Genetic Variability and Correlation Studies in Chilli (Capsicum annuum L.) UnderAgro-climatic Condition of Prayagraj.

Original Research Article

Abstract

Chilli is one of the important vegetables as well as spice crop of India. India ranks first in dry chilli production worldwide. Chilli is used throughout the world as a spice and also in the making of beverages and medicines. Since time immemorial chilli is an indispensable part of Indian diet. There are more than 400 cultivars of chilli grown all over the world. Few of them are praised for their red colour because of the pigment 'capsanthin,' while others are known for 'hotness' due to presence of alkaloid 'capsaicin.' It is reported that chilli helps in boosting immune system and lowering of cholesterol. India is rich source of genetic variability of chilli with different quality factors. Limited efforts have been made to release location specific suitable varieties. There is an urgent need and vast scope of evaluating and developing location specific varieties having higher yield potential. In the present investigation twelve diverse chilli genotypes were assembled from different parts of India to study their performance in the Prayagrajagro-climatic condition.The genetic information gathered on yield and yield attributing traits would be of utility in formulation of an efficient breeding programme for the improvement of chilli crop as well as to develop promising genotypes/ hybrids.

Key Words: Chilli, genetic variability, capsanthin.

Introduction

Chilli (*Capsicum annuum* L.) shrubs are perennial and short-lived; they can develop up to1.5 m in height; their stems are woody at the base, fleshy, and either erects or semi-prostrate, and the shrub comprises of a primary tap root with various lateral roots. The leaves can grow up to 12 cm long and 7.5 cm wide and are changing in shape with a pointed tip. Chilli flowers are independently or in small groups of two or three flowers. They're small and bisexual, with five to six petals each; the flowers of *Capsicum annuum* are white-green. Red chillies get their color from a coloring compound called capsanthin and have a hot, pungent taste due to a chemical called capsaicin, and the numerous small chilli seeds moreover contain capsaicin. Chilli is basically cultivated for fruits which are utilized as vegetables in pharmaceutical as a stimulant and source of oleoresin [11].

Fruit yield as well as quality improvement efforts proceed to be the major aims of the chilli improvement program. Fruit yield is a complex inherited character influenced by a few properties of the plant. Area-based screening for upgrading the productivity of this crop is an important step to expanding production [2]. A wide range of variability is available in chilli genotypes, which provide great scope for improving fruit yield through systematized breeding. An estimation of the genetic variability show in the germplasm of a crop is a pre-requisite for designing a successful breeding program [9].

In Uttar Pradesh, chillies are basically developed in the eastern districts, viz., Ballia, Azamgarh, Mirzapur, Basti, Faizabad, and Ghazipur. The larger part of cultivators is still developing local cultivars. Other than soil and climatic components, the cultivar itself is really important in regard of its performance with respect to earliness, disease resistance, and yield. Numerous cultivars have been developed and suggested by different research institutes and State Agricultural Universities, but the adoptability and yielding capacity of the cultivars aren't the same in all regions. So, there's a pressing demand for a appropriate variety in Prayagrajagro-climatic conditions. Therefore, an attempt was made in the present research at the Department of Horticulture, SHUATS, Prayagraj, to assess the extent of genetic variability and correlation in 12

different genotypes of chillies for various compositional and yield properties for identifying predominant genotypes for involvement in coming breeding programs.

Materials and Method

The field trial was conducted from December 2022 to June 2023 at the Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) for the genetic variability and correlation studies in chilli under the agro climate conditions of Prayagraj. This research was carried out in a randomized block design (RBD) with 12 genotypes (released varieties and local collection) which were collected from diverse sources (Table 1).

