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Research on chilli (*Capsicum annuum* L.) genetic diversity

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Abstract
An effective selection of parents for hybridization requires a plant breeder to consider the genetic variety of the available germplasm, hence research on genetic diversity were carried out with 20 genotypes of chilli (*Capsicum annuum* L.) at the Crop Research Institute.Center-1, School of Agriculture, ITM University, Gwalior (Madhya Pradesh), during Rubi season of 2022-23. The D^2 Twenty genotypes were examined for genetic divergence using statistics. These genotypes were broadly divided into three clusters based on genetic distance. The most genotypes were found in Clusters 1 and 2, with 7, followed by Cluster 3 with 6. Among the different characters studied, Number of fruits per cluster (11.02%) contributed the days to 50% flowering provide the greatest to the total genetic diversity among the genotypes. (10.90%), days to first flowering (10.61%), yield per plant (8.76%), number of flowers per cluster (7.95%) and fruit diameter (7.54%). Cluster 2 displayed a minimum intra-cluster distance of (2.283) while cluster 1 had a maximum inter-cluster distance of (2.719). The genetically more diverse genotypes from the cluster with the greatest intercluster distance could be used in hybridization programmes to produce promising segregants.

Keywords: Cluster, yield, hybridization, genetic diversity, and chilli

Introduction
One of the most significant vegetable plants growing in India is the chilli. It is a member of the family Solanaceae. It is grown for export as well as for domestic market. Chilli is native to India but originated in South America" and was made available by the Portuguese in the late the 15th century. One of the most significant is the chilli and widely produced spice plants in Asia. The major chilli growing countries in the world are Bangladesh, Pakistan, Ghana, India, China, Ethiopia, Myanmar, Mexico, Peru, and the United States. Among all these countries, India tops the list of chilli exports. They account for about 33% of India's total spice exports and about 16% of the global spice trade. The major Indian Andhra Pradesh, Karnataka, Maharashtra, Orissa, Tamil Nadu, Madhya Pradesh, West Bengal, and Rajasthan are states that grow chillies. Capsicum is derived from the Greek word “capsicum", which means to bite. 22 wild species, three variations, five domestic species, and their wild relatives make up the genus Capsicum. In general, the domesticated species have larger but fewer fruits than their wild relatives, although the seeds per plant are about the same size. The chilli plant is an annual under plant, fruits differ in size, colour, pungency, form, and texture. The annual or perennial capsicum plant is herbaceous or semi-woody. Oval-shaped leaves are pointed, dark green on top and pale green on the underside, up to 15 cm tall. Flowers are white, tiny, and they can be seen on leaf axils alone or in groups of two or three. Proteins, Ca, Mg, P, K, Cu, and S are all abundant in green chilies. Vitamin C, riboflavin, and thiamine, among others. Curry powder's primary constituents are chillies. Chilli contains a number of essential nutrients and bioactive compounds known to have antioxidant, antimicrobial, antiviral, anti-inflammatory and anti-cancer properties. It is an excellent source of vitamins A, B, C, E, and P (Quresh *et al*., 2015) [8]. It is also a good source of 'oleoresin' which allows better distribution of colour and flavour in foods (Chattopadhyay *et al*., 2011) [3]. The improvement potential of any crop is proportional to the extent of genetic variability in the germplasm. The greater the variability, the greater the chance of selecting the desired genotypes after validating the heterogeneity in different

features among various genotypes, improvement can be put into practise. By dividing the correlation coefficient, path coefficient analysis distinguishes between direct and indirect effects based on these and other associated variables (Hasanuzzaman and Golam, 2011) [5].

Materials and Methods

The present investigation was done at research farm of the department of horticulture science ITM University Gwalior Madhya Pradesh during year 2022-23. Twenty genotypes (Table 1) were evaluated for plant growth and yield characters. The seedling was during the third week of November, transplanted. The same set of guidelines and plant protection measures that apply to universities were followed. Recommendation during the crop period. Growth parameters such as days to first flowering, day to 50% Flowering, day to first fruit setting, day to first harvesting, number of fruits Per cluster, number of fruits Per Plant, number of flowers per Cluster, Fruit length (cm), Fruit dimeter, Fruit Weight (g), Plant height(cm), number of Primary branching per plant, Fruit yield per plant. The genotypes were clustered Mahalanobis (1936) [7] and Rao (1952) [9] recommended utilising Tocher's approach and D2 statistics, while Panse & Sukhatme (1985) [10] recommended analysing and presenting observation data. According to Lush (1949; Burton, 1953) [2], GCV and PCV were calculated, while GA and heritability (in the wide sense) were calculated using Johnson *et al*.'s percent of mean at 5% selection intensity.

Results and Discussion

In this study we are used 20 genotypes for genetic divergence studies and these were divided into five clusters and it facilitates to easy identification genotypes which are similar features. Are given the (Table 4) The genotype collections from various locations demonstrated independence from their sources, with cluster I (7) having the greatest number of genotypes and other clusters like II (7) and III (6) following.

