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Estimation of heterosis for yield and yield contributing characters in CGMS based pigeonpea [*Cajanus cajan* (L.) mill sp.] hybrids

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Abstract
The objective of present study is to estimate the standard heterosis among parents and crosses to find out promising cross combinations for seed yield and its components. The experimental material comprised of 40 crosses along with 13 parents (5 lines and 8 testers) and a standard check BDN 716. The experiment was laid out in Randomized Block Design with two replications. The observations were recorded on eleven characters for evaluation. The analysis of variance revealed that there were significant differences among the parents and crosses for all the characters studied. The cross BDN 2004-4 A x BDNHR 35-8 had manifested significant positive standard heterosis over check BDN 16 for yield and yield contributing characters *viz*., seed yield per plant and number of pods per plant.

Keywords: Heterosis, standard heterosis, positive and negative standard heterosis, pigeonpea, CGMS

Introduction
Pigeonpea *Cajanus cajan* (L.) *Millsp.* (2n=22) member of family Leguminosae (Fabaceae) is an important legume (pulse) crop of tropical and subtropical regions of Asia and Africa. India is considered as the center of origin of pigeonpea (Van der Maesen., 1980) because of its natural genetic variability available in the local germplasm and the presence of its wild relatives in the country. Pigeonpea [*Cajanus cajan* (L.) *Millsp.*] occupies an important place among rainfed resource poor farmers as it is with so many benefits at low cost. In addition to its main use as dehulled split dhals, its immature green seeds and pods are consumed as a green vegetable. In India, pigeonpea is grown in an area of 4.45 million hectares with a production of 4.18 million tonnes (Anonymous 2018).
The Indian sub-continent alone contributes nearly 92 per cent of the total pigeonpea production in the world. Although India leads the world both in area and production of pigeonpea with its productivity (937 kg/ha).
In India, pigeonpea is important in the states of Maharashtra (1.29 m ha), Karnataka (0.88 m ha), Madhya Pradesh (0.64 m ha), Telangana (0.33 m ha), Uttar Pradesh (0.28 m ha) and Andhra Pradesh (0.27 m ha). These six states account for over 81.89 per cent of the total pigeonpea area in India. In Maharashtra, pigeonpea having largest role in area, production and productivity. In the year 2018-19, pigeonpea covered the area of 12.20 lakh ha with production of 10.56 lakh tonnes and productivity of 866 kg/ha. One of the factors responsible for the poor productivity of pigeonpea are the lack of improved cultivars.
Research for genetic improvement of this crop to raise yield levels effectively has to be strengthened countering biotic stresses, through widening genetic base. In pigeonpea, heterosis for grain yield and its component have not been reported for various quality parameters in pigeonpea hybrids by using CGMS lines and diverse restorers that will be expected to stable, good combiner across the environment.
However, varieties good in *per se* performance may not necessarily produce desirable progenies when used in hybridization, proper understanding of underlying inheritance of quantitative traits and also in identifying the promising crosses for further use in breeding program. In view of above consideration, the present study has been planned on heterosis in CGMS based pigeonpea hybrids.

Materials and Methods

The experiment consisted of 40 crosses developed by using 5 female and 8 male parents along with BDN 716 as check. The female parents consist of BDN 2004-1 A, BDN 2004-2 A, BDN 2004-3 A, BDN 2004-4 A and BSMR 736 A and male parents consists of BDNHR 1, BDNHR 21-1-1, BDNHR 22-1-1, BDNHR 24-1-1-1, BDNHR 35-8, BDNHR 36-1, BDNHR 36-6 and BDNHR 36-7 along with their F_1,s developed during 2017-18. The randomized block design was utilized for the evaluation of the material with 2 replications and spacing of 90 x 20 cm during the *Kharif* season 2018-2019 at Agricultural research station, Badnapur. The heterosis was calculated as per the procedure suggested by Fonseca and Patterson (1968) and the standard heterosis effects in terms of per cent increase or decrease over standard check (useful heterosis) were measured for all the eleven characters.

Results and Discussion

Mean performance of parent and crosses for yield and yield contributing characters

The mean performance of thirteen parents and forty crosses were studied for plant height, the line BSMR 736 B (157.53) and the tester BDNHR 36-6 (160.62 cm) recorded highest plant height. Among the crosses BSMR 736 A x BDNHR 36-1 (178 cm) showed highest plant height followed by BSMR 736 A x BDNHR 21-1-1 (168 cm).

