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Genetic variability, heritability and genetic advances in chilli (*Capsicum annuum*)

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Abstract
The present investigation was carried out to find out the variability, heritability and genetic advance in chilli (*Capsicum annuum* L.) at the College of Horticulture, Bidar. The experiment was laid out in randomized block design. All the treatments were randomly distributed among the plots and were replicated two times. Transplanting of seedlings was done at spacing of 60x45 cm. The observations were recorded on five plants per plots for days to 50 per cent flowering, days to maturity plant height, number of branches per plant, number of fruits per plant, fruit length, fruit width, test weight and yield per plant. The genotypes GCA-1 has recorded significantly higher yield per plant of 638 g, while lower yield per plant was recorded in GPM-41 of 79 g. Number of branches per plant (13) was noticed in Pant C-1 and maximum number of fruit per plant was noticed in genotype Nalchatii (37.50).

Keywords: Chilli, genetic advance, genetic variability, growth, and yield

Introduction
Chilli is one of the most important vegetable crops grown throughout India. It belongs to family *Solanaceae* with chromosome number 2n=24. It is grown for export as well as for domestic market. Chilli contributes about 33% of the total spice export from India and share about 16% of the world spice trade (Kadwey *et al*., 2016) [4]. In India, chilli is grown in area of 9, 40,000 ha as it is specially liked for its pungency, aroma and spicy taste. India is the second largest producer of vegetables after China and also maximum numbers of vegetable crops are grown due to great diversity of agro climatic condition. A wide range of variability reportedly exists in this crop, (Nandi, 2012) [9]. 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 in order to develop promising genotypes/ hybrids. Yield is a determining factor for crop improvement (Addissu, 2012) [2]. Its yield is a quantitative trait that is influenced by a number of yield contributing parameters. The selection of desirable genotypes is usually based on yield and yield components. It is therefore necessary to study the mutual relationship between yield and yield components for efficient utilization of the genetic stock in crop improvement program of chili pepper. Variability in plants is the first step in understanding how to improve or produce new plants. Heritability is the degree of genetic control associated to some important traits (Nechif *et al.*, 2011) [10]. The present study was under taken to estimate the variability, and correlation section includes for identification of promising genotypes to use in genetic improvement of chilli. The present investigation was conducted to determine the direction variability and degree of association among the characters.

Material and Methods
The studies were carried out at College of Horticulture, Bidar. The basic material for the study involved 45 diverse chilli genotypes laid in two replications in randomized block design. Five plants were selected randomly from each genotype and replication. All the cultural operation was carried out as per package of practices of UHS, Bagalkot. The observations were recorded on five competitive plants taken at random over the replications on fruit length, fruit girth, fruit width, plant height, number of branches per plant, Number of fruits per plant, yield per plant and days to maturity. The details of genotypes given in table number 1.

Results and Discussion

The estimate of genetic parameters *viz.*, phenotypic and genotypic coefficient of variation along with heritability in broad sense and genetic advance as percentage of mean for different characters are given in (Table 2). A wide variation in the mean performance of parents was observed for all the characters under study. The extent of variability with respect to various characters in different genotypes measured in terms of range, general mean, genotypic coefficient if variation, phenotypic coefficient of variation along with heritability and expected genetic advance as percent of mean (Table 2.). yield per plant showed maximum range of variability from 79.00 to 638.00 with a mean of 287.99 followed by day to maturity from 135.00 to 166.50 along with a grand mean of 148.93, days to 50 per cent flowering from 92.50 to 115.00 along with a grand mean of 102.56, plant height from 20.04 to 71.00 cm along with a grand mean 34.82cm, fruit length from 2.88 to 8.99 cm along with a grand mean of 6.28 cm, fruit weight from 4.63 to 24.07 mm along with a grand mean of 9.23 mm and Murda incidence from 1.00 to 3.50 along with a grand mean of 2.15. The magnitude of phenotypic coefficient of variability was higher than that of genotypic coefficient of variability for all the characters except yield per plant and murda incidence indicating that effect of environment on their genetic expression. Maximum phenotypic coefficient of variation (per cent) was obtained for yield per plant (61.54) followed by Number of fruit per plant of 58.88, fruit width (36.04), plant height of 29.99, Murda incidence of 29.62 number of branches per plant (29.46), fruit length (23.71), test weight of 14.79 and days to 50% flowering (7.16). The maximum amount of genotypic coefficient of variation (per cent) was observed for yield per plant (63.09) followed by Number of fruit per plant of 55.56, fruit width (35.40), plant height of 28.51, Murda incidence of 38.24, number of branches per plant (23.70), fruit length (22.38), test weight of 13.95 and days to 50% flowering (6.89). These results indicated that higher magnitude of genotypic coefficient of variation for the above traits offer a better opportunity for improvement through selection. Similar findings were reported by (Acharya *et al*., 2007; Maurya *et al*.,2015) [5], (Pujar *et al.*, 2017; Nahak *et al.*, 2018) [8]. The genotypic coefficient of variation provides help to measure the genetic variability in a character and accordingly, it is not possible to partition existing heritable variation in population based solely on this estimate. According to this the maximum heritability was observed for fruit weight of 96.00 per cent whereas the lowest heritability was observed for murda incidence of 60.00 per cent. These findings are in accordance with the observations made by **(**Tembhurne, *et al.*, 2008) [13], (Mishra, *et al*., 2002) [7] and (Negi and Sharma, 2019) [11]. High heritability in broad sense indicated that large proportion of phenotypic variance was attributable to the genotypic variance and were less influenced by environment. Hence, selection can bring worthwhile improvement in these traits. Genetic advance is still a more useful estimate because heritability value by itself does have much significance as it fails to account for the magnitude of absolute variability. It is therefore, necessary to utilize heritability in conjunction with selection differential which would then indicate the expected genetic gain resulting from selection. The yield per plant has maximum value (123.65), succeeded by number of fruit per plant (108.00),fruit width (71.61), plant height (55.82), murda incidence (47.26),fruit length (43.50),Number of branches (39.28) , days to 50 per cent flowering (13.66) and days to maturity (12.79). The results of present investigation are also in agreement with the findings reported by (Ukkund *et al*, 2007) [14], (Gupta, *et al*., 2009) [3], (Addissu *et al*, 2012) [3] and (Meena *et al*, 2016) [6]. High estimates of heritability along with high genetic advance provide good scope for further improvement in advance generation if characters subject mass progeny or family selection.

