Indian J.L.Sci. 1(2) : 129-133, 2012
ISSN: 2277-1743 (Print)
ISSN: 2278-7879 (Online)

STUDIES ON MORPHOLOGICAL CHARACTERIZATION AND GENERAL COMBINING ABILITY EFFECTS FOR VARIOUS TRAITS IN EGG PLANT (*Solanum melongena* L.)

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ABSTRACT

The analysis of ten attributes for gene effects and morphological characteristics on basis of them per se performance were carried out involving 19 parent, 60 F1 and 60 F2 at Vegetable Research Station (CSAU&T, Kanpur) during Kharif season. Morphological features are very important attribute to preference the selection such as dwarf plant, early maturity, rounded fruits, attractive fruit colour and high yielding cultivars in egg plant. The present investigation the parents differed significantly in their general combining ability effects and none of them exhibited high general combining ability for all the characters. Among the female lines, days to flowering, days to marketable maturity, plant height, number of branches per plant, number of fruits per plant, plant spread and yield per plant were good general combiner in both the generations. Among the male lines, superior general combiners in both the generations were observed in all the ten characters.

KEYWORDS: Analysis of Variances, Morphological Features, Gene Effects

Among the vegetable crops, egg plant (*Solanum melongena* L.) is one of the most popular vegetables grown commercially in India. It belongs to the family Solanaceae and has high yielding potential with better adaptability to diverse agro-climatic conditions. Thompson and Kelly (1957) reported that brinjal is undoubtedly originate in India and a number of cultivars grown for long time depending upon the consumer's preference like yield, colour, size and shape. Bajaj *et al.* (1979) observed that round fruited brinjal have high polyphenol oxidase activity and glycoalkaloid content than long types. The oblong brinjal is rich in total water-soluble sugars while long fruited brinjal contain anthocyanin, phenols, glycoalkaloids, dry matter and amide proteins. Generally, a bitter taste of brinjal have high amount (20 mg per 100 gram) of glycoalkaloids, while 0.37 to 4.83 mg per 100 g of glycoalkaloids is suitable for edible purposes. Kirtikar and Basu (1957) found that white cultivars of brinjal have medicinal value and are beneficial to the diabetic patient. It also has to be an appetizer cardio tonic which beneficial *in Vata and Kapha*. In order to identify superior genotypes, general combining ability is a useful tool to select best general combining parents and it may be used as a parent in hybridization programme to exploit the heterosis in hybrid. Patil *et al.* (2000) reported the pattern of dominance and additive gene effects for better yield egg plant. The separate parent of best general combining ability will have to be sued for improvement of different traits studied suggested by Raghavaish and Joshi (1982). Therefore, the present study was conducted to estimate the genetic effect to determine combining ability of parents to develop hybrid vigour's through breeding programme.

MATERIALS AND METHODS

The present investigation was carried out in *Kharif* season at the Vegetable Research Station, Kalyanpur, C.S. A. University of Agriculture and Technology, Kanpur. The experiment comprising 19 parents and 60 F_1 and 60 F_2 was conducted in Randomized Block Design with three replications. Fifteen lines used as female parent with each of four testers used as male parent in line x tester fashion. For the emasculation prosses, flower buds are selected one day before in the evening time that about bloom next day. Pollination was done in next day after emasculation during 7:00 to 10:00 a.m. Pollinated flower buds were bagged with better paper and tagged along with necessary information. The fruits of parents, F_1s and F_2s were harvested after complete maturity to get parental and $F_1$and F_2 seeds. The seeds of parents and F_{1s} were shown in field with proper spacing in plant to plant and line to line. Five plants from each parent and F_1s and 10 plants from each F_2s in each replication were selected at random for recording data on days to flowering, days to marketable maturity, plant height, number of branched per plant, number of fruits per plant, length of fruit, fruit width, fruit weight, plant spread and yield per plant. Estimates of general combining ability variances were worked out as per methodology given by Kemthorne (1957) and Comstock and Robinson (1952).

