Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(5): 34-37
Received: 11-07-2019
Accepted: 15-08-2019

Qurat ul Ain
Division of Vegetable Science, Division of GPB, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Shalimar, Srinagar, Jammu and Kashmir, India

K Hussain
Division of Vegetable Science, Division of GPB, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Shalimar, Srinagar, Jammu and Kashmir, India

SH Khan
Division of Vegetable Science, Division of GPB, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Shalimar, Srinagar, Jammu and Kashmir, India

Kouser Parveen
Division of Vegetable Science, Division of GPB, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Shalimar, Srinagar, Jammu and Kashmir, India

B Afroza
Division of Vegetable Science, Division of GPB, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Shalimar, Srinagar, Jammu and Kashmir, India

ZA Dar
Division of Vegetable Science, Division of GPB, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Shalimar, Srinagar, Jammu and Kashmir, India

Nageena Nazir
Division of Agriculture Statistics, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Shalimar, Srinagar, Jammu and Kashmir, India

Sajad Mohi ud Din
Division of Entomology, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Shalimar, Srinagar, Jammu and Kashmir, India

Correspondence
Qurat ul Ain
Division of Vegetable Science, Division of GPB, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir, Shalimar, Srinagar, Jammu and Kashmir, India

Genetic evaluation of biometrical traits in Chilli (*Capsicum annuum* L.)

Qurat ul Ain, K Hussain, SH Khan, Kouser Parveen, B Afroza, ZA Dar, Nageena Nazir and Sajad Mohi Ud Din

Abstract
In the present investigation, various biometrical traits in thirty genotypes of Chilli (*Capsicum annuum* L.) evaluated at the Experimental Farm of Division of Vegetable Science, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Srinagar revealed significance of genotypic effects. Analysis of variance revealed significant differences among genotypes for all the traits studied. The phenotypic and genotypic coefficients of variation were high for fruit yield ha^{-1}, vitamin C content at green stage, vitamin C content at ripe stage, number of fruits plant^{-1}, plant spread, plant height, number of branches plant^{-1}, stem diameter, placenta length fruit length fruit diameter, fruit weight, fruit pedicel length and moderate for days to flower initiation, days to 50% flowering, days to 50% fruiting, days to harvesting and dry matter content. None of the traits showed low values for GCV and PCV. In general PCV was marginally higher than the corresponding GCV indicating the less influence of environment in the expression of characters under study. High heritability coupled with high genetic advance as percentage of mean was observed for almost all characters except fruit diameter, number of branches plant^{-1}, indicating that most of the characters studied were mainly controlled by additive gene effect and thus selection may be effective.

Keywords: Biometrical traits, genetic variability, heritability, phenotypic coefficient of variation, genotypic coefficient of variation, genetic advance, genetic gain, Chilli

Introduction
Chilli is a leading spice-cum-vegetable crop grown commercially throughout the world. It is highly valued for its green or red ripe fruits with characteristic pungency, colour and flavour. It is consumed fresh, dried or in powder form. The fruits are an excellent source of health-related phytochemical compounds, such as ascorbic acid (vitamin C), carotenoids (provitamin A), tocopherols (vitamin E), flavonoids, and capsaicinoids that are very important in preventing chronic diseases such as cancer, asthma, toothache and cardiovascular diseases (El-Ghoraba *et al.*, 2013 [5]. Besides it is rich in mineral salts like Ca, P and Fe the colouring agent present in its fruits is Capsanthin ($C_{40}H_{56}0_3$). The alkaloid capsaicin/capsicutin ($C_{18}H_{27}NO_3$) present in placenta of the chilli fruit responsible for its pungency has diverse prophylactic and therapeutic uses in allopathic and ayurvedic medicine and can directly scavenge various free radicals. It has also acquired a great importance because of the presence of 'oleoresin', which permits better distribution of colour and flavour in foods. Chili has antioxidant, anti-mutagenesis, hypocholesterolemic and immunosuppressive properties, inhibits bacterial growth and platelet agglomeration (Wahyuni *et al.*, 2013) and facilitates starchy food digestion.

