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Research Note

Genetic diversity analysis for dry fruit yield, its attributes and quality traits in chilli (*Capsicum annuum* L.)

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Abstract
Genetic variability, correlation, path coefficient analysis and genetic diversity were studied for green fruit yield and its components in 32 diverse genotypes of chilli. The analysis of variance indicated presence of significant variability among the genotypes for all the characters. Higher estimates between GCV and PCV values indicated presence of substantial genetic variability and less environmental influence for plant height, secondary branches per plant, fruit weight, stalk length, fruits per plant, seeds per fruit, fresh fruit yield per plant, dry fruit yield per plant, ascorbic acid, capsaicin content, oleoresin content and capsanthin content. High heritability coupled with high genetic advance as per cent mean was noticed for most of the traits except days to 50 % flowering and 1000 seed weight suggesting presence of additive gene action for inheritance of these yield attributes. Hence, simple selection would be effective for improvement of these traits. Dry fruit yield per plant depicted significant and positive correlation with fruits per plant and fresh fruit yield per plant suggesting possibility of simultaneous improvement. Positive direct effects of fruit length, fruit girth, fresh fruit yield per plant and capsaicin content on dry fruit yield per plant were revealed by path co-efficient analysis suggesting that more importance should be given to these characters for improving dry fruit yield per plant. Cluster I (26) had maximum genotypes and cluster III (1) had minimum genotype. Maximum contribution of capsanthin content (70.97) was observed to the total diversity followed by ascorbic acid (19.56). The inter-cluster distance was observed to be maximum between cluster II and III (D= 447.86). Hence, genotypes from these two clusters can be used in future hybridization program.

Key words
Dry Chilli, Genetic Variability, Correlation, Path Analysis, Genetic diversity

Chilli (*Capsicum annuum* L.), 2n = 24, family Solanaceae is one of the most important vegetable cum spice crop.The genus *Capsicum* consists of approximately 22 wild and 5 cultivated species, which includes *C. annuum, C. baccatum, C. chinense, C. frutescens* and *C. pubenscens* and it comes under the category of often cross pollinated crops. Chilli has different uses at mature green, red ripe and dried stages.It is valued for its pungency which is due to crystalline acrid volatile alkaloid capsaicin, present in the placenta of fruits. Capsaicin has diverse prophylactic and therapeutic uses in medicine (SumathyKutty and Mathew, 1984). From a nutritional aspect Szent-Gyorgyi discovered ascorbic acid (vitamin C) in chilli. It is also a rich source of vitamin A and E, small quantity of proteins, fats, carbohydrates and traces of minerals (Hosmani, 1993).Chilli is also a good source of oleoresin, which is the total flavour extract of the dried ground chillies and is a concentrated homogenous free flowing product, having varied uses in processed food and beverage industries.The success of good breeding programme usually depends upon the genetic variability present in the breeding material. Thus, knowledge on genetic variability, heritability and genetic advance is essential for a breeder to choose parents for hybridization and further crop improvement. Association and inter-association of characters should be known before starting any breeding program. Plant breeders are always interested in knowing the genetic divergence among the genotypes as it provides a basis for selection of parents for hybridization. As less work has been done on chilli, the present study was undertaken to give clear idea in a set of diverse 32 chilli genotypes.

The present investigation was conducted during *Kharif-rabi*, 2014-15 at the College Farm, NAU, Navsari. The experimental materials consisting of 32 genotypes (15 from Main Vegetable Research Station, AAU, Anand, Gujarat; 17 from local markets and traders of Anand, Navsari and Porbandar in Gujarat) were grown according to randomized block design with three replications consisting of one row of 10 plants for each accession. A spacing of 60 cm x 45 cm was followed and the crop was raised as per the recommended package of practices. Five representative plants per treatment were selected randomly, tagged and observations were recorded on these plants for 17 characters like days to 50% flowering, plant height (cm), secondary branches per

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plant, primary branches per plant, fruit length (cm), fruit girth (cm), fruit weight (g), stalk length (cm), fruits per plant, seeds per fruit, 1000 seed weight (g), fresh fruit yield per plant (g), ascorbic acid (mg/100 ml), capsaicin content (mg/g), oleoresin content (g/150 ml), capsanthin content (ASTA units). The observation on days to 50 per cent flowering was recorded on population basis. The mean values were used for statistical analysis. The estimates of genotypic and phenotypic coefficient of variations were calculated according to Burton (1952), heritability in broad sense and expected genetic advance as per the procedure of Allard (1960) and Johnson *et al.* (1955) respectively. The genotypic correlation was calculated following the method of Panse and Sukhatme (1978). The path coefficient analysis was estimated as per method given by Dewey and Lu (1959). Genetic divergence was calculated according to Mahalanobis D^2 statistics (1936).

