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GENETIC DISTANCE AND HETEROSIS IN INTERSPECIFIC CROSSES OF *CAPSICUM*

K. Krishnakumari and K. V. Peter

College of Horticulture, Vellanikkara 680654, Kerala, India

The genus *Capsicum* to which chilli belongs has two main sources of considerable importance *Capsicum annuum* L. and *Capsicum frutescens* L. *Capsicum frutescens* is valued for its high pungent principle, capsaicin. This species is also the source of resistance to viral diseases, leaf curl and mosaic complex. The present study aims to amalgamate desirable characteristics of the two species in F_1 hybrid level.

Materials and Methods

The materials comprised of two lines *of Capsicum annuum L.* and three lines of *Capsicum frutescens* L. The *Caps/cum annuum* lines were Jwala and K2 and *Capsicum frutescens* lines were White Kanthari, Green Chuna and Ornamental Type. These five lines were chosen from a germplasm collection maintained at the Department of Olericulture, Kerala Agricultural University, Vellanikkara, Trichur. Hybridization was attempted by taking initially *Capsicum annuum* lines Jwala and K2 as female and *Capsicum frutescens* lines White Kanthari, Green Chuna and Ornamental Type as male parents. Reciprocal F1 hybrids were also synthesised, Out of the 12 cross combinations, only 10 were successful. They were Jwala x White Kanthari, Jwala x Green Chuna, Jwala x Ornamental Type, K2 x White Kanthari. K2 x Green Chuna, K2xJwala, Green Chuna x K2, Ornamental TypexJwala and Ornamental Type x K2. They were grown during May-September 1983 in a randomised block design with three replications. Five plants were randomly tagged in each block and observations were recorded on characters like plant height, primary branches/plants, days to flower, days to first green fruit harvest, daysto maturity, fruits/plant, green fruit yield/plant, dry fruit yield/plant, seeds/fruit and seed yield/plant. The parents and hybrids were analysed for oleoresin content. Heterosis was estimated as per Briggle (1963) and Hayes *et al.* (1965). The genetic distance between the species *Capsicum annuum* and *Capsicum frutescens* was calculated considering plant height, days to flower, green fruit yield/plant and seeds/fruit. The method of Mahalanobis (1928) was followed to calculate the genetic distance.

Results and Discussion

The five parental lines and ten F1 hybrids were significantly different for plant height, days to flower, days to first harvest, days to maturity, fruits/plant, green fruit yield/plant, seeds/fruit and seed yield/plant (Table 1). The parental lines showed significant differences for plant height, primary branches/plant, days

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Table 1

Mean performance of five chilli lines and ten F1 hybrids

	Characters									
	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10
Capsicum annuum										
1 (Jwala)	28.17	2.23	86.67	122.67	143.33	**11.43**	22.67	4.43	55.33	**11.77**
2 (K2)	32.80	2.17	86.00	**121.00**	141.67	12.70	26.50	5.13	60.00	10.97
Capsicum frutescens										
3 (White Kanthari)	47.97	2.27	88.30	126.67	148.33	19.43	38.13	7.33	33.33	11.80
4 (Green Chuna)	50.27	2.10	89.00	124.67	145.33	**21.03**	25.20	4.77	18.00	8.70
5 (Ornamental Type)	**41.77**	1.80	87.30	127.33	148.00	15.63	32.37	6.23	48.33	22.40
F_1 hybrids										
1x3	38.27	2.13	77.67	**114.00**	134.00	13.10	24.60	4.97	53.67	12.53
1x4	39.57	2.07	78.67	111.67	127.33	14.70	27.77	6.27	58.00	**11.07**
1x5	36.63	2.30	80.33	114.33	133.67	24.23	48.80	9.73	62.67	18.33
2x3	**41.42**	2.23	76.00	**110.00**	130.33	16.83	29.57	6.67	54.33	11.67
2x4	41.87	2.30	76.30	109.67	129.00	17.43	32.37	6.77	59.00	10.87
2x5	41.73	2.30	75.67	109.00	128.33	23.67	**48.17**	9.50	56.67	16.77
4x1	58.53	2.13	77.67	**111.33**	132.00	26.62	32.45	6.70	18.00	**11.93**
4x2	59.93	2.23	75.00	**112.00**	132.00	28.20	36.37	6.80	18.33	10.90
5x1	46.87	2.20	76.30	**110.00**	130.00	25.03	48.47	9.67	54.67	17.27
5x2	47.40	2.07	79.30	**115.33**	135.33	26.80	52.63	10.47	47.00	17.33
SEm	1.96	0.10	1.36	0.97	1.52	1.48	3.72	0.64	1.46	0.44
CD (0.05)	5.69	3.04	3.94	2.80	4.41	6.04	7.88	5.89	4.22	1.27

