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Studies on bitter gourd (*Momordica charantia* L.) hybrids under salinity

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ABSTRACT

Eight genetically diverse parents identified through genetic divergence analysis were subjected to full diallel mating. Evaluation of parents along with the resultant fifty six hybrids under saline sodic soil revealed the presence of considerable heterosis for most of the traits. Based on *per se* performance the hybrid combinations IC 85643 x Bikaneer 1, Bikaneer 1 x MDU 1, Bikaneer 1 x Bikaneer 3, Bikaneer 3 x BGS 1, Bikaneer 1 x CO 1 and Bikaneer 3 x Paravai Local could be regarded as the best as they had exhibited significant *per se* performance for yield of fruits per vine as well as leaf sodium: potassium ratio. Significant *sca* effects for yield of fruits per vine and leaf sodium: potassium ratio together could be recorded in the cross combinations MDU 1 x CO 1, MDU 1 x Bikaneer 1, MDU 1 x Paravai Local, IC 85643 x Bikaneer 1, IC 85643 x BGS 1, Bikaneer 3 x Vadipatti Local, Bikaneer 3 x Paravai Local, Vadipatti Local x Paravai Local and CO 1 x MDU 1, indicating the possibilities of exploiting them for simultaneous improvement of yield and saline tolerance. Considering the *per se* performance, *sca* and the standard heterosis, the hybrids Bikaneer 1 x CO 1 (2777.22 g / vine), CO 1 x Bikaneer 1 (1951.78 g / vine), IC 85643 x Bikaneer 3 (1911.55 g / vine), CO 1 x MDU 1 (1840.89 g / vine) and MDU 1 x Vadipatti Local (1804.22 g / vine) were identified as the best ones for fruit yield and other yield components.

Key words : Hybrid vigour, Standard heterosis, Mean, Specific combining ability (*sca*), Genetic diversity.

The production and productivity of vegetables in our country had increased tremendously with the advent of hybrid technology. However, the hybrids are capable of expressing their potential only under favourable environment. The restricted scope for enhancing the cultivable area necessitates the use of even marginal or problem soils for cultivation. Increasing salinity of soil has been one of the serious concerns limiting production of vegetables. The identification of species and developing genotypes for growing under salinity thus assumes significance. Cucurbits are a large group of vegetables reported to have a better degree of salt tolerance. Bitter gourd is one of the most nutritive and commercially as well as medicinally important cucurbitaceous vegetables grown for its tubercled, fleshy, unripe fruits throughout India. The present investigation was hence focused on identification of suitable hybrid combinations in bittergourd under salinity.

MATERIALS AND METHODS

The study was taken up at the Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, Puducherry (U.T.). The soil of the selected field was sandy loam textured with the saturation extract having a pH of 8.9, EC 4.78 dSm^{-1} and ESP 20.21 percentage and classified as saline sodic. Eight genetically diverse parents (MDU 1, CO 1, IC 85643, Bikaneer 1, Bikaneer 3, BGS 1, Vadipatti Local and Paravai Local) identified through genetic divergence analysis were subjected to full diallel mating. The parents along with the resultant fifty six hybrids were evaluated in a randomised block design with three replications. Observations on nine biometric traits *viz*., days to first female flower appearance, node of first female flower appearance, sex ratio (M/F), fruit length (cm), fruit girth (cm), individual fruit weight (g), number of fruits per vine, yield of fruits per vine (g) and leaf sodium and potassium content were recorded on five randomly selected plants. Heterosis in F1 hybrids was estimated for each trait as suggested by Gowen (1952). The sodium and potassium contents in the leaf samples were determined by using the flame photometry (Stanford and English, 1949).

