

Variability and Heritability Estimates in Bird Chilli (*Capsicum frutescens* L.)

**Bandla Srinivas, Beena Thomas, S. Sathishkumar,
Reshma Gopi**

Received 17 March 2016 ; Accepted 22 April 2016 ; Published online 20 May 2016

Abstract Ten bird chilli genotypes were grown in a randomized block design with three replications to estimate variability and heritability for various characters. High phenotypic and genotypic coefficients of variation were observed for incidence of leaf curl disease, fruit yield per plant and number of seeds per fruit. Genotypic coefficient of variation and phenotypic coefficient of variation were closely corresponded with each other for most of the characters. Comparatively low values of environmental coefficient of variation for all the characters indicated that environment has less influence on these traits. High heritability (in broad sense) estimate was recorded for all the characters under study viz., number of seeds per fruit, fruit yield per plant, plant height, number of fruits per plant, average fruit width, individual fruit weight, fruit length, number of white flies per plant, number of days to first flowering, number of thrips per leaf, number of primary branches, number of mites per leaf, number of secondary branches and incidence of leaf curl disease. Genetic advance as per cent of mean was high for all the characters except number of days to first flowering and average

fruit length for which it was low and moderate respectively.

Keywords Bird chilli, Fruit characters, Variability, Heritability, Leaf curl resistant.

Introduction

Chilli is a widely used vegetable / spice crop cultivated throughout India. It is consumed both in unripe (green) and ripe (red) forms. It is a rich source of vitamin C. It also contains vitamin A, vitamin B and minerals [1]. Bird chilli (*Capsicum frutescens* L.) or bird's eye chilli is a stimulating herb renowned for aroma, taste, flavour and pungency. Besides its culinary use, it possesses many medicinal and nutritional values. Bird chilli or cayenne pepper is widely used to treat stomach ulcers, cold, sore throat, fevers and cholesterol aggregation, thus prevents the risk of heart attacks and strokes. Most important thing is that chilli helps to fight prostate cancer by killing prostate cancer cells themselves. Some hot varieties of chilli can be used as a remedy for painful joints and to stop bleeding. Daily use of this hot chillies can stimulate blood flow to the affected area and reduce discomfort and inflammation. Thus bird chilli has a beneficial effect on the circulatory system. India is the leading country in the production of chillies contributing 41.11% of the world's production.

India is the only country which is rich in many varieties of chilli with different quality factors. It is

B. Srinivas*, B. Thomas, S. S. Kumar, R. Gopi
Department of Plant Breeding and Genetics, College of Agriculture, Vellayani, Thiruvananthapuram 695522, India
e-mail: bandla.srinivas@gmail.com

*Correspondence

presently grown extensively throughout the country under rainfed and irrigated conditions [2]. In India chilli is cultivated in 7.94 lakhs hectare, its production is 1304 million tonnes and productivity is 1.6 million tonnes per hectare [3]. Bird chilli (*C. frutescens* L.) is commercially cultivated only in Mizoram (approximately 140 hectare with annual production of 560 tones) and in some areas of Manipur (approximately 122 hectare with annual production of 488 tonnes) whereas in other areas it is widely grown as a homestead crop [4].

Even though chilli is an important vegetable crop some major factors responsible for the low productivity are lack of varieties adapted to different agro-climatic conditions and resistant to pests and diseases. More than 45 viruses have been reported infecting chilli worldwide. 'Leaf curl' is found to be a serious problem affecting chilli production. The present investigation was carried out to determine and illustrate the nature and magnitude of genetic variability, heritability and genetic advance, in bird chilli.

Materials and Methods

Ten bird chilli genotypes were grown in a randomized block design with three replications during April to November 2014, at College of Agriculture, Vellayani, Thiruvananthapuram, Kerala, India, to estimate the genetic variability in bird chilli (*Capsicum frutescens* L.). The four weeks old seedlings were transplanted at a spacing of 50 cm × 50 cm between rows and 75 cm × 75 cm between plants. Timely management practices as per the package of practices recommendations of Kerala Agricultural University [5] were carried out. The observations were recorded on five randomly selected plants of each genotype on number of days to first flowering, number of primary branches, number of secondary branches, number of fruits per plant, average fruit length (cm), average fruit width (cm), individual fruit weight (g), fruit yield per plant (g), number of seeds per fruit, plant height (cm), leaf pubescence incidence of leaf curl disease (vulnerability index is calculated on the basis of leaf curl virus disease scoring, 0 to 4 scale), number of white flies per plant, number of aphids per plant, number of thrips per leaf and number of mites per leaf (Table 1).

