Journal of Tropical Agriculture 49 (1-2) : 107-109, 2011


Short communication

# Gene effects of fruit yield and leaf curl virus resistance in interspecific crosses of chilli (*Capsicum annuum* L. and *C. frutescens* L.)

K. Anandhi* and K.M. Abdul Khader

*Department of Plant Breeding and Genetics, College of Agriculture, Kerala Agricultural University, Vellayani, Thiruvananthapuram, Kerala 695522, India.*

Received 3 June 2011; received in revised form 25 August 2011; accepted 27 August 2011.

**Abstract**

Generation mean analysis for leaf curl virus resistance and yield was performed in two interspecific crosses of chilli namely 'Mavelikkara Local' x 'Jwalasakhi' and 'Nenmara Local' x 'Vellayani Athulya'. The additive (*d*) component was significant for all the traits studied. But wherever dominance gene effects were significant, the dominance (*h*) values were higher than the additive (*d*) values. Dominance (*h*) and dominance x dominance (*l*) effects were also in the same direction, suggesting complementary-type epistasis in most cases. The dominance x dominance (*l*) interaction was predominant. Significant levels of all types of gene actions (additive, dominance and epistasis) for yield and virus resistance indicate that methods like recurrent selection, multiple cross, or diallel selective mating system may be adopted in chilli improvement programmes.

**Keywords**: Epistasis, Generation mean, Gene action.

Leaf curl virus (LCV) disease is one of the major biotic stresses of *Capsicum* spp. causing severe loss in yield especially during the summer season. Yield reduction due to chilli leaf curl virus has been reported to be up to 50% (Meena et al., 2006). Although the disease can be controlled by suppressing the vector, *Bemisia tabaci* Genn., chemical control results in only partial success and adds to the cost of production, besides causing human and environmental hazards. Developing resistant varieties, therefore, becomes a promising option. Most genotypes of *Capsicum annuum*, however, are susceptible, but *C. frutescens* is resistant to this disease (Khader et al., 2007). The objective was to obtain information on the nature of gene action for yield, yield contributing characters, and virus resistance in chilli to provide a basis for an evaluation of selection methods for the production of high yielding leaf curl virus resistant chilli.

The experimental material comprised of six basic generations ($P_1$ and $P_2$: parent cultivars, $F_1$ and $F_2$: first and second filial generations, and $BC_1$ and $BC_2$: first and second backcrosses) of two interspecific crosses of chilli, namely 'Mavelikkara Local' x 'Jwalasakhi' and 'Nenmara Local' x 'Vellayani Athulya', selected from the ongoing research project on "Breeding leaf curl virus resistant chilli through interspecific hybridisation". The parents of the respective crosses were used as the male parent and the $F_1$ generation as the female parent and backcrosses were made to produce $B_1$ ($F_1$ backcrossed to $P_1$) and $B_2$ ($F_1$ backcrossed to $P_2$) generations and the $F_1$ hybrids were selfed to obtain $F_2$ seeds. All generations were raised in a randomized block design with three replications at Vellayani (8°28' 56" N; 76°55' 12" E) during March 2009. Ten plants of each entry were planted in one row for the parents and hybrids, 20 rows for $F_2$ population and 15 rows for back crosses. Spacing of 60 x 75 cm was followed. The crop was managed as per the recommended practices (KAU, 2007). Since the non-segregating generations represent

*Author for correspondences: Phone 9847145010; Email <anandhiagri@gmail.com>.

the homogeneous population while the segregating generations represent the heterogeneous population, the sample size was variable: five random plants from each replication in the parents and $F_1$, 30 plants per replication in $F_2$, and 15 plants per replication in the backcrosses. The traits assessed were plant height, number of branches, number of fruits per plant, fruit length, fruit width, number of seeds per fruit, crop duration, green fruit yield per plant, vector population, and leaf curl virus score on 45 days. The artificial condition for maintaining vector population was done as per Nene (1972) and the virus scoring was based on Rajamony et al. (1990). Means, standard errors, and variances of different generations were subjected to scaling test to estimate the gene effects, using the Jinks and Jones (1958) model. Both compatible and incompatible crosses have been obtained depending on the genotypes. Significance of any of the four scales (A, B, C, and D) indicates the inadequacy of additive-dominance model and presence of epistasis. The type of epistasis was determined only when dominance (h) and dominance x dominance (l) effects were significant.