RESULTS AND DISCUSSION

Scope for heterosis breeding:

Hybridisation to exploit heterosis on commercial basis or for selection of promising recombinants in subsequent generations is the prime objective of heterosis breeding programme. Cross pollinated crops like bitter gourd offers tremendous scope for heterosis breeding owing to its out crossing nature. Heterosis in cross pollinated crop has long been known to offer good potentialities for increased yield. Considerable heterosis over the check was observed for majority of the traits in most of the hybrids evaluated in the present study. The number of hybrid combinations which expressed superiority over the standard check and

the number of traits for which standard heterosis was observed in each hybrid is presented in Table 1 and Table 2, respectively.

Standard heterosis:

Heterotic vigour over standard parent was shown by majority of the hybrids for yield of fruits per vine, leaf sodium: potassium ratio, fruit girth, number of fruits per vine, sex ratio and days to first female flower appearance. Selection based on these characters would certainly help in the identification of high yielding lines. The extent of heterosis over check variety was found to be the maximum for yield of fruits per vine followed by leaf sodium potassium ratio. The heterosis over check variety recorded for sex ratio was the maximum among the traits for which negative heterosis was favourable (Table 2). High standard heterosis in bitter gourd for number of fruits by Sirohi and Choudhury (1978), for fruit yield by Sirohi and Choudhury (1978), Tewari and Ram (1999) and Chaubey and Ram (2004) and node of first female flower appearance, fruit length, fruit weight and yield by Chaubey and Ram (2004) had been reported earlier.

Table 1 : Hybrids with high standard heterosis for various characters

Characters	Number of hybrids exhibiting significant standard heterosis
Days to first female flower appearance	33
Node of first female flower appearance	7
Sex ratio	36
Fruit length	2
Fruit girth	41
Individual fruit weight	21
Number of fruits per vine	40
Yield of fruits per vine	52
Leaf sodium: potassium ratio	43

Exploitation of hybrid vigour:

The evaluation of hybrids based on any one of the

Table 2 : Number of traits expressing significant standard heterosis in each hybrid

Hybrid	Number of characters expressing significant standard heterosis	Hybrid	Number of characters expressing significant standard heterosis
MDU 1 x CO 1	7	Bikaneer 3 x MDU 1	9
MDU 1 x IC 85643	9	Bikaneer 3 x CO 1	7
MDU 1 x Bikaneer 1	10	Bikaneer 3 x IC 85643	9
MDU 1 x Bikaneer 3	8	Bikaneer 3 x Bikaneer 1	8
MDU 1 x BGS 1	8	Bikaneer 3 x BGS 1	11
MDU 1 x Vadipatti Local	10	Bikaneer 3 x Vadipatti Local	12
MDU 1 x Paravai Local	10	Bikaneer 3 x Paravai Local	10
CO 1 x MDU 1	5	BGS 1 x MDU 1	3
CO 1 x IC 85643	9	BGS 1 x CO 1	7
CO 1 x Bikaneer 1	7	BGS 1 x IC 85643	8
CO 1 x Bikaneer 3	9	BGS 1 x Bikaneer 1	5
CO 1 x BGS 1	7	BGS 1 x Bikaneer 3	6
CO 1 x Vadipatti Local	9	BGS 1 x Vadipatti Local	10
CO 1 x Paravai Local	8	BGS 1 x Paravai Local	10
IC 85643 x MDU 1	5	Vadipatti Local x MDU 1	9
IC 85643 x CO 1	7	Vadipatti Local x CO 1	8
IC 85643 x Bikaneer 1	12	Vadipatti Local x IC 85643	11
IC 85643 x Bikaneer 3	12	Vadipatti Local x Bikaneer 1	12
IC 85643 x BGS 1	12	Vadipatti Local x Bikaneer 3	11
IC 85643 x Vadipatti Local	12	Vadipatti Local x BGS 1	12
IC 85643 x Paravai Local	10	Vadipatti Local x Paravai Local	10
Bikaneer 1 x MDU 1	10	Paravai Local x MDU 1	11
Bikaneer 1 x CO 1	9	Paravai Local x CO 1	6
Bikaneer 1 x IC 85643	11	Paravai Local x IC 85643	11
Bikaneer 1 x Bikaneer 3	6	Paravai Local x Bikaneer 1	5
Bikaneer 1 x BGS 1	10	Paravai Local x Bikaneer 3	11
Bikaneer 1 x Vadipatti Local	12	Paravai Local x BGS 1	8
Bikaneer 1 x Paravai Local	12	Paravai Local x Vadipatti Local	11