Variability, Heritability and Genetic Advance: The results obtained under the present investigation are presented in Table 1 to 7. Analysis of variance revealed significant differences present among the genotypes for all the characters. Higher values of heritability and genetic advance as per mean and less difference between GCV and PCV values indicated presence of substantial genetic variability and less environmental influence for plant height, secondary branches per plant, fruit weight, stalk length, fruits per plant, seeds per fruit, fresh fruit yield per plant, dry fruit yield per plant, ascorbic acid, capsaicin content, oleoresin content and capsanthin content. Simple selection would be effective for improvement of these traits. Low to moderate GCV and PCV values were observed for days to 50 per cent flowering and 1000 seed weight indicating presence of low to moderate genetic variability. Similar results for high GCV for dry fruit yield per plant were obtained by Subasri and Natarajan (2000), Ibrahim *et al.*(2001), Mishra *et al.*(2001), Sreelathakumary and Rajamony (2002), Gogoi and Gautam (2002), Smita and Basavaraj (2006), Sharma and Sharma (2006), Srilakshmi (2006) and Shirshat *et al.*(2007).

High heritability and high genetic advance as per cent mean were noticed for most of the traits except for days to 50 per cent flowering and 1000 seed weight suggesting presence of additive gene action for inheritance of these traits. Hence, simple selection would be effective for improvement of these traits. High heritability for dry fruit yield per plant were observed by Munshi and Behera (2000), Venkateshwar Rao (2000), Ibrahim *et al.*(2001), Mishra *et al.*(2001), Sreelathakumary and Rajamony (2002), Gogoi and Gautam (2002), Smita and Basavaraj (2006), Sharma and Sharma (2006) and Srilakshmi (2006). Johnson *et al.* (1955) and Arya and Saini (1977) have suggested that characters with high heritability coupled with high genetic advance would respond better to selection than those with high heritability and low genetic advance.

Correlation: The dry fruit yield per plant had positive and significant correlation with fruits per plant (0.54) and fresh fruit yield per plant (0.90) suggesting possibility of simultaneous improvement. Negative and significant association was found with seeds per fruit (-0.23), 1000 seed weight (-0.43) and capsanthin content (-0.26). This surprising result indicated that during fruit development, there is a competition for sinks between dry fruit yield and afore mentioned seed related traits showing negative and significant correlations. It indicated that simultaneous improvement of these traits will not be possible. Significant and positive association was observed for plant height with fresh fruit yield per plant (0.33). Significant and negative associations were observed for days to 50 per cent flowering with plant height (-0.21), secondary branches per plant (-0.26) and fruit length (0.27); plant height with 1000 seed weight (-0.30), capsaicin content (-0.28), oleoresin content (-0.25) and capsanthin content (-0.60); secondary branches per plant with fruit weight (-0.29), stalk length (-0.36), 1000 seed weight (-0.57) and ascorbic acid (-0.38); primary branches per plant with stalk length (-0.33), 1000 seed weight (-0.25) and ascorbic acid (-0.42); fruit length with fruit girth (-0.22) and capsanthin content (-0.27); fruit girth with capsaicin content (-0.20), oleoresin content (-0.20) and capsathin content (-0.35); fruit weight with oleoresin content (-0.35); stalk length with seeds per fruit (-0.35); fruits per plant with seeds per fruit (-0.39), capsaicin content (-0.32) and oleoresin content (-0.24); seeds per fruit with 1000 seed weight (-0.28) and fresh fruit yield per plant (-0.24); 1000 seed weight with fresh fruit yield per plant (-0.61) and ascorbic acid with oleoresin content (-0.31). The findings suggested that simultaneous improvement of these trait combinations will not be possible. Surprisingly, most of the significant associations of fruit quality traits with other traits were negative in nature.

