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INHERITANCE OF FRUIT YIELD AND ITS COMPONENTS IN SPONGE GOURD [*LUFFA CYLINDRICA* (ROEM). L.]

ST Sanandia, DR Mehta and VD Tarpara

Department of Horticulture, Junagadh Agricultural University, Junagadh-362 001 (India)

Summary

Six generation (P_1, P_2, F_1, F_2, BC_1 and BC_2) means of six crosses obtained by crossing eight inbred of sponge gourd were used to study the inheritance of fruit yield per vine and its component characters. All the characters studied showed non-allelic gene interaction indicating the presence of epistasis in determining their inheritance. The fruit characters *viz.,* vine length, number of branches per vine, fruit length, fruit girth, number of fruits per vine, average fruit weight and fruit yield per vine predominantly governed by dominance (h) and dominance x dominance (l) interaction effects which can be improved through heterosis breeding. However, additive x additive component was also predominant in few cases where it is possible to isolate transgrants in advance generations in such cases for fixing that particular character.

सारांश

नेनुआ के 6 संततियों (P_1, P_2, F_1, F_2, BC_1 और BC_2) में उपज एवं उसके संम्बधित गुणों के लिए अनुवांशिक अध्ययन किया गया। सभी गुणों के लिए इपिस्टैशिस की उपस्थिति पायी गयी। पौध लम्बाई, पौध शाखा, फल की लम्बाई, फल की संख्या, फल भार एवं उपज के लिए प्रभावी जीन की अधिकता पाई गयी। जो कि दर्शाता है कि इन गुणों के लिए शंकर किस्में विकसित की जा सकती है।

Introduction

The information on mode of inheritance of various yield attributes is helpful in the development of suitable superior genotypes in crops. Hybrid offers great scope in increasing yield of sponge gourd [*Luffa cylindrica* (Roem). L.], a highly remunerative vegetable crop. The methodology for accumulation of the favourable genes can be checked out based on the gene action of the characters. In the present investigation, gene action of length of vine, number of branches per vine, fruit length, fruit girth, number of fruit per vine, average fruit weight and fruit yield per vine were analyzed.

Materials and Methods

Eight promising genotypes/cultivars of diverse nature *viz.,* CHSG-2, JSGL-46, JSGL-71, JSGL-51, JSGL-39 JSGL-23, Pusa Chikni and NSG-28 were used as parental lines in the present investigation. The trial was conducted at the Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh during *Kharif*, 2003. The experiment material consisted of six basic generations (P_1, P_2, F_1, F_2, BC_1 and BC_2) of six crosses namely CSHG-2 x JSGL-46 (Cross-I), JSGL-71 x JSGL-46 (Cross-II), JSGL-71 x JSGL-51 (Cross-III), Pusa Chikni x JSGL-51 (Cross-IV), NSG-28 x JSGL-39 (Cross-V) and NSG-28 x JSGL-23 (Cross-VI) involving eight genotypes. The experiment was carried out in RBD with three replications. The plants were spaced at 2.0 m between rows and 1.0 m within a row. The vines were trained to horizontal trellises. All the recommended cultural practices were adopted to raise a healthy crop. In each replication, observations were reordered on five plants for each parental lines and their F_1 crosses, 40 plants for each F_2 and 20 plants for each BC_1 and BC_2 generations. The family mean values for P_1, P_2, F_1, F_2, BC_1 and BC_2 were calculated for each cross in each replication.

The observations were recorded on seven characters (Table-1) to study various statistical parameters used in this investigation. The estimate of six genetic parameters *viz.*, m (mean), d (additive), h (dominance), i (additive x additive), j (additive x dominance) and l (dominance x dominance) were calculated based on the formula suggested by Hayman (1958).