For all plant development and yield parameters, the analysis of variance revealed substantial genotype differences. It also reveals the greatest genetic divergence among the 20 genotypes produced in CRC-1 Gwalior (Madhya Pradesh). According to the data, cluster III (2.510) had the largest intra-cluster distance. The largest inters cluster distance, however, of 5.00 was measured between clusters III and II. The averages for fruit length, average fruit weight, fruit weight, chlorophyll 'a' content, chlorophyll 'b' content, and dry fruit yield per plant were documented. Similar opinions were also reported by Gogate *et al*. (2006) [11]. The ascorbic acid content, initial flowering date, 50% flowering date, and fruit seed count of Cluster II were highlighted. It seemed most likely that the desired traits could be combined by crossing between the genotypes of two clusters. In the current examinations, clusters III and II were discovered to be more divergent, and there will be a greater likelihood of obtaining better segregants in F2 and later. The most fruits and vegetables were observed by Ajjapplavara (2009) [1]; Datta and Das (2013) [4]; external influences. To increase yield in chilli, yield traits with high genetic variation and heritability, Considerations should be made for factors including fruit length, fruit diameter, and fruit weight. Therefore, it is fair to conclude that the genotypes chosen have a wide range of variability among all economically significant traits and that the crop improvement programme for chilli continues to be advantageous.

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Table 1: List of chilli genotypes.

S. No.	Genotypes	Source
1.	IC-119455	IIVR, Varanasi.
2.	ISC-2	IIVR, Varanasi
3.	KASHI ABHA	IIVR, Varanasi
4.	EC- 622085	IIVR, Varanasi
5.	IIHR-8	IIVR, Varanasi
6.	IIHR-16	IIVR, Varanasi.
7.	CMB-15	IIVR, Varanasi
8.	IC-119474	IIVR, Varanasi
9.	CMB-19	IIVR, Varanasi
10.	UTTKAL AVA	IIVR, Varanasi
11.	EC-519687	IIVR, Varanasi.
12.	DC-24	IIVR, Varanasi
13.	CO-5661	IIVR, Varanasi
14.	KASHI ANMOL	IIVR, Varanasi
15.	CSB-8	IIVR, Varanasi
16.	COO-714	IIVR, Varanasi.
17.	EC-341075	IIVR, Varanasi
18.	EC-519630	IIVR, Varanasi
19.	KASHI GOURAV	IIVR, Varanasi
20.	PKM-1	IIVR, Varanasi

Table 2: Average intra and inter cluster (D^2)

Cluster	I	II	III
I	2.719	4.514	2.283
II	4.514	2.283	5.00
III	5.00	2.973	2.510

Table 3: Cluster means for different traits of twenty genotypes of chilli.

Sr. No.	Traits	Clusters		
		I	II	III
1.	Day to First Flowering	38.40	39.65	47.17
2.	Day to 50% Flowering	54.23	55.16	65.54
3.	Day to first fruit setting	65.14	65.35	73.22
4.	Day to first harvesting	97.19	111.53	111.00
5.	Number of fruits per cluster	3.42	4.31	4.44
6.	Number of fruits per plants	14.76	20.24	20.00
7.	Number of flowers per cluster	4.14	6.95	6.50
8.	Fruit Length (mm)	48.32	57.84	55.47
9.	Fruit Diameter (mm)	4.52	8.78	7.80
10.	Average fruit weight (g)	3.25	4.52	5.21
11.	Plant height (cm)	45.05	56.29	49.83
12.	No of primary branching	4.29	4.39	4.41
13.	Yield per plant (g)	168.00	223.06	217.18

Table 4: Clustering patters of twenty genotypes of chilli on the basis of genetic divergence

Clusters	No of genotypes	Genotypes
I	7	EC-622085, IIHR-8, IC-119474, EC-519687, EC-341075, EC-519630
II	7	ISC-02, KASHIABHA, IIHR-16, DC-24, CO-5661, CSB-08, PKM-1
III	6	IC-119455, CMB-8, CMB-19, UTTKAL AVA, COO-714, KASHI GOURAV

Table 5: Genetic divergence contribution of characters

Sr. No.	Traits	Contribution %
1.	Day to First Flowering	10.61
2.	Day to 50% Flowering	10.90
3.	Day to first fruit setting	6.45
4.	Day to first harvesting	6.78
5.	Number of fruits per cluster	11.02
6.	Number of fruits per plants	4.61
7.	Number of flowers per cluster	7.95
8.	Fruit Length (mm)	6.13
9.	Fruit Diameter (mm)	7.54
10	Average fruit weight (g)	7.41
11.	Plant height (cm)	6.59
12.	No of primary branching	5.25
13	Yield per plant (g)	8.76

Conclusion

According to the study, there is a large level of genetic variation across the 20 genotypes for the characteristics of the chilli germplasms that affect plant development, yield, and quality. Cluster I whereas cluster I and cluster II had the lowest intra-cluster distances, cluster III had the most.

Genotypes from clusters I, III, and II have the potential to be used directly or indirectly as varieties and as possible breeding stock for chilli crop improvement programmes.

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