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Studies on genetic variability in chilli (*Capsicum annuum* L.) Germplasm

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Abstract
The present studies on genetic variability in chilli (*Capsicum annuum* L.) germplasm was conducted at AICRP on Vegetable Crops, Orissa University of Agriculture & Technology, Bhubaneswar, Odisha, India during *rabi* season of 2017-18 with an objective to study the nature and extent of genetic variability in chilli genotypes for improvement in fruit yield and yield attributing traits. Thirty four genotypes were evaluated in a RBD with three replication. The genotypes were evaluated on the basis of 17 parameters that included growth, yield and quality parameters. The analysis of variance revealed significant difference among 34 genotypes for all the character studied indicating the presence of variability in the studied material. The GCV and PCV were more in fruit yield per plant (37.02% and 40.75%), average dry fruit weight (19.25 and 20.42%) and average fresh fruit weight (33.10 and 34.38%). High heritability was recorded with TSS (96.18%), average dry fruit weigh (92.69%), and average fresh fruit weight (91.33%); genetic advance as percentage of mean was higher in case of dry fruit yield per plant (69.28%) and average dry fruit weight (65.64%).

Keywords: Chilli, variability, genetic advance, heritability, genetic variance, phenotypic variance

Introduction
Chilli or hot pepper (*Capsicum annuum* L.) native to new world tropics is one of the most important vegetable and spice crop in all over the world. In India, it is an indispensable spice cum vegetable in every household. Chilli belongs to family solanaceae of the genus capsicum with eleven species and the diploid chromosome number of this genus is 2n=2x=24.

Chillies were cultivated from 3500B.C. Christopher Columbus who discovered America in 1493 brought chilli to the rest of the world. Through, it was introduced in India, late in the 17th century, chillies have become an essential part of Indian cuisine and are valued for their characteristics pungency, color, aroma and taste it imparts to the food materials. Majority of the Indian chilli belonging to species *Capsicum annuum* L. is distinguished for its medium pungency and short duration. It is cultivated almost all the states of the country like Andra Pradesh, Karnataka, west Bengal, Madya Pradesh, Odisha, Rajasthan, Maharastra, Gujarat, Bihar etc.

High variability present in this crop in India has not been fully utilized. Limited efforts have been made by some research institutes to release varieties suited for different location with resistant to insect pest and disease with high yield. There is an urgent need to evaluate and develop important varieties for different purposes based on various traits. Highly resistant and stable lines need to be evaluated for use in the future breeding programme. Chilli, being an often self-pollinated crop is often found with enormous amount of variability for yield and other economically important yield attributes character. There is a possibility to exploit the available variability to achieve substantial crop improvement in chilli.

Varietal improvement work consequently depends on the amount of genetic variability present in existing material. The critical assessment of nature and magnitude of variability in the germplasm stock is one of the important pre-requisites for formulating effective breeding methods (Krishna *et al.*, 2007) [5].

Greater the variability in a population, there are the greater chance for effective selection for desirable types (Vavilov, 1951) [14]. When, variability is partitioned into heritable and non-heritable components, efficiency of selection is better understood. Heritability is the portion of phenotypic variation which is transmitted from parent to progeny. Higher the heritable variation, greater will be the possibility of fixing the characters by selection. Hence, heritability studies are of foremost importance to judge whether the observed variation for a particular character is due to genotype or due to environment. Heritability estimates may not provide clear predictability of the breeding value.

Thus, estimation of heritability accompanied with genetic advance is generally more useful than heritability alone in prediction of the resultant effect for selecting the best individuals (Johnson *et al.*, 1955) [4]. Wide ranges of variability reportedly exist in this crop (Munshi and Behera, 2000) [7]. The improvement of genotypes is based on the amount of genetic variability present in existing material.

