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ESTIMATE OF GENETIC DIVERGENCE FOR YIELD AND YIELD RELATED TRAITS IN CHILLI (*CAPSICUM ANNUUM* L.)

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ABSTRACT

In a field experiment forty genotypes of chilli were examined genetic diversity for various growth and yield traits during winter season 2021-2022, with the aim of genetic divergence (D^2) among the genotypes for various traits. The experimental material for the study consisted of 40 genotypes including one check (Kashi Anmol), laid in Randomized Complete Block Design with three replications. Observations were recorded on thirteen quantitative characters and forty genotype. The clustering pattern of the forty genotypes were grouped into seven different non- overlapping cluster. Cluster I had highest number of genotypes (12) followed by cluster V (11), cluster IV (7), III (6), VII (2) whereas cluster II, cluster VI had presented one entry in each group. The minimum intra cluster distance (0.00) was found for cluster VI, II and maximum was found for cluster V (46.41). The maximum inter-cluster distance was found between cluster IV to VII (1537.87). The minimum inter- cluster D^2 value found in case of cluster I to II (36.58). Highest per cent contribution were observed in pedicle length (9.49%) followed by days to 50 per cent flowering (9.36%), fruit length (9.10%), no. of fruit per plant (8.59%). Thus, it can be inferred from the data above that selecting for these qualities will effectively enhance the crop for increased production and contributing traits.
Keywords **:** chilli, (*Capsicum annuum*), genotype, genetic diversity, inter cluster, intra cluster.

Introduction

Chilli is one of the most important vegetable crops grown almost throughout the country. It belongs to family Solanaceae with chromosome number 2n=24. Chilli is one of the most important and the largest produced spice crop in Asia. Major chilli growing countries in world are India, China, Ethiopia, Myanmar, Mexico, Peru, Vietnam, Pakistan, Ghana, and Bangladesh. In India subcontinent, chillies are produced throughout the year two crops are produced in *Kharif* and *Rabi* season in the country. Chilli grow best at 20-30^{0}C and yield suffer when temperatures exceed 30^{0}C or drops below 15^{0}C for extended period. The crop can be grown over a wide range of altitudes from sea level upto nearly 2100 meter.

In India green chilli is growing in an area of 411 thousand ha with production of 4363 thousand MT and dried chillies (spice) grown an area of 702 thousand ha with production of 2049 thousand MT (Anony., 2020-2021).

Himachal Pradesh, the acreage under chilli and bell pepper is 2072 ha with annual production of 34,132 metric tonnes. Chilli contains a range of essential nutrients and bioactive compounds which are known to exhibit antioxidant, antimicrobial, antiviral, anti-inflammatory and anticancer properties. It is a excellent source of Vatamin A, B, C, E and P (Quresh

et al., 2015). It is also a good source of 'oleoresin', which permits better distribution of colour and flavour in foods (Chattopadhyay *et al*., 2011).

The productivity of chilli in India is low due to the dominance of open polllinated varieties (Pandit and Adhikary, 2014). The other limiting factor attributed for low productivity are lack of superior geneotypes or improved cultivars for use in breeding programme to develop potential hybrid, severe incidence of insect pests (thrips, mites and borers) and diseases (anthracnose, leaf spots and viral diseases) resulting in tremendous reduction in yield and quality.

The understanding of association of characters is of prime importance in developing an efficient breeding programme. Mahalanobis 'D^{2}' statistic approach, which is based on multivariate analysis of quantitative traits, is a powerful tool for measuring genetic diversity using the concept of statistical distance utilizing multiple measurements. The use of such statistical technique in classification problems has been extensively indicated because it permits precise comparison among all possible pairs of population before affecting the actual crosses.

To benefit transgressive segregation, the knowledge of genetic distance between parent is necessary (Srinivas *et al.,* 2015). This facilitates identification of promising genotype which can further be used directly or indirectly in breeding programmes. Likewise, it also helps to choose the right type of parents for purposeful hybridization in heterosis breeding.

