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Short communication

Genetics of inheritance of quality parameters in chilli

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Chilli (*Capsicum annum* L.) is one of the most valuable and commercial spice of crops of India. It is virtually indispensable item in the kitchen. The green chilli fruits are used in salad as well as in curries. Chilli contains a crystalline colourless alkaloid known as capsaicin which imparts pungency to the fruits. This capsaicin is known to be stimulant, alterative, rubefaciant, carminative and anticoagulant (Anon, 3). Further research has indicated that the medicinal applications of capsaicinoids have brought innovative ideas for their use. The pharmaceuticals industry uses capsaicin as a counter irritant balm for external application. The red colour of fruits is due to carotenoid pigment of which capsanthin is more important. The fruits also contain a fixed oil (red colouring matter), which is non-pungent and yield 20-25 per cent alcoholic extract called oleoresin. This processed product is gaining more importance especially from export point of view because it offers uniform quality, longer shelf life, freedom from microorganism and lesser freight charges. Chilli oleoresin has a vast demand in pharmaceutical and food industries. The increasing interest in chilli emanates from increasing awareness of its nutritional value, medicinal properties, ornamental characteristics and industrial values. Considering the importance of chlorophyll, capsanthin, oleoresin and capsaicin, the present investigation was undertaken by utilizing a basic set of six generations.

The investigation was carried out at Vegetable Experimental Area, Sher-e-Kashmir University of Agricultural Sciences and Technology, Kashmir for two seasons. The material for the present study comprised of three crosses from six generations (P_1, P_2, F_1, F_2, B_1 and B_2), namely Arka Lohit (dark green) × SH-C-405 (light green) and SH-C-1154 (green) x SH-PC-1 (purplish green) when mature, Arka Lohit (red) and Kashmir Long-1 (deep red) and Arka Lohit (red) × SH-C-405 (light red) when ripe. The crosses between AL × KL-1, AL × SH-C-405 and SH-C-1154 × SH-PC-1 were made during *kharif* season in first year, the F_2 and back cross generations were produced during *kharif* second season. The six generations, *viz*., P_1, P_2, F_1, F_2, BC_1 and BC_2 of each cross were sown in the nursery in March 2006. The seedling were transplanted to experimental plots in April 2006 with a spacing of 60 cm × 45 cm in three replications. In each replication the following number of plants were planted. The number of plants allocated to different generations were P_1, P_2, F_2, 10; BC_1, BC_2, 60 and F_2, 100 plants in three replications. Estimation of chlorophyll was carried out from six generations of two crosses namely Arka Lohit (dark green) × SH-C-405 (light green) and SH-C-1154 (green) × SH-PC-1 (purplish green) in the fruits of each plant was estimated as per the method by Arnon (4).

The capsanthin and oleoresin content in the fruits of each plant was determined following the method suggested by AOAC (1) and capsaicin in the fruits of each plant of the two crosses in which capsanthin and oleoresin was carried out was determined following method suggested by Balasubramanian *et al.* (6).

To assess the type of gene effects a simple dominance model was fitted but the $\chi 2$ value for joint scaling test indicated the inadequacy of three parameter model where only additive component was found significant, while the 6 parameter model indicated was non-significant additive component [d] in both the crosses. The dominance component [h] and additive x additive component were significant but negative and were of higher magnitude than all other components in cross SH-C-1154 × SH-PC-1 while in cross Arka Lohit × SH-C-405. Additive × dominance component [j] and dominance x dominance component were positive and significant. The over all perusal of study revealed involvement of dominance × dominance, additive × dominance gene action in cross Arka Lohit × SH-C-405 while only dominance and additive × additive where found important in cross SH-C-1154 × SH-PC-1. The use of inter mating followed by usual selection in early segregating generation would exploit the gene effects.

Capsanthin (ASTA) units and oleoresin was estimated in the two crosses, *viz*., Arka Lohit (red) × Kashmir Long-1 (Bright red) and Arka Lohit (red) × SH-C-405 (Light red). The capsanthin value of F_1 was more than the mid parental value, indicating bright red colour to be dominant over the light red colour. The F_2 and back cross generations showed continuous variation thereby suggesting its polygenic nature.The χ^2 value for joint scaling test indicated adequacy of three paramter model in the cross Arka Lohit × SH-C-405

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Table 1. Means and standard error, three parameter model and six parameter model for the cross SH-C-1154 x SH-PC-1and Arka Lohit x SH-C-405 for chlorophyll.

	SH-C-1154 x SH-PC-1	Arka Lohit x SH-C-405
	Chlorophyll (mg/g)	Chlorophyll (mg/g)
Means and SE for different generations and characters		
P_1	0.049 ± 0.001	0.034 ± 0.002
P_2	0.073 ± 0.004	0.140 ± 0.008
F_1	0.056 ± 0.003	0.086 ± 0.002
F_2	0.088 ± 0.007	0.117 ± 0.007
B_1	0.067 ± 0.005	0.069 ± 0.006
B_2	0.073 ± 0.004	0.084 ± 0.006
Three parameter model		
m	0.063 ± 0.002**	0.081 ± 0.003**
[d]	0.014 ± 0.002**	0.047 ± 0.003**
[h]	-0.002 ± 0.003	0.005 ± 0.004
χ^2	25.55**	47.82**
Six parameter model		
m	0.088 ± 0.007**	0.117 ± 0.007**
[d]	-0.005 ± 0.007	-0.015 ± 0.008
[h]	-0.076 ± 0.030**	-0.163 ± 0.031**
[i]	-0.072 ± 0.030*	-0.162 ± 0.031**
[j]	0.007 ± 0.007	0.038 ± 0.009**
[l]	0.026 ± 0.038	0.202 ± 0.043**

*,**significant at 5 and 1 per cent levels respectively.

with additive component [d] being of higher magnitude than the dominance component [h] . However for the cross Arka Lohit x Kashmir Long-1, the $\chi 2$ for three parameter model was significant confirming the epistatic interaction. The extended model identified only dominance [h] and component [j] with positive direction to be significant and component [h] was of higher magnitude, that revealed predominance of dominant genes in the inheritance of capsanthin. Bal and Singh (5) while studying two crosses, *viz.*, Punjab Lal (female) × California Wonder and Ludhiana Local selection × Indonesian Selection indicated that fruit colour was controlled by duplicate gene action As such exploitation of dominance component in the form of hybrid breeding programme would be important.