three criteria *viz.*, mean, *sca* and standard heterosis would lead to the identification of different sets of cross combinations for each of these criteria. However, the scope for exploitation of hybrid vigour in a heterosis breeding programme depends not only on the extent of heterosis for individual traits but also on the mean performance and *sca* effects of hybrids. Hence, it would be more appropriate to evaluate the hybrids based on all these criteria. Such an evaluation had revealed that none of the hybrid was found to exhibit superiority for all the three criterions for all the characters under study. Such hybrid combinations identified for each trait is given in Table 3. Considering the aforementioned points in view it was observed that a maximum of seventeen hybrids exhibited superior performance in terms of all the three criteria for sex ratio, eleven for leaf sodium: potassium ratio and ten for yield of fruits per vine. These hybrids could be better utilized for the improvement of the characters concerned and intermating among superior segregants resulting from these heterotic hybrids is likely to throw desirable progenies in the subsequent later generations. A few promising hybrids identified from heterosis breeding are CO 1 x MDU 1, CO 1 x Bikaneer 1, Bikaneer 1 x CO 1 and Bikaneer 3 x Paravai Local.

Table 3 : Hybrids for heterosis breeding

Character	Hybrid	Mean	*sca* effect	Standard heterosis (%)
Days to first female flower appearance	MDU 1 x Vadipatti Local	31.78**	-1.15**	-17.46**
	CO 1 x Vadipatti Local	30.83**	-1.90**	-19.91**
	IC 85643 x X Bikaneer 3	33.67**	-1.99**	-12.55**
	IC 85643 x Paravai Local	31.45**	-1.27**	-18.32**
	Bikaneer 3 x Vadipatti Local	28.78**	-1.43**	-25.26**
	BGS 1 x Vadipatti Local	31.11**	-1.38**	-19.19**
	Paravai Local x MDU 1	32.44**	-1.56**	-15.73**
Node of first female flower appearance	Vadipatti Local x Bikaneer 1	13.78**	-2.11**	-16.77**
	Vadipatti Local x BGS 1	12.17**	-3.42**	-26.50**
Sex ratio (M/F)	MDU 1 x IC 85643	13.77**	-7.15**	-53.86**
	MDU 1 x Vadipatti Local	11.38**	-3.34**	-61.86**
	MDU 1 x Paravai Local	19.23**	-2.39**	-35.57**
	CO 1 x Vadipatti Local	9.11**	-4.66**	-69.47**
	IC 85643 x MDU 1	10.46**	-1.66**	-64.96**
	IC 85643 x CO 1	12.12**	-4.13**	-59.43**
	IC 85643 x Bikaneer 1	16.05**	-4.59**	-46.23**
	Bikaneer 1 x Vadipatti Local	13.99**	-6.51**	-53.12**
	Bikaneer 1 x Paravai Local	14.23**	-5.87**	-52.31**
	Bikaneer 3 x IC 85643	12.87**	-4.63**	-56.89**
	Bikaneer 3 x Vadipatti Local	10.79**	-2.81**	-63.83**
	Bikaneer 3 x Paravai Local	13.48**	-5.37**	-54.83**
	BGS 1 x Vadipatti Local	5.24**	-3.49**	-82.44**
	BGS 1 x Paravai Local	3.13**	-7.03**	-89.51**
	Vadipatti Local x IC 85643	4.64**	-2.40**	-84.45**
	Paravai Local x MDU 1	13.48**	-2.87**	-54.82**
	Paravai Local x Bikaneer 3	9.48**	-2.00**	-68.25**
Fruit length (cm)	MDU 1 x Bikaneer 1	16.26**	1.51**	5.36**
	Bikaneer 1 x CO 1	17.95**	2.68**	16.31**
	IC 85643 x Bikaneer 1	13.03**	0.73**	53.74**
	IC 85643 x Bikaneer 3	12.10**	0.86**	42.80**
	IC 85643 x BGS 1	11.14**	0.40**	31.47**
Fruit girth (cm)	IC 85643 x Paravai Local	10.93**	0.48**	28.95**
	Bikaneer 1 x CO 1	12.22**	0.84**	44.22**
	Bikaneer 1 x Bikaneer 3	13.89**	1.81**	63.89**
	Bikaneer 3 x Bikaneer 1	15.09**	0.60**	78.09**