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Path coefficient analysis: In the present study dry fruit yield per plant was taken as the dependent variable. Positive direct effects of fruit length (0.2530), fruit girth (0.3888), fresh fruit yield per plant (1.309) and capsaicin content (0.0438) on dry fruit yield per plant were revealed by path co-efficient analysis. The results suggested that simultaneous improvement of these traits is possible through simple selection. While, seeds per fruit (-0.2360), 1000 seed weight (-0.4341) and capsanthin content (-0.2665) had significant and negative correlation with dry fruit yield indicating that simultaneous selection will not be possible. Most of the traits exhibited negative direct effect on dry fruit yield. In this case, positive indirect effects of these traits through other traits might be considered while designing selection strategy.

Genetic diversity: Three clusters were revealed after employing D^2 statistics for assessment of diversity among 32 germplasm lines. Of these, cluster I was the largest group comprising of 26 genotypes followed by cluster II of 5 genotypes and cluster III of 1 genotype. There was no relationship between genetic and geographic diversity. Prabhudeva (2003) also had this conclusion. Maximum contribution of capsanthin content (70.97) to the total diversity was observed followed by ascorbic acid (19.56), oleoresin content (8.27), capsaicin content (0.01) and seeds per fruit (0.20%). Collectively, capsaicin content, ascorbic acid and oleoresin content accounted 98.80 per cent contribution to total divergence. These results are similar to the results of Yatung *et al.* (2014). Other characters showed negligible contribution towards divergence. Maximum mean values for most of the characters were observed in cluster III followed by cluster I, whereas minimum mean values for most of the characters were found to be with cluster II. The inter cluster distance was observed to be maximum between cluster II and III. These two clusters showed more variation in mean values also. Hence, genotypes in these two clusters can be used in future hybridization program.

The analysis of variance, high heritability and high genetic advance indicated the presence of significant variability among the genotypes for all the characters. Hence simple selection would be effective for improvement of the traits. Correlation and path coefficient analysis suggested that simultaneous improvement of various traits through simple selection would be beneficial. Genetic divergence conveyed that the crosses between NCG-153, NCG-163, NCG- 156, NCG- 158, NCG- 165 with NCG-174 can be used for producing hybrids. Details of the characters (qualitative and quantitative) and the genotypes possessing them helps in forming a proper hybridization program.

Saturated linkage maps may be developed utilizing recent Next Generation Sequencing (NGS) platforms / SNP discovery methods and segregating generations developed from above diverse genotypes, followed by consensus mapping, QTL analysis and association mapping. Presently, association mapping or LD (Linkage disequilibrium) mapping is emerging concept in crop improvement to analyze diverse germplasm lines. Development of saturated linkage maps and consensus mapping increases power of QTL analysis and association mapping. Saturated maps and QTLs, developed or identified utilizing above methods will be very useful for marker assisted backcrossing to transfer qualitative traits as well as marker assisted recurrent selection for valuable yield attributes which are quantitative in nature.

References

Allard, R.W. 1960. Principles of plant breeding. *John Whiley Sons Inc*. New York. p.485

Arya, P. S. and Saini, S. S. 1976. Variability and correlation studies in chilli (*Capsicum annuum* L.). *Haryana J. Hort. Sci*., **5**(3-4) :236-244.

Burton, G.W. 1952. Quantitative inheritance in grasses.*In : Proc. of Sixth Int. Grassland Congress*, **1**: 277-283.

Dewey, D. R. and Lu, K. H. 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J.,* **51:** 515-518.

Gogoi, D. and Gautam, B. P. 2002.Variability, heritability and genetic advance in chilli. Agric. Sci. Digest, **22**(2) : 102-104.

Hosmani, M. M. 1993. Chilli Crop (*Capsicum annuum* L). M/S Bharat Photo Offset Works

Dharwad. Ibrahim, M., Ganigar, V. M. and Yenjerappa, S. T. 2001. Genetic variability, heritability,genetic advance and correlation studies in chilli. *Karnataka J. Agric. Sci*., **14** : 784-878.

Johnson, H. W., Robinson, H. F. and Comstock, R. E. 1955. Estimation of genetic and environmental variability in soybean. *Agron. J*., **47** : 477-483.

