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GENETICS OF FRUIT BEARING HABIT AND FRUIT ORIENTATION IN CHILLI (*CAPSICUM ANNUUM* L.)

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ABSTRACT

The present investigation was carried out in chilli to study the nature of gene action involved in the expression of plant ideotype at Horticultural Research Station, Lam Farm, Guntur, Andhra Pradesh during *kharif*, 2013-14 and 2014-15 using generation mean analysis. Three parents *viz.,* LCA 712, LCA 710 and HC-28 were identified with contrasting characters for fruit bearing habit, fruit orientation and branching habit and two crosses *viz.,* LCA 712 × HC-28 and LCA 712 × LCA 710 were generated using these parents. For each cross, six generations (P_1, P_2, F_1, F_2, B_1 and B_2) were developed and grown in family block design and the data was subjected to chi- square test. The results revealed that the nature of solitary fruit bearing habit and pendent fruit position was monogenic and dominant whereas the nature of the branching habit was digenic and governed by two gene pairs with dominant suppression epistasis.

Keywords **:** Branching habit, *capsicum annuum,* clustering, epistasis, fruit orientation.

Introduction

Chilli (*Capsicum annuum* L.) is one of the most important commercial crops of India. It belongs to the family Solanaceae *(2n = 24)* and the primary centre of origin is Mexico and secondary centre is Guatemala and Bulgaria (Salvador, 2002). Chilli has diverse uses as spice, condiment, culinary supplement, medicine, vegetable and ornamental plant. It is an indispensable spice due to its pungency, taste, appealing colour and flavour. The alkaloid capsaicin responsible for its pungency has diverse prophylactic and therapeutic uses in Allopathic and Ayurvedic medicine (Sumathy and Mathew,1984). India is the largest producer (1.492 million tonnes from 0.775 million hectares), consumer and exporter of chilli in the world (NHB, 2017) with productivity of 1.9 metric t/ha. In India, Andhra Pradesh is the leading producer and exporter of the chilli followed by Telangana, Karnataka, West Bengal and Madhya Pradesh *etc*.

In chilli, most of the popular varieties or hybrids have solitary and pendulous fruits. Moreover, the fruits are strongly attached with the pedicel. Thus, nearly 20 per cent of the total cost of production goes for only harvesting due to individual fruit harvesting and additional labour is also required to remove persistent calyx from the harvested fruits (Dhamayanthi and Reddy, 2003). Therefore, there is a necessary to develop the suitable ideotypes for mechanical harvesting coupled with higher yields. The compact plant types enable closer spacing leading to higher yield per unit area (Thomas and Peter, 1986). The genotypes with cluster fruit bearing habit along with upright fruit position are suitable for mechanical harvesting as the fruits are borne mainly in the periphery (Dhamayanthi and Reddy, 2001) and the genotypes with cluster fruit bearing habit and pendent / upright fruit position are suitable for bunch harvesting avoiding picking of individual fruits normally from solitary types which reduces labour requirement as well as cost of production.

In chilli, very few attempts were made earlier to transfer the characters such as clusterness and fruit orientation through hybridization between the locally available cultivars (Dhamayanthi and Reddy, 2001 & Thomas and Peter, 1986). Therefore an attempt was made in the present study to develop compact plant types and amenable ideotypes with clustered and upright fruit types so as to increase the yield and to minimize the labour cost involved in harvesting and processing which ultimately increases the net profit to the farmers.

Materials and Methods

The present investigation was carried out at Horticultural Research Station, Lam Farm, Guntur, Andhra Pradesh during *kharif*, 2013-14 and 2014-15 to study the nature of gene action involved in the expression of plant ideotype in chilli. Three parents *viz.,* LCA 712, LCA 710 and HC-28 were identified in chillies improvement scheme at HRS, Lam farm, Guntur with contrasting characters for fruit

bearing habit, fruit orientation and branching habit in chilli and developed two crosses (F_1s) *viz.,* LCA 712 × HC-28 and LCA 712 × LCA 710 during 2012-13. Details of parent materials used in this experiment were presented in Table 1. The cross LCA 712 × HC-28 was used to study the inheritance pattern of fruit bearing habit and fruit orientation in chilli as the parents involved in this cross have contrasting characters in respect to these traits. The parent LCA 712 is solitary bearing accession with pendent fruit position while HC-28 is the cluster bearing genotype with erect fruit position. The cross LCA 712 × LCA 710 was used to study the inheritance pattern of branching habit in chilli as the parents involved in this cross have contrasting characters for branching pattern. The parent LCA 712 is intermediate branching type while LCA 710 is dense branching type.

The parents were selfed to maintain as well as crossed to generate F_1s during 2012-13. The generated F_1s were selfed to generate F_2 as well as crossed with both the parents to generate B_1 ($F_2 \times P_1$) and B_2 ($F_2 \times P_2$) for both the crosses and the parents were again selfed to maintain as well as crossed to generate F_1s during 2013-14. The two crosses (F_1s) along with their parents, F_2s, B_1s and B_2s were raised in a compact family block design with three replications during *kharif,* 2014 - 15. The parents and F_1s in five rows (one row of 4 m length), F_2s in 30 rows and B_1s & B_2s in 20 rows were planted at a spacing of 75 cm × 30 cm. Thirteen plants were maintained in a single row and the crop was raised as per the standard package of practices.