X1=plant height (cm). X2 = Primary branches/plant, X3 = days to flower, X4 = days to first harvest, X5 = days to maturity, X6= fruits/plant, X7 = Green fruit yield/plant (g), X8 = dry fruit yield/plant (g), X9 = seeds/fruit, X10 = seed yield/plant (g)

Table 2

Interspecific F_1 heterosis

Parents and hybrids	Plant height			Days to flower		
	Mean (cm)	Percentage increase or decrease over		Mean	Percentage increase or decrease over	
		Better parent	Mid parent		Better parent	Mid parent
1 (Jwala)	28.17			86.67		
2 (K2)	32.80			86.00		
3 (White Kanthari)	47.97			88.30		
4 (Green Chuna)	50.27			89.00		
5 (Ornamental type)	41.77			87.30		
1x3	38.27	-20.22 xx	0.53	77.67	-10.38 xx	-11.22 xx
1x4	39.57	-21.29 xx	0.89	78.67	- 9.23 xx	-10.44 xx
1x5	36.63	-12.31 xx	4.75	80.33	- 7.31 x	- 7.66 xx
2x3	41.42	-13.65 x	2.55	76.00	-11.63 xx	-12.79 xx
2x4	41.87	-16.71 xx	0.79	76.30	-11. 28 x	-12.80 xx
2x5	41.73	- 0.10	11.91 xx	75.67	-12.01 xx	-12.67 xx
4x1	58.53	16.43 xx	49.24 xx	77.67	-10.38 x	-11.58 xx
4x2	59.93	19.22 xx	44.27 xx	75.00	-12.79 xx	-14.29 xx
5x1	46.87	12.21 x	34.03 x	76.30	-11.96 xx	-12.29 xx
5x2	47.40	13.48 x	27.11 xx	79.30	- 7.79 xx	- 8.48 xx
CD (P=0.05)	5.69			3.94		

Table 2 (continued)

Parents and hybrids	Days to first harvest			Days to maturity		
	Mean	Percentage increase or decrease over		Mean	Percentage increase or decrease over	
		Better parent	Mid parent		Better parent	Mid parent
1	122.67			143.33		
2	121.00			141.67		
3	126.67			148.33		
4	124.67			145.33		
5	127.33			148.00		
1x3	114.00	- 7.07 xx	- 8.56 xx	134.00	- 6.51 xx	- 8.11 xx
1x4	111.67	- 8.95 xx	- 9.70 xx	127.33	-11.16 x	-11.78 x
1x5	114.33	- 6.80 xx	- 8.54 xx	133.67	- 6.74 xx	-12.14 xx
2x3	110.00	- 9.09 xx	-11.18 xx	130.33	- 8.00 xx	-10.12 xx
2x4	109.67	- 9.36 xx	-10.72	129.00	- 8.94 xx	-10.10 xx
2x5	109.00	- 9.91 xx	-12.22 xx	128.33	- 9.42 xx	-11.40 xx
4x1	111.33	- 9.24 xx	- 9.98 xx	132.00	- 7.90 xx	- 8.54 xx
4x2	112.00	- 7.44 x	- 8.82 xx	132.00	- 6.83 x	- 8.01 x
5x1	110.00	-10.33 xx	-12.00 xx	130.00	- 9.30 xx	-10.76 xx
5x2	115.33	- 4.69	- 7.12	135.33	- 4.48	- 6.57
CD (0.05)	2.80			4.41		