Mahalanobis, P. C. 1936. On the generalized distance in statistics. *Proc.Of Nation. Acad. Sci.*, **2:** 55-79.

Mishra, A., Sahu, G. S. and Mishra, P. K. 2001.Variability in fruit characters of chilli (*Capsicum annuum* L.).*Orissa J. Hort*., **29**(2) : 107-109.

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Munshi, A. D. and Behera, T. K. 2000. Genetic variability, heritability and g*enetic advance for some traits in chillies (Capsicum annuum* L.*). Veg. Sci.*, **27**(1) : 39-41.

Panse, V.G. and Sukhatme, P.V. 1978. Statistical Methods for Agricultural Workers (3rd edition revised) I.C.A.R., New Delhi, India.

Prabhudeva, S.A. 2003. Variability, genetic diversity and heterosis study in chilli (*Capsicum annuum* L.). *M. Sc. Thesis*, Univ. Agric. Sci., Dharwad (India).Sharma, A. and Sharma, S. 2006. Variation studies for bell pepper (*Capsicum annuum*) improvement under cold desert conditions of North-Western Himalayas., *Indian J. Genet. Pl. Breeding*, **66**(4) : 357-358.

Shirshat, S. S., Giritammannavar, V. A. and Patil, S. J. 2007. Analysis of genetic variability for quantitative traits in chilli. *Karnataka J. Agric. Sci*., **20**(1) : 29-32.

Smita, R. P. and Basavaraj.2006. Variability and correlation studies in Chilli (*Capsicum annuum* L.). *Karnataka J. Agric. Sci*., **19**(4) : 888-891.Sreelathakumary, I. and Rajamony, L. 2002. Variability, heritability and correlation studies in chilli under shade (*Capsicum* spp.) under shade. *Indian J. Hort*., **59**: 493-494.

Srilakshmi P. 2006. Genetic diversity, heritability and genetic advance studies in chilli (*Capsicum annuum* L.) for quantitative and qualitative characters. *M. Sc. (Agri.) Thesis.* Univ. Agric. Sci., Dharwad (India).

Subashri, S. and Natarajan, S. 2000. Genetic variability in segregating progenies of chilli (*Capsicum annuum* L.).*South Indian Hort*., **48**(1-6) : 36-39.

Sumathykutty, M. A. and Mathew, A. G. 1984. Chilli processing.*Indian Cocoa*, *Arecanut and Spice J.*, **7**: 112-113.Venkateshwar Rao, K. 2000. Assessment of variability for fruit quality parameters in local collections of Byadgi chilli (*Capsicum annuum* L.) variety. *M. Sc. (Agri.) Thesis*, Univ. Agric. Sci., Dharwad (India).

Yatung, T., Dubey, R. K., Singh, V. and Upadhyay. G. 2014. Genetic diversity of chilli (*Capsicum annuum* L.) genotypes of India based on morpho-chemical traits. *AJCS,* **8**(1): 97-102.

Table 1. Analysis of variance for various characters in chilli

Sr. No.	Characters	Mean squares Replication	Treatment	Error
	d.f.	2	31	62
1	Days to 50% flowering	1.34	35.12*	4.63
2	Plant height (cm)	30.65	600.15*	52.38
3	Secondary branches per plant	2.37	39.74*	0.94
4	Primary branches per plant	0.07	2.94*	0.43
5	Fruit length (cm)	1.30	17.81*	2.28
6	Fruit girth (cm)	0.38	1.23*	0.33
7	Fruit weight (g)	0.24	19.31*	0.36
8	Stalk length (cm)	0.13	1.80*	0.04
9	Fruits per plant	135.96	1808.40*	44.63
10	Seeds per fruit	21.98	847.90*	16.96
11	1000 seed weight (g)	0.72	0.93*	0.53
12	Fresh fruit yield per plant (g)	6100.79	85908.52*	5413.63
13	Dry fruit yield per plant (g)	23.76	1557.32*	87.74
14	Ascorbic acid (mg/100 ml)	0.28	1302.67*	0.12
15	Capsaicin content (mg/g)	0.01	1.24*	0.01
16	Oleoresin content (g/150 ml)	0.01	91.01*	0.01
17	Capsanthin content (ASTA units)	0.27	5502.21*	0.09