RESULTS AND DISCUSSION

The analysis of variance for combining ability was done for all the characters are presented in Table 1 & 2. The analysis of variances due to treatments, parents, F_1s, F_2s, parents vr F_1s and F_1s vr F_2s showed highly significant for all the characters except days to marketable maturity due to F_1s vr F_2s and number of branches per plant due to parents vr F_1s. The study of combining ability effects along with mean performance is

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of crucial important to the breeders, because superior lines/cultivars are isolated for utilization in the subsequent breeding programme. Ranking of the good general combiners in F_1 and F_2 and over the generations for different characteristics is presented in Table 3. Among the female lines KS 253 and KS 247 for days to flowering; KS 247, KS 253 and KS 228 for days to marketable maturity; KS 262, KS 233, KS 219, ACC 8207, KS 250 and KS 253 for plant height; ACC 2623 for number of branched per plant; KS 228, KS 227 and KS 219 for number of fruits per plant; KS 262,KS 247 and KS 263 for plant spread and KS 219, KS 228, KS 263, KS 227 and KS 247 for yield per plant were good general combiners in both the generation along with superior *per se* performance. KS 224 for days to flowering and days to marketable maturity; T 3 and KS 224 for plant height; T 3 for number of branches per plant, number of fruits per plant, width of fruit and yield per plant, T 3 and AB 1 for fruit weight and AB 1, KS 224 and DBR 8 for plant spread among the male lines were superior general combiners along with high mean value in both the generations. Kumar and Ram (1987) also revealed that T 3 was best general combiner among the parents. Bhutani *et al.* (1980), Dixit *et al.* (1982), Kumar and Ram (1987), Mishra and Mishra (1990), Prasad *et al.* (1994), Kumar *et al.* (1996), Babu and Thirumurugan (2001) and Prasath *et al.* (2000) also reported similar result between general combining ability effects and *per se* performance.

Table 1: Morphological characteristic features of the genotypes/ cultivars in egg plant

Genotypes/ Cultivars	Characteristic Feature					
	Stem type	Branching behaviour	Flowering pattern	Fruit shape	Fruit colour	Yield behaviour
Female Lines						
KS 247	Semi-erect	sparse branching	early flowering	round fruited	purple colour	moderate yielder
KS 253	Erect	intermediate branching	early flowering	round fruited	purple colour	moderate yielder
KS 262	Erect	sparse branching	intermediate flowering	round fruited	purple colour	moderate yielder
KS 228	Erect	intermediate branching	medium in flowering	round fruited	purple colour	moderate yielder
KS 233	Erect	sparse branching	medium in flowering	round fruited	purple colour	low yielder
KS 250	Erect	sparse branching	medium in flowering	round fruited	purple colour	moderate yielder
KS 263	Semi-erect	sparse branching	medium in flowering	round fruited	purple colour	low yielder
KS 235	Erect	sparse branching	medium in flowering	round fruited	purple colour	Low to moderate yielder
KS 227	Bushy	sparse branching	medium in flowering	round fruited	purple colour	moderate yielder
ACC 5114	Semi-erect	sparse branching	medium in flowering	round fruited	purple colour	low yielder
ACC8204	Erect	sparse branching	Intermediate in flowering	round fruited	purple colour	low yielder
ACC 8206	Erect	sparse branching	early flowering	round fruited	purple colour	low yielder
ACC 8207	Semi-erect	sparse branching	medium in flowering	round fruited	purple colour	Low to moderate yielder
ACC 2623	Erect	profuse branching	medium in flowering	round fruited	purple colour	moderate yielder
Male Lines						
T 3	Spreading type	intermediate branching	late flowering	Fruit oblongish oval	purple colour	high yielder
AB 1	Erect	sparse branching	Medium flowering	round fruited	purple colour	high yielder
KS 224	Erect	sparse branching	early flowering	Fruit oblongish oval	purple colour	Medium to high yielder
DBR 8 *	Semi-erect	intermediate branching	Medium in flowering	round fruited	Dark purple colour	moderate yielder

*Compact plant and thick leaves of DBR 8 cultivar.