The mean F_1 values in both the crosses were more than mid parental values indicating partial dominance for oleoresin attribute. The χ^2 value of three- parameter model was significant in both the crosses. However, the component [d] in the three-parameter model was of higher magnitude. Estimation of the genetic component of generation mean in the six- parameter model indicated component [d] to be significant and negative in the cross Arka Lohit × Kashmir Long-1, while component [h] was significant in both the crosses with positive direction in the cross Arka Lohit × Kashmir Long-1 and additive × additive component [i] was significant in both the crosses but was negative in cross Arka Lohit × SH-C-405 and component [j] and [l] were significant and positive only in cross Arka Lohit × SH-C-405. In general dominance x dominance and additive × dominance gene interactions in cross Arka Lohit × SH-C-405 and dominance and additive × additive component were significant and higher in magnitude in cross Arka Lohit × Kashmir Long-1 suggesting that the red fruit colour is due to the involvement of dominant genes and also had interaction with additive effects. Since the trait is under the influence of both additive and non-additive gene actions a recurrent selection followed by conventional selection methods would be appropriate to generate more variation.

The mean value of F_1 was slightly more than mid-parent value in both the crosses (Arka Lohit and Kashmir Long-1) and (Arka Lohit × SH-C-405) for capsaicin indicating partial dominance of pungency over non-pungency while the F_2 mean was less than F_1 in both the crosses, B_1 mean was less than B_2 but more than P_1. The χ^2 value for joint scaling test was significant in both the crosses. In the three parameter model both [d] and [h] components were positive and significant.

Table 2. Means and standard error, three-parameter model and six parameter model for the cross, Arka Lohit x SH-C-405 and Arka Lohit x Kashmir Long-I for capsaicin, capsanthin and oleoresin.

	Arka Lohit x SH-C-405			Arka Lohit x Kashmir Long-I		
	Capsaicin (mg/g)	Capsanthin ASTA (units)	Oleoresin ASTA (units)	Capsaicin (mg/g)	Capsanthin ASTA (units)	Oleoresin ASTA (units)
Means and SE for different generations and characters						
P_1	0.369±0.002	72.80±0.84	559.92±4.61	0.326±0.002	84.00±1.29	662.40±8.62
P_2	0.459±0.004	84.00±1.29	662.40±9.62	0.459±0.004	136.80±1.26	892.04±8.69
F_1	0.418±0.001	82.36±0.44	649.48±4.66	0.382±0.001	126.26±0.73	787.20±3.67
F_2	0.396±0.001	78.99±1.44	639.67±12.60	0.362±0.001	114.31±2.96	649.97±20.78
B_1	0.382±0.001	76.59±1.25	584.25±11.15	0.350±0.001	115.47±3.36	692.18±24.67
B_2	0.386±0.001	79.229±1.39	592.73±15.60	0.373±0.001	121.85±3.39	766.59±24.41
Three-parameter model						
M	0.369±0.001**	77.53±0.69**	606.94±4.66**	0.351±0.001**	110.27±0.88**	768.78±5.97**
[d]	0.007±0.001**	4.67±0.85**	48.15±4.71**	0.029±0.001**	25.71±0.89**	113.50±6.03**
[h]	0.046±0.001**	4.60±0.85**	39.26±6.72	0.027±0.002**	15.89±1.16**	15.39±7.08*
χ^2	853.94**	7.38	18.81**	379.82**	18.79**	48.38**
Six-parameter model						
M	0.396±0.001**		639.64±12.60**	0.362±0.001*	114.31±2.96**	649.97±20.78**
[d]	-0.005±0.001**		8.47±19.18	- 0.023±0.001*	-6.38±4.78	-74.41±34.71*
[h]	-0.043±0.004**		-166.27±63.70**	- 0.012±0.005	33.08±15.27*	327.63±108.29**
[i]	-0.046±0.003**		-204.59±63.34**	- 0.003±0.004	17.42±15.23	317.65±108.29**
[j]	0.040±0.002**		42.77±19.79*	0.042±0.003**	20.02±4.86**	40.41±35.24
[l]	0.173±0.006**		371.92±92.78**	0.105±0.008**	-18.74±22.61	-106.36±162.43

*, ** significant at 5 and 1 per cent levels, respectively.

The six parameter model, revealed m, [d], [j] and [l] significant in cross (Arka Lohit × Kashmir Long-1) while all the parameters were significant with negative, additive, dominance and additive components in both the crosses. However dominance and dominance x dominance components were opposing each other indicating duplicate type of gene action. In general dominance x dominance and additive and dominance gene interaction were significant in both the crosses Arka Lohit × SH-C-405 and Arka Lohit × Kashmir Long-1 suggesting that capsaicin is due to involvement of dominant genes and, also has interactions with additive effects. The importance of additive gene effects was also reported by Sharma and Saini (7), and Ahmed *et al.* (2). Since the trait is under the influence of both additive and non-additive genes as such hybrid breeding and recurrent could be exploited.

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