.38	10.20	61.34
28.	VL-1032 × VL-109178	14.82	12.40	25.77	39.77	113.30	77.59	10.57	63.05
29.	VL-1032 × BLD-11	14.47	11.33	26.27	38.80	111.16	77.10	10.27	63.35
30.	VL-1032 × MRCN-3	15.12	12.53	26.63	39.47	112.22	67.37	10.43	61.86
31.	CML 338 ×VL-109178	14.99	12.67	26.33	39.80	117.89	77.43	10.49	62.03
32.	CML 338 × BLD-11	14.41	12.40	24.60	38.13	111.73	74.11	10.36	61.71
33.	CML 338 × MRCN-3	15.01	12.67	28.53	38.00	117.31	78.62	10.49	62.74
34.	VL-109178 × BLD-11	14.83	12.00	26.47	39.53	120.02	69.71	10.40	62.41
35.	VL-109178 × MRCN-3	14.44	12.27	25.27	35.00	112.33	74.91	10.31	62.76
36.	BLD-11 × MRCN-3	14.83	12.93	28.27	39.37	113.67	75.48	10.34	61.70
37.	GAYMH-1 (Check)	13.75	13.90	18.03	32.92	86.82	65.55	10.26	62.05
	Hybrid mean	14.95	12.31	25.98	38.16	110.64	74.14	10.33	62.13
	S.Em±	0.30	0.38	0.65	0.84	1.80	1.90	0.07	0.30
	CD at 5%	0.84	1.07	1.83	2.38	5.07	5.35	0.19	0.84
	CV %	3.61	5.43	4.76	3.89	3.13	4.35	1.13	0.82

Where ASI= Anthesis silking interval

Table 3. Number of hybrids having significant heterotic effect in maize

Characters	Over mid parent				Over better parent				Over standard check			
	+ve	-ve	Total	Range	+ve	-ve	Total	Range	+ve	-ve	Total	Range
Days to tasseling	00	27	27	-18.73 to -1.74	00	24	24	-14.44 to 2.42	00	25	25	-10.59 to -0.59
Days to silking	00	27	27	-16.92 to -3.00	00	27	27	-12.43 to -1.11	00	26	26	-11.11 to -1.11
Anthesis-silking interval (ASI)	01	04	05	-46.15 to 57.14	02	00	02	-36.36 to 100.0	00	00	00	-40.00 to 10.00
Days to dry husk	00	08	08	-4.21 to 1.80	02	02	04	-3.63 to 2.44	00	06	06	-4.42 to 2.01
Plant height (cm)	28	00	28	61.84 to 71.12	28	00	28	62.40 to 72.02	28	00	28	7.71 to 13.05
Cob height (cm)	28	00	28	67.10 to 107.52	28	00	28	68.25 to 110.43	00	16	16	-15.34 to 2.60
Cob weight (g)	28	00	28	62.29 to 157.69	28	00	28	52.42 to 139.70	19	00	19	-4.79 to 37.48
Cob length (cm)	28	00	28	20.96 to 48.93	28	00	28	20.00 to 47.80	06	00	06	-5.47 to 8.75
Cob girth (cm)	28	00	28	13.46 to 36.24	28	00	28	14.45 to 35.86	22	00	22	3.97 to 14.03
Number of kernel row per cob	20	00	20	0.59 to 21.06	09	00	09	-2.30 to 19.75	00	25	25	-5.08 to -18.50
Number of kernel per row	28	00	28	39.51 to 85.58	28	00	28	35.06 to 83.80	28	00	28	25.32 to 60.44
100-kernel weight (g)	22	00	22	0.10 to 16.85	14	00	14	-1.41 to 16.57	27	00	27	6.31 to 21.80
Kernel yield per plant (g)	28	00	28	38.85 to 136.46	28	00	28	17.71 to 126.78	28	00	28	6.42 to 46.05
Shelling percentage	00	22	22	-27.46 to 4.06	00	23	23	-29.04 to -1.79	20	00	20	-7.98 to 31.07
Protein content (%)	04	01	05	-2.24 to 3.87	02	02	04	-2.67 to 3.70	06	01	07	-2.83 to 2.96
Starch content (%)	04	00	04	-1.01 to 2.45	02	02	04	-1.62 to 2.12	02	01	03	-1.46 to 2.09

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Table 4. Comparative study of heterotic crosses in maize

Sr. No.	Hybrids	Heterobeltiosis (%)	Standard heterosis (%)	Useful and significant heterobeltiosis for component trait
1.	CBE-26 × MRCN-3	126.78** (119.93)	38.12**	CW, CL, CG, NKC, NKR
2.	CBE-26 × VL-109178	117.53** (119.16)	37.23**	CW, CL, CG, NKC, NKR, 100-KW
3.	VL-109178 × MRCN-3	105.08** (112.33)	29.37**	CW, CL, CG, NKC, NKR,
4.	CBE-98 × MRCN-3	104.82** (126.61)	45.81**	CW, CL, CG, NKC, NKR, 100-KW
5.	CBE-15 × VL-109178	87.73** (102.83)	18.43**	CW, CL, CG, NKC, NKR, 100-KW
6.	CBE-98 × BLD-11	79.31** (126.81)	46.05**	CW, CL, CG, NKR

Figure in the parentheses indicated *per se* performance for kernel yield per plant.
*** P ≤ 0.05, ** P ≤ 0.01**

CW	:	Cob weight	NKC	:	Number of kernel rows per cob
CL	:	Cob length	NKR	:	Number of kernels per row
CG	:	Cob girth	100-KW	:	100-kernel weight

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