* Significance at 5% level

Table 2. Estimates of components of variances for different characters in chilli

Sr. No.	Characters	Range	$\sigma^2 g$	$\sigma^2 p$	GCV (%)	PCV (%)	h^2 (%)	GAM (%)
1	DFF	53.00-68.00	10.16	14.79	5.22	6.30	68.00	8.91
2	PH (cm)	22.00-82.33	182.58	234.97	31.35	35.57	77.00	56.93
3	SB	3.00-18.00	12.93	13.87	41.24	42.72	93.00	82.02
4	PB	1.00-6.00	0.83	1.27	25.30	31.24	65.00	42.22
5	FL (cm)	2.23-13.64	5.17	7.46	27.28	32.76	69.00	46.81
6	FG (cm)	2.30-5.39	0.30	0.63	17.78	25.78	47.00	25.27
7	FW (g)	1.20-12.00	6.31	6.68	44.64	45.91	94.00	89.42
8	SL (cm)	1.39-4.49	0.58	0.63	23.78	24.70	92.00	47.18
9	FPP	26.00-116.00	587.92	632.55	38.77	40.22	92.00	77.00
10	SPP	27.00-103.00	276.97	293.94	26.85	27.66	94.00	53.70
11	SW (g)	4.15-6.40	0.13	0.66	6.86	15.47	19.00	6.27
12	FFYPP (g)	117.66-711.66	26831.63	32245.26	40.42	44.31	83.00	75.95
13	DFYPP (g)	19.09-101.60	489.86	577.60	39.11	42.47	84.00	74.19
14	AA (mg/100 ml)	71.49-130.37	434.18	434.30	22.00	22.00	99.00	45.32
15	Caps (mg/100 mg)	0.55-3.95	0.41	0.99	33.86	33.90	99.00	69.69
16	OLE (g/150 ml)	4.68-24.48	30.33	30.35	29.15	29.16	99.00	60.03
17	Capsan (ASTA units)	17.62-219.55	1834.04	1834.13	29.81	29.82	99.00	61.42

$\sigma^2 g$= genotypic variance, $\sigma^2 p$= phenotypic variance, GCV= Genotypic coefficient of variation, PCV= phenotypic coefficient of variation, h^2= Heritability, GAM= Genetic advance as per mean

DFF= Days to 50% flowering, PH= Plant height, SB= Secondary branches per plant, PB= Primary branches per plant, FL= Fruit length, FG= Fruit girth, FW= Fruit weight, SL= Stalk length, FPP= Fruits per plant, SPF= Seeds per fruit, SW= 1000 seed weight, FWYPP= Fresh fruit yield per plant, DFYPP= Dry fruit yield per plant, AA= Ascorbic acid, Caps= Capsaicin content, OLE= Oleoresin content, Capsan= Capsanthin content

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Table 3. Genotypic correlation between dry fruit yield and other yield attributes in chilli

Characters	DFF	PH	SB	PB	FL	FW	FG	SL	FPP	SPF	SW	FFYPP	AA	Caps	OLE	Capsan	Dry fruit yield per plant
DFF	**1.00**	-0.21*	-0.26*	-0.05	-0.27**	-0.02	-0.09	0.06	-0.09	-0.18	-0.04	-0.04	0.06	0.10	0.06	-0.17	0.00
PH		**1.00**	0.11	0.00	0.13	0.61	0.06	0.05	0.19	0.14	-0.30**	0.33**	0.18	-0.28**	-0.25*	-0.60***	0.10
SB			**1.00**	0.44***	0.21*	0.09	-0.29**	-0.36***	0.02	0.15	-0.57***	-0.03	-0.38***	-0.00	0.16	0.00	-0.03
PB				**1.00**	0.09	0.38***	-0.13	-0.33**	0.07	0.16	-0.25*	0.16	-0.42***	-0.08	-0.09	0.13	0.19
FL					**1.00**	-0.22*	0.31**	-0.10	0.08	0.05	0.24*	-0.04	-0.17	-0.00	0.02	-0.27**	0.03
FG						**1.00**	0.06	-0.15	0.06	0.27**	0.19	0.10	0.02	-0.20*	-0.20*	-0.35**	0.03
FW							**1.00**	0.07	0.08	0.03	0.28**	-0.03	0.05	-0.13	-0.35***	0.02	-0.17
SL								**1.00**	0.19	-0.35***	0.16	0.17	0.22*	0.17	0.10	-0.06	-0.02
FFP									**1.00**	-0.39***	-0.14	0.72***	0.03	-0.33**	-0.24*	-0.08	0.54***
SPF										**1.00**	-0.28**	-0.24*	-0.17	-0.18	-0.19	-0.16	-0.23*
SW											**1.00**	-0.61***	0.33**	0.37***	0.14	-0.03	-0.43***
FFYPP												**1.00**	0.17	-0.27	-0.24	-0.27	0.90***
AA													**1.00**	-0.09	-0.31**	-0.16	0.08
Caps														**1.00**	0.79***	0.11	-0.14
OLE															**1.00**	-0.03	-0.07
Capsan																**1.00**	-0.26*