The results indicate that the scaling tests were significant (Table 1), implying epistatic interaction for all characters in both crosses. Dominance x dominance (l) interaction was larger than the other two effects. Additive (d) component was significant for all traits studied in both the crosses, as reported by Jagadeesha and Wali (2008) for *C. annuum*. But wherever dominance gene effects were significant, dominance (h) values were higher than the additive (d) values, implying that dominant gene effect is relatively more important. Dominance (h) and dominance x dominance (l) effects were in the same direction, suggesting complementary-type epistasis in most cases. Dominance and epistatic types of gene interaction in each cross for different traits were different. For majority of the characters 'Mavelikkara Local' x 'Jwalasakhi' showed additive x additive gene effects, as reported by Somashekhar et al. (2008). 'Nenmara Local' x 'Vellayani Athulya' also showed dominance x dominance effects for majority of the characters. Both the leaf curl virus score and vector population showed significance in negative direction implying that leaf curl virus score is directly influenced by vector population.

For majority of the characters in both crosses the dominance effect was pronounced with complementary epistasis. But coexistence of *h* and *l* indicates presence of duplicate epistasis for characters like number of fruits and fruit length in 'Mavelikkara Local' x 'Jwalasakhi'. However, the contribution of additive effects cannot be neglected. Generation mean analysis illustrates that the crosses differed in gene action and on an overall basis all types of gene actions, additive, dominance, and epistasis are important.

## References


Jagadeesha, R.C. and Wali, M.C. 2008. Combining ability for fruit quality parameters in chilli (*Capsicum annuum* L.). Asian J Hort., 3: 217–221.

Jinks, J.L. and Jones, R.M. 1958. Estimation of the components of heterosis. Genetics, 43:223–224.

KAU, 2007. *Package of Practices Recommendations: Crops*. 12th Ed. Directorate of Extension, Kerala Agricultural University, Thrissur, 278p.

Khader, K.M.A, Anandhi, K., Umamaheshwaran, K., and Kumar, V. 2007. Response of bird pepper (*Capsicum frutescens* L.) genotypes to leaf curl virus. Proc. XVI Internat. Plant Prot. Congr. 15 – 18 Oct. 2007. Glasgow, UK, pp 714–716.

Meena, R., Patni, V. and Arora, D.K. 2006. An epidemic of chilli leaf curl disease in Rajasthan. J. Phytol. Res., 19: 335–336.

Nene, Y.L. 1972. A survey of viral diseases of pulse crops in Uttar Pradesh. Final Technical Report. G.B.P.U.A.T., Pant Nagar, India, 191p.

Rajamony, L., More, T.A., Seshadri, V.S. and Varuna, A. 1990. Reaction of muskmelon collections to cucumber green mottle mosaic virus. Phytopathology, 29:239–224.

Somashekhar, S., Patil, S.A., and Salimath, P.M. 2008. Estimation of gene effects for fruit yield and its components in chilli (*Capsicum annuum* L.). Karnataka J. Agric. Sci. 21: 181–183.

*Table 1.* Means ± standard error and scaling test and genetic effects for 10 characters in two interspecific crosses of chilli.

