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Heterosis For Growth, Earliness and Yield in CGMS Based Hybrids Chilli (*Capsicum annum* L.)

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ABSTRACT
A set of 24 male sterile based F_1hybrids developed as Line x Tester mating design involving three cytoplasmic genic male sterile line (CGMS) lines and eight testers were evaluated for growth, earliness and yield parameters. Out of these crosses, KCMS-44 x BDB(84.85 cm) was found best for plant height, KCMS-31 x PC1(15.18mm) for stem girth, KCMS-16 x VN-2(6.75) for number of primary branches, KCMS-16 x LCA234(14.80) for number of secondary branches, KCMS-44 x VN-2 (36.50) for days to first flowering, KCMS-31 x AL (42.50) for days to 50 per cent flowering, KCMS-31 x H-31 (20.17) for average fruit weight, KCMS-44 x AL(99.00) for number of green fruits per plant, KCMS-16 x AL(822.00 gms) green fruit weight per plant and also for green fruit yield per hectare. The most heterotic cross for the trait green fruit yield was KCMS-16 x AL(40.00%) followed by KCMS-44 x PC1(14.80%) and KCMS-31 x LCA234(14.50%).
Key words: *Heterosis, CGMS, Line x Tester, Heterotic cross, Economic heterosis*

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INTRODUCTION

Chilli (*Capsicum annuum* L.) a spice as well as vegetable crop. Chillies are used in both green and dry form in all culinary preparations. Among the spice crops of India Chilli a member of Solanaceae family is an important one. It is an indispensible condiment of every home as used in the daily diet. Being introduced by Portuguese in 17th century, now the crop is grown all over India, especially in Andhra Pradesh, Karnataka, Tamil Nadu and Maharastra [1].One of the ways to improve the production and productivity is to harness the potential of heterosis breeding. The quantum jump in yield achieved through heterosis, has been reported for many of the economic attributes in chilli, especially for quantitative traits [2]. The Hand emasculation and hand pollination is highly uneconomical method of F_1 seed production in chilli as it is tedious process and chilli flowers are small and delicate in nature, resulting in flower drop and poor fruit set after emasculation and even set fruits have few number of seeds per fruits. The only alternative is to have male sterility in female parent to solve this problem as being practiced in few other vegetables. Farmers prefer to grow early yielding hybrids in order to catch early market to get higher prices and to avoid market glut and to reduce the risk of crop maintenance late in the season. The aim of heterosis analysis is to find out the best combination of crosses giving high degree of heterobeltiosis and characterization of hybrids for commercial exploitation [3]. Therefore, the present investigation was carried out to assess the magnitude and direction of heterosis in cytoplasmic genic male sterile (CGMS) based chilli hybrids for growth, earliness and yield parameters in 24 F1 CGMS based hybrids.

MATERIAL AND METHODS

The experimental material consisted of three CGMS lines (KCMS-31, KCMS-44 and KCMS-16) and eight testers (Byadagi Dabbi (BDB), Pant C-1(PC1), Ujjwal(UJ), Vietnam-2(VN-2), ArkaLohit(AL), PMR534, H-31 and LCA234). The Line x tester analysis, is biometrical method is available for studying the combining ability, hybrid vigour and genetics which was first developed during 1957 [4], is one such method, using this large number of lines can be tested for combining ability and heterosis. These parents were crossed in a Line x Tester design to get 24 F_1hybrids. All the 11 parents, 24 hybrids and one commercial hybrid *viz.*, Garima (BejoSheetal Seeds Pvt. Ltd.,) were sown in rows spaced at ten cm apart during the last week

of July 2012. Five weeks old healthy seedlings of 35 entries and one commercial hybrid as check were transplanted during the second week of September 2012 in the experimental blocks in randomized block design with two replications. Each entry was represented by single row of 15 plants with spacing of 75 cm between the rows and 45 cm between the plants within row. Observation recorded on growth parameters *viz.,* plant height (cm), stem girth(mm), number of primary branches and number of secondary branches. Earliness parameters *viz.,* days to first flowering and days to 50 percent flowering. Yield parameters *viz.,* average fruit weight(g), number of green fruit per plant, green fruit weight per plant(g) and green fruit yield per hectare(t/ha). The mean over the replications for all the parents and crosses for the each of the character was calculated and used in the estimation of heterosis. The magnitude of heterosis was calculated as per cent increase or decrease in F1over the means of commercial check hybrid [5].