Table 2: Desirable parents based on per se performance with general combining ability effects for ten characters in egg plant

Characters		Superior parent based on per se performance	Good general combiners		Common parents based on per se performance and gca effects (F_1 and F_2)
			F_1	F_2	
Days to flowering	F	KS 219 (38.67), KS 253 (39.67), KS 247 (40.67), ACC 8206(46.67), KS 227 (51.67), KS 228 (52.67)	KS 253 (-4.71**), KS 247 (-4.218*)	KS 219 (-2.58**), KS 247 (-2.49**), KS 253 (-2.49**)	KS 253, KS 247
	M	KS 224 (49.67), DBR 8 (51.33)	KS 224 (-2.64**)	KS 224 (-1.74**)	KS 224
Days to marketable maturity	F	KS 219(51.33), KS 247 (54.33), KS 253 (55.00), KS 228 (68.00)	KS 247 (-6.96**), KS 253 (-6.21**), KS 228 (-3.21**), KS 235 (-1.62**)	KS 247 (-4.96**), KS 253 (-4.21**), KS 228 (-3.12**)	KS 247, KS 253, KS 228
	M	KS 224 (59.00), DBR 8 (65.33)	KS 224 (-3.29**)	KS 224 (-2.92**)	KS 224
Plant Height	F	KS 219 (59.73), KS 233 (63.339), KS 262 (65.60), KS 227 (66.73), ACC 8207 (71.60), KS 250 (72.87)	KS 262 (-8.06**), KS 233 (-6.44**), KS 227 (-6.41**), KS 228 9-5.02**), KS 219 (-3.56**), ACC 8207 (-2.94**), KS 250 (-2.36**), KS 253 (-1.84**), KS 235 (-1.74*)	KS 262 (-8.11**), KS 253 (-5.89**), KS 233 (-5.49**), KS 250 (-4.43**), KS 219 (-4.43**), ACC 8207 (-4.26**)	KS 262, KS 233, KS 219, ACC 8207, KS 250, KS 253
	M	KS 224 (66.47), DBR 8 (71.40)	KS 224 (-2.59**), T 3 (-1.99**)	T 3 (3.93**), KS 224 (-2.44**)	T3, KS 224
No. of branches per plant	F	ACC 2623 (10.87), KS 228 (8.53), KS 247 (8.37)	KS 219 (1.09**), KS 247 (1.09**)		
	M	T 3 (8.80), DBR 8 (8.60)	T 3 (1.33**)	T 3 90.73**)	T 3
No. of fruits per plant	F	KS 253 (15.37), KS 247 (15.30), KS 219 (14.64), KS 227 (14.49)	KS 228 (3.37**), KS 227 (3.11**), KS 263 (3.06**), KS 219 93.03**), KS 235 (1.71*)	KS 227 (3.39**), KS 228 (3.33**), KS 219 (2.31**), KS 247 (1.82**)	KS 228, KS 227, KS 219
	M	T 3 (16.52), DBR 8 (16.40)	T 3 (3.11**)	T 3 (2.04**)	T 3
Length of fruit	F	KS 235 (8.49), KS 227 (8.54), KS 250 (8.96)	KS 262 (-0.68**), KS 233 (-0.67)		
	M	DBR 8 (8.36), T 3 (9.09)	DBR 8 (-0.52**)	DBR 8 (-0.62**)	DBR 8
Width of fruit	F	ACC 5114 (8.82), KS 262 (8.24), KS 247 (8.33), KS 253 (8.13), KS 233 (8.01)	KS 263 (70**), KS 235 (0.55*)	ACC 2623 (0.86**)	
	M	AB 1 (9.21), T 3 (8.63)	T 3 (0.56**)	T 3 (0.52**)	T 3

