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Assessment of genetic variability, heritability and genetic advance for yield and yield attributing traits in chilli (*Capsicum annuum* L.)

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Abstract
The present investigation was carried out during rabi *season* of 2020-21 at Horticultural Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur (C.G) with 48 genotypes including (two check variety) of hot pepper (*Capsicum annuum* L.) in Randomized block design (RBD) with three replications. To estimate the genetic variability, heritability and genetic advance for fifteen yield and yield attributing traits in hot pepper. Analysis of variance revealed the significant variability in the studied materials. The phenotypic coefficient of variation (PCV) was slightly higher than the genotypic coefficient of variation (GCV) for all the characters indicating some amount of environmental influence on their genetic expression. Number of fruits per plant, fruit girth, fruit yield per plant, fruit yield per plot, fruit length, dry weight of fruits, total number of picking and number of primary branches showed high estimation of PCV and GCV. The characters *viz*., fruit length, fruit yield per plant, days to 50% flowering, days to first flowering, fruit girth, number of fruits per plant, fresh weight of fruits, dry weight of fruits and fruit yield per plot, showed high PCV, GCV and high heritability coupled with high genetic advance as % of mean suggesting that existence of wide range of genetic variability broad genetic base, less environmental influence, predominance of additive gene action and selection for these characters based on phenotypic would be rewarding.

Keywords: Hot pepper (*Capsicum annuum* L.), genetic variability, heritability, genetic advance, fruit yield and GCV and PCV

Introduction
Hot pepper (*Capsicum annuum* L.) is one of the most widely cultivated vegetable and spices (dry pepper) crop in India. Hot pepper is a Solanaceae vegetable with chromosome no. (2n = 24). Mexico is probably center of origin for hot pepper. It was introduced in India by the Portuguese towards the end of 17th century. In India, two species *Capsicum annum* and *Capsicum frutescence* are the most cultivated species among them 5 cultivated and 22 wild species in the genus of capsicum.

Chilli has been considered as often cross pollinated up to 64%. India has emerged the foremost producer and exporter of chilli and chilli (Green & Dry powder). Indian chilli is considered to be world famous for colour and pungency. Andhra Pradesh share maximum contribution in chilli production (37%), following Telangana (23%) and Madhya Pradesh (15%).

Capsanthin is a major pigment of hot pepper, which is responsible for red colour of pepper. Hot pepper is quite high in other nutritive value containing protein (2.9%), Phosphorus (80 mg), Riboflavin (0.39 mg) and Thiamine (0.19 mg) per 100 g of fruits. Dry peppers contain capsaicin in pericarp 40%, seed 54% and fruit stalk 6%. The pharmaceutical and medicinal application of capsaicinoid is attributed to antioxidant, antiarthritc, and analgesic properties.

Importance of genetic variability in any breeding material is a pre-requisite as it provides not only a basis for selection of divers' parent for use in hybridization programme. Thus, improvement in any crop is based on the extent of genetic variation and the degree of improvement depends upon the magnitude of available beneficial genetic variability. Hence, the present study was undertaken to analysis of hot pepper in respect of yield and yield contributing to the extending trend of low productivity of chilli can be improved through developing high yielding varieties with desirable qualities. The prerequisite for improvement of a crop is the selection of variable genotypes in respect of desired quantitative traits and its acquainted exploitation thought efficient breeding methods.

Material and Methods

The present investigation was carried out during *season* of 2020-21 at Horticultural Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur (C.G). Forty eight genotypes obtained from different part of India under completely randomized block design in three replications. The crop was raised as per the recommended package of practices. The parameters considered for the plant height (cm), number of primary branches, days to first flowering, days to 50% flowering, fruit stalk length (cm), fruit length (cm), fruit girth (cm), days to first fruit harvesting, total number of picking, number of fruits per plant, fruit weight per plant (gm), fresh weight of fruit (gm), dry weight of fruit (cm), fruit weight per plant (gm), fruit yield per plot (kg), fruit yield per hectare (q/ha).