RESULTS

The data revealed that there were significant differences for all the characters (Table1). The parent PMR534 was found best for plant height, PC1for stem girth, LCA234 for number of primary branches and BDB for number of secondary branches. The parent LCA234 for days to first flowering and also for days to 50 per cent flowering. The parentVN-2for average fruit weight, PMR534 for number of green fruits per plant, AL green fruit weight per plant and also for green fruit yield per hectare. Out of 24 crosses developed and evaluated the per se *per se* performance, the cross KCMS-44 x BDB (84.85) was found best for plant height, the cross KCMS-31 x PC1 (15.18) for stem girth, the cross KCMS-16 x VN-2(6.75) for number of primary branches and cross KCMS-16 x LCA234 (14.80) for number of secondary branches. The cross KCMS-44 x VN-2 (36.50) for days to first flowering and cross KCMS-31 x AL for days to 50 per cent flowering shown maximum desirable negative direction towards earliness. The cross KCMS-31 x H-31(20.17) was exhibited maximum per se value for Average fruit weight, KCMS-44 x AL (99.00) for number of green fruits per plant, KCMS-16 x AL (822.00) green fruit weight per plant and KCMS16 x AL (24.36 t/ha) green fruit yield per hectare. These best crosses also exhibited the maximum heterosis over the commercial check in desirable direction for their respective traits. Among 24 crosses, 21 crosses over the commercial check for days to first flowering and 11 crosses for days to 50 per cent flowering exhibited the significant negative heterosis and the cross KCMS-44 x VN-2 exhibited maximum negative (-24.70%) and significant heterosis over the commercial check for days to first flowering and with respect to days to 50 per cent flowering, the maximum and significantly negative standard heterosis (-15.80%) was observed in the cross KCMS-31 x AL (Table 2). Among 24 crosses, 18 and 15 hybrids exhibited positive and significant heterosis for average fruit weight and number of green fruits per plant. The cross KCMS-31 x H-31 exhibited maximum standard heterosis (100.90 %) for average fruit weight (Table 2.) and the cross KCMS-16 x AL exhibited maximum heterosis over the commercial check for green fruit weight per plant (40.00%) and for green fruit yield per hectare (41.40%). Among 24 crosses, 11 crosses over commercial check exhibited positive and significant heterosis for green fruit weight per plant and green fruit yield per hectare.

DISCUSSION

In present study heterotic crosses shown high frequency over commercial check these results are in agreement with earlier workers [6, 7]. With respect to earliness the cross KCMS-44 x VN-2 exhibited maximum negative and significant heterosis over the commercial check for days to first flowering and with respect to days to 50 per cent flowering, the maximum and significantly negative standard heterosis was observed in the cross KCMS-31 x AL (Table 2). These results are in line with the findings earlier research [6, 8] and Yield components greatly influence the yield and expression of heterosis for average fruit weight, green fruit weight per plant and number of fruits per plant can greatly contribute for heterosis observed for total green fruit yield per plant. For all these traits, positive heterosis is desirable. In case of yield characters The cross KCMS-31 x H-31 exhibited maximum standard heterosis (100.90 %) for average fruit weight (Table 2.) and it was higher compared to earlier reports [9, 10] (19.58%) and (57.29%) and the cross KCMS-16 x AL exhibited maximum heterosis over the commercial check for green fruit weight per plant (40.00%) and for green fruit yield per hectare (41.40%). Among 24 crosses, 11 crosses over commercial check exhibited positive and significant heterosis for green fruit weight per plant and green fruit yield per hectare. These results are conformity with those of earlier workers [10, 11] Furthermore, the novelty of these crosses reveals from the fact that these crosses are male sterile based, thereby minimizing the hybrid seed production cost by eliminating tedious hand emasculation and pollination. Hence there is great scope for commercial exploitation of these hybrids after further evaluation tests.

Table 1.*Per se* performance of parents (lines and testers) and hybrids for growth, earliness and yield parameters in chilli.