Material and Methods

The current study was conducted at the Main Experiment Station, Department of Vegetable Science, Acharya Narendra Deva University of Agriculture and Technology (Narendra Nagar), Kumarganj, Ayodhya (U.P), during the Rabi season 2021- 22. Based on the analysis of 40 genotypes, the experiment was carried out in a Randomized Block Design with three replications in the autumn-winter season of 2021–2022. The goal was to determine the correlation between various features. Twelve plants in two rows, spaced 60 x 50 centimetres apart, made up each treatment, with a net plot of 3.0 x 1.8 metres. The seedlings were shown in last week of August, on the nursery bed and transplanted on first week of October, 2021. To produce a successful harvest, all the necessary agronomic practises and plant protection measures were implemented. Observations were recorded on thirteen quantitative characters *viz.,* days to 50% flowering, days to mature green fruit, days to mature red ripe stage, plant height (cm), primary branches per plant, secondary branches per plant, no. of fruit per plant, fruit length (cm), pedicel length (cm), fruit circumference (mm), average fruit weight (g), ascorbic acid (mg/100g), fruit yield per plant (kg). The genetic divergence of forty genotypes of chilli was worked out using Mahalanobis (1936) D^{2} statistics.

Table 1 : Distinguishing features of the genotypes included in the study

S. No.	Name of genotypes	Source of origin
1.	2021/CHIVAR-1	A.N.D.U.A.&T., Ayodhya
2.	2021/CHIVAR- 2	A.N.D.U.A.&T., Ayodhya
3.	2021/CHIVAR- 3	A.N.D.U.A.&T., Ayodhya
4.	2021/CHIVAR- 4	A.N.D.U.A.&T., Ayodhya
5.	2021/CHIVAR- 6	A.N.D.U.A.&T., Ayodhya
6.	2021/CHIVAR- 7	A.N.D.U.A.&T., Ayodhya
7.	2021/CHIVAR- 8	A.N.D.U.A.&T., Ayodhya
8.	2021/CHIVAR- 9	A.N.D.U.A.&T., Ayodhya
9.	2021/CHIVAR- 10	A.N.D.U.A.&T., Ayodhya
10.	2021/CHIVAR- 11	A.N.D.U.A.&T., Ayodhya
11.	2021/CHIVAR- 12	A.N.D.U.A.&T., Ayodhya
12.	2021/CHIVAR- 13	A.N.D.U.A.&T., Ayodhya
13.	2021/CHIVAR- 14	A.N.D.U.A.&T., Ayodhya
14.	2020/CHIVAR- 1	A.N.D.U.A.&T., Ayodhya
15.	2020/CHIVAR- 2	A.N.D.U.A.&T., Ayodhya
16.	2020/CHIVAR- 3	A.N.D.U.A.&T., Ayodhya
17.	2020/CHIVAR- 4	A.N.D.U.A.&T., Ayodhya
18.	2020/CHIVAR- 6	A.N.D.U.A.&T., Ayodhya
19.	2020/CHIVAR- 7	A.N.D.U.A.&T., Ayodhya
20.	2020/CHIVAR- 8	A.N.D.U.A.&T., Ayodhya

21.	2020/CHVAR- 9	A.N.D.U.A.&T., Ayodhya
22.	2020/CHIVAR- 10	A.N.D.U.A.&T., Ayodhya
23.	2020CHIVAR- 11	A.N.D.U.A.&T., Ayodhya
24.	2020/CHIVAR- 12	A.N.D.U.A.&T., Ayodhya
25.	2020/CHIVAR- 13	A.N.D.U.A.&T., Ayodhya
26.	NDC-15	A.N.D.U.A.&T., Ayodhya
27.	NDC-17	A.N.D.U.A.&T., Ayodhya
28.	NDC-18	A.N.D.U.A.&T., Ayodhya
29.	NDC-20	A.N.D.U.A.&T., Ayodhya
30.	NDC-22	A.N.D.U.A.&T., Ayodhya
31.	NDC-23	A.N.D.U.A.&T., Ayodhya
32.	NDC-25	A.N.D.U.A.&T., Ayodhya
33.	NDC-26	A.N.D.U.A.&T., Ayodhya
34.	NDC-27	A.N.D.U.A.&T., Ayodhya
35.	NDC-28	A.N.D.U.A.&T., Ayodhya
36.	NDC-29	A.N.D.U.A.&T., Ayodhya
37.	NDC-31	A.N.D.U.A.&T., Ayodhya
38.	NDC-33	A.N.D.U.A.&T., Ayodhya
39.	NDC- 36	A.N.D.U.A.&T., Ayodhya
40.	Kashi Anmol (C)	I.I.V.R. Varanasi, (U.P.)