Results and Discussion

The analysis of variance for generation mean analysis revealed significant differences among the six basic generation means for all the characters in most of the crosses except number of branches per vine in cross II and III and fruit girth in cross IV and V which were dropped from the further analysis owing to non-significant differences among the generation means. The character wise results of scaling tests (Table-1) indicated that scaling test A, B and C were significant for all the characters for all the crosses except scale B in cross III and VI and scale C in cross IV for length of vine; scale A in cross IV and V and scale C in cross V for number of branches per vine; scale A in cross II, V and VI; scale B in cross III, IV and VI and scale C in cross I and III for fruit length; scale B in cross II for fruit girth; for scale A in cross IV, scale B in cross II and scale C in cross II, III and VI for number of fruit per vine; scale A in cross III and IV, scale B in cross V and scale C in cross I, II and VI for fruit weight and scale B in cross VI and scale C in cross V for fruit yield per vine. These results indicated that epistatic interaction was noticed almost all the crosses for all the seven characters studied as evident from significant for any one or more of individual scaling test and confirmed by c^2 test of joint scaling test.

Table 1: Estimation of scaling and joint scaling tests for various characters in sponge gourd

Characters	Cross No	A	B	C	Joint $\chi^2_{(3)}$
Length of vine (m)	I	-3.53 ± 0.56**	-5.44 ± 0.47**	-8.72 ± 1.01*	23.08**
	II	-5.65 ± 0.32**	-8.41 ± 0.23**	-11.42 ± 0.91**	16.89**
	III	-2.43 ± 0.20**	-0.14 ± 0.20	-3.11 ± 0.61**	16.30**
	IV	-2.31 ± 0.17**	-1.10 ± 0.14**	1.46 ± 0.79	23.40**
	V	-1.44 ± 0.17**	0.92 ± 0.16**	2.56 ± 0.93**	13.30**
	VI	-1.91 ± 0.15**	0.23 ± 0.22	5.17 ± 0.76**	22.80**
Number of branches per vine	I	-6.93 ± 0.50**	-1.47 ± 0.40**	-4.73 ± 1.08**	19.15**
	IV	0.47 ± 0.46	-3.53 ± 0.42**	-6.20 ± 0.85**	13.21**
	V	-0.20 ± 0.37	1.80 ± 0.38**	0.13 ± 0.57	29.36**
	VI	-1.07 ± 0.31**	-5.20 ± 0.34**	-7.27 ± 0.72**	27.08**
Length of fruit (cm)	I	-14.06 ± 0.49**	-7.13 ± 0.89**	-1.18 ± 2.60	85.72**
	II	-4.19 ± 3.92	-7.32 ± 0.81**	-3.11 ± 1.44*	83.32**
	III	-8.06 ± 0.95**	-0.24 ± 0.74	0.14 ± 1.79	72.67**
	IV	-8.12 ± 0.94**	-1.15 ± 1.00	-5.94 ± 2.03**	76.27**
	V	0.93 ± 1.08	6.25 ± 1.10**	12.29 ± 2.35**	56.05**
	VI	0.61 ± 0.97	0.69 ± 1.34	2.90 ± 1.41*	8.32*
Fruit girth (cm)	I	1.74 ± 0.41**	-2.35 ± 0.36**	-1.78 ± 0.64**	71.13**
	II	-2.37 ± 0.44**	-0.78 ± 0.43	-3.42 ± 0.63**	42.91**
	III	1.64 ± 0.40**	0.93 ± 0.29**	1.01 ± 0.51*	26.46**
	VI	0.83 ± 0.35*	1.19 ± 0.38**	3.07 ± 0.60**	30.88**
Number of fruit per vine	I	-6.40 ± 0.67**	-3.00 ± 0.79**	-5.40 ± 2.43*	95.22**
	II	-5.87 ± 1.34**	-2.87 ± 1.79	-13.40 ± 2.82	42.10**
	III	-4.60 ± 0.65*	-5.00 ± 0.49**	4.33 ± 3.06	14.87**
	IV	-0.40 ± 0.94	-2.87 ± 1.16*	-7.60 ± 2.33**	16.20**
	V	-4.60 ± 1.22**	-1.40 ± 0.60*	3.80 ± 1.81*	24.96**
	VI	-4.20 ± 0.85**	-2.13 ± 0.78**	-2.87 ± 2.51	31.09**
Average fruit weight	I	46.02 ± 3.88**	-17.62 ± 3.70**	-1.05 ± 13.44	222.84**
	II	-80.86 ± 11.47**	-56.25 ± 11.49**	-48.47 ± 24.67	107.74**
	III	-10.50 ± 6.24	36.21 ± 3.65**	33.19 ± 10.26**	114.18**
	IV	-4.89 ± 4.86	21.03 ± 5.31**	43.13 ± 9.64**	36.88**
	V	-51.99 ± 7.42**	-2.49 ± 5.19	-36.12 ± 13.51**	54.54**
	VI	-20.57 ± 6.37**	17.63 ± 3.94**	-16.64 ± 10.54	36.15**
Fruit yield per vine	I	-0.21 ± 7.73**	-0.61 ± 0.11**	-0.89 ± 0.27**	42.71**
	II	-2.05 ± 0.24**	-1.36 ± 0.24**	-2.72 ± 0.52**	70.72**
	III	-0.83 ± 8.99**	-0.15 ± 6.00*	6.65 ± 0.30*	10.28**
	IV	-0.15 ± 0.08	-0.05 ± 0.10**	-0.49 ± 0.19*	9.70*
	V	-1.35 ± 0.10**	-0.21 ± 0.08*	-0.05 ± 0.29	18.63**
	VI	-0.86 ± 0.11**	-0.03 ± 8.81	-0.70 ± 0.30*	60.61**