Statistical Analysis

Analysis of variance was carried out as per the procedure given by Panse and Sukhatme (1985). The genotypic and phenotypic coefficient of variation were computed as per Burton and Devane (1953) [4] and categorized as per while the heritability in broad sense and genetic advance were calculated as per Allard (1960) [1] and categorized as per Johnson *et al*. (1955) [7].

Table 1: Analysis of variance for fruit yield and its attributing traits in hot pepper

S. No.	Characters	Mean Sum of Square		
	Replication		Treatment	Error
	Degree of freedom			
		2	47	94
1	Plant height(cm)	21.73	319.30**	15.49
2	Number of primary branches	3.03	4.010**	0.63
3	Days to first flowering	8.44	236.51**	15.29
4	Days to 50% flowering	15.74	221.68**	14.08
5	Fruit stalk length (cm)	0.03	1.850**	0.09
6	Fruit length (cm)	0.27	23.73**	0.47
7	Fruit girth (cm)	0.30	1.180**	0.17
8	Days to first fruit harvesting	19.22	77.950**	6.31
9	Total number of picking	0.56	1.960**	0.39
10	Fresh weight of fruits (g)	13.70	488.56**	33.05
11	Dry weight of fruits (g)	1.37	6.56**	0.82
12	Number of fruits per plant	110.11	5669.25**	497.20
13	Fruit yield per plant (g)	114.35	16616.54**	758.76
14	Fruit yield per plot (kg)	1.33	14.35**	0.90
15	Fruit yield per hectare (q)	23.07	1886.16**	193.66

** Significant at 1% levels of significance

Results and Discussion

Analysis of variance revealed significant differences among the genotypes for all the traits indicating presence of wide range of variability in the genotypes which can be exploited through selection. The mean performance of genotypes for different traits indicating that the high range of variability was recorded for number of fruits per plant, fruit yield per plant, fruit yield per plot, days to first fruit harvesting, fruit yield per hectare, days to 50% flowering, fresh weight of fruits, fruit length. Relatively low range of variability was observed in respect of dry weight of fruits, fruit girth, fruit stalk length and total number of picking and suggesting that these traits were least affected by the environment influence.

Table 2: Estimation of genetic parameter of variation for fruit yield and its attributing traits in hot pepper

S. No.	Parameters	Mean	Range		Coefficient of variation (%)		Heritability (%)	Genetic Advance	Genetic Advance as % of mean
			Minimum	Maximum	Genotypic	Phenotypic			
1	Plant height(cm)	61.37	34.93	79.26	16.11	17.31	86.67	19.04	30.90
2	Number of primary branches	5.44	3.23	8.43	20.98	23.21	81.54	2.18	39.02
3	Days to first flowering	43.73	26.03	56.8	19.8	21.52	83.49	17.0	38.44
4	Days to 50% flowering	57.01	42.67	76.33	16.03	17.96	86.82	18.01	30.78
5	Fruit stalk length (cm)	3.95	2.78	5.66	19.37	20.77	86.91	1.47	37.2
6	Fruit length (cm)	8.94	5.56	18.35	31.15	32.08	94.26	5.66	62.31
7	Fruit girth (cm)	3.69	2.88	5.33	15.72	19.29	66.50	0.97	26.42
8	Days to first fruit harvesting	97.19	85.23	101.02	5.14	5.66	82.69	9.35	9.64
9	Total number of pickings	4.90	3.80	6.47	16.40	20.73	62.63	1.31	26.73
10	Fresh weight of fruits (g)	52.52	29.79	74.27	23.46	25.89	82.13	23.00	43.8
11	Dry weight of fruits (g)	5.93	3.17	10.6	23.34	27.89	70.06	2.39	40.25
12	Number of fruits per plant	136.11	63.83	286.06	32.94	36.79	80.17	82.70	60.76
13	Fruit yield per plant (g)	283.2	145.26	444.2	25.45	26.75	87.41	139.18	48.24
14	Fruit yield per plot (kg)	8.63	5.54	14.93	24.04	26.71	81.78	3.86	44.94
15	Fruit yield per hectare ((q)	95.55	61.18	165.29	23.55	27.48	81.67	45.10	46.89