As far as development of superior genotype (s) is concerned, it is an often cross pollinated crop, exhibits wide variability for different qualitative and quantitative traits. Information on the nature and magnitude of variations available in the genotypes of a crop and the role of environment in the expression of various biometrical traits is essential for breeding programme as it leads to selection of most potent genotypes for rapid improvement in yield and for making hybridization programme successful. Genotypic and phenotypic coefficients of variability help to assess the divergence of those traits, which exhibit high variability along with moderate to high genetic gain for making selection more meaningful.

Materials and Methods
The experimental material for the present investigation consisted of thirty genotypes evaluated during *Kharif* 2015 in Randomized Complete Block Design with three replications at Vegetable Experimental Farm, Division of Vegetable Science, SKUAST-Kashmir, Shalimar. The row to row and plant to plant spacing was maintained at 60 cm x 45 cm. Recommended package of practices were adopted to raise a healthy crop.

The observations were recorded on twenty one quantitative traits *viz*., plant height, plant spread, stem diameter, number of branches plant^{-1}, days to flower initiation, days to 50% flowering, days to 50% fruiting, days to harvesting, placenta length, fruit length, fruit diameter, fruit weight plant^{-1}, fruit pedicel length, fruit pedicel diameter, number of fruits plant^{-1}, fruit yield hectare^{-1}, dry matter content, vitamin C content at green stage, vitamin C content at red ripe stage, capsaicin content and capsanthin content. The mean values of five randomly selected plants were used for statistical analysis. The analysis of variance and the genetic variability were computed as per the model suggested by Panse and Sukhatme. The phenotypic and genotypic coefficients of variation were calculated according to Burton and Devane. Heritability estimates (broad sense) were obtained following Burton and Devane and Johnson *et al*. Formulae given by Johnson *et al*. was used for calculating genetic gain.

Results and discussion

Significant variation was observed for all the traits under study. Analysis of variance confirmed the importance of genotype influence on all the traits (Table 1). Significant differences among genotypes in terms of traits which indicate the existence of genetic variation. General mean, range, genotypic and phenotypic coefficients of variation, heritability (bs), genetic advance and genetic gain are presented in table 2. The range of mean values revealed sufficient variation for all the traits under study. Considerable range of variation was observed for all the traits under study indicating enough scope for bringing about improvement in the desire direction.

Most of the economic characters (yield) are complex in inheritance and greatly influenced by several genes interacting with various environmental conditions, therefore, the study of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) is not only useful for comparing the relative amount of phenotypic and genotypic variations among different traits but also very useful to estimate the scope for improvement by selection. The presence and magnitude of genetic variability in a gene pool is the pre-requisite of a breeding programme. The knowledge of certain genetic parameters is essential for proper understanding and their manipulation in any crop improvement programme. Genetic parameters like genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability and genetic advance are useful biometrical tools for determination of genetic variability. Therefore, selection for yield per se may not be much rewarding unless other yield attributing traits are taken into consideration.