Sl. No.	Parents and crosses	Plant height (cm)	Stem girth (mm)	Primary branches	Secondary branches	Days to first flowering	Days to 50per cent flowering	Average fruit weight (g)	Number of green fruits per plant	Green fruit weight per plant(g)	Green fruit yield per ha (t)
1	KCMS-31 x BDB	69.30	8.79	5.00	12.70	48.50	56.50	13.20	51.88	403.50	11.96
2	KCMS-31 x PC1	72.20	15.18	4.20	12.37	42.00	48.50	7.81	59.50	393.32	13.15
3	KCMS-31 x H-31	69.50	10.34	3.80	8.50	42.00	48.00	20.17	43.02	361.60	11.70
4	KCMS-31 x PMR534	75.10	12.62	4.95	9.10	43.50	48.50	10.12	47.00	614.50	18.21
5	KCMS-31 x UJ	70.05	14.17	5.70	11.30	38.50	46.50	8.63	46.58	655.20	19.41
6	KCMS-31 x LCA234	75.95	12.61	6.00	8.65	39.00	43.50	10.08	78.50	672.40	19.95
7	KCMS-31 x VN-2	68.72	10.12	6.10	10.31	41.00	51.50	13.92	83.50	542.90	16.09
8	KCMS-31 x AL	77.66	11.75	5.10	8.70	38.50	42.50	11.38	76.50	657.00	19.50
9	KCMS-44 x BDB	84.85	13.30	5.55	13.35	43.00	57.50	13.76	55.04	623.05	18.46
10	KCMS-44 x PC1	77.70	11.39	6.60	11.90	40.50	45.50	16.19	43.98	674.00	19.97
11	KCMS-44 x H-31	76.70	11.47	6.32	9.10	42.50	56.00	11.99	70.00	459.50	13.61
12	KCMS-44 x PMR534	60.40	11.48	4.90	14.55	39.50	48.00	14.51	72.00	636.50	18.86
13	KCMS-44 x UJ	70.00	13.94	6.30	9.90	40.50	53.50	19.80	68.44	583.00	17.27
14	KCMS-44 x LCA234	52.00	9.48	5.25	12.30	42.00	55.50	12.44	67.00	498.50	15.75
15	KCMS-44 x VN-2	63.10	12.97	5.65	14.10	36.50	43.00	11.91	92.50	573.20	18.00
16	KCMS-44 x AL	64.50	14.37	5.70	11.90	37.50	50.50	11.34	99.00	401.00	13.90
17	KCMS-16 x BDB	70.30	9.60	6.20	12.20	46.00	56.00	7.32	77.00	480.80	14.25
18	KCMS-16 x PC1	68.30	9.15	6.50	10.70	41.50	55.00	11.51	73.40	445.20	13.20
19	KCMS-16 x H-31	75.57	10.01	4.85	9.70	39.00	56.00	15.16	74.68	582.30	17.85
20	KCMS-16 x PMR534	64.60	14.28	5.35	8.10	47.00	58.50	13.03	67.00	486.40	14.45
21	KCMS-16 x UJ	74.20	11.63	5.95	6.10	39.50	44.50	14.23	54.96	455.00	13.65
22	KCMS-16 x LCA234	75.25	12.39	6.05	14.80	39.00	43.50	13.74	48.03	513.40	15.45
23	KCMS-16 x VN-2	71.35	11.65	6.75	13.15	43.50	50.50	10.03	62.72	597.40	17.70
24	KCMS-16 x AL	69.60	8.64	6.70	6.72	41.00	52.50	16.58	50.06	822.00	24.36

Cont…….