BDN 2004-3 B (101 days) was earlier in flowering among lines while in testers it was BDNHR 21-1-1 (88 days). The cross BDN 2004-3 A x BDNHR 21-1-1 (93 days) and BDN 2004-3 A x BDNHR 36-7 (93 days) was earlier to flower among the cross combinations.

The line BSMR 736 B (99.45%) and among the testers BDNHR 22-1-1 (99.09%) recorded highest pollen fertility. Among the crosses, BDN 2004-4 A x BDNHR 35-8 (98.33%) exhibited highest pollen fertility followed by BSMR 736 A x BDNHR 36-7 (98.32%).

Maturity duration is a very important factor that determines the adaptation. In the present investigation, line BDN 2004-3 B (147 days) and tester BDNHR 21-1-1 (142 days) were early in maturing among the lines and testers respectively. Out of forty crosses, the cross BDN 2004-3 A x BDNHR 36-7 (139 days) recorded early maturity.

Line BDN 2004-4 B (10.3) and tester BDNHR 36-7 (11.2) recorded maximum number of primary branches per plant when compared to the two controls. The crosses, BDN 2004-4 A x BDNHR 35-8 (12.00) had maximum number of primary branches per plant followed by BSMR 736 A x BDNHR 22-1-1 (11.55) and BSMR 736 A x BDNHR 36-7 (11.55).

The highest number of secondary branches were registered by BDN 2004-4 B (21.5) and BDNHR 36-1 (22.45) among lines and testers respectively. Among the crosses, BDN 2004-4 A x BDNHR 35-8 (24.7) was with highest number of secondary branches per plant followed by BDN 2004-4 A x BDNHR 1 (24.4). Among the lines and testers highest number of pods per plant is recorded by BDN 2004-4 B (259.3) and BDNHR 36-1 (208.05) respectively. Out of the forty crosses, BDN 2004-4 A x BDNHR 35-8 (265) had highest number of pods followed by BDN 2004-4 A x BDNHR 36-7 (226.9).

BDN 2004-2 B (4.9) and BDNHR 35-8 (4.2) recorded maximum number of seeds per pod among the lines and testers respectively. The cross BDN 2004-1 A x BDNHR 24-1-1-1 (4.6) was with maximum number of seeds per pod among the forty crosses.

Highest pod length has been recorded by BDN 2004-2 B (7.53 cm), BDNHR 35-8 (5.27 cm) and BDN 2004-3 A x BDNHR 1 (5.43 cm) among the lines, testers and crosses respectively.

Maximum 100 seed weight was recorded by BDN 2004-2 B (13.39 g), BDNHR 1 (11.47 g) and BDN 2004-2 A x BDNHR 35-8 (15.81 g) among lines, testers and crosses respectively.

In the present investigation, among the lines BDN 2004-1 B (61.77 g) has manifested highest grain yield per plant while among the testers, BDNHR 36-1 (72.08 g) has shown highest grain yield per plant. Out of the forty crosses evaluated, highest grain yield was recorded by BDN 2004-4 A x BDNHR 35-8 (84.95 g) followed by BSMR 736 A x BDNHR 22-1-1 (71.77 g) and BDN 2004-4 A x BDNHR 36-6 (69.56g).

Analysis of variance for line x tester analysis

The analysis of variance indicated that the differences due to crosses were significant for all of the characters except pod length. The analysis of variance due to lines were significant for all the characters except days to 50 per cent flowering and number of pods per plant. The analysis of variance due to testers were significant for the characters plant height, days to 50% flowering, days to maturity and number of seeds per pod. The analysis of variance due to line x tester were significant for all the characters except plant height, number of seeds per pod, pod length and grain yield per plant.

Estimation of standard heterosis

Plant height is desirable character for achieving high yield as vigour in plant height may lead to increase biomass as well as source-sink capacity for obtaining optimum yield. For plant height, the range of standard heterosis is -11.36 to 21.99 per cent over check BDN 716. Out of forty crosses, only one cross BSMR 736 A x BDNHR 36-1 (21.99%) exhibited significant positive heterosis over check BDN 716. Similar results were also reported earlier by Wankhade *et al.* (2005), Baskaran and Muthiah (2006), Patel and Tikka, (2008) [11], Sarode *et al.* (2009) [13], Chandrikala *et al.* (2010), Shoba and Balan (2010), Vaghela *et al.* (2011), Pandey *et al.* (2013), Gite *et al.* (2014).