The analysis of variance revealed that all the twenty one quantitative traits exhibited highly significant differences among the genotypes (Table 1). The estimates of phenotypic and genotypic coefficients of variation of all the characters studied are presented in (Table 2). In general the phenotypic and genotypic coefficients of variation were almost similar with slight higher phenotypic coefficients of variation, which indicates the role of environment in the expression of traits under observation. This was in agreement with the study of Jyothi *et al.* (2008), Patel *et al.* (2009), Gupta *et al.* (2009), Kumari *et al.* (2010)), Janaki *et al.* (2013), and Lakshmi and Padma (2012), Pandiyaraj *et al.* (2017) [15]. It is evident from the data presented in Table 1 that average fruit yield hectare^{-1} (88.79, 88.80), number of fruits plant^{-1} (40.03, 40.43), plant height (23.83, 23.89%), plant spread (37.09, 37.01), stem diameter (25.58, 25.57), placenta length (25.64, 27.78), fruit length (22.43 and 24.26%), fruit diameter (27.07, 44.73), fruit weight (24.57, 27.14), fruit pedicel length (23.80, 26.27), number of branches plant^{-1} (33.10, 45.99), recorded high phenotypic and genotypic coefficients of variation, indicating that genotypes had broad genetic base for these characters. Similar results were obtained by Mohammed *et al.* (2001), Singh *et al.* (2009), Sarkar *et al.* (2009) [18]. for fruit length, Patel *et al.* (2009), Singh *et al.* (2009), Sarkar *et al.* (2009) [18]. Padhar and zaveri (2010) [14]. Basavaraja *et al.* (2012) and Janaki *et al.* (2013) for number of fruits plant^{-1}and fruit yield per plant and Sarkar *et al.* (2009) [18]. for pant height. Rest of the traits *viz*., days to flower initiation (17.99 and 18.20%), days to 50% flowering (13.93, 14.01), days to 50% fruiting (17.99, 18.20), days to harvesting (18.01, 18.20), fruit pedicel diameter (17.90, 20.17), dry matter content (17.34, 17.35) showed moderate phenotypic and genotypic coefficients of variation. Thus these characters were less amenable for improvement through selection. This was in conformity with findings of Singh *et al.* (2009) and Diwakar *et al.* (2012). Among quality parameters Vitamin C content at green stage (57.63, 57.61), Vitamin C content at ripe stage (53.07, 53.05), Capsanthin content (40.13, 40.12), Capsaicin content (32.15, 30.98) recorded high phenotypic and genotypic coefficients of variation, indicating that genotypes under study have broad genetic base for these characters as well. Similar results were obtained by Datta and jana (2010) [3]. Choudhary *et al.* (2011) and Pandiyaraj *et al.* (2017) [15]. Characters which possessed moderate to high coefficients of variation suggested that there is better potential for improvement through selection. A wide range of variability along with high estimates of phenotypic and genotypic coefficients of variation further indicate that these attributes would respond to selection. It should be noted that range only provides rough estimates of variability while the PCV and GCV estimates are reliable in determining the extent of variability present within the material. Parallelism between the magnitude of PCV and GCV estimates were observed for almost all the traits except fruit diameter and number of branches plant^{-1}, depicting relative stability of these traits to environmental fluctuations.

Heritability (b.s.) estimates were high for almost all the characters except fruit diameter, number of branches plant^{-1} and ranged from 37 to 99 per cent indicating that the characters are less influenced by environmental effects and the characters are effectively transmitted to the progeny, suggesting major role of genetic constitution in the expression of a character and thus selection based on phenotypic expression could be relied upon. This is in accordance with the findings of Smitha and Basavaraja (2006) [18]. and, Sarkar *et al.* (2009) [18]. for number of fruits plant^{-1}, number of branches plant^{-1}, plant height, length of fruit and fruit yield plant^{-1}, Ibrahim *et al.* (2001) [7]. Smitha and Basavaraja (2006) [18].) Krishna *et al.* (2007) [11]. Janaki *et al.* (2015) [8]. Chakarbarty *et al.* (2017) for number of fruits plant^{-1} and plant height and Mahantesh *et al.* (2017) for plant spread.Among quality characters high heritability estimates were recorded for Vitamin C content at green stage, Vitamin C content at red ripe stage, Capsaicin content and Capsanthin content. Number of branches plant^{-1} and fruit diameter recorded moderate heritability. This is consistent with the reports of Mohammed *et al.* (2008).

Table 1: Analysis of Variance for various characters in chilli (Capsicum annuum L.)

S. No.	Source of variation	d.f	Mean sum of Squares									
			Plant height(cm)	Plant spread(cm)	Stem diameter(cm)	No. of branches plant^{-1}	Days to flower initiation	Days to 50% flowering	Days to 50% fruiting	Days to harvesting	Placenta length(cm)	Fruit length(cm)
1.	Replication	2	0.04	0.05	0.0008	4.52	5.17*	0.90	10.17**	7.54	0.80	0.63
2.	Genotype	29	614.79**	373.49**	0.231**	62.26**	84.28**	262.52***	393.34**	788.77**	14.07**	13.71**
3.	Error	58	0.79	0.07	0.001	14.73	0.69	1.11	1.22	5.64	0.77	0.74

Table 1: Cont...