*, ** Significant at P=0.05 and P= 0.01, respectively
χ^2 = Chi Square value at 3 degree of freedom.

Length of vine: Inheritance of vine length indicated the importance of all the types of gene effects except (h) in cross II and (i) in cross III (Table-2). The absolute magnitude of both (d) and (h) indicated that dominance (h) effect attributed much as compared to additive (d) effect. Among the epistatic gene effects, additive x additive (i) and dominance x dominance (l) gene effects also contributed higher as compared to additive x dominance (j) effect. Except cross I, all other crosses showed duplicate epistasis. These results suggested that substantial gain for this trait can be more through heterosis breeding. Sirohi and Chaoudhary (1979)and Celine and Sirohi (1998) also observed duplicate epistasis, dominance and as well as dominance x dominance effects in the inheritance of vine length in bitter gourd.

Number of branches per vine: All the types of gene effects were significant for number of branches per vine in all the four crosses except (d), (h) and (j) in cross VI (Table-2). Greater contribution of dominance (h) and dominance x dominance (l) gene effects were observed for the inheritance of this trait. However, the absolute magnitude of dominance x dominance (l) effect was greater than rest of the gene effects. While analysing the type of epistasis, it was found that in all the crosses, duplicate epistasis was present for number of branches per plant. Hence, heterosis breeding may be advantageous for obtaining higher gain for this trait. Non-additive gene effects were reported by Sahani *et al* (1987) and Kadam (1989) in ridge gourd which confirmed present findings.

Fruit length: As regard to various gene effects, variable results were obtained for various crosses (Table-2). In majority of cases, additive (d), additive x dominance (j) and dominance x dominance (l) gene effects were significant and important for inheritance of fruit length. The absolute value of (l) was greater than rest of the gene effect for cross I to IV indicating major role of (l) effect in these crosses. Complementary epistasis was exhibited by cross IV and V, while duplicate epistasis was observed in rest of the crosses. Both additive and non-additive gene effects were recorded by Khattra *et al* (2000) and Rajeswari and Natrajan (2002) in bitter gourd. While epistatic gene effects were reported by Tewari *et al* (1998) in bitter gourd and Singh *et al* (2003) in bottle gourd.

Fruit girth: Among the interacting crosses, both additive (d) and dominance (h) gene effects were significant in cross I and III with propordance of dominance in both the crosses (Table-2). The contribution to total epistatic variation is more by (j) in cross I; (j) and (l) in cross II; (i) and (l) in cross III and only (i) in cross VI. Complementary epistasis was noticed in cross II and VI, while duplicate epistasis was recorded in cross I and III for this trait.