Table1- List of chilli genotypes and their sources used in study

Notation	Genotypes	Sources
$\mathbf{V_1}$	KSP-1350	Kalash Seeds Pvt. Ltd
$\mathbf{V_2}$	KSP-1342	Kalash Seeds Pvt. Ltd
$\mathbf{V_3}$	Hybrid Eagle	AcsenHyVegPvt. Ltd
$\mathbf{V_4}$	VNR-305	VNR Seed Pvt. Ltd.
$\mathbf{V_5}$	Shravani 301	Pancha Ganga Seeds Pvt. Ltd.
$\mathbf{V_6}$	TMPH-484	TriMurti Plant Science Pvt. Ltd.
$\mathbf{V_7}$	TMPH-404	TriMurti Plant Science Pvt. Ltd.
$\mathbf{V_8}$	TMPH-407	TriMurti Plant Science Pvt. Ltd.
$\mathbf{V_9}$	TMPH-409	TriMurti Plant Science Pvt. Ltd.
$\mathbf{V_{10}}$	F1-Hybrid	Eco Green Hybrid Seeds Co.
$\mathbf{V_{11}}$	Pusa Jwala	IARI, NEW DELHI
$\mathbf{V_{12}}$	F1-6106	Eco Care Seeds

Result and Discussion

Significant differences were obtained among the genotypes for all the characters, showing satisfactory variability among all the genotypes. F1-6106 took a least number of days (37.4) to first flowering taken after by KSP-1350 (42.2), and most extreme days by TMPH-409 (49.93); however, F1-6106 also took a least day to 50% flowering, taken after by Pusa Jwala (48.2), and greatest days by VNR-305 (53.35). F1-6106 took the least number of days (63.34) to the first harvest, taken after by KSP-1350 (65.47) and the greatest days (73.17) taken by VNR-305. The highest plant height was recorded (89.74cm) in F1-6106, taken after by Pusa Jwala (88.67 cm), and the lowest plant height was recorded (75.8 cm) in VNR-305. The most extreme number of branches recorded (19.33) in F1-6106, taken after by Pusa Jwala (18.07), and the least number of branches recorded was (9.53) in TMPH-484. F1-6106 appears the highest leaf area (29.74 cm^2), taken after by Pusa Jwala (29.37 cm^2), and the lowest leaf area appeared by VNR-305 (23.32 cm^2). The maximum number of fruit $plant^{-1}$ was recorded (63.99) in F1-6106, taken after by Pusa Jwala (63.21) and the minimum number of fruit $plant^{-1}$ (52.33) in VNR-305. The maximum fruit weight was recorded in F1-6106 (6.41 g), taken after by F1-hybrid (5.31 g), and the minimum fruit weight was recorded in VNR-305 (2.36g). The maximum fruit length was recorded in F1-6106 (10.31 cm), taken after by Pusa Jwala (9.98 cm) and the minimum fruit length were recorded in VNR-305 (6.44 cm). The greatest fruit diameter was recorded in F1-6106 (11.00 mm), taken after by Pusa Jwala (10.33 mm) and the least fruit diameter was recorded in VNR-305 (5.83 mm). The highest fruit yield $plant^{-1}$ (g) was recorded in F1-6106 (382.91 g), taken after by Pusa Jwala (332.14 g), and the least fruit yield $plant^{-1}$ was recorded (145.32 g) in VNR-305. The highest fruit yield ha^{-1} (t) was recorded in F1-6106 (12.76 t), taken after by Pusa Jwala (11.07 t), and the least fruit yield $plant^{-1}$ was recorded (4.84 t) in TMPH-404. The highest TSS content was recorded in VNR-305 (9.73^0), Taken after by hybrid eagle (9.63^0), and the least TSS content was recorded (6.07^0) in F1-6106. The highest ascorbic acid (mg/100g) content was recorded in F1-6106 (196.46mg/100g), taken after by VNR-305

(187.63mg/100g), and the lowest ascorbic acid content was recorded (105.56mg/100g) in hybrid eagle (Table 2 and Table 3) [3], [16].

Table2- Mean performance of chilli genotypes for growth and earliness parameters

Genotypes	Plant height (cm)	Number of branches	Leaf area (cm^2)	Days taken to first flowering	Days taken to 50% of flowering	Days to first harvest
V1	79	16.53	24.43	42.2	49.56	65.47
V2	83.54	14.27	25.67	43.73	48.53	69.87
V3	76.2	12.26	24.67	44.2	48.94	70.33
V4	75.8	11.0	23.32	48.8	53.35	73.17
V5	82.64	13.8	25.54	46.87	50.67	70.67
V6	76.9	9.53	27.6	42.73	51.1	70.04
V7	83.6	12.0	26.57	48.44	52.6	70.4
V8	82.94	17.0	27.64	47.37	51.27	70.63
V9	80.8	13.6	27.77	49.93	50.37	72.4
V10	85.14	13.07	25.04	42.8	49.8	70.93
V11	88.67	18.07	29.37	43.13	48.2	69.4
V12	89.74	19.33	29.74	37.4	42.47	63.34
S.Ed(±)	**5.78**	**2.09**	**2.09**	**0.41**	**0.73**	**1.87**
CV	**8.63**	**17.98**	**9.72**	**1.12**	**1.80**	**3.29**
$CD_{0.05}$	**1.97**	**4.33**	**4.35**	**0.85**	**1.52**	**3.89**