Sl. No.	Genotypes	Plant height (cm)	Stem girth (mm)	Primary branches	Secondary branches	Days to first flowering	Days to 50 per cent flowering	Average fruit weight (g)	Number of fruits per plant	Green fruit weight per plant	Green fruit yield per ha(t)
LINES											
25	KCMS-31	64.00	9.95	3.55	10.50	50.00	57.50	9.46	63.00	345.00	10.22
26	KCMS-44	68.90	11.43	3.85	10.10	51.00	55.50	11.29	65.00	551.60	16.34
27	KCMS-16	51.30	9.04	4.10	7.40	52.50	60.00	7.91	44.58	303.75	9.25
TESTERS											
28	ByadagiDabbi	57.80	7.75	5.90	13.40	51.00	62.50	12.61	49.68	411.95	12.21
29	Pant C-1	66.10	12.73	6.70	9.60	45.50	53.50	12.56	43.04	360.00	10.68
30	H-31	64.02	8.63	6.35	9.65	50.50	56.50	13.21	57.50	356.20	11.05
31	PMR534	74.90	11.92	5.95	8.70	48.00	55.00	8.25	70.00	432.50	12.81
32	Ujjwal	68.10	10.09	5.50	11.00	47.00	55.00	11.95	65.50	486.50	14.41
33	LCA234	69.70	8.65	6.90	12.80	41.50	51.50	13.71	54.50	461.60	13.68
34	VN-2	57.40	7.83	6.60	12.25	52.50	59.00	14.42	46.50	496.50	14.71
35	ArkaLohit	70.10	10.51	6.85	13.10	48.50	53.50	12.40	55.96	625.50	18.53
Commercial check											
36	CC	65.40	9.60	5.50	8.55	48.50	55.50	10.04	53.00	558.70	17.23

BDB :ByadagiDabbi PC1 : Pant C-1 UJ : Ujjwal VN-2 : Vietnam-2 AL : ArkaLohit

Table 2.Heterosis (%) over commercial check (Garima) in respect of growth, earliness and yield parameters in chilli.

Sl. No.	Parents and crosses	Plant height	Stem girth	Primary branches	Secondary branches	Days to first flowering	Days to 50per cent flowering	Average fruit weight	Number of fruits per plant	Green fruit weight per plant	Green fruit yield per ha
1	KCMS-31 x BDB	6.00**	-8.40**	-9.10**	48.50**	0.00	11.90**	31.50**	-2.10	-31.30**	-30.60**
2	KCMS-31 x PC1	10.40**	58.10**	-23.60**	44.70**	-13.40**	-4.00**	-22.00**	12.30**	-33.00**	-23.70**
3	KCMS-31 x H-31	6.30**	7.70**	-30.90**	-0.60	-13.40**	-8.90**	100.90**	-18.80**	-38.40**	-32.10**
4	KCMS-31 x PMR534	14.80**	31.40**	-10.00**	6.40**	-10.30**	-4.00**	0.80	-11.30**	4.70**	5.700**
5	KCMS-31 x UJ	7.10**	47.60**	3.60**	32.20**	-20.60**	-7.90**	-14.00**	-12.10**	11.60**	12.70**
6	KCMS-31 x LCA234	16.10**	31.30**	9.10**	1.20	-19.60**	-13.90**	0.40	48.10**	14.50**	15.80**
7	KCMS-31 x VN-2	5.10**	5.40**	-10.90**	20.60**	-15.50**	2.00	38.60**	57.50**	-7.50**	-6.60**
8	KCMS-31 x AL	18.70**	22.40**	-7.30**	1.80	-20.60**	-15.80**	13.33**	44.30**	11.90**	13.20**
9	KCMS-44 x BDB	29.70**	38.50**	0.90	56.10**	-11.30**	13.90**	37.10**	3.80	6.10**	7.10**
10	KCMS-44 x PC1	18.80**	18.60**	20.00**	39.20**	-16.50**	-9.90**	61.30**	-17.00**	14.80**	15.90**
11	KCMS-44 x H-31	17.30**	19.50**	-9.10**	6.40**	-12.40**	10.90**	19.40**	32.10**	-21.70**	-21.00**
12	KCMS-44 x PMR534	-7.60**	19.50**	-10.90**	70.20**	-18.60**	-5.00**	44.50**	35.80**	8.40**	9.50**
13	KCMS-44 x UJ	7.00**	45.20**	14.50**	15.80**	-16.50**	5.90**	97.20**	29.10**	-0.70	0.20
14	KCMS-44 x LCA234	-20.50**	-1.30**	-4.50**	43.90**	-13.40**	9.90**	23.90**	26.40**	-15.10**	-8.60**
15	KCMS-44 x VN-2	-3.50**	35.10**	2.70**	64.90**	-24.70**	-14.90**	18.60**	74.50**	-2.40**	4.50**
16	KCMS-44 x AL	-1.40	49.70**	3.60**	39.20**	-22.70**	0.00	12.90**	86.80**	-31.70**	-19.30**
17	KCMS-16 x BDB	7.50**	-0.10	12.70**	42.70**	-5.20**	10.90**	-27.10**	45.30**	-18.10**	-17.30**
18	KCMS-16 x PC1	4.40**	-4.70**	18.20**	25.10**	-14.40**	8.90**	14.60**	38.50**	-24.20**	-23.40**
19	KCMS-16 x H-31	15.60**	4.30**	-11.80**	13.50**	-19.60**	10.90**	51.00**	40.90**	-0.80	3.600**
20	KCMS-16 x PMR534	-1.20	48.70**	-2.70**	-5.30**	-3.10	15.80**	29.80**	26.40**	-17.10**	-16.10**
21	KCMS-16 x UJ	13.50**	21.10**	8.20**	-28.70**	-18.60**	-11.90**	41.70*	3.70	-22.50**	-20.80**
22	KCMS-16 x LCA234	15.10**	29.00**	10.00**	73.10**	-19.60**	-13.90**	36.90**	-9.40**	-12.50**	-10.30**
23	KCMS-16 x VN-2	9.10**	21.30**	22.70**	53.80**	-10.30**	0.00	-0.10	18.30**	1.80**	2.70**
24	KCMS-16 x AL	6.40**	-10.00**	21.80**	-21.40**	-15.50**	4.00**	65.10**	-5.50*	40.00**	41.40**
	S.Em±	0.84	0.28	0.54	0.61	1.49	1.20	0.59	1.87	0.59	0.73
	CD at 5%	1.71	0.57	1.09	1.24	3.02	2.44	1.20	3.80	1.20	1.49
	CD at 1%	2.30	0.77	1.47	1.66	4.06	3.27	1.61	5.10	1.6	2.0