| Character / Cross | A | B | C | D | m (Mean) | d (Additive) | h (Dominance) | i (Additive x Additive) | j (Additive x Dominance) | l (Dominance x Dominance) | Type of epistasis |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Plant height (cm) | | | | | | | | | | | |
| C1 | - | ** | ** | ** | 34.18**±1.10 | 8.11**±2.94 | 22.61**±7.60 | 22.40** 7.34 | 6.45*±3.14 | 8.05±13.15 | C |
| C2 | - | ** | ** | - | 33.91**±1.20 | 9.05**±2.41 | 11.46±7.29 | 7.74±6.80 | 4.67±2.71 | 8.84±11.98 | C |
| Number of branches | | | | | | | | | | | |
| C1 | - | ** | ** | - | 4.84**±0.19 | 1.91**±0.42 | 1.6±1.18 | 0.53±1.12 | 1.04*±0.45 | 4.09*±1.96 | C |
| C2 | - | ** | * | - | 5.27**±0.23 | 0.96*±0.45 | 2.35±1.32 | 0.49±1.27 | 0.82±0.47 | 1.96±2.12 | C |
| Number of fruits/plant | | | | | | | | | | | |
| C1 | * | ** | ** | ** | 23.60**±1.62 | 67.87**±3.68 | 706.23**±9.86 | 41.33**±9.80 | 15.98**±3.73 | –36.93*±16.23 | D |
| C2 | * | ** | ** | - | 26.48**±1.24 | 58.20**±4.86 | 723.53**±8.47 | 10.49±10.91 | 6.46±4.94 | 43.44*±20.38 | C |
| Fruit length | | | | | | | | | | | |
| C1 | ** | ** | ** | ** | 5.37**±0.11 | 0.09**±0.21 | –1.88**±0.63 | –3.87**±0.62 | 1.50**±0.22 | 9.81**±0.99 | D |
| C2 | ** | ** | ** | ** | 5.18**±0.15 | –1.41**±0.35 | 4.63**±0.95 | 6.77**±0.92 | –0.33±0.39 | 10.38**±1.59 | C |
| Fruit width | | | | | | | | | | | |
| C1 | - | ** | - | ** | 1.64**±0.03 | 0.16*±0.07 | –0.11±0.19 | –0.51**±0.18 | 0.18**±0.07 | 1.12**±0.31 | D |
| C2 | ** | ** | - | - | 1.57**±0.03 | 0.32**±0.05 | –0.05±0.17 | –0.15±0.17 | 0.55**±0.06 | 0.58*±0.25 | D |
| Number of seeds per fruit | | | | | | | | | | | |
| C1 | ** | ** | ** | - | 47.44**±1.20 | –10.20**±3.15 | 20.71*±8.15 | 3.78±7.92 | –14.13**±3.20 | 60.53**±14.03 | C |
| C2 | ** | ** | ** | - | 46.46**±1.46 | –2.25±3.57 | 6.73±9.69 | –1.6±9.23 | 13.29**±3.99 | 122.04**±16.52 | C |
| Duration of crop | | | | | | | | | | | |
| C1 | - | * | ** | - | 187.71**±4.67 | 37.02**±7.66 | –28.63±24.21 | –25.6±24.15 | –10.61±7.72 | 0.29±36.06 | D |
| C2 | - | * | ** | - | 208.73**±3.61 | 26.62**±8.25 | –97.52**±22.05 | 104.36**±21.94 | –21.41*±8.34 | 97.44**±36.31 | D |
| Green fruit yield per plant | | | | | | | | | | | |
| C1 | - | ** | ** | * | 94.63**±5.32 | 221.06**±8.91 | 2616.03**±28.45 | 63.60*±27.76 | 28.89**±9.43 | 8.43±43.34 | C |
| C2 | ** | ** | ** | - | 113.11**±4.78 | 207.02**±8.47 | 2914.68**±26.71 | –38.39±25.55 | 40.17**±9.51 | 281.35**±41.91 | C |
| Vector population | | | | | | | | | | | |
| C1 | - | - | ** | ** | 1.99**±0.05 | –0.51**±0.09 | –0.81**±0.27 | –0.89**±0.26 | –0.09±0.11 | 0.8±0.44 | D |
| C2 | - | - | - | * | 1.74**±0.03 | –0.50**±0.08 | 0.29±0.23 | 0.45*±0.22 | 0.00±0.10 | –0.88*±0.39 | D |
| Leaf curl virus score on 45 days | | | | | | | | | | | |
| C1 | ** | ** | ** | ** | 40.76**±18.46 | –18.58**±–5.37 | –43.52**±–3.82 | –36.42**±11.22 | 1.71**±3.68 | –2.27**±16.85 | C |
| C2 | ** | ** | ** | ** | 32.21**±24.06 | –13.27**±–4.54 | 9.53±1.16 | 9.86**±7.93 | 4.74**±3.34 | –27.70**±13.50 | D |

C1= ‘Mavelikkara Local’ x ‘Jwalasakhi’, C2 =‘Nenmara Local’ x ‘Vellayani Athulya’, *Significant at 5%, **Significant at 1%