Early maturing hybrids are generally preferred therefore, negative heterosis for days to 50 per cent flowering is considered as useful parameter. For days to 50 per cent flowering, the standard heterosis range is -16.22 to 0.9 per cent over check BDN 716. Out of forty crosses, thirty four crosses exhibited significant negative heterosis over the check BDN 716. Maximum significant negative heterosis is recorded by BDN 2004-3 A x BDNHR 21-1-1 (-16.22%) and BDN 2004-3 A x BDNHR 36-7 (-16.22%). Heterosis in both negative and positive directions for days to 50 per cent flowering have also been reported by Wankhade *et al.* (2005), Baskaran and Muthiah (2006), Wanjari *et al.* (2007), Patel and Tikka (2008) [11], Sarode *et al.* (2009) [13], Chandrikala *et al.* (2010), Vaghela *et al.* (2011), Pandey *et al.* (2013), Gite *et al.* (2014) and Patil *et al.* (2015).

The range of standard heterosis for the trait pollen fertility is -91.14 to -1.06 per cent. None of the crosses exhibited significant positive heterosis over check BDN 716. The cross BDN 2004-2 A x BDNHR 1 (-91.14%) showed maximum significant negative heterosis over the check BDN 716.

For days to maturity, standard heterosis ranged from -17.99 to 0.29 per cent. None of the crosses exhibited significant positive heterosis over check BDN 716 for this trait. The crosses BDN 2004-3 A x BDNHR 36-7 (-17.99%), BDN 2004-1 A x BDNHR 36-7 (-17.40%) and BDN 2004-4 A x BDNHR 24-1-1-1 (-17.40%) registered maximum significant negative heterosis over check BDN 716. The desirable combinations were common for both the heterosis for days to maturity are not cross specific. Solanki *et al.* (2008) [15] reported that most of the hybrids depicted significant negative heterosis for days to 50 per cent flowering and days to maturity, thereby suggesting that high yield in hybrids can be achieved along with early flowering and maturity. These results are in agreement with earlier results reported by Veeraswamy *et al.* (1973), Hooda *et al.*(1999), Kalimagal and Ravikesavan (2003), Aher *et al.* (2006) [2], Sarode *et al.* (2009) [13], Gupta *et al.* (2011), Pandey *et al.* (2013), Gite *et al.*(2014) and Patil *et al.*(2015).

More primary branches per plant are believed to be closely associated with high seed yield per plant resulting high productivity. Therefore, the cross combinations with more primary branches per plant were to be identified. The range of standard heterosis for the trait number of primary branches per plant is -40.76 to 0.84 per cent. None of the crosses registered significant positive heterosis over check BDN 716 for this trait. The cross BDN 2004-2 A x BDNHR 1 (-40.76%) registered maximum significant negative heterosis over check BDN 716.

For the trait number of secondary branches per plant, standard heterosis ranged from -36.90 per cent to 12.53 per cent. None of the crosses exhibited significant positive heterosis. Maximum significant negative heterosis is exhibited by BDN 2004-2 A x BDNHR 36-1 (-36.90%) and BDN 2004-3 A x BDNHR 21-1-1 (-35.54%) over the check BDN 716.

The hybrids with positive heterosis for number of pods per plant are desirable to increase the yield. The range of standard heterosis for the trait number of pods per plant is -66.40 to 39.11 per cent. Out of forty crosses, thirteen crosses showed significant negative heterosis. The cross BDN 2004-2 A x BDNHR 1 (-66.40%) showed maximum significant negative heterosis over the check BDN 716. Only One cross BDN 2004-4 A x BDNHR 35-8 (39.11%) registered significant positive heterosis over check BDN 716. These results are in agreement with the finding of Hooda *et al* (1999), Aher *et al.* (2006) [2], Baskaran and Muthiah (2006), Patel and Tikka (2008) [11], Sarode *et al.* (2009) [13], Chandrikala *et al.* (2010), Gupta *et al.* (2011), Vaghela *et al.* (2011), Pandey *et al.* (2013), Gite *et al.* (2014) and Patil *et al.* (2015).

The hybrids with positive heterosis for number of seeds per pod are desirable to increase the yield. For the trait number of seeds per pod, the range of standard heterosis was -49.37 to 16.46 per cent over the check BDN 716. Out of forty crosses, only two crosses BDN 2004-1 A x BDNHR 24-1-1-1 (16.46%) and BDN 2004-1 A x BDNHR 36-1 (13.92%) manifested significant positive heterosis over check BDN 716. These findings were in agreement with the findings of Banu *et al.* (2006), Patel and Tikka (2008) [11], Sarode *et al.* (2009) [13], Kumar *et al.* (2012), Pandey *et al.* (2013), Patil *et al.* (2015), Mhasal *et al.* (2015).