Table 2 (continued)

Parents and hybrids	Fruits/plant			green yield/plant		
	Mean	Parents increase or decrease over		Mean (g)	Percentage increase or decrease over	
		Better parent	Mid parent		Better parent	Mid parent
1	11.43			22.67		
2	12.70			26.50		
3	19.43			38.33		
4	21.03			25 20		
5	15.63			32.37		
1x3	13.10	-32.58 xx	-15.10 xx	24.60	-35.80 xx	-19.34 xx
1x4	14.70	-30.10 xx	- 9.43 xx	27.70	10.20 x	16.00 xx
1x5	24.23	55.02 xx	79.08 xx	48.80	50.76 xx	77.33 xx
2x3	16.83	-13.38 xx	4.73 x	29.57	-22.85 xx	- 8.79
2x4	17.43	-17.12 xx	3.32 x	32.27	21.27 xx	24.95 xx
2x5	23.67	51.44 xx	67.04 xx	48.17	48.81 xx	63.62 xx
4x1	26.62	26.58 xx	64.02 xx	32.45	28.77 xx	35.54 xx
4x2	28.20	34.09 xx	67.56 xx	36.37	37.25 xx	40.70 xx
5x1	25.03	60.14 xx	85.00 xx	48.47	49.74 xx	76.13 xx
5x2	26.80	71.47 xx	89.13 xx	52.63	65.59 xx	78.77 xx
CD (0.05)	5.04			7.88		

Table 2 (continued)

Parents arid hybrids	Seed/fruits			Seed yield/plant		
	Mean	Percentage increase or decrease over		Mean (g)	Percentage increase or decrease over	
		Better parent	Mid parent		Better parent	Mid parent
1	55.33			11.77		
2	60.00			10.97		
3	33.33			11.80		
4	18.00			8.70		
5	48.33			22.40		
1x3	53.67	- 3.00	21.07 xx	12.53	6.19 xx	6.28 xx
1x4	58.00	4.83	58.17 xx	11.07	- 5.94 xx	9.11 xx
1x5	62,67	13.27 xx	20.91 xx	18.33	-18.17 xx	7.26 xx
2x3	54.33	- 9.45 xx	16.41 xx	11.67	- 1.10	2.46 xx
2x4	59.00	- 1.67	51.28 xx	10.87	- 0.91 x	10.47 xx
2x5	56.67	- 5.55 x	4.62 x	16.77	-25.13 xx	0.48
4x1	18.00	-67.44 xx	-50.91 xx	11.93	1.36	16.50 xx
4x2	18.33	-69.45 xx	-53.00 xx	10.90	- 0.64	10.77 xx
5x1	54.67	- 1.19	5.48 x	17.27	-22.90 xx	1.05
5x2	47.00	-21.67 xx	-13.24	17.33	- 22.63 xx	3.83 xx
CD (0.05)	4.22			1.27		

x Significant at P = 0.05 xx Significant at P = 0.01

Table 3

Oleoresin content of five parental lines and ten F_1 hybrids

Genotypes	Oleoresin content (% on dry weight basis)
1 (Jwala)	16.83
2 (K_2)	14.47
3 (White Kanthari)	10.10
4 (Green Chuna)	13.70
5 (Ornamental type)	13.80
1x3	13.21
1x4	14.10
1x5	16.60
2x3	11.43
2x4	12.27
2x5	10 00
4x1	13.90
4x2	12.01
5x1	15.37
5x2	13.70

Table 4

Genetic distance (D^2) between two varieties of *Capsicum annuum* and three varieties of *Capsicum frutescens*

Parents	White Kanthari	Green Chuna	Ornamental type
Jwala	6.70	10.69*	2.19
K_2	5.53	9.54*	1.49

X^2 (4df) = 9.49

Significant at P = 0.05

to first harvest, days to maturity, fruits/plant, seeds/fruit and seed yield/plant. They were not different for days to flower. The hybrids were significantly different for plant height, days to first harvest, days to maturity, fruits/plant, green fruit yield/plant, seeds/fruit and seed yield/plant. Variances due to parents vs. F1 hybrids were significant for plant height, days to flower, days to first harvest, days to maturity, fruits/plant, green fruit yield/plant, seeds/fruit and seed yield/plant.