*, **, *** Significance at 5%, 1% and 0.1 % levels, respectively. DFF= Days to 50% flowering, PH= Plant height (cm), SB= Secondary branches per plant, PB= Primary branches per plant, FL= Fruit length (cm), FG= Fruit girth (cm), FW= Fruit weight (g), SL= Stalk length (cm), FPP= Fruits per plant, SPF= Seeds per fruit, SW= 1000 seed weight (g), FFYPP= Fresh fruit yield per plant (g), AA= Ascorbic acid (mg/100 ml), Caps= Capsaicin content (mg/g), OLE= Oleoresin content (g/150 ml), Capsan= Capsanthin content (ASTA units).

Table 4. Genotypic path coefficient analysis showing direct (diagonal and bold) and indirect effects of different characters on dry fruit yield in chilli

Characters	DFF	PH	SB	PB	FL	FW	FG	SL	FPP	SRP	SW	FFYPP	AA	Caps	OLE	Capsan	'r_g' with DFYP
DFF	**-0.1013**	0.0214	0.0265	0.0058	0.0283	0.0024	0.0099	-0.0068	0.0100	0.0184	0.0049	0.0041	-0.0065	-0.0103	-0.0065	0.0181	0.0031
PH	0.1191	**-0.5633**	-0.0626	-0.0015	-0.0736	-0.3453	-0.0371	-0.0316	-0.1106	-0.0800	0.1737	-0.1882	-0.1024	0.1628	0.1456	0.3419	0.1039
SB	0.0111	-0.0047	**-0.0425**	-0.0190	-0.0094	-0.0040	0.0126	0.0155	-0.0012	-0.0065	0.0243	0.0016	0.0162	0.0004	-0.0068	-0.0002	-0.0073
PB	0.0117	-0.0005	-0.0907	**-0.2032**	0.0227	-0.0777	0.0275	0.0673	-0.0161	-0.0326	0.0518	-0.0344	0.0870	0.0179	0.0194	-0.0277	0.1928
FL	-0.0707	0.0331	0.0556	-0.0283	**0.2530**	-0.0575	0.0801	-0.0267	0.0210	0.0138	0.0617	-0.0114	-0.0437	-0.0014	0.0059	-0.0687	0.0318
FG	-0.0094	0.2383	0.0364	0.1486	-0.0884	**0.3888**	0.0246	-0.0604	0.0271	0.1068	0.0746	0.0418	0.0085	-0.0808	-0.0808	-0.1398	0.0334
FW	0.0215	-0.0145	0.0650	0.0298	-0.0696	-0.0139	**-0.2198**	-0.0160	-0.0186	-0.0069	-0.0633	0.0070	-0.0126	0.0305	0.0785	-0.0050	-0.1739
SL	-0.0112	-0.0094	0.0611	0.0555	0.0177	0.0260	-0.0122	**-0.1677**	-0.0335	0.0601	-0.0275	-0.0290	-0.0375	-0.0291	-0.0171	0.0109	-0.0297
FFP	0.0373	-0.0745	-0.0109	-0.0300	-0.0315	-0.0265	-0.0322	-0.0758	**-0.3793**	0.1498	0.0540	-0.2768	-0.0122	0.1272	0.0941	0.0303	0.5496
SPF	0.0356	-0.0279	-0.0302	-0.0315	-0.0107	-0.0539	-0.0062	0.0703	0.0775	**-0.1962**	0.0552	0.0480	0.0352	0.0362	0.0391	0.0328	-0.2360
SW	0.0002	0.0013	0.0024	0.0011	-0.0011	-0.0008	-0.0012	-0.0007	0.0006	0.0012	**-0.0042**	0.0026	-0.0014	-0.0016	-0.0006	0.0001	-0.4341
FFYPP	-0.0529	0.4375	-0.0485	0.2214	-0.0590	0.1407	-0.0414	0.2264	0.9555	-0.3206	-0.8027	**1.309**	0.2333	-0.3540	-0.3207	-0.3633	0.9007
AA	-0.0082	-0.0232	0.0488	0.0547	0.0221	-0.0028	-0.0073	-0.0286	-0.0041	0.0230	-0.0429	-0.0228	**-0.1278**	0.0126	0.0397	0.0206	0.0850
Caps	0.0045	-0.0127	-0.0004	-0.0039	-0.0002	-0.0091	-0.0061	0.0076	0.0147	-0.0081	0.0166	-0.0118	-0.0043	**0.0438**	0.0350	0.0052	-0.1450
OLE	-0.0068	0.0273	-0.0170	0.0101	-0.0025	0.0225	0.0377	-0.0108	0.0262	0.0211	-0.0148	0.0259	0.0328	-0.0843	**-0.1051**	0.0032	-0.0771
Capsan	0.0224	0.0758	-0.0006	-0.0170	0.0340	0.0449	-0.0029	0.0082	0.0100	0.0209	0.0044	0.0347	0.0202	-0.0148	0.0038	**-0.1249**	-0.2665