For pod length standard heterosis ranged from -11.98 to 8.38 per cent. Out of forty crosses, none of the cross exhibited positive or negative heterosis over standard check BDN 716.

The hundred seed weight is one of the important common traits which influence the yield. The range of standard heterosis for the trait 100 seed weight is -29.73 to 27.19 per cent. Out of forty crosses, eight crosses showed significant positive heterosis. Maximum significant positive heterosis is exhibited by BDN 2004-2 A x BDNHR 35-8 (27.19%) over check BDN 716. The cross BSMR 736 A x BDNHR 35-8 (-27.27%) showed maximum significant negative heterosis. Heterosis with respect to 100 seed weight in positive and negative direction have also been reported by Wankhade *et al.* (2005), Baskaran and Muthiah (2006), Patel and Tikka (2008) [11], Sarode *et al.* (2009) [13], Vaghela *et al.* (2011), Kumar *et al.* (2012), Pandey *et al.* (2013), Gite *et al.* (2014), Patel *et al.* (2014) [12] and Patil *et al.* (2015).

Ultimate aim of breeding is to gain the heterotic yield associated with other heterotic characters. Grain Yield is the complex character of all other yield contributing characters. All changes in yield must be accompanied by changes in one or more characters have been pointed out by Grafius (1959). A wide range of variation in the estimates standard heterosis in positive and negative direction was observed for grain yield per plant. For the trait, standard heterosis ranged from -58.16 to 33.16 per cent. Out of 40 crosses, the cross BDN 2004-4 A x BDNHR 35-8 (33.16%) manifested significant positive heterosis over check BDN 716. These findings were in close agreement with the results of earlier workers Hooda *et al.* (1999), Pandey and Singh (2002), Wankhade *et al.* (2005), Anantha and Muthiah, (2007), Wanjari *et al.* (2007), Solanki *et al.* (2008) [15], Patel and Tikka, (2008) [11], Sarode *et al.* (2009) [13], Singh and Singh, (2009),Dheva *et al.* (2009) [7], Bharate *et al.* (2010) [13], Chandrikala *et al.* (2010), Vaghela *et al.* (2011), Gupta *et al.* (2011), Kumar *et al.* (2012), Pandey *et al.* (2013), Patil *et al.* (2015) and Mhasal *et al.*(2015).

Table 1: ANOVA for Line x Tester analysis

Sources of Variation	d. f.	Mean sum of squares										
		Plant Height (cm)	**Days to 50% Flowering**	**Pollen fertility (%)**	**Days to maturity**	**No. of primary branches per plant**	**No. of secondary branches per plant**	**No. of pods per plant**	**No. of seeds per pod**	**Pod length (cm)**	**100 seed weight (g)**	**Grain yield per plant (g)**
Replications	1	380.89	12.01	7.65	1.51	2.59	1.68	1035.36	0.03	0.19	0.31	133.54
Crosses	39	235.47*	44.78**	1029.33**	158.99**	3.26**	15.71**	3984.89*	1.03**	0.17	6.86**	285.52**
Parents (Line)	4	1023.12**	30.20	2941.87*	510.45**	15.25**	54.85**	24653.48	9.36**	0.64**	55.56**	1454.39**
Parents (Tester)	7	361.97**	118.01*	916.11	382.01**	2.24	22.20	1551.99	0.17*	0.20	1.39	264.94
Line x Tester	28	91.33	28.55**	784.42**	53.03**	1.80*	8.50*	1640.45**	0.063	0.09	1.28**	123.68
Error	39	111.45	5.52	6.74	10.71	0.98	4.43	459.20	0.063	0.16	0.12	72.80