Materials and Method

Field experiments were conducted during *Rabi* season of 2017-18 at All India coordinated Vegetable Research project, OUAT, Bhubaneswar for evaluation, genotypes performance and genetic variability studies in chilli. The experiment was laid out in randomized complete block design (RCBD) with 34 genotypes collected from all over India namely, Utkal Rashmi, BC-7-2-2, BC-24-1, BC-7-2-1, BC-79-1, BC-27-2-2, BC-25, BC-28, BC-40-3-1-1, BC-40-2-1-1, BC-40-2, BC-21, BC-30, BC-7-1-1, BC-20, BC-70-2, BC-406, BC-5-1-7, BC-78-1, BC-78-1-2, BC-43, Manipur local 1, Manipur local 2, Arka Abhir, Arka Lohit, Arka Suphul, Byadagi Kaddi, LAM-358, LAM-620, LAM-625, Anugraha, Ujwala, Pusa sadabahar and Kunchinda local

Result

The estimation of Coefficient error variation CV ranged from pedicel length (4.78%) to dry fruit yield per plant (17.03%) relatively high CV value were observed for number of fruits for plant (15.95%) and plants spread (12.55%) and plant height (11.10%) then rest of characters recorded lower CV

The phenotypic coefficient of variation (PCV) ranged from 11.22% in case of plants spread EW to 40.75% in case of fruit yield per plant. PCV was moderate (10 to 20%)for 8 characters viz., plant spread NS (11.22%), Days to 50% flowering (12.10%), Days to initial flowering (13.75%), plant spread (13.75%), plant height (13.89%), number of primary branches (16.79%) and fruit girth (18.78%). Relatively higher PCV (>20%) was observed in rest of the characters.

The GCV values were lower than PCV with range of 3.81% (plant spread NS) to 37.02% (dry fruit yield per plant). This happened because PCV estimates include the variation due to environment (E) and genotype and environment (GE) interaction. The maximum difference in magnitude of GCV and PCV was found in plant spread EW (5.59%-13.75%), plant spreads NS (3.81%-11.22%), plant height (8.34%-13.89%), fruit yield per plant (37.02-40.75%) and ascorbic acid (22.09-25.11%),similarly relatively low different of GCV and PCV for primary branches, leaf area, Days to initial flowering, days to 50% flowering, fruit length, fruit girth, pedicel length, average fresh fruit weight, average dry fruit weight, number of seeds per fruit and TSS indicated that there are mostly governed by genetic factors and minor effect of environments. Hence simple selection followed on the phenotypic variation mean most given worth while improving there fruits.

Relatively higher value for GCV for characters like fruit yield per plant (37.02%), average dry fruit weight (33.10%), average fresh fruit weight (32.37%) and number of fruit per plant (28.08%) indicated better scope for genetic important in the character through simple selection

The heritability estimates for 17 characters ranged from 11.52% in case of plant spread (NS) to 96.18% in TSS. Average dry fruit weight (92.69%), pedicel length (91.66%), average fresh fruit weight (91.33%), leaf area (90.39%) and fruit length (90.27%) recorded above 90% heritability. Similarly, fruit girth (89.19%), number of seeds per fruit (88.87%) and number of branches per plant (88.87%), ascorbic acid (77.39%) and number of fruits per plant (75.33%) and days to 50% flowering (66.29%) showed above 60% but below 90% heritability. Plant height (36.08%), plant spread EW (16.54%) and plant spread NS (11.52%) showed low heritability.

The range of genetic advance (GA) among different character varied from 0.33% in dry fruit weight to 49.90% in number of fruits per plant

The GA as% of mean was found to be range of 2.66% (plant spread NS) to 69.28% (fruit yield per plant). Expected GA was found to be low (<10%) for traits like plant spreads EW (4.68%). Similarly, moderate value of expected GA (10-20%) was recorded for plant height (10.32%), days to 50% flowering (16.52%), whereas, relatively higher value of GA as% of mean (>20%) was recorded for rest of the characters.