Table 1: Details of genotypes

Sl. No.	Genotypes	Sl. No.	Genotypes	Sl. No.	Genotypes
1	GPM-31	16	GPM-55	31	Pragna
2	GPM-33	17	GPM-56	32	Reshem Patto
3	GPM-34	18	GPM-57	33	Achari
4	GPM-36	19	GPM-58	34	Nalchatti
5	GPM-37	20	GPM-59	35	Bamra
6	GPM-38	21	GPM-60	36	Pant C-1
7	GPM-39	22	KCA-2	37	KCA-17-1
8	GPM-40	23	KCA-21-1	38	KA-2
9	GPM-41	24	Parekh	39	BD Sel-1
10	GPM-42	25	HP-2	40	Pusa Jwala
11	GPM-43	26	KCA-24-1	41	BK Sel-1
12	GPM- 45	27	KCA-20-1	42	G-4
13	GPM-51	28	KDL Deluxe	43	BK Sel-2
14	GPM-52	29	KCA-19-1	44	GCA-1
15	GPM-54	30	KCA-18-1	45	GCA-2

Table 2: Range, mean, genotypic, phenotypic coefficient of variability, heritability and genetic advance for different characters in chilli

Parameters	Mean	Range		PCV (%)	GCV (%)	Heritability (%)	Genetic advance % of mean
		Minimum	Maximum				
Days to 50% flowering	102.567	92.50	115.00	7.16	6.89	0.93	13.66
Day to Maturity	148.933	135.00	166.50	6.64	6.42	0.94	12.79
Plant height	34.826	20.04	71.00	29.99	28.51	0.90	55.82
Number of branches	7.942	4.50	13.00	29.46	23.70	0.65	39.28
Number of fruits	12.567	4.50	37.50	58.88	55.56	0.89	108.00
Fruit length	6.284	2.88	8.99	23.71	22.38	0.89	43.50
Fruit width	9.235	4.63	24.07	36.04	35.40	0.96	71.61
Test weight	4.494	2.98	6.15	14.79	13.95	0.89	27.11
Yield per plant	287.99	79.00	638.00	61.54	63.09	0.95	123.65
Murda incidence	2.156	1.00	3.50	29.62	38.24	0.60	47.26