Result and Discussion

Genetic Divergence:

The studies of genetic divergence among the 40 genotypes of chilli were carried out by using Mahalanobis D^2 statistics.

The clustering pattern of the forty genotypes were grouped into seven different non- overlapping cluster (Table 2). Cluster I had highest number of genotypes (12) followed by cluster V (11), cluster IV (7), III (6), VII (2) whereas cluster II, cluster VI had presented one entry in each group. This indicated presence of considerable diversity in the genotype. The major clusters in the mentioned genetic divergence analysis contained frequently the genotypes of heterogenous origin. Although the genotypes of same origin or geographic region were also found to be grouped together in the same cluster. The instance of grouping of genotypes of different origin or geographic region in same cluster were frequently observed. This suggested that there is no parallelism between genetic and geographic diversity.

The estimates of intra and inter- cluster distance represented by D^2 values are given in table 3. The minimum intra cluster distance (0.00) was found for cluster VI, II and maximum was found for cluster V (46.41) followed by cluster IV (38.03), cluster I (30.61), cluster III (27.44), cluster VII (16.06). The maximum inter-cluster distance was found between cluster IV to VII (1537.87) followed by cluster I to VII (1023.32), cluster II to VII (862.88), cluster IV to V (806.76), cluster VI to VII (744.93), cluster III to VII (575.59), cluster I to V (455.50), cluster II to V (350.28) were very high. The minimum inter-cluster D^2 value found in case of cluster I to II (36.58) followed by cluster II to VI (39.00), cluster I to VI (51.07), cluster III to VI (51.50), cluster II to III (57.50). The higher inter-cluster distance indicated greater genetic divergence between the genotypes of those clusters, while lower inter-cluster values between the clusters suggested that the genotypes of the clusters were not much genetically diverse from each other.

These results are in close conformation with the findings of Hasan *et al*. (2015), Janaki *et al*. (2016) and Farwah *et al.* (2022).

A perusal of table 4 showed that cluster means for the different traits indicated considerable differences between the clusters. The entire cluster from cluster I to cluster VII had average mean performance for most of the characters.

Cluster V showed earliest mean value for day to 50 per cent flowering (48.90 day), cluster V showed earliest mean value for the days to mature green stage (70.20 day), cluster II showed earliest mean value for days to mature red ripe stage (92.37 day), cluster VI showed maximum mean value for plant height (63.41), cluster I showed maximum mean value for primary branches per plant (3.55), cluster VI showed maximum mean value for secondary branches per plant (6.35), cluster IV showed maximum mean value no. of fruit per plant (63.61), cluster IV showed maximum mean value for fruit length (9.73), cluster IV showed maximum mean value for pedicle length (3.48), cluster

III maximum mean value for fruit circumference (11.58), cluster II showed maximum mean value for average fruit weight (3.25), cluster VII showed maximum mean value for ascorbic acid (204.75), cluster II and III showed maximum mean value for fruit yield per plant (0.19). These results are in close conformation with the findings of Yadav *et al.* (2016) and Vanitha and Jansirani (2017) Farwah *et al.* (2022).