Table 1. Bird chilli genotypes employed in the experiment.

Sl. No.	Name of genotypes	Place of collection
1	Vandithadam-I	Thiruvananthapuram (Kerala, India)
2	Kakkamoola-IX	Thiruvananthapuram (Kerala, India)
3	Kottakkal-IV	Malappuram (Kerala, India)
4	Kozhencheri	Pathanamthitta (Kerala, India)
5	Kumarapuram-I	Kanyakumari (Tamilnadu, India)
6	Kumarapuram-II	Kanyakumari (Tamilnadu, India)
7	Thamallakkal	Alleppey (Kerala, India)
8	Kalitthatu	Alleppey (Kerala, India)
9	Chappanangadi-III	Malappuram (Kerala, India)
10	Narikkuni-II	Calicut (Kerala, India)

Results and Discussion

The phenotypic, genotypic and environmental coefficients of variations were worked out and are presented in Table 2.

The phenotypic coefficient of variation (PCV) was the highest for incidence of leaf curl disease (60.20) followed by fruit yield per plant (44.89), number of seeds per fruit (40.68), number of white flies per plant (37.10), individual fruit weight (30.91) and number of primary branches (22.32). Moderate phenotypic coefficient of variation was observed for number of fruits per plant (18.13), average fruit width (16.71), number of thrips per leaf (15.65), plant height (15.14), number of mites per leaf (13.09) and number of secondary branches (11.80). The characters number of days to first flowering (3.81) and average fruit length (9.33) had low phenotypic coefficient of variation.

Genotypic coefficient of variation (GCV) ranged from 3.73 for number of days to first flowering to 48.71 for incidence of leaf curl disease. It was the highest for incidence of leaf curl disease (48.71) followed by fruit yield per plant (44.75), number of seeds per fruit (40.67), number of white flies per plant (36.53), individual fruit weight (30.71) and number of primary branches per plant (20.72). Moderate genotypic coef-

Table 2. Genetic parameters.

Characters	Variance			Coefficient of variation			Heritability	Genetic advance (as % of mean)
	Phenotypic	Genotypic	Environmental	PCV	GCV	ECV		
Number of days to first flowering	12.75	12.22	0.53	3.81	3.73	0.77	95.88	7.52
Number of primary branches	12.27	10.56	1.71	22.34	20.72	8.35	86.03	39.60
Number of secondary branches	24.90	20.51	4.39	11.80	10.71	4.96	82.37	20.03
Number of fruits per plant	3022.78	2991.77	31.01	18.13	18.04	1.84	98.97	36.96
Average fruit length (cm)	0.41	0.40	0.01	9.33	9.22	1.46	97.56	18.76
Average fruit width (cm)	0.28	0.27	0.00	16.71	16.60	1.91	98.70	33.97
Individual fruit weight (g)	0.20	0.20	0.00	30.91	30.71	3.55	98.68	62.84
Fruit yield per plant (g)	41999.21	41730.98	268.23	44.89	44.75	3.59	99.36	91.88
Number of seeds per fruit	150.11	150.02	0.09	40.68	40.67	1.00	99.94	83.75
Plant height (cm)	227.56	225.47	2.09	15.14	15.07	1.45	99.08	30.90
Incidence of leaf curl disease (V.I)	28.70	18.80	9.91	60.20	48.71	35.37	65.48	81.20
Number of white flies per plant	0.14	0.14	0.00	37.10	36.53	6.50	96.93	74.09
Number of thrips per leaf	0.14	0.12	0.02	15.65	14.68	5.44	87.95	28.36
Number of mites per leaf	0.07	0.06	0.01	13.09	11.94	5.38	83.13	22.42

efficient of variation was observed for number of fruits per plant (18.04), average fruit width (16.60), plant height (15.07), number of thrips per leaf (14.68), number of mites per leaf (11.94) and number of secondary branches per plant (10.71). The characters number of days to first flowering (3.73) and average fruit length (9.22) had low genotypic coefficient of variation.

In general, the environmental coefficient of variation (ECV) was low for most of the characters. However, incidence of leaf curl disease (35.37), number of primary branches (8.35) and number of white flies per plant (6.50) showed comparatively higher ECV indicating the influence of environment on these characters.

High heritability (in broad sense) estimate was recorded for all the characters under study (Table 2). The highest heritability was obtained for number of seeds per fruit (99.94%) followed by fruit yield per plant (99.36%), plant height (99.08%), number of fruits per plant (98.97%), average fruit width (98.70%), individual fruit weight (98.68%), average fruit length

(97.56%), number of white flies per plant (96.93%), number of days to first flowering (95.88%), number of thrips per leaf (87.95%), number of primary branches (86.03%), number of mites per leaf (83.13%), number of secondary branches (82.37%) and incidence of leaf curl disease (65.48%).