Table3- Mean performance of chilli genotypes for quality and yield parameters

Genotypes	Number of fruit $plant^{-1}$	Average fruit weight (g)	Average fruit length (cm)	Average fruit diameter (mm)	Fruit yield $plant^{-1}$ (g)	Fruit yield ha^{-1} (t)	TSS ($Brix^0$)	Ascorbic acid (mg/100g)
V1	59.18	4.47	7.69	9.27	235.19	7.83	6.47	132.1
V2	59.29	4.69	7.38	9.93	250.25	8.34	7.16	135.3
V3	55.4	4.23	7.12	7.01	250.41	8.65	9.63	105.56
V4	52.33	2.36	6.44	5.83	145.62	4.85	9.73	187.63
V5	59.4	3.35	7.94	7.31	209.91	6.99	7.66	126.8
V6	59.19	2.64	6.75	7.24	183.50	6.16	9.63	149.4
V7	52.82	2.43	7.35	7.65	146.05	4.84	6.47	166.6
V8	59.51	2.38	6.99	6.46	149.85	4.91	9.4	186.53
V9	53.56	2.62	7.03	6.12	154.74	5.84	7.7	193
V10	59.58	5.31	8.29	9.44	327.31	10.90	9.6	186.23
V11	63.21	5.11	9.98	10.33	332.14	11.07	7.5	185.3
V12	63.99	6.41	10.31	11.00	382.91	12.76	6.07	196.46
S.Ed(±)	**2.73**	**0.55**	**0.12**	**0.45**	**30.37**	**3.22**	**0.23**	**0.72**
CV	**5.75**	**17.47**	**1.94**	**6.77**	**16.11**	**17.56**	**3.34**	**0.57**
$CD_{0.05}$	**5.66**	**1.13**	**0.26**	**0.93**	**62.98**	**6.69**	**0.46**	**1.49**

The extent of variability show in 12 genotypes of chilli was measured in terms of range, mean, PCV, GCV, heritability, and genetic advance (Table 4). All the genotypes differed significantly with regard to the distinctive characters examined. A wide range of variation was observed in all the characters. [4], [8], [16] moreover detailed a wide range of variation for most extreme of the characters. The genotypic coefficient of variance (GCV) and phenotypic coefficient of variance (PCV) were high for fruit weight (36.40 g and 36.44 g) taken after by fruit yield $plant^{-1}$ (31.95 g and 41.67 g), and fruit diameter (21.82 mm and 21.80 mm), appearing great differences for these traits. GCV in common, was lower than the PCV (Table 4), which shown a close affiliation between phenotype and genotype[4], [8], [13]. Low genotypic coefficient of

variance (GCV) and phenotypic coefficient of variance were recorded for days taken to 50% flowering (5.05 and 5.06), taken after by the number of fruits plant^{-1}(6.54 and 6.55) [7], [11], [13].

Heritability is a parameter of huge importance to breeders, as its magnitude indicates the dependability with which a genotype can be recognized through its phenotypic expression (Table 4). Heritability in a wide sense was observed to be high for all the traits examined. Heritability estimates along with genetic advance are more useful than heritability values alone in reading the selection of the best individuals [11], [15]. In the present studies, fruit yield plant^{-1}, fruit weight, ascorbic acid, and the number of branches plant^{-1} shown high genetic advance as percentage of the mean along with high heritability. These results shown the impact of additive gene action. High genetic advance for the number of fruits plant^{-1} and fruit yield plant^{-1}[4],[14], [16].