Number of fruits per vine: Non-allelic interaction was noticed for this fruit in all the six crosses (Table-2). The additive effect (d) was significant in cross I and III, while dominance gene effect (h) was significant in all crosses except cross IV and VI. When additive and dominance effects were compared, dominance effect made a major contribution to the inheritance of number of fruits per plant. The total epistatic effects exceeded additive and dominance effects in all the crosses. Out of non-allelic interaction effects, dominance x dominance (l) followed by additive x additive (i) gene effects contributed more towards more number of fruits per vine. Except in cross II, duplicate epistasis was noticed in all the crosses. Tewari *et al* (1998) and Singh *et al* (2003) in bitter gourd and Pitchaimuthu and Sirohi (1997) in bottle gourd reported all the three types of epistatic effects which confirmed the present findings.

Average fruit weight: Epistatic gene effects (Table-2) played a major role in the inheritance of average fruit weight as compared to main effects i.e. (d) and (h). Additive gene effect (d) in cross I and dominance gene effect (h) in cross I, II and III were significant but the contribution of both effects were lowered as compared to (i), (j) and (l). In addition to significance of (j) component, (i) and (l) components in cross I and II, (i) in cross IV and (l) in cross V were also significant. Except in cross III, duplicate epistatic was observed for all the remaining five crosses. Non-additive gene effects were observed by Shaha *et al* (1999) and Rao *et al* (2000) in ridge gourd. Duplicate type of epistasis was also observed by Ram *et al* (1997).

Fruit yield per vine: Non-allelic interaction was observed for this trait in all the crosses (Table-2). Additive (d) gene effect in cross I, II and VI and dominance (h) gene effect in cross II, III, IV and V were significant for this trait. Either one or two epistatic gene effects was contributed towards increase in fruit yield per vine. The absolute magnitude of all the gene effects indicated that dominance (d) and dominance x dominance (l) components were more important in the expression of fruit yield per vine in all these crosses. Duplicate epistasis was involved in controlling fruit yield per plant in all the crosses except cross I. Non-additive gene effects in the expression in this trait was reported by Rao *et al* (2000) in ridge gourd. Celine and Sirohi (1998) observed duplicate