Table 3 Contd.....

Contd.…… Table 3

	CO 1 x Bikaneer 1	45.29**	8.64**	55.99**
	IC 85643 x BGS 1	34.19**	3.68**	17.75**
	Bikaneer 1 x CO 1	57.82**	6.27**	99.16**
Individual fruit weight (g)	Bikaneer 1 x Bikaneer 3	43.47**	5.23**	49.72**
	Bikaneer 3 x MDU 1	33.41**	2.17*	15.09**
	Bikaneer 3 x CO 1	37.45**	2.38*	28.98**
	Bikaneer 3 x Bikaneer 1	50.80**	3.67**	74.97**
	Bikaneer 3 x Paravai Local	175.89**	21.47**	247.15**
	BGS 1 x Paravai Local	151.33**	14.94**	198.68**
Number of fruits per vine	Vadipatti Local x IC 85643	192.22**	29.44**	279.39**
	Vadipatti Local x Paravai Local	239.72**	60.98**	373.14**
	Paravai Local x Vadipatti Local	307.51**	33.89**	506.93**
	MDU 1 x Vadipatti Local	1804.22**	95.09**	63.38**
	MDU 1 x Paravai Local	1770.55**	164.84**	60.33**
	CO 1 x MDU 1	1840.89**	74.33*	66.70**
	CO 1 x Bikaneer 1	1951.78**	796.36**	76.74**
	IC 85643 x Bikaneer 1	1784.56**	128.97**	61.60**
Yield of fruits per vine (g)	IC 85643 x Bikaneer 3	1911.55**	63.11**	73.10**
	IC 85643 x BGS 1	1767.56**	139.45*	60.06**
	Bikaneer 1 x MDU 1	1768.33**	75.22**	60.13**
	Bikaneer 1 x CO 1	2777.22**	412.72**	151.49**
	Vadipatti Local x Bikaneer 3	1774.33**	81.89*	60.67**
	MDU 1 x CO 1	0.2183**	-0.03**	-20.00**
	MDU 1 x IC 85643	0.1854**	-0.03**	-32.05**
	MDU 1 x Bikaneer 1	0.2127**	-0.01**	-22.07**
	CO 1 x MDU 1	0.1755**	-0.02**	-35.68**
	CO 1 x IC 85643	0.1760**	-0.03**	-35.52**
Leaf sodium: potassium ratio	IC 85643 x Bikaneer 1	0.1876**	-0.03**	-31.27**
	Bikaneer 1 x BGS 1	0.1994**	-0.02**	-26.93**
	Bikaneer 3 x MDU 1	0.2120**	-0.02**	-22.30**
	Bikaneer 3 x BGS 1	0.1647**	-0.01**	-39.65**
	Bikaneer 3 x Vadipatti Local	0.1896**	-0.02**	-30.52**
	Bikaneer 3 x Paravai Local	0.1768**	-0.04**	-35.23**

* and ** indicates significance of values at P=0.05 and P=0.01, respectively

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