The estimation of genetic parameter *viz.*, phenotypic and genotypic coefficient of variation for different characters is given in (Table 2.). The characters with high magnitude of GCV and PCV *via;* number of fruits per plant, fruit girth (cm), fruit yield per plant, fruit yield per plot (kg), fruit yield per plant (g), fruit length (cm), dry weight of fruits (g) days to 50% flowering, plant height, days to first flowering and number of primary branches. The effect of environment on any characters is indicated by the magnitude of the differences between the genotypic and phenotypic coefficient of variation as huge amounts of difference reflect the wide environmental effect and narrow difference reveal the high genetic influence in further generation for these character (Khatum *et al*., 2015) [8]. These findings are in consonance with the findings by Munshi and Behra (2000) [10] for fruit length, Verma *et al*., (2004) [18] for days to 50% flowering, Sandeep *et al.*, (2008) [14] for fruit girth, plant height, number of primary branches and number of fruits per plant, Sharma *et al.*, (2010) [16] for fruit yield per plant, Rosmaina *et al.*, (2016) [16] for days to first flowering. The genetic material possesses considerable amount of variation for these characters can be utilized for improvement of genotypes.

Broad sense heritability values for the fifteen traits such as fruit length, fruit girth, days to 50% flowering, days to first flowering, fruit yield per plant, plant height, fruit stalk length, days to first fruit harvesting, fruit yield per plot, fruit yield per hectare, number of primary branches and number of fruits per plant indicates the traits are low influence by environmental fluctuations and governed by additive gene action that additive gene effect contribute towards the expression of these traits. These result were in line with results of earlier finding of Arup *et al*., (2011) [3] for days to 50% flowering, Rajyalakshmi and Vijyapadma. (2012) [13], Gupt *et al.*, (2009) for fruit diameter.

High heritability coupled with high genetic advance was recorded for fruit length, number of fruits per plant, fruit yield per plant, fruit yield per hectare, fruit yield per plot, fresh weight of fruits and dry weight of fruits indicating that the heritability is due to additive gene action and selection may be effective because of additive gene effect.

Moderate heritability coupled with moderate genetic advance was observed for characters namely; number of primary branches, days to first flowering, fruit stalk length, plant height, days to 50% flowering and fruit girth. While, high heritability coupled with low genetic advance was observed for days to first fruit harvesting. Similar finding reported by the various works *viz.*, Shrishat *et al.* (2007) [17] for dry weight of fruits, Sarkar *et al*. (2009) [15] for plant height, 50% flowering, fruit length, number of fruits per plant, Sharma *et al.* (2010) [16] for fruit girth and fresh weight, Datta *et al.* (2013) [5] for number of primary branches, Patel *et al*. (2015) [11] for days to first picking, Farwah *et al*. (2020) [6] for fruit weight and fruit yield per plant and Kumar *et al*. (2020) [9et al] for fruit yield per hectare Effectiveness of selection depends not only on heritability but also on genetic advance.

Conclusion

Phenotypic coefficient of variation (PCV) was greater than the genotypic coefficient of variation (GCV) observed for all the characters indicating that the environmental factors were influencing the expression of characters. Wide difference between phenotypic coefficient of variation and genotypic coefficient of variations suggested there acquiescent to environmental fluctuations whereas, narrow difference indicating less environmental interference on the expression of these characters. The above finding indicates that the characters high heritability with high and moderate genetic advance can be considered for direct selection for improvement of yield attributing characters. Hence, heritability estimates coupled with genetic advance are more useful than the heritability alone for selecting the best individual. High heritability with low genetic advance indicating characters highly influenced due to environmental factors, such traits may be rewarding some time for breeding programme.

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