Interspecific F1 heterosis over better mid-parental values was calculated (Table 2). The plant height of four F1 hybrids, Green Chuna x Jwala (58.51 cm), Green Chuna x K2 (59.9 cm), Ornamental Type x Jwala (46.94cm) and Ornamental Type x K2 (47.4 cm) was more than their taller parents. All hybrids flowered earlier

than the early parent. Green Chuna x K2 was the earliest (74 days). Significant heterobeltiosis was observed in all hybrids except Ornamental Type x K2 for days to first harvest. K2 x Ornamental Type took only 109 days to first harvest. Ornamental Type x K2 was the latest (115 days). All hybrids except Ornamental Type x K2 matured earlier than the early parents. Jwala x Green Chuna took 127 days to mature. Ornamental Type x K2 took the maximum of 135 days. Ornamental type x K2 yielded 27 fruits/plant showing heterosis to an extent of 71.47% over better parent. Ornamental Type x K2 yielded 52.63 g of green fruit/plant.

Being interspecific hybrids, the yield levels were not substantially higher for their direct use. These hybrids could be utilised to evolve chilli lines possessing desirable characteristics of *Capsicum frutescens.*

The parents and hybrids were analysed for oleoresin content (Table 3). Among parents, maximum oleoresin content was in Jwala (16.83%) and minimum in White Kanthari (10.1 %). The F1 hybrids with higher oleoresin were Jwala x Ornamental Type (16.6%) followed by Ornamental Type x Jwala (15.37%).

The genetic distances between lines *Capsicum annuum* and *Capsicum frutescens* were worked out (Table 4). Jwala and Green Chuna were the farthest ($D^2 = 10.69$). K2 and Ornamental Type were the nearest ($D^2 = 1.49$). Plant height contributed maximum towards genetic distance (80%). It was followed by seeds/fruit (20%). Days to flower and green fruit yield/plant did not contribute to divergence.

Summary

Significant heterosis was observed for plant height, days to flower, days to first harvest, days to maturity, fruits/plant, green fruit yield/plant, seeds/fruit and seed yield/plant in 10 interspecific F1 hybrids of chilli. Jwala and Green Chuna were the farthest while K2 and Ornamental Type, the nearest. Maximum oleoresin was in Jwala (16.83%) and in the hybrids, Jwala x Ornamental Type (16.6%).

സംഗ്രഹം

മുളകിന്റെ രണ്ട് സ്പീഷീസുകൾ തമ്മിൽ ജൈനിക സങ്കലനം നടത്തിയപ്പോൾ ചെടികളുടെ ഉയരം, പൂവിടുന്നതിനുള്ള കാലം, ഫലങ്ങൾ പറിക്കുന്നതിനുള്ള കാലം, പച്ച മുളകിന്റെ തൂക്കം, വിത്തുകളുടെ എണ്ണം, തൂക്കം മുതലായവയിൽ വർദ്ധനവ് ഉണ്ടായി. ജ്വാല എന്ന ഇനവും പച്ചച്ചുന്ന എന്ന ഇനവും ജൈനികമായി വളരെ അകലെയാണെന്നുകണ്ടു. കെ. 2 എന്ന ഇനം ഓർണമെന്റൽ ടൈപ്പ് എന്നിനത്തിന്റെ അടുത്താണ്, ജൈനികമായി എന്ന് മനസ്സിലായി. ഒലിയോറെസിൻ എന്ന പദാർത്ഥം ജ്വാല ഇനത്തിൽ കൂടുതലാണ് (16.83%). സങ്കര ഇനങ്ങളിൽ ജ്വാല x ഓർണമെന്റൽ ടൈപ്പിനാണ് ഒലിയോറെസിൻ കൂടുതലുള്ളത് (16.6%).

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