* -Significant at 5% level of significance

** -Significant at 1% level of significance

Table 2: Estimation of Standard Heterosis over check BDN 716

Sr. No.	Crosses	Plant height (cm)	Days to 50 per cent flowering	Pollen fertility	Days to maturity	No. of primary branches per plant	No. of secondary branches per plant	No. of pods per plant	No. of seeds per pod	Pod length (cm)	100 Seed weight (g)	Grain yield per plant (g)
1.	BDN 2004-1 A x BDNHR 1	2.12	-5.86**	-7.46**	-10.91**	-13.45	-4.78	3.67	-1.27	-9.38	-9.45**	1.99
2.	BDN 2004-1 A x BDNHR 21-1-1	3.87	-10.36**	-16.76**	-8.85**	-30.25**	-20.96*	-11.31	11.39	-9.58	-7.40**	-25.47*
3.	BDN 2004-1 A x BDNHR 22-1-1	-8.16	-13.96**	-34.80**	-10.32**	-36.55**	-23.46*	-35.93**	7.59	-8.38	-13.31**	-38.49**
4.	BDN 2004-1 A x BDNHR 24-1-1-1	-11.36	-8.11**	-1.12	-13.86**	-23.53*	-24.37*	3.88	16.46*	7.78	-21.36**	-14.59
5.	BDN 2004-1 A x BDNHR 35-8	4.79	-6.76**	-2.24	-15.04**	-15.97	-19.82*	-3.23	8.86	0.8	-13.64**	-10.69
6.	BDN 2004-1 A x BDNHR 36-1	9.48	-5.41*	-18.43**	-9.73**	-7.98	-28.02**	-41.42**	13.92*	-3.59	-11.63**	-35.69**
7.	BDN 2004-1 A x BDNHR 36-6	15	-5.86**	-89.34**	-3.83*	-19.33*	-27.11**	-13.44	-1.27	-4.79	-10.02**	-33.71**
8.	BDN 2004-1 A x BDNHR 36-7	1.14	-11.71**	-2.51	-17.40**	-21.85*	-14.35	-5.98	11.39	7.19	-21.96**	-13.87
9.	BDN 2004-2 A x BDNHR 1	-3.09	-10.36**	-91.14**	-4.13*	-40.76**	-26.88**	-66.40**	-36.71**	-5.19	19.83**	-45.90**
10.	BDN 2004-2 A x BDNHR 21-1-1	-1.01	-9.91**	-29.52**	-7.37**	-32.77**	-11.39	-35.14**	-41.77**	-10.98	15.65**	-35.33**
11.	BDN 2004-2 A x BDNHR 22-1-1	-1.65	0.9	-18.32**	-0.29	-27.31**	-26.20**	-44.80**	-39.24**	-11.98	11.58**	-39.33**
12.	BDN 2004-2 A x BDNHR 24-1-1-1	-2.38	-12.16**	-16.82**	-7.67**	-27.73**	-7.97	-6.01	-31.65**	-4.59	20.92**	-21.72
13.	BDN 2004-2 A x BDNHR 35-8	-2.75	-13.06**	-15.54**	-5.31**	-38.24**	-30.75**	-19.69	-31.65**	-7.19	27.19**	-34.27**
14.	BDN 2004-2 A x BDNHR 36-1	2.73	-2.7	-90.30**	-3.24	-36.13**	-36.90**	-53.70**	-49.37**	-1.1	13.19**	-58.16**
15.	BDN 2004-2 A x BDNHR 36-6	-1.99	-3.6	-28.94**	-0.59	-26.89**	-24.83*	-31.05**	-39.24**	-2.69	4.02	-42.48**
16.	BDN 2004-2 A x BDNHR 36-7	-3.3	-13.06**	-15.22**	-6.78**	-14.29	-26.20**	-58.40**	-36.71**	-3.29	24.30**	-45.79**
17.	BDN 2004-3 A x BDNHR 1	-9.05	-7.66**	-3.83	-15.04**	-27.31**	-12.3	-11.89	5.06	8.38	-8.45**	-6.33
18.	BDN 2004-3 A x BDNHR 21-1-1	0.27	-16.22**	-15.08**	-14.45**	-23.95*	-35.54**	-47.03**	3.8	3.39	-3.86	-35.95**
19.	BDN 2004-3 A x BDNHR 22-1-1	-4.12	-10.36**	-4.17	-2.06	-13.87	-22.78*	-17.82	3.8	2.99	-3.26	-19.48
20.	BDN 2004-3 A x BDNHR 24-1-1-1	1.29	-10.81**	-7.03**	-16.62**	-22.27*	-24.15*	-35.41**	3.8	3.99	-9.53**	-38.07**
21.	BDN 2004-3 A x BDNHR 35-8	-2.2	-14.41**	-3.02	-17.40**	-11.34	-22.10*	-17.45	8.86	7.98	-18.34**	-13.75
22.	BDN 2004-3 A x BDNHR 36-1	13.18	-7.21**	-13.67**	-9.14**	-24.37*	-23.01*	-23.28*	6.33	2.59	-17.46**	-26.54*