Fruit weight	F	KS 250 (113.93), ACC 2623 (110.40), KS 263 (106.40)		ACC 8207 94.21**)	
	M	AB 1 (119.33), T 3 (113.40), KS 224 (109.20)	T 3 (10.41**), AB 1 (6.25**)	T 3 (7.85**), AB 1(6.24**)	T 3, AB 1
Plant spread	F	KS 262 (0.36), KS 233 (0.38), KS 263 (0.43), KS 228 (0.248, KS 235 (0.47), KS 247 (0.47), KS 253 (0.49), KS 250 (0.49), KS 227 (0.49)	KS 262 (-0.07**), KS 233 (-0.04**), KS 247 (-0.03**), KS 263 & KS 235 (-0.02**)	KS 247, KS 262 & KS 263 (-0.04**)	KS 262, KS 247, KS 263
	M		AB 1 (-0.07**), KS 224 (-0.06**), DBR 8 (-0.05**)	AB 1 (-0.06**), KS 224 9(-0.06**), DBR 8 (-0.03**)	AB 1, KS 224, DBR 8
Yield per plant	F	KS 219 (1.39), KS 227 (1.27), KS 253 (1.25), KS 247 (1.20)	KS 219 (0.43**), KS 228 (0.26**), KS 235 (0.25**), KS 263 (0.21**), KS 227 (0.20**), KS 247 (0.15**)	KS 219 (0.19**), KS 247 (0.19**), KS 228 (0.18**), KS 263 (0.17**), KS 227 (0.16**)	KS 219, KS 228, KS 263, KS 227, KS 247
	M	T 3 (1.95), AB 1 (1.75), KS 224 (1.61), DBR 8 (1.41)	T 3 (0.43**),	T 3 (0.21**)	T 3

Table 3: Analysis of variance for 10 matric traits involving parents, F_1s and F_2s in egg plant

Source of Variation	d.f.	Mean square									
		Days to flowering	Days to marketable maturity	Plant Height	No. of branches per plant	No. of fruits per plant	Length of fruit	Width of Fruit	Fruit weight	Plant spread	Yield per plant
Replications	2	13.88**	5.25	24.63**	3.34**	3.50	0.36	0.26	26.25	0.002	0.09**
Treatments	138	56.33**	103.29**	237.13**	6.29**	83.74**	2.26**	1.72**	322.11**	0.037**	0.78**
Parents	18	146.74**	333.45**	504.48**	4.59**	28.27**	2.07**	0.96	329.22**	0.045**	0.37**
F_1s	59	43.80**	73.80**	200.34**	7.92**	81.52**	2.53**	2.12**	347.18**	0.040**	0.73**
F_2s	59	38.82**	64.10**	172.61**	3.46**	50.17**	1.97**	1.56**	272.56**	0.028**	0.22**
Parents V*r* F_1s	1	99.53**	95.69**	1237.84**	0.61	1955.54**	1.96*	3.27**	1359.94**	0.009*	19.82**
F_1s V*r* F_2s	1	69.35**	0.69	960.48**	94.15**	352.09**	8.82**	1.39**	105.00**	0.227**	10.10**
Error	276	7.68	7.80	9.06	1.69	7.76	1.12	1.11	35.25	0.002	0.03

* Significant at 5 per cent probability level, ** Significant at 1 per cent probability level

High general combining ability effects for all the characters have economic importance and may be useful to screen out superior parents which has favourable alleles to the different component of yield. The gene effect such as additive and additive x additive components of gene action which represent the fixable genetic effect. Sprague (1966) and Gilbert (1967) studied that the additive parental effects as measured by general combining ability effects are of practical value to the plant breeders, since non-allelic interaction are unpredictable. As aforesaid parents having good general combining ability effects are superior to the rest for many characters, a multiple crossing programme or an intermating population involving all possible crosses among them subjected to biparental mating may be expected to offer the maximum promise in breeding for high yield. Selection for Economic traits in such a population is likely to result worthwhile gain the yield potential.

CONCLUSION

The present investigation was carried out to know the genetic architecture of yield contributing traits by computing variability, combining ability variances and effects involving fifteen lines (females) and four testers (males) as per procedure of Kempthorne (1957). The observations were recorded for 10 matric traits subjected to biometrical analyses as mentioned above. The results obtained on related aspects summarized here. The analysis of variance showed significant variation for most of all characters. None of the parents was found to be a good general combiner for all the characters. Overall, among females KS 219, KS 247 and KS 228 and among males T 3 and KS 224 were good general combiners for one or more characters in desirable direction. The ranking of the parents on the basis of general combining ability and per se performance was almost the same for most of the characters. The males, contributed maximum in comparison to females for plant spread, fruit weight and width of fruit in both the generations. For plant height, days to marketable maturity, number of fruits per plant and days to flowering maximum contribution were showed by females than males in both the generations. This method provides to combine the favourable gene or gene complexes by the use of series of multiple crosses which would supplement speedy recombination and also break genetic barriers, if present.

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