All the characters exhibited high genetic advance except for number of days to first flowering 7.52% (low genetic advance) and average fruit length 18.76% (moderate genetic advance). The highest estimate of genetic advance obtained was 91.88% (fruit yield per plant) followed by 83.75% (number of seeds per fruit), 81.20% (incidence of leaf curl disease) and 74.09% (number of white flies per plant) (Table 2).

The phenotypic variation present in a population with respect to yield and morphological characters gives the basic idea of the extent of variability. In the present investigation, all the characters under study showed a wide range of variation. Similar findings have also been reported by earlier workers [6, 7]. Fruit yield per plant showed the greatest range of

variation followed by number of fruits per plant, plant height and number of seeds per fruit [8—11].

Genetic improvement through conventional breeding approaches depends mainly on the availability of the diverse germplasm and the amount of genetic variability present in the population for the desired characters. The genotypic coefficient of variation measures the range of variability available in the crop and also enables a breeder to compare the amount of variability present among different characters. The phenotypic expression of the character is the result of interaction between genotype and environment. Hence, the total variance should be partitioned into heritable and non heritable components to assess the true breeding nature of the particular trait under study.

In the present study there was close association between the estimates of PCV and GCV. High phenotypic and genotypic coefficients of variation were observed for incidence of leaf curl disease, fruit yield per plant and number of seeds per fruit. Similar results were reported earlier [12—19] in chilli. The character, number of days to first flowering showed extremely low variance. Similar results were reported earlier [14—19, 20] in chilli. Moderate phenotypic coefficient of variation was observed for number of fruits per plant, average fruit width, number of thrips per leaf, plant height, number of mites per leaf and number of secondary branches. A major portion of PCV was contributed by GCV for most of the characters suggesting that the observed variation was mainly due to genetic factors. Genotypic coefficient of variation and phenotypic coefficient of variations were closely corresponded with each other for most of the characters. However, comparatively low values of environmental coefficient of variation for all the characters indicated environment has less influence on these traits.

Heritability indicates the relative degree at which a character is transmitted from parents to off-spring. High heritability values indicate that the characters under study are less influenced by environment in their expression. The traits exhibiting high heritability could be improved by adopting simple selection methods. Further, the information on genetic varia-

tion, heritability and genetic advance helps to predict the genetic gain that could be obtained in later generations.

High heritability (in broad sense) estimate was recorded for all the characters under study viz., number of seeds per fruit, fruit yield per plant, plant height, number of fruits per plant, average fruit width, individual fruit weight, fruit length, number of white flies per plant, number of days to first flowering, number of thrips per leaf, number of primary branches, number of mites per leaf, number of secondary branches and incidence of leaf curl disease. Genetic advance as per cent of mean were high for all the characters except number of days to first flowering and average fruit length for which it was low and moderate respectively.

Many workers have reported high heritability coupled with high genetic advance for different characters in chilli. High heritability coupled with high genetic advance for all the 14 characters studied except number of days to first flowering, for which the genetic advance was moderate. Similar finding was reported earlier [14] in chilli. High heritability coupled with high genetic advance for number of fruits per plant, yield per plant and number of secondary branches per plant. Similar findings have also been reported by earlier workers [21—24].

High heritability along with high genetic advance in chilli was also noticed for average fruit weight, fruit yield per plant and fruit diameter [16], number of fruits per plant, fresh fruit yield per plant, seed weight, number of seeds per fruit [25], number of days to first flowering, duration of flowering, number of fruits per plant, green fruit yield per plant, number of seeds per fruit, duration of crop and vulnerability index [17].

In the present study, moderate genetic advance was expressed by average fruit length and low genetic advance was shown by number of days to first flowering. These results were supported by earlier worker [6, 7]. In the present research, high heritability values were obtained for all the traits indicating negligible influence of environment. High heritability coupled with high genetic advance indicates that the traits are controlled by additive gene action which

makes selection very effective [16]. Hence, selection can be considered as an important breeding method in the crop improvement program of bird chilli.

