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

India

Abstract

The present research, entitled “Genetic variability and correlation studies in chilli (*Capsicum annuum* L.) underagro-climatic condition of Prayagraj” was conducted at Vegetable Research Farm, Department of Horticulture, Naini Agriculture Institute, SHUATS, Prayagraj (Uttar Pradesh) from December 2022 to June 2023. Twelve genotypes were used to study the genetic variability and correlation for growth and yield contributing characters in chilli at sixteen different characters, viz., days taken to germinate, no. of branches plant^{-1}, leaf area, days to 1st flower initiation, days of 50% flowering, days of 1st harvesting, and number of pickings under growth parameters. Length of fruits(cm), diameter of fruits(mm), number of fruit plant^{-1}, average fruit weight(g), fruit yield plant^{-1}(g), and fruit yield hectare^{-1}(t) are under fruit yield parameters, and ascorbic acid(mg/100g), TSS(Brix^{0}) were studied under quality parameters.The highest fruit yield plant^{-1}(382.91g) and per hectare (12.76t) were recorded in the genotype F1-6106. The highest TSS content was recorded in genotype VNR-305 (9.73Brix^{0}) and the highest value for the ascorbic acid content was recorded in genotype F1-6106(196.49mg/100g). A high genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV)were recorded for the fruitweight and fruit yield plant^{-1}. All the characters showed high heritability estimates.However, the number of fruits plant^{-1}, fruit yield plant^{-1},and fruit weight exhibited a high genetic advance as a percentage of the mean. Fruit yield plant^{-1} was positively and significantly correlated with plant height, number of fruits plant^{-1} and fruit length. It 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 the genetic improvement of chilli.

Key Words: Chilli, correlation, genetic variability, GCV, PCV, yield, TSS, ascorbic acid.

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 (Samadia 2007).

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. (Datta & Jana 2004) detailed that the efficiency of chilli can be increased by cultivating new genotypes. So, area-based screening for upgrading the productivity of this crop is an important step to expanding production. 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 (Parkash 2012).

In Uttar Pradesh, chillies are basically developed in the eastern districts, viz., Ballia, Azamgarh, Mirzapur, Basti, Faizabad, and Ghazipur. The larger part of cultivators are 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

A 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). Prior Deb *et al.* (2008) and Warshamana*et al*. (2008) moreover detailed comparable results whereas working on chilli genotypes.

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. Munshi &Behra (2000), Warshamana*et al.* (2008), and Gupta *et al.* (2009) 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. These results are in agreement with those detailed by Munshi &Behra (2000), Singh *et al.* (2005), and Gupta *et al.* (2009). 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). These results are in similarity with the findings of Kumar *et al.* (1999), Singh *et al*. (2005) and Samadia (2007).

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). Johnson *et al.* (1955) stressed that for estimating the real effect of selection, heritability estimates, along with genetic advance are more significant. Heritability in a wide sense was observed to be high for all the traits examined. High heritability estimates were also detailed before by Verma *et al.* (2004) and Samadia (2007). Heritability estimates along with genetic advance are more useful than heritability values alone in reading the selection of the best individuals. 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} were also recorded before by Sreelathakumary&Rajamony (2002), Warshamana*et al.* (2008), and Gupta *et al.*(2009).

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). Prior, Hosamani& Shivkumar (2008), Gupta *et al.* (2009), and Singh & Singh (2011) 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 (Gupta *et al.* 2009).

Table5- Correlation coefficient (genotypic) of different characters in chilli

Characters	1	2	3	4	5	6	7	8	9	10	11	12
1	1.0000											
2	0.819**	1.0000										
3	-0.440**	-0.635**	1.0000									
4	-0.473**	-0.690**	0.731**	1.0000								
5	-0.796**	-0.716**	0.685**	0.705**	1.0000							
6	-0.679**	-0.819**	0.856**	0.745**	0.748**	1.0000						
7	-0.821**	-0.792**	0.754**	0.634**	0.784**	0.834**	1.0000					
8	-0.841**	-0.887**	0.645**	0.623**	0.721**	0.836**	0.913**	1.0000				

1-Days taken to 1st flowering, 2- Days taken to 50% flowering, 3-Plant height, 4-Number of branches, 5-Number of fruits plant-1, 6-Fruit length, 7-Fruit diameter, 8- Fruit weight, 9-Fruit yield(g plant-1), 10-Leaf area, 11-TSS, 12-Ascorbic Acid

*Significant at P<0.01; **Significant at P<0.05

9	-0.737**	-0.720**	0.555**	0.635**	0.693**	0.769**	0.906**	0.981**	1.0000			
10	-0.295**	-0.520**	0.681**	0.566**	0.547**	0.615**	0.366*	0.256	0.064	1.0000		
11	-0.528**	-0.479**	0.549**	0.384**	0.729*	0.523**	0.380*	0.393*	0.252	0.707	1.0000	
12	0.070	-0.037	0.455	0.316	0.091	0.307	0.054	0.022	0-.112	0.472**	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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