*and**indicate significance of values at p=0.05 and 0.01, respectively. DAT :Days After Transplanting

BP- Heterosis over better parent **BTP**- Heterosis over the best parent **CC**- Heterosis over the commercial check (Garima)

BDB :ByadagiDabbi, PC1 : Pant C-1, UJ : Ujjwal, VN-2 : Vietnam-2 , AL : ArkaLohit

REFERENCES

1. Khan, S. and Pariari, A.,2012, Effect of n- fixing biofertilizers on growth, yield and quality of chilli (capsicum annuum l.) *The Bioscan*., 7 (3) : 481-482.
2. Deshpande, R. B., 1933, Studies in Chillies. The inheritance of some characters in *Capsicum annum* L. *Indian J. Agri. Sci*, 3: 219-300.
3. Vikas, P. and Nandan, M., 2014,Combining ability and heterosis for seed yield and it's attributes in linseed (linum usitatissimum l.). *The Bioscan*., 9 (2): 701-706.
4. Kempthorne, O., 1957, An introduction to genetic statistics. John Wiley and Sons, New York, pp. 408-711.
5. Narasimhaprasad, B. C., Madhavi Reddi, K. and Sadhasiva, A. T., 2003, Heterosis studies in chilli (*Capsicum annuum* L.). *Indian. J. Hort*., 60 (1): 69-74.
6. Themburne, B. V. and Rao, S. K., 2012, Heterosis and combining ability in CMS based hybrid chilli (*Capsicum annuum*L.). *J. Agr. Sci*., 4 (10): 89-96.
7. Singh, D. K.,Tewari, P. and Jain, S. K., 2012, Heterosis studies for growth, flowering, and yield of chilli (*Capsicum annuum* L.). *Patnagar J. Res*., 10 (1): 61-65.

8. Thiruvelavan, P., Thamburaj, S., Veeraragavathatham, D. and Natarajan, S., 2002, Studies on *per se* performance and heterosis in male sterile based hybrids in chilli (*Capsicum annuum*L.). *South Indian Hort*., 50 (4-6) : 392-397.
9. Ram, A. and Lal, A., 1989, Heterosis and inbreeding depression in chilli (*Capsicum annuum* L.). Prog. Hort., **21**: 368-372.
10. Patel, J. A., Patel, M. J., Acharya, R. R., Bhanvadia, A. S. and Bhalala, M. K., 2001, Heterosis studies over environments in chilli (*Capsicum annum* L.). *Veg. Sci*., 28 (2): 130-132.
11. Burli, A. V., Jadhav, M. G., More, S. M. and Gare, B. N., 2001, Heterosis studies in chilli, *J. Maharashtra Agric. Univ*. 26 (2) : 208-209.

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