Data on plant branching habit, fruit bearing habit and fruit orientation was recorded by counting the plants for particular character. The plants were grouped into solitary *vs* clustering for fruit bearing habit, pendent *vs* erect for fruit position and intermediate *vs* dense for branching habit. The pattern of inheritance of above characters was studied by subjecting the data to chi- square test for testing the goodness of fit and test of homogeneity as suggested by Panse and Sukhatme (1985).

$$\chi^2 = \frac{\Sigma(O-E)^2}{E}$$

Where, O= observed value and E=Expected value.

Deviations were considered significant only when the calculated chi-square value was more than tabulated value at (n-1) degrees of freedom and 5% level of significance.

Results and Discussion

For cross LCA 712×HC-28, all the F_1 plants were produced solitary fruits (Table 2) indicating the dominance of solitary bearing over the clustered bearing habit. The F_2 generation was segregated into solitary fruits and clustered fruits in the ratio of 246:87 which is in accordance with the expected genetic ratio of 3:1. In B_1 generation, out of 205 plants, 197 plants were with solitary fruits and only eight plants were with clustered fruits, which fitted the generation ratio of 1:0. The B_2 generation was segregated into 105 plants with solitary fruits and 116 plants with clustered fruits which fitted the segregation ratio of 1:1. Non-significance of chi square value also confirmed that there was no significant difference between the observed ratio and the expected ratio. These results confirmed the monogenic dominant nature of solitary fruit bearing and monogenic recessive nature of cluster fruit bearing habit. These results are in agreement with earlier findings of Ahamed *et al.* (1994) and Dhamayanthi and Reddy (2001) in chilli.

The pendent fruit position was observed in all the F_1 plants of LCA 712 × HC-28 (Table 3) indicating the dominance of pendent fruit position over the erect fruit character. The F_2 plants segregated in the ratio of 249 plants with pendent fruits and 84 plants with erect fruits which indicated that the pendent fruit position was controlled by single dominant gene as the evident from the expected genetic ratio of 3:1. In B_1 generation, out of 205 plants, 198 plants produced pendulous fruits and only seven plants were with erect fruits, which fitted the generation ratio of 1:0. The B_2 generation was segregated into 114 pendulous and 107 erect fruited plants fitting the segregation ratio of 1:1. Non-significance of chi square value also confirmed that the observed ratio was in accordance with the expected ratio. The results confirmed the monogenic dominant nature of pendent fruit position and monogenic recessive nature of erect fruit position. These results are in agreement with earlier findings of Ahamed *et al*. (1994), Dhamayanthi and Reddy (2001) and Gopalakrishnan *et al*. 1989 who also reported that the nature of pendent fruit position was monogenic and dominant.

In cross LCA 712 × LCA 710, all the F_1 plants were intermediate like the female parent LCA 712 (Table 4). In F_2 generation, 309 plants showed intermediate branching habit while 75 plants showed dense branching habit and fitted the genetic ratio of 13:3 indicating the epistatic gene interaction. Out of 250 B_1 plants, 244 plants were intermediate plants and six were dense plants which clearly fitted to genetic ratio of 1:0. The B_2 fitted to genetic ratio of 1:1 from 115 intermediate and 125 dense plants. The results revealed that the nature of this character is digenic and governed by two gene pairs with dominant suppression epistasis *i.e.* inhibitory gene action.

From the chi-square analysis, it was concluded that the nature of solitary fruit bearing habit and pendent fruit position was monogenic and dominant whereas the nature of the branching habit was digenic and governed by two gene pairs with dominant suppression epistasis.

Table 1: Salient features of three parents involved in two crosses used in generation mean analysis of chilli

S. No.	Parents	Features
1	LCA-710	Erect but dwarf plant, cluster and pendent bearing habit
2	HC-28	Erect plant with two or three primary branches, cluster and erect bearing habit
3	LCA-712	High yielding line, more no. of fruits, solitary and pendent fruit bearing

Table 2: Inheritance of fruit bearing habit in F_2, B_1 and B_2 generations of cross LCA 712 × HC-28 in chilli.

	Observed frequencies			Expected Ratio	χ2-calculated	Probability
Generations	**Solitary**	**Clustering**	**Total plants**			
P_1	50	0	50	-	-	-
P_2	0	50	50	-	-	-
F_1	55	0	55	-	-	-
F_2	245	88	333	3:1	0.36	0.70-0.50
B_1	190	5	195	1:0	-	-
B_2	140	121	261	1:1	1.38	0.30-0.20

Table 3: Inheritance of fruit orientation in F_2, B_1 and B_2 generations of cross LCA 712 × HC-28 in chilli.

	Observed frequencies			Expected Ratio	χ2-calculated	Probability
Generations	**Pendent**	**Erect**	**Total plants**			
P_1	50	0	50	-	-	-
P_2	0	50	50	-	-	-
F_1	55	0	55	-	-	-
F_2	240	93	333	3:1	1.52	0.30-0.20
B_1	186	9	195	1:0	-	-
B_2	135	126	261	1:1	0.31	0.70-0.50

Table 4: Inheritance of branching habit in F_2, B_1 and B_2 generations of cross LCA 712 × LCA 710 in chilli.

	Observed frequencies			Expected Ratio	χ2-calculated	Probability
Generations	**Intermediate**	**Dense**	**Total plants**			
P_1	61	0	61	-	-	-
P_2	0	58	58	-	-	-
F_1	55	0	55	-	-	-
F_2	309	75	384	13:3	5.584	0.05-0.01
B_1	244	6	250	1:0	-	-
B_2	115	125	240	1:1	0.417	0.70-0.50

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