23.	BDN 2004-3 A x BDNHR 36-6	3.35	-6.31**	-13.86**	-9.44**	-10.08	-6.15	-30.94**	1.27	-2	-4.02	-27.23*
24.	BDN 2004-3 A x BDNHR 36-7	4.04	-16.22**	-2.32	-17.99**	-5.04	2.73	-22.05*	8.86	7.78	-19.67**	-24.84*
25.	BDN 2004-4 A x BDNHR 1	-9.12	-12.61**	-6.39**	-9.73**	-16.39	11.16	12.23	-13.92*	-11.28	-13.88**	2.16
26.	BDN 2004-4 A x BDNHR 21-1-1	-7.25	-14.41**	-10.88**	-5.60**	-16.81	-12.07	12.76	-8.86	-1.2	-13.07**	-16.04
27.	BDN 2004-4 A x BDNHR 22-1-1	-4.86	-3.15	-16.23**	0.29	-25.63**	-20.27*	-9.92	0	-5.79	14.00**	-6.98
28.	BDN 2004-4 A x BDNHR 24-1-1-1	-2.67	-11.26**	-2.94	-17.40**	-8.4	-1.59	14.36	-6.33	-3.79	-26.67**	-3.76
29.	BDN 2004-4 A x BDNHR 35-8	-5.19	-6.31**	-1.06	-11.21**	0.84	12.53	39.11**	-1.27	-3.09	-18.34**	33.16**
30.	BDN 2004-4 A x BDNHR 36-1	-1.31	-7.66**	-8.60**	-7.96**	-4.62	-22.55*	12.86	-11.39	0.6	-18.62**	-21.29
31.	BDN 2004-4 A x BDNHR 36-6	5.08	-4.50*	-1.17	-3.24	-7.14	-10.25	15.93	-13.92*	-9.28	-23.21**	9.03
32.	BDN 2004-4 A x BDNHR 36-7	-1.4	-14.86**	-5.17*	-15.34**	-18.07	4.56	19.11	-1.27	-3.59	-29.73**	6.07
33.	BSMR 736 A x BDNHR 1	10.34	-7.66**	-9.92**	-8.85**	-7.98	9.79	1.86	1.27	-8.18	-18.26**	7.87
34.	BSMR 736 A x BDNHR 21-1-1	15.14	-15.32**	-19.02**	-15.63**	-15.55	-13.9	-2.94	7.59	-2.4	-19.43**	-22.06
35.	BSMR 736 A x BDNHR 22-1-1	3.97	-13.06**	-4.70*	-11.21**	-2.94	-4.78	17.95	6.33	-1	-12.99**	12.5
36.	BSMR 736 A x BDNHR 24-1-1-1	8.39	-9.01**	-7.49**	-14.75**	-18.07	-17.31	-10.45	11.39	-3.19	-13.84**	-24.11*
37.	BSMR 736 A x BDNHR 35-8	7.53	-3.6	-6.81**	-7.37**	-16.81	-16.63	-11.52	1.27	-4.09	-27.27**	-22.34
38.	BSMR 736 A x BDNHR 36-1	21.99**	-5.86**	-2	-13.86**	-6.3	-14.81	-11.71	10.13	7.39	-13.11**	-19.73
39.	BSMR 736 A x BDNHR 36-6	7.87	-3.6	-12.40**	-7.37**	-7.98	-0.23	-10.08	-1.27	0.4	-12.11**	-13.35
40.	BSMR 736 A x BDNHR 36-7	10.98	-10.36**	-1.07	-15.04**	-2.94	2.28	-4.99	5.06	3.19	-26.87**	-22.77
	SE (±)	11.81	2.27	2.30	3.09	1.10	2.04	19.02	0.25	0.40	0.32	7.51
	CD at 5%	23.90	4.59	4.66	6.25	2.23	4.13	38.47	0.52	0.82	0.65	15.19
	CD at 1%	31.99	6.15	6.24	8.37	2.98	5.54	51.51	0.70	1.09	0.87	20.34

Conclusion

Heterosis breeding has been used extensively in improving yield potential through development of hybrid cultivars in crops including pigeonpea. Out of forty CGMS based hybrids, only one hybrid *i.e.* BDN 2004-4 A x BDNHR 35-8 has exhibited significant superiority over the standard check BDN 716. However, the extent of heterosis among the tested hybrids might with is low, it may be due to early withdrawal of monsoon and uneven distribution of rainfall, only 437 mm rain received in 20 rainy days during crop season. It is essential to judge the potential of hybrids along with stability across the location. Hence it is suggested to evaluate hybrid combination at multilocation.

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