Table 2: Estimation of gene effects for various characters in sponge gourd

Cross No	m	(d)	(h)	(i)	(j)	(l)	Epistasis
			Length of the vine (m)				
I	2.96±0.25**	-0.61±0.24*	13.40±1.21**	-25.20±1.21**	0.95±0.35**	9.22±1.74**	C
II	3.23±0.22**	0.43±0.18*	-1.64±0.97	-2.04±0.97*	13.77±0.19**	16.69±1.16**	D
III	2.66±0.15**	-0.28±0.21*	-1.47±0.64*	0.54±0.63	-1.14±0.13**	2.03±0.78*	D
IV	4.03±0.19**	0.21±0.09**	-5.30±0.80**	-4.88±0.79**	-0.60±0.10**	8.30±0.86**	D
V	3.52±0.23**	-0.18±0.09*	-2.95±0.94**	-2.08±0.94*	-1.18±0.11**	2.59±1.00**	D
VI	4.61±0.19**	-0.66±0.12**	-7.42±0.78**	-6.84±6.78**	1.07±0.13**	8.52±0.90**	D
			Number of branches per vine				
I	4.57±0.23**	-3.00±0.23**	-5.57±1.07**	-3.67±1.03**	-2.73±0.27**	12.07±1.41**	D
IV	3.50±0.13**	1.63±0.19**	5.17±0.74**	3.13±0.66**	2.00±0.22**	-6.67±1.15**	D
V	4.03±0.29**	-0.47±0.20*	3.20±0.59**	1.47±0.55**	-1.00±0.22**	-3.07±1.00**	D
VI	2.95±0.15**	0.01±0.17	-1.07±0.73	1.00±0.70	2.07±0.20**	5.23±0.99**	D
			Length of fruit (cm)				
I	22.79±0.63**	-10.05±0.45**	-12.84±2.69**	-2.00±2.67	-3.46±0.47**	41.20±3.16**	D
II	28.50±0.34**	3.74±1.99	-6.27±4.21	-8.40±4.21*	1.56±2.00	19.91±8.09*	D
III	25.28±0.42**	0.77±0.56	-10.19±2.05**	-8.44±2.03**	-3.91±0.58**	16.74±2.86**	D
IV	23.44±0.46**	-1.43±0.57*	0.31±2.20	-3.34±2.15	-3.48±0.64**	12.62±3.06**	C
V	24.91±0.57**	3.33±0.74**	-3.45±2.74	-5.12±2.73	-2.67±0.76**	-2.06±3.78	C
VI	23.76±0.51**	2.73±0.79**	-1.70±2.59	-1.61±2.60	-4.03±0.81**	0.32±3.81	D
			Fruit girth (cm)				
I	12.17±0.14**	0.75±0.24**	2.06±0.76**	1.16±0.74	2.04±0.26**	-0.55±31.15	D
II	12.50±0.11**	-0.19±0.25	1.24±0.70	0.27±0.66	-0.80±0.27**	2.88±1.20*	C
III	11.94±0.11**	0.69±0.23**	1.65±0.66*	1.57±0.65*	0.35±0.24	-4.14±1.05**	D
VI	12.80±0.13**	0.11±0.22	-0.60±0.70	-1.65±0.68*	-0.18±0.24	-0.96±1.08	C
			Number of fruits per vine				
I	13.43±0.58**	-2.20±0.45**	-2.10±2.53*	-4.00±250	-1.70±0.47**	13.40±3.02**	D
II	14.95±0.69**	-0.63±1.10	9.27±3.54**	4.67±3.53	-1.50±0.71*	4.07±5.22	C
III	14.65±0.75**	1.13±0.35**	-16.80±3.11**	-13.93±3.10**	0.20±0.39	23.53±3.36**	D
IV	12.95±0.57**	0.27±0.71	4.50±2.70	4.33±2.69	2.23±0.74**	-1.07±3.69	D
V	13.65±0.44**	0.33±0.66	-10.27±2.22**	-9.80±2.21**	-1.60±0.67*	15.80±3.20**	D
VI	14.75±0.62**	-0.43±0.55	-2.40±2.71	-3.47±2.70	-1.03±0.56	9.80±3.33**	D
			Average fruit weight (g)				
I	119.50±3.17**	9.75±2.09**	38.48±13.53**	29.45±13.34*	31.82±2.22**	-57.85±15.84**	D
II	126.39±2.83**	-0.58±2.35	-87.35±16.43**	-88.44±12.24**	-12.30±2.46**	225.55±26.40**	D
III	128.91±2.06**	1.25±2.24	-25.95±9.86*	-7.48±9.37	-23.35±3.44**	-18.23±13.61	C
IV	121.59±2.30**	-1.07±3.36	-14.26±11.48	-26.99±11.39*	-12.96±3.54**	10.86±16.54	D
V	119.46±3.29**	4.34±4.38	-9.55±15.87	-18.35±15.80	-24.75±4.40**	72.83±22.13**	D
VI	122.19±2.50**	3.63±3.50	7.19±12.32	13.70±12.20	-19.10±3.61**	-10.76±17.52	D
			Fruit yield per vine (kg)				
I	1.58±0.07**	-0.16±0.06**	0.30±0.29	0.04±0.29	0.20±0.06**	0.86±0.37*	C
II	1.80±0.08**	-4.32±0.10**	-6.04±0.44**	-0.70±0.39	-0.35±0.10**	4.11±0.66**	D
III	1.82±0.27**	0.15±3.97	-2.24±0.30**	-1.63±0.30**	-0.34±5.24	2.60±0.34**	D
IV	1.51±0.05**	0.02±0.06	0.51±0.22*	0.29±0.22	-0.25±0.06**	-0.09±0.31	D
V	1.64±0.29**	4.73±6.23	-1.52±0.32**	-1.52±0.32**	-0.57±6.40	3.08±0.39**	D
VI	1.78±0.35**	-25.33±6.98**	-0.16±0.33	-0.19±0.33	-0.42±7.07	1.07±0.41**	D