S. No.	Source of variation	d.f	Mean sum of squares										
			Fruit diameter(cm)	Fruit width(cm)	Fruit pedicel length(cm)	Fruit pedicel diameter(cm)	No. of fruits plant^{-1}	Fruit yield hectare^{-1}	Dry matter Content (%)	Vitamin C (green)(mg 100^{-1})	Vitamin C(ripe)mg 100^{-1}	Capsaicin content(g 100^{-1})	Capsanthin content(ASTA)units
1.	Replication	2	0.67	0.45	1.64**	0.007	2.53	0.35	0.29*	0.235	5.31	0.001	0.343
2.	Genotype	29	1.06*	3.37**	2.07**	0.03**	137.27**	1693.8**	439.78**	3759.03**	3977.70**	0.0400*	4088.05**
3.	Error	58	0.38	0.23	0.14	0.003	0.92	0.13	0.07	1.01	1.00	0.01	1.04

*Significant at 0.05 probability level

**significant at 0.01 probability level

Table 2: Estimates of mean, range, phenotypic variance, Genotypic variance, phenotypic and genotypic coefficients of variation for various quantitative traits in chilli (*Capsicum annuum* L.)

S. No.	Characters	Mean	Range	Phenotypic variance $(\hat{\sigma}^2 p)$	Genotypic variance $(\hat{\sigma}^2 g)$	Phenotypic coefficient of variation (PCV) %	Genotypic coefficient of variation (GCV) %	Heritability in broad Sense (%)	Genetic gain
1.	Plant height (cm)	60.02	41.47-95.13	205.46	204.67	23.89	23.83	0.99	49.00
2.	Plant spread (cm)	30.84	13.76-58.45	124.55	124.47	37.01	37.09	0.99	76.22
3.	Stem diameter (cm)	1.083	0.38-1.80	0.077	0.076	25.57	25.58	0.98	52.35
4.	Number of branches plant^{-1}	12.02	6.00-24.40	30.58	15.85	45.99	33.10	0.52	49.08
5.	Days to flower initiation	29.35	24.00-39.60	28.56	27.85	18.20	17.99	0.98	36.58
6.	Days to 50% flowering	67.04	50.00-85.67	88.26	87.14	14.01	13.93	0.99	28.49
7.	Days to 50% fruiting	63.55	42.00-77.34	131.93	130.70	18.07	17.99	0.99	36.89
8.	Days to harvesting	89.71	65.00-109.0	266.69	261.04	18.20	18.01	0.98	36.70
9.	Placenta length (cm)	8.21	4.60-14.54	5.20	4.44	27.78	25.64	0.86	48.72
10.	Fruit length (g)	9.27	5.76-15.64	5.06	4.33	24.26	22.43	0.86	42.70
11.	Fruit diameter (cm)	1.75	0.67-3.55	0.62	0.23	44.73	27.07	0.37	33.77
12.	Fruit weight (g)	4.17	2.29-12.91	1.28	1.04	27.14	24.57	0.82	45.83
13.	Fruit pedicel length (cm)	3.38	1.95-5.50	0.79	0.65	26.27	23.80	0.83	44.46
14.	Fruit pedicel diameter (cm)	0.59	0.40-0.83	0.014	0.011	20.17	17.90	0.79	32.77
15.	Number of fruits plant^{-1}	16.84	6.40-37.40	46.37	45.45	40.43	40.03	0.98	81.65
16.	Fruit yield (qhec^{-1})	39.76	5.45-176.43	564.70	564.57	88.80	88.79	0.99	182.93
17.	Dry matter content (%)	30.16	15.4-50.46	146.65	146.57	17.35	17.34	0.99	35.70
18.	Vitamin C content at green stage (mg/100g)	61.42	13.28-175.75	1253.03	1252.01	57.63	57.61	0.99	118.70
19.	Vitamin C content at ripe stage (mg/100g)	68.62	18.78-187.37	1326.49	1325.57	53.07	53.05	0.99	109.34
20.	Capsaicin content (mg/g)	0.368	0.201-0.620	0.014	0.013	32.15	30.98	0.93	66.24
21.	Capsanthin content (ASTA units)	91.99	45.58-188.97	1363.38	1362.34	40.14	40.13	0.99	82.69

The reliability of a parameter to be selected for breeding programme among other factors is dependent on the magnitude of its coefficient of variations (CV) especially the genotypic coefficient of variation (GCV). However, the differences between genotypic and phenotypic coefficient of variability indicate the environmental influence. While a lower value of coefficient of variations (CV) generally depicts low variability among the tested sample; a high proportion genotypic coefficient of variation (GCV) to the phenotypic coefficient of variation (PCV) is desirable in breeding works. However, high heritability does not mean a high genetic advance for a particular quantitative character. Johnson *et al*. (1995) reported that heritability estimates along with genetic gain would be more rewarding than heritability alone in predicting the consequential effect of selection to choose the best individual. Low estimates of genetic gain were observed for none of the traits under study and was high in all the traits studied. Thus, from the present study it could be inferred that most of the traits are under the additive gene effects which could be improved by direct selection.