References

1. Singh SP (2007) Production and management of spices. *Agrihortica Publ*, Junagadh, pp 171—190.
2. Kallu PJA, Ravindran PN (2004) Chilli varieties for higher yield. *Spice India* 17 : 2—8.
3. Kumar B (2013) Indian Horticulture Database 2013. Mistry NC, Singh B, Gandhi PC (eds), pp 6.
4. Baruah SJN, Baruah M (2004) Bird's eye chilli-a forex earner for North East. *Spice India* 17 : 40—43.
5. KAU [Kerala Agricultural University] (2011) Package of practices recommendations: Crops (14th edn). Direct Exten, Kerala Agric Univ, Thrissur, pp 180—181.
6. Pandit MK, Adhikary S (2014) Variability and heritability estimates in some reproductive characters and yield in chilli (*Capsicum annum* L.). *Int J Pl and Soil Sci* 3 : 845—853.
7. Amit K, Ahad I, Kumar V, Thakur S (2014) Genetic variability and correlation studies for growth and yield characters in chilli (*Capsicum annum* L.). *J Spices and Aromat Crops* 23 : 170—177.
8. Khurana DS, Singh P, Hundal JS (2003) Studies on genetic diversity for growth yield and quality traits in chilli (*Capsicum annum* L.). *Ind J Hort* 60 : 277—282.
9. Gupta AM, Singh D, Kumar A (2009) Genetic variability, genetic advance and correlation in chilli (*Capsicum annum*). *Ind J Agric Sci* 79 : 221—223.
10. Singh DK, Singh A (2011) Assessment of variability parameters and character association for quantitative traits in chilli (*Capsicum annum* L.). *Prog Agric* 11 : 113—116.
11. Dowu A, Ogunniyan DJ, Ajayi EO (2012) Flowering and fruiting behavior of long cayenne pepper (*Capsicum frutescens* L.). *Int J Pl Breed and Genet* 6 : 228—237.
12. Nandadevi, Hosamani RM (2003) Variability, correlation and path analysis in *kharif* grown chilli (*Capsicum annum* L.) genotypes for different characters. *Capsicum Eggplant Newsl* 22 : 43—46.
13. Sreelathakumary I, Rajamony L (2003) Variability, heritability and genetic advance in bird pepper (*Capsicum frutescens* L.). *Capsicum and Eggplant Newsl* 22 : 51—54.
14. Mathew N (2006) Screening for leaf curl virus disease complex resistance, genetic evaluation and molecular characterization of bird chilli (*Capsicum frutescens* L.). MSc (Ag) thesis. Kerala Agric Univ, Thrissur, pp 100.
15. Reddy GM, Mohankumar HP, Salimath PM (2006) Variability, Correlation and path coefficient analysis in chilli (*Capsicum annum* L.). *Karnataka J Agric Sci* 2: 225—261.
16. Sharma VK, Semwal CS, Uniyal SP (2010) Variability and character association analysis in chilli (*Capsicum annum* L.). *J Hort and For* 3 : 58—65.
17. Anandhi K (2010) Genetic analysis of yield and curl virus resistance in chilli (*Capsicum* spp.). PhD thesis. Kerala Agric Univ, Thrissur, pp 148.
18. Ullah MZ, Hasan MJ, Saki AI, Rahman AHMA, Biswas PL (2011) Association of correlation and cause-effect analysis among morphological traits in chilli (*Capsicum frutescens* L.). *Int J Biol Res* 10 : 19—24.
19. Krishnamurthy SL, Reddy MK, Rao MA (2013) Genetic variation, path and correlation analysis in crosses among Indian and Taiwan parents in chilli. *Veg Sci* 40 : 210—213.
20. Sandeep (2007) Genetic variability, correlation, morphological and molecular diversity in byadgi kaddi and byadgi dabbi chillies (*Capsicum annum* L.) accessions. MSc (Ag) thesis. Univ Agric Sci, Dharwad, pp 153.
21. Bharadwaj DN, Singh SK, Singh HL (2007) Genetic variability and association of component characters for yield in chilli. *Int J Pl Sci* 2 : 93—96.
22. Sood S, Bindal A, Sharma A (2007) Genetical study for quality traits in bell pepper (*Capsicum annum* L.). *Ind J Genet* 67 : 95—98.
23. Sarkar S, Murmu D, Chattopadhyay A, Hazra P (2009) Genetic variability, correlation and path analysis of some morphological characters in chilli. *J Crop and Weed* 5 : 162—166.
24. Sharma VK, Semwal CS, Uniyal SP (2009) Genetic variability and character association analysis in bell pepper (*Capsicum annum* L.). *Hort and For* 2 : 58—65.
25. Kumari SS, Uma JK, Srihari D, Sankar SA, Sankar CR (2010) Variability and genetic divergence in paprika (*Capsicum annum* L.). *J Spices and Aromat Crops* 19 : 71—75.