Highest per cent contribution were observed in pedicle length (9.49%) followed by days to 50 per cent flowering (9.36%), fruit length (9.10%), no. of fruit per plant (8.59%), plant height (8.46%), primary branches per plant (8.33%), secondary branches per plant (7.82%) and days to mature red ripe stage (7.18%), ascorbic acid (6.92%), average fruit weight (6.67%) the contribution for other three characters *viz.,* days to mature green stage and fruit circumference (6.54%) and fruit yield per plant (5.00%) were very low for the diversification of genotype in table 5. These results are in close conformation with the findings of Singh *et al.* (2017) and Nahak *et al.* (2018).

The overall review of the results obtained by genetic diversity study in present investigation revealed that the crosses between the entries separated by the large inter-cluster distance and having high cluster mean values for one or other character will be helpful in the improvement of this important crop *i.e.,* chilli.

Table 2 : Clustering pattern of 40 genotypes of chilli based on Mahalanobis' D^2 statistics

Cluster Number	Number of Genotypes	Genotypes
I	12	2021/CHIVAR-4, Kashi Anmol, NDC-25, NDC-15, 2020/CHIVAR-8, NDC-27, 2020/CHIVAR-2, 2021/CHIVAR-3, 2020/CHIVAR-13, NDC-20, 2021/CHIVAR-1, NDC-33
II	1	NDC-28
III	6	2021/CHIVAR-6, NDC-22, NDC-26, NDC-36, 2021/CHIVAR-11, 2020/CHIVAR-11
IV	7	2021/CHIVAR-10, 2020/CHIVAR-1, 2021/CHIVAR-9, 2021/CHIVAR-8, 2020/CHIVAR-9, 2020/CHVAR-10, 2021/CHIVAR-2
V	11	2021/CHIVAR-7, 2021/CHIVAR-14, NDC-29, 2020/CHIVAR-4, 2020/CHIVAR-12, 2021/CHIVAR-13, NDC-23, NDC-31, 2020/CHIVAR-3, 2020/CHIVAR-6, NDC-18
VI	1	NDC-17
VII	2	2021/CHIVAR-12, 2020/CHIVAR-7

Table 3: Average an intra and inter-clusters D^2 values for seven clusters in chilli

Clusters	I	II	III	IV	V	VI	VII
I	30.61	36.58	94.93	86.37	455.50	51.07	1023.32
II		0.00	57.50	125.85	350.28	39.00	862.88
III			27.44	263.97	187.74	51.50	575.59
IV				38.03	806.76	190.69	1537.87
V					46.41	284.45	153.89
VI						0.00	744.93
VII							16.06

Table 4 : Intra-cluster group means for thirteen characters in chilli.

Cluster	Days to 50% flowering	Days to mature green fruit	Days to mature red ripe stage	Plant height	Primary branches per plant	Secondary branches per plant	No. of fruit per plant	Fruit length	Pedicel length	Fruit circumference	Average fruit weight	Ascorbic acid	Fruit yield per plant
I	48.90	71.42	95.61	63.04	3.55	6.04	55.81	7.89	3.05	8.78	2.33	95.23	0.13
II	49.54	70.20	92.37	63.20	3.52	6.21	57.16	7.54	3.39	11.39	3.25	81.50	0.19
III	52.00	74.16	96.55	57.61	3.39	6.02	62.88	8.34	3.29	11.58	3.16	117.03	0.19
IV	51.00	70.38	92.66	60.64	3.22	6.26	63.61	9.73	3.48	10.21	2.86	58.91	0.18
V	52.38	74.47	95.61	57.26	3.13	5.70	61.28	8.02	3.41	11.29	2.81	170.13	0.17
VI	48.91	72.25	96.91	63.41	3.52	6.35	53.75	6.73	3.19	10.07	2.19	149.87	0.11
VII	50.16	70.50	93.83	62.65	3.06	6.10	51.16	6.98	3.19	10.77	2.92	204.75	0.15

Table 5 : Percent contribution of thirteen characters towards total genetic divergence in chilli.