Table4- Genetic variability components for major characters in chilli

Characters	Range	Mean	Coefficient of variance (%)		Heritability (%)	Genetic advance	GAM (%)
			GCV	PCV			
Days taken to first flowering	49.93	44.77	7.79	7.80	7.80	7.17	16.03
Days taken to 50% flowering	53.27	49.78	5.05	5.06	5.06	5.16	10.37
Plant height	58.66	81.92	6.65	5.66	5.66	9.53	11.64
Number of branches	12.62	14.19	21.01	21.04	21.04	6.13	43.21
Number of fruits plant^{-1}	63.99	58.13	6.54	6.55	6.55	7.83	13.47
Fruit length	7.77	7.73	15.82	15.86	15.86	2.51	32.49
Fruit diameter	11.0	8.15	21.80	21.82	21.82	3.65	44.86
Fruit weight	6.41	3.83	36.40	36.44	36.44	2.86	74.91
Fruit yield plant^{-1} (g)	382.91	225.21	31.95	41.67	41.67	115.20	51.19
Leaf area	29.73	26.44	7.39	7.44	7.44	4.01	15.07
TSS	9.73	8.07	17.63	17.74	17.74	2.91	36.09
Ascorbic acid	196.47	162.61	19.21	19.12	19.12	64.38	39.57

Genotypic correlation of 12 yield and yield attributing characters displayed in (Table 5) shown that fruit yield plant^{-1} appears a positive and highly significant correlation with plant height (0.555), number of branches (0.635), number of fruit plant^{-1}(0.693), fruit length (0.769), fruit diameter (0.906) and fruit weight (0.981); similarly, fruit weight shows a positive correlation with plant height (0.645), number of branches (0.623), number of fruits plant^{-1} (0.721),fruit length (0.836), and fruit diameter (0.913). Fruit diameter appears a positive correlation with plant height (0.754), number of branches (0.634), number of fruit plant^{-1} (0.784) and fruit length (0.834) though fruit length appears a positive correlation with plant height (0.856), number of branches (0.745) and number of fruit plant^{-1} (0.748). The number of fruit plant^{-1} appears a positive correlation with only plant height (0.685) and the number of branches (0.705). [4], [5], [12] moreover detailed that fruit yield plant^{-1} had a positive and highly significant correlation with the number of fruits plant^{-1} and fruit length.The positive association of fruit weight with fruit breadth and fruit length shown that selection of only one of the traits might lead to an increase in the size of fruit [4].

Table5- Correlation

Characters	1	2	3	4	5	6	7	8	9	10	11	12

1-Days taken to 1st flowering, 2-Days taken to 50% flowering, 3-Plant height,

1	2	3	4	5	6	7	8	9	10	11	12
1.0000	0.819**	-0.440**	-0.473**	-0.796**	-0.679**	-0.821**	-0.841**	-0.737**	-0.295**	-0.528**	0.070
	1.0000	-0.635**	-0.690**	-0.716**	-0.819**	-0.792**	-0.887**	-0.720**	-0.520**	-0.479**	-0.037
		1.0000	0.731**	0.685**	0.856**	0.754**	0.645**	0.555**	0.681**	0.549**	0.455
			1.0000	0.705**	0.745**	0.634**	0.623**	0.635**	0.566**	0.384**	0.316
				1.0000	0.748**	0.784**	0.721**	0.693**	0.547**	0.729*	0.091
					1.0000	0.834**	0.836**	0.769**	0.615**	0.523**	0.307
						1.0000	0.913**	0.906**	0.366*	0.380*	0.054
							1.0000	0.981**	0.256	0.393*	0.022
								1.0000	0.064	0.252	0-.112
									1.0000	0.707	0.472**
										1.0000	0.384*
											1.0000

Conclusion

Based on the overall performance of the various genotypes under study, genotypes F1-6106 and Pusa Jwala were found to be best under the agroclimatic conditions of Prayagraj. These can either be directly used as cultivars or may be involved in breeding programs to evolve superior cultivars and hybrids. On the basis of mean performance and other genetic parameters of different growth and yield characters, it was revealed that the characters, viz., plant height, fruit length, number of fruits plant^{-1}, fruit weight, and fruit yield are the most important traits for improving the genotypes, while the number of branches plant^{-1} can be considered the second most important character for selection in chilli genotypes. Based on estimates of the correlation coefficient, numbers of fruits plant^{-1} and fruit weight were adjudged as yield attributing characters that needed to be focused during selection.

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