*, ** Significant at P=0.05 and P= 0.01, respectively, D = Duplicate epistasis, C = Complementary epistasis

epistasis in bitter gourd. However, Mishra *et al* (1998) also noticed complementary epistasis for fruit yield per vine in bitter gourd.

In general, the magnitudes of dominance (h) effect was noticed to be fairly large than additive (d) effect for majority of the characters in most of the crosses. Thus, it was concluded that dominance gene effect played an important role in determining fruit characters in sponge gourd. Among the epistasis interactions, the major role of dominance x dominance (l) followed by additive x additive (i) interactions was observed for fruit yield per vine and fruit related attributes. Epistasis gene effects exceeded the additive and the dominance effects in all the crosses in most of the characters. As evident from the results of present investigation, since non-additive gene effects contributed more towards the inheritance of fruit yield and its component traits, heterosis breeding should be appropriate for their improvement in this crop. However, additive x additive component was also predominant in few crosses, there it is possible to isolate transgresses sergeants in advance generations in such crosses for fixing that character.

References

Celine VA and Sirohi PS (1998). Generation mean analysis for earliness and yield in bitter gourd *(Monordica charantia* L.). Veg. Sci. 25(1): 51-54.

Hayman BI (1958). The separation of epistatic form additive and dominance variation in generation means. Heredity. 12: 371-390.

Kadam PY (1989). Heterosis studies in ridge gourd [*Luffa acutangula* (Roxb.)L.]. Unpublished Ph.D. thesis submitted to Mahtma Phule Krishi Vidyapeeth, Rahuri, India.

Khattra AS, Singh R and Thakur JC (2000). Combining ability studies in bitter gourd in relation to line x tester crossing system. Veg. Sc. 27(2): 148-151.

Mishra HN, Mishra R S Parhi, G and Mishra S N (1998). Diallel analysis of variability in bitter gourd (*Momordica charantia* L.). Indian J. of Agric. Sci. 68(1): 18-20.

Pitchaimuthu M and Sirohi, PS (1997).Genetic analysis of fruit characters in bottle gourd [*Legenaria siceraria* (stanll)]. Journal of Genetic and Breeding. 51(1): 33-37.

Rajeswari KS and Natarajan S (2002). Genetics and inheritance of yield and its components in bitter gourd (*Momordica charantia* L.). South Indian Hort. 50(1-3): 82-90.

Ram D, Kalloo G and Singh M (1997). Inheritance of quantitative characters in bitter gourd (*Momordia charantia* L.). Veg. Sci. 24(1): 45-48.

Rao, BN, Venkata Rao P and Reddy YN (2000). Combining ability studies in ridge gourd [*Luffa acutangula* (Roxb.) L.]. Indian J. Trop. Agric. 18(2): 141-146.

Sahani GP, Singh RK and Saha BC (1987). Genotypic and phenotypic variability in ridge gourd. Indian J. Agric. Sci. 59(9): 666-668.

Shaha SR, Kale PN and Navale PA (1999). Combining ability analysis in ridge gourd. J. Maharastra Agric. Univ. 24 (2) : 133-135.

Singh PP, Singh SP and Singh PK (2003). Triple test-cross analysis for yield and some component characters in bottle gourd. Veg. Sci. 30(2): 135-137.

Sirohi PS and Choudhury B (1979). Gene effect in bitter gourd (*Momordica charuntia* L.) Veg. Sc*i*.6(2): 106-112.

Tewari D, Ram HH and Jaishwal HR (1998). Gene effects for various horticultural traits in bitter gourd (*Momordica charantia* L.). Veg. Sci. 25(2): 159-161.