Table number3. Character means of different chilli genotypes

Sl. No.	Name of the accession	Days to 50% flowering	Day to Maturity	Plant height	Number of branches per plant	Number of fruits per plant	Fruit length	Fruit width	Test weight	Incidence of leaf curl	Yield per plant
1	GPM-31	115.00	162.50	33.00	10.50	9.00	6.95	9.93	3.87	2.00	194.00
2	GPM-33	104.00	149.00	27.20	5.50	13.50	6.15	14.91	4.56	2.50	525.00
3	GPM-34	92.50	137.50	26.84	7.50	7.00	6.01	9.49	4.50	2.00	270.00
4	GPM-36	96.50	141.00	37.50	6.00	5.50	5.69	8.94	4.47	2.00	134.00
5	GPM-37	108.00	152.50	20.04	5.50	8.00	8.05	6.87	3.92	3.00	115.00
6	GPM-38	95.50	135.00	33.00	10.50	9.00	6.82	8.84	5.34	2.00	151.00
7	GPM-39	95.00	137.50	36.40	7.00	17.50	8.18	8.90	4.36	2.50	320.00
8	GPM-40	95.00	135.00	27.83	9.00	16.00	4.85	12.20	4.20	1.50	309.00
9	GPM-41	112.50	162.50	29.00	11.00	4.50	6.82	10.05	4.60	3.00	79.00
10	GPM-42	107.50	158.00	25.63	9.50	31.00	7.17	6.37	4.02	1.00	548.00
11	GPM-43	95.00	135.00	36.50	9.50	10.50	7.74	6.72	4.28	2.50	185.00
12	GPM- 45	106.50	155.00	30.13	5.88	7.00	5.37	7.11	6.15	2.50	140.00
13	GPM-51	96.50	144.50	47.00	8.20	11.00	4.20	8.83	4.77	2.50	246.50
14	GPM-52	92.50	140.00	33.50	9.50	8.50	6.65	6.59	3.60	2.00	115.00
15	GPM-54	95.00	142.50	20.50	7.00	10.00	4.17	9.67	4.66	2.50	160.00
16	GPM-55	101.00	155.00	39.45	9.75	17.50	7.20	7.56	4.01	2.50	440.00
17	GPM-56	102.50	152.50	59.50	7.20	11.00	7.99	10.61	5.11	2.50	285.00
18	GPM-57	110.00	157.50	27.83	5.90	7.00	6.03	9.26	4.51	3.50	144.50
19	GPM-58	95.50	142.50	24.73	6.40	9.00	5.54	9.38	5.76	2.50	335.50
20	GPM-59	106.50	152.50	40.90	8.20	9.00	6.99	7.12	4.99	1.00	280.50
21	GPM-60	106.50	152.50	30.50	6.60	6.50	4.55	8.82	4.84	3.50	85.00
22	KCA-2	95.50	137.50	41.45	6.60	12.50	8.63	8.98	3.88	2.00	462.50
23	KCA-21-1	92.50	135.00	44.50	4.50	11.00	4.85	7.46	4.23	2.50	351.00
24	Parekh	109.00	159.00	32.50	9.50	7.00	4.41	5.66	5.05	3.00	142.00
25	HP-2	96.50	140.00	26.38	4.88	7.00	8.22	12.79	4.29	2.00	273.00
26	KCA-24-1	115.00	162.50	53.38	5.63	12.50	5.30	9.40	4.82	1.50	511.00
27	KCA-20-1	102.50	147.50	42.28	7.10	14.00	6.97	10.52	4.45	1.50	604.00
28	KDL Deluxe	114.00	166.50	31.54	8.50	4.50	8.90	9.40	4.52	3.00	159.00
29	KCA-19-1	113.50	165.00	36.00	9.34	6.50	6.04	5.66	3.87	3.00	121.00
30	KCA-18-1	109.00	162.50	28.00	8.38	22.50	6.75	6.70	3.91	1.00	475.00
31	Pragna	110.00	160.00	34.90	11.00	28.50	6.40	8.95	5.68	1.00	575.00
32	Reshem Patto	105.00	151.00	43.50	7.38	9.00	6.27	24.07	5.55	1.50	559.50
33	Achari	101.00	152.00	27.25	5.25	13.00	5.60	17.26	3.69	1.50	165.00
34	Nalchatti	110.00	155.00	71.00	11.50	37.50	5.40	8.02	2.98	1.00	547.00
35	Bamra	95.00	137.50	27.50	9.34	10.00	2.88	4.63	4.49	2.00	80.00
36	Pant C-1	96.00	142.50	30.00	13.00	17.50	3.90	9.38	3.33	2.50	225.50
37	KCA-17-1	105.00	150.00	42.63	10.50	22.50	4.92	8.51	3.50	1.00	371.00
38	KA-2	113.50	162.50	22.25	5.00	7.00	6.83	9.11	4.94	3.50	93.00
39	BD Sel-1	101.00	150.00	27.75	5.50	6.50	4.92	13.81	4.55	2.50	140.00
40	Pusa Jwala	102.50	147.50	39.95	7.20	11.00	6.33	6.67	4.81	2.50	270.00
41	BK Sel-1	109.00	155.00	23.60	6.30	7.00	8.04	7.90	4.62	2.50	117.00
42	G-4	106.50	151.00	28.20	6.10	13.50	6.05	6.64	5.02	1.50	202.00
43	BK Sel-2	96.50	137.50	38.20	11.40	22.00	8.14	9.33	4.79	1.00	499.00
44	GCA-1	95.50	140.00	43.93	7.90	18.50	8.99	8.29	4.70	1.00	638.00
45	GCA-2	92.50	135.00	43.53	9.50	16.50	4.98	8.38	4.12	2.50	317.00
	Mean	102.57	148.93	34.83	7.94	12.57	6.28	9.24	4.49	2.16	287.99
	C V (%)	1.95	1.69	9.31	17.50	19.49	7.85	6.79	4.92	24.18	13.92
	C.D. 5%	4.03	5.06	6.53	2.80	4.94	0.99	1.26	0.45	1.05	40.60
	S.E.	1.41	1.78	2.29	0.98	1.73	0.35	0.44	0.16	0.37	14.24

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