S. No.	Traits	Percent contribution
1	Days to 50% flowering	9.36
2	Days to mature green stage	6.54
3	Days to mature red ripe stage	7.18
4	Plant height	8.46
5	Primary branches per plant	8.33
6	Secondary branches per plant	7.82
7	No. of fruit per plant	8.59
8	Fruit length	9.10
9	Pedicle length	9.49
10	Fruit circumference	6.54
11	Average fruit weight	6.67
12	Ascorbic acid	6.92
13	Fruit yield per plant	5.00

Conclusion

Based on the above result of genetic diversity it could be concluded that clustering pattern of the forty genotypes were grouped into seven different non-overlapping cluster. Cluster I had highest number of genotypes (12). The minimum intra cluster distance (0.00) was found for cluster VI, II and maximum was found for cluster V (46.41). The maximum inter-cluster distance was found between cluster IV to VII (1537.87). Highest per cent contribution were observed in pedicle length (9.49%) followed by days to 50 per cent flowering (9.36%), fruit length (9.10%). Thus, this finding indicated that these traits could utilize in various breeding as well as improvement programmes. The information may further help the breeders in formulating appropriate strategy aimed at getting higher yield and character improvement in chilli.

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Competing Interests

Author have declared that no competing interests exist.

References

Anonymous, (2020-21). Data base *National Horticulture Board*. 85, *Gurgaon*, *Haryana, India*

Chattopadhyay, A., Sharangi, A.B., Dai, N. and Dutta, S. (2011). Diversity of genetic resources and genetic association analysis of green and dry chillies of eastern India. *Chilean J. Agric. Res.* **71**, 350-356.

Farwah, Syeda & Hussain, Khursheed & Dar, zahoor ahmad & Mir, Mohammad & Rizvi, Seerat & Mazahir Hussain, & Rashid, Majid & Lone, Sameena & Shama, Rani & Lone, Sameena. (2022). Genetic Divergence in Chilli (*Capsicum annuum* L.) Genotypes.

Hasan, R., Huque, A.K., Hossain, M.K. and Alam, N. (2015). Assessment of genetic divergence in Chilli (*Capsicum annuum* L.) genotypes. *Plant Gene and Trait* **6**, 1-5

Janaki, M., Naidu, L.N., Ramana, C.V. and Rao, M.P. (2016). Genetic divergence among chilli (*Capsicum annuum* L.) genotypes based on quantitative and qualitative traits. *Int. J. Sci. and Nature* **7**, 181-189.

Mahalanobis, P.C. (1936). A statistical study at Chinese head measurement. *J. Asiatic soc. Bengal*, **25**, 301-377.

Nahak, S.C., Nandi, A., Sahu, G.S., Tripathy, P., Dash, S.K. Patnaik, A. and Pradhan, S.R. (2018). Studies on variability, heritability and genetic advance for yield and yield contributing characters in chilli (*Capsicum annuum* L.). *J. Pharmacog. Phytochem.,* **7**, 2506-2510.

Pandit, M.K. and Adhikary, S. (2014). Variability and heritability estimates in some reproductive characters and yield in chilli (*Capsicum annuum* L.). *Int. J. Plant and Soil Sci.* **3**, 845-853.

Singh, T., Joshi, A., Vikram, A., Dogra, R. (2022). Genetic variability and stability analysis in chilli landraces (*Capsicum annuum* L.) of North-western Himalayas, in Proceedings of the, 16–30 April, MDPI, Basel, Switzerland, doi,10.3390/ *IECH*o2022-12501.

Srinivas, B., Thomas, B. and Gogineni, S. (2015). Genetic divergence for yield and its component trait in chilli accessions of Kerala. *Int. J. Sci. Res.,* **4**, 442-446.

Vanitha and Jansirani. (2017). Studies on genetic divergence in chilli. *Int. J. Agric. Sci. Res.,* **7**, 15-20.

Yadav, A., Dhaliwal, M.S., and Jindal, S.K. (2016). Diversity analysis of indigenous and exotic chilli genotypes. *Indian J. Hort.* **73**, 54-59.