References

1. Burton GW, Devane EM. Estimation of heritability in tall fescue (*Festuca arundinacea*). Agron. J. 1953; 45:478-481.
2. Choudhary BS, Samadia D. Variability and character association in chilli land races and genotypes under arid environment. Indian Journal of Horticulture. 2004; 61(2):132-136.
3. Datta S, Jana JC. Genetic Variability, heritability and correlation in chilli genotypes under Terai zone of West Bengal. SAARC Journal of Agriculture. 2010; 8(1):33-45.
4. Diwaker K, Vijay B, Rangare SB, Devi S. Genetic variability, heritability and correlation studies in chilli (*Capsicum annuum* L.). Hort Flora Research Spectrum. 2012; 1(3):248-252.
5. El-Ghoraba AH, Javed Q, Anjum FM, Hamed SF, Shaabana HA. Pakistani Bell pepper (*Capsicum annuum* L.): Chemical compositions and its Antioxidant Activity. International Journal of Food Properties. 2013; 16(1):18-32.
6. Gogai D, Gautam BP. Variability, heritability and genetic advance in chilli. (*Capsicum* spp.). Agricultural Science Digest. 2002; 22(2):102-104.
7. Ibrahim M, Ganigar VM, Yenjerappa ST. Genetic variability, heritability, genetic advance and correlation studies in chilli. Karnataka Journal of Agricultural Sciences. 2001; 14:784-878.
8. Janaki M, Naidu N. Assessment of genetic variability, heritability and genetic advance for quantitative traits in chilli (*Capsicum annuum* L.). The Bioscan. 2015; 10(2):729-733.
9. Johnson HW, Robinson HF, Comstock RE. Estimate of genetic and environmental variability in soybean. Agron. J. 1955; 46:314-318.
10. Jyothi KU, Kumari SS, Ramana CV. Variability studies in chilli (*Capsicum annuum* L.) with reference to yield attributes. Journal of Horticultural Sciences. 2011; 6(2):133-135.
11. Krishna C, Madalageri MB, Patil MP, Kotlkal YK. Variability Studies in Green Chilli (*Capsicum annuum* L.). Karnataka Journal of Agricultural Sciences. 2007; 20(1):102-104.
12. Mahantesh J, Madalager Y, Ganiger MB. Genetic variability studies in chilli (*Capsicum annuum* L.). International Journal of Plant Science. 2013; 8(2):241-248.
13. Mohammed ETI. Collection and characterization of hot pepper germplasm in Sudan. Capsicum Eggplant News Letter. 1994; 13:36-37.
14. Padhar PR, Zaveri PP. Genetic studies in relation to selection criteria in chilli. Research on Crops. 2010; 11(3):722-727.
15. Pandiyaraj P. Genetic variability, heritability and genetic advance for quantitative and qualitative traits in chilli (*Capsicum annuum* L.). International Journal of Agriculture Sciences. 2017; 9(14):4081-4083.
16. Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. Indian Coun. Agric. Res., New Delhi, 1978; pp 68-75.
17. Patil SD, Bidari B, Shashidhara GB, Hegde NK. Genetic variability in chilli (*Capsicum annuum* L.) genotypes. Asian Journal of Horticulture. 2008; 3(2):310-312.
18. Sarkar S, Murmu D, Chattopadhyay A, Hazra P. Genetic variability, correlation and path analysis of some morphological characters in chilli. Journal of Crop and Weed. 2009, Basavaraja N. Variability and Correlation Studies in Chilli (*Capsicum annuum* L.). Karnataka Journal of Agricultural Sciences. 2006b; 19(4):888-891.