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Genetic Variability Studies in Chilli (*Capsicum annuum* L.) Genotypes under the Mid Hill region of Himachal Pradesh, India

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ABSTRACT

A field experiment was carried out at the Vegetable farm of Dr Y S Parmar University of Horticulture and Forestry, Nauni to evaluate variability parameters of fifteen yield and yield contributing characters in twenty-five chilli genotypes during the Kharif season 2020-21. The analysis of variance revealed significant differences among all the genotypes studied. High phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were observed for nine characters except for days to 50% flowering, fruit length and fruit diameter, plant height, days to maturity (mature green) and days to maturity (red ripe stage). High estimates of PCV and GCV coupled with high heritability and genetic gain were recorded for nine traits indicating the existence of additive gene action and these traits can be improved through selection.

Key words: *Chilli, Genetic Variability, Heritability*

Introduction

Capsicum annuum L. commonly known as chilli pepper or hot pepper is a member of the Solanaceae family and placed under the genus *Capsicum*. It has a diploid genome with 12 pairs of chromosomes. Despite being a self-pollinated crop, chilli has a massive genetic diversity owing to the chance outcrossing that occurs at a phenomenally high rate *i.e.* up to 66% (Patel and Patel, 2014).

Berries are the main economic part of chillies that are used for multiple purposes. The berries can serve as vegetable (green chilli), spice (dried ripe chilli) and also sold as processed food products such as pickles and sauces across the world (Hazra *et al*., 2011). Encompassing approximately 40% of the world's production, India holds the leading position in the production, consumption and export of chilli (Janaki *et al*., 2015). In India, Andhra Pradesh, Telangana, Karnataka, Orissa, West Bengal, Maharashtra and Tamil Nadu are the leading chilli producing states. In our country, green and dry chilli has an extensive annual production of 3720,000 MT in 364,000 ha acreage and 1690,000 MT in 721,000 ha respectively (Anonymous, 2020).

Over centuries of cultivation, outcrossing nature, selection and popularity of the crop among growers, abundance genetic variability as well as landraces of chillies, have evolved in the Indian subcontinent. Variability acts as the preliminary tool for a breeder and serves as the basis for any crop improvement programme. Estimating variability parameters, particularly heritability and genetic advance, are important indicators for character improvement through selection, whereas selection for highly heritable characters is more effective for a successful breeding

programme. Considering this, the present investigation attempted to assess the magnitude of variability, heritability, and genetic advance for various yield and yield contributing characters of chilli.

Materials and Methods

The experiment was conducted during the Kharif season of 2019-20 at the Research Farm, Department of Vegetable Science, Dr Y.S. Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh. The experiment material consists of twenty-five diverse chilli genotypes which were raised in Randomized Complete Block Design (RCBD) with three replications with a plant spacing of 45 cm × 45 cm. To ensure optimal growth, standard cultural practices recommended for chilli cultivation were implemented. Specifically, observations on mature green fruit traits were recorded on five selected plants, while another set of five plants were tagged for recording red ripe fruit traits for each genotype in each replication. The collected data were averaged and subjected to statistical analysis.

The PCV and GCV were estimated as per formulae given by Burton and Devane (1953) and heritability in the broad sense was calculated as per the formula given by Allard (1960). The expected genetic advance resulting from the selection of five per cent superior individuals and Genetic advance expressed as per cent of population mean was calculated by the method given by Johnson *et al*. (1955).

Results and Discussion

The analysis of variance (Table 1) conducted on fifteen parameters revealed significant variations among the twenty-five chilli genotypes included in the study. The analysis of data revealed that in general PCV values are higher than that of GCV but the difference between them is meagre.

Genetic Variability

High PCV and GCV (*i.e.* >20%) were recorded for the dry fruit yield per plant, followed by ascorbic acid content, capsaicin content, ripe fruit yield per plant, green fruit yield per plant, number of fruits per plant, oleoresin content, dry yield as percentage of fresh ripe and average fruit weight. High PCV and GCV observed for these traits indicated that the population had sufficient variability for these traits and effective selection could be made using these traits for the improvement of yield and related characters.