Note: Diagonal values are direct effects. 'r_g' Genotypic correlation coefficients with Dry fruit yield per plant (DFYP)
DFF= Days to 50% flowering, PH= Plant height (cm), SB= Secondary branches per plant, PB= Primary branches per plant, FL= Fruit length (cm), FG= Fruit girth (cm), FW= Fruit weight (g), SL= Stalk length (cm), FPP= Fruits per plant, SPF= Seeds per fruit, SW= 1000 seed weight (g), FFYPP= Fresh fruit yield per plant (g), AA= Ascorbic acid (mg/100 ml), Caps= Capsaicin content (mg/g), OLE= Oleoresin content (g/150 ml), Capsan= Capsanthin content (ASTA units).

Table 5. Intra and inter cluster D^2 value

Cluster	I	II	III
I	123.96	204.24	286.63
II		64.71	447.86
III			0.00

Table 6. Per cent contribution of 17 characters towards diversity in chilli genotypes

Sr. No.	Characters	% contribution
1	Capsanthin content	70.97
2	Ascorbic acid	19.56
3	Oleoresin content	8.27
4	Capsaicin content	1.01
5	Seeds per plant	0.2

Table 7. The mean values of clusters for morpho-physiological fruit quality parameters in chilli germplasm

S. No.	Characters	Clusters		
		I	II	III
1	Days to 50% flowering	61.49	58.60	61.33
2	Plant height (cm)	42.94	37.67	74.33
3	Secondary branches per plant	8.53	9.53	9.67
4	Primary branches per plant	3.58	3.80	3.67
5	Fruit length (cm)	8.17	8.12	13.65
6	Fruit girth (cm)	3.14	2.81	2.86
7	Fruit weight (g)	5.64	5.56	5.59
8	Stalk length (cm)	3.27	2.84	3.78
9	Fruits per plant	64.97	53.60	43.67
10	Seeds per plant	59.67	68.27	90.33
11	1000 seed weight (g)	5.37	5.07	4.22
12	Fresh fruit yield per plant (g)	408.55	348.73	601.33
13	Dry fruit yield per plant (g)	56.53	53.15	75.16
14	Ascorbic acid (mg/100 g)	98.55	77.94	78.13
15	Capsaicin content (mg/g)	1.88	2.03	1.94
16	Oleoresin content (mg/150 ml)	18.68	19.41	21.69
17	Capsanthin content (ASTA units)	136.44	206.13	17.62