Discussion

From the present study, it is clearly observed that there exists a wide range of phenotypic as well as genotypic coefficient variation for majority of the 17 quantitative and qualitative characters in chilli. Minimum differences were observed between the values of GCV and PCV for most of the traits studied except the traits plant height, plant spread (EW) plant spread (NS), days to 50% flowering, and fruit yield per plant, this type of observation was also reported by Gogoi (2002). The existence of minimum variation between these two parameters indicated that environment has a little effect in expression of these characters and phenotype truly represents the genotype it has been also reported by Shivkumar and Hosamani (2006) [12].

In the present investigation, high estimates of heritability coupled with high genetic advance over mean observed for characters like leaf area, fruit length, pedicel length, average fresh fruit weight, average dry fruit weight and TSS may be ascribed to effect of additive genes (Panse and Sukhatme, 1954; Liang and Walter, 1968) [8] and may be amenable for selection. However, operation of both additive and non-additive gene action was indicated for plant height and days to 50% flowering through moderate genetic advance. Further improvement of this character would be easier through mass selection, progeny selection or any modified selection procedure aiming to exploit the additive gene effect rather than simple selection the character like plant spread EW and NS have low heritability with low GAM indicating that there is no scope for selecting this traits. Similar observations were also reported by Patel *et al.*, (2015) [9], Janaki *et al*., (2015) [3], Ukkund *et al*., (2007) [13], Patil *et al*., (2008) [10] and Sharma *et al*., (2010) [11]

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Table 1: Estimation of mean, range, component of variance, heritability, genetic advance and genetic advance over mean for growth, yield and quality characters in 34 genotypes of chilli (*Capsicum annuum* L.)

Sl. No	Character	Mean	Range		ECV (%)	GCV (%)	PCV (%)	h^2 (b) (%)	GA	GAM
			Min	max						
1.	Plant height (cm)	93.77	70.47	110.33	8.34	11.10	13.89	36.08	9.68	10.32
2.	Number of branches per plant	3.94	2.68	5.83	15.80	5.67	16.79	88.57	1.21	30.64
3.	Leaf area (cm^2)	36.15	21.12	46.92	22.53	7.34	23.70	90.39	15.95	44.12
4.	Plant spread EW (cm)	51.24	41.42	60.31	5.59	12.55	13.75	16.54	2.40	4.68
5.	Plant spread NS (cm)	53.18	44.44	60.00	3.81	10.55	11.22	11.52	1.42	2.66
6.	Days to initial flowering	43.81	37.33	60.33	12.06	6.60	13.75	76.91	9.54	21.78
7.	Days to 50% flowering	50.30	46.00	69.97	9.85	7.02	12.10	66.29	8.31	16.52
8.	Fruit length (cm)	6.49	2.98	9.72	21.02	6.90	22.12	90.27	2.67	41.13
9.	Fruit girth (cm)	3.56	2.00	5.08	17.73	6.17	18.78	89.19	1.23	34.50
10.	Pedicel length (cm)	3.24	1.83	4.53	15.85	4.78	16.56	91.66	1.01	31.27
11.	Number of fruits per plant	98.42	38.00	147.20	28.03	15.95	32.26	75.53	49.40	50.19
12.	Average fresh fruit weight (g)	2.70	1.36	5.91	32.37	9.96	33.87	91.33	1.72	63.72
13.	Average dry fruit weight (g)	0.51	0.27	1.15	33.10	9.29	34.38	92.69	0.33	65.64
14.	Number of seeds per fruit	46.56	33.63	72.60	19.25	6.81	20.42	88.87	17.40	37.38
15.	Fruit yield per plant (g)	49.55	13.67	78.71	37.02	17.0	40.75	82.53	34.33	69.28
16.	TSS (^{0} brix)	3.34	2.10	4.70	24.02	4.79	24.50	96.18	1.62	48.54
17.	Ascorbic acid(mg/100 g)	40.97	22.64	66.66	22.09	11.94	25.11	77.39	16.40	40.03

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