The results were in agreement with the findings of Kadwey *et al.* (2016) for dry fruit yield per plant, Mishra *et al.* (2015) for ascorbic content at the immature green stage, Naresh *et al*. (2013) for capsaicin content, Krishnamurthy *et al.* (2013) for ripe fruit yield per plant. Patel *et al*. (2015) for number of fruits per plant and green fruit yield per plant,

Table 1. Analysis of variance for different traits in chilli

Source of variation		Mean Sum of Square			
		Replication	Genotype	Error	F_{cal}
Characters	df	2	24	48	
Days to 50 per cent flowering		10.49	169.63*	4.23	40.11
Days to maturity (mature green stage)		4.33	159.85*	4.32	37.01
Days to maturity (red ripe stage)		0.84	194.82*	3.88	50.19
Plant height (cm)		1.16	181.10*	7.42	24.41
Fruit length (cm)		0.75	3.32*	0.30	11.05
Fruit diameter (cm)		0.01	0.03*	0.003	9.13
Number of fruits per plant		30.79	1318.08*	10.71	123.06
Average fruit weight (g)		0.07	1.77*	0.02	73.32
Green fruit yield per plant (g)		267.74	15859.50*	216.05	73.41
Ripe fruit yield per plant (g)		152.54	16276.62*	143.12	113.73
Dry Fruit yield per plant (g)		11.10	1190.67*	29.55	40.29
Dry yield as percentage of fresh ripe (%)		1.56	69.69*	1.44	48.34
Ascorbic acid content (mg/100g)		6.56	2041.99*	5.23	390.09
Oleoresin content (%)		0.55	26.19*	0.49	53.62
Capsaicin content (%)		0.0002	0.0383*	0.0002	4.61

*Significant at 5% level of significance

Chattopadhyay *et al.* (2011) for oleoresin content, Zehra *et al.* (2017) for dry yield as percentage of fresh ripe and Amit *et al*. (2014) for average fruit weight.

Moderate PCV and GCV (*i.e.* 10-20%) were recorded for days to 50 per cent flowering, fruit length and fruit diameter, which depicted that the genotypes used in the present study had less variability for these traits. Similar findings were reported by Ajjapplavara and Channagoudra (2009) for days to 50 per cent flowering and Suryakumari *et al.* (2010) for fruit length and fruit diameter. Low PCV and GCV (*i.e.* <10%) were recorded for plant height, days to maturity (mature green) and days to maturity (red ripe stage). Previously, Amit *et al*. (2014) also recorded similar findings for days to maturity (red ripe stage) and days to maturity (mature green stage).

Heritability and Genetic advance

High heritability was observed for all the traits considered in the study Similar results on high heritability have also been reported in chilli by Chattopadhyay *et al*. (2011) for days to 50 per cent flowering, green fruit length and girth, no of fruits per plant, green fruit yield per plant, dry fruit yield per plant, ascorbic acid content, oleoresin content and capsaicin content, Zehra *et al.* (2017) for days to first green fruit harvest, days to first ripe fruit harvest, plant height, fruit length, fruit diameter, average fruit weight, number of fruits per plant and capsaicin content.

High heritability coupled with a high genetic gain was found for characters like days to 50% flowering, number of fruits per plant, average fruit weight, green fruit yield per plant, ripe fruit yield per plant, dry fruit yield per plant, dry yield as percentage of fresh ripe, ascorbic acid content, oleoresin content and capsaicin content which indicates that these characters were under the strong influence of additive gene action and hence simple selection based on the phenotypic performance of these traits would be effective. Further, high heritability along with moderate genetic gain was observed for fruit length, plant height, fruit diameter, days to maturity (mature green stage) and days to maturity (red ripe stage) suggesting an equal role of both additive and non-additive gene action and selection can partially improve such traits.

Conclusion

The findings of the study indicate a significant level of genetic variability among different chilli genotypes, presenting valuable opportunities for crop improvement programs. Several traits, including the number of fruits per plant, average fruit weight, green fruit yield per plant, ripe fruit yield per plant, dry fruit yield per plant, dry yield as a percentage of fresh ripe, ascorbic acid content, oleoresin content, and capsaicin content, demonstrated substantial estimates of PCV and GCV along with high heritabil-

Table 3. Estimates of components of genetic variability for various characters in chilli

Characters	Coefficient of Variability (%)		Heritability (%)	Genetic advance	Genetic gain (%)
	Phenotypic	Genotypic			
Days to 50% flowering	14.88	14.34	92.88	14.74	28.47
Days to maturity (mature green stage)	9.48	9.10	92.31	14.25	18.02
Days to maturity (red ripe stage)	7.63	7.40	94.25	15.96	14.81
Plant height (cm)	10.47	9.86	88.64	14.76	19.12
Fruit length (cm)	12.50	10.97	77.02	1.81	19.83
Fruit diameter (cm)	12.50	10.68	73.06	0.17	18.81
Number of fruits per plant	29.70	29.34	97.60	42.49	59.72
Average fruit weight (g)	22.94	22.48	96.02	1.54	45.38
Green fruit yield per plant (g)	31.42	30.79	96.02	145.77	62.14
Ripe fruit yield per plant (g)	35.82	35.36	97.41	149.10	71.89
Dry fruit yield per plant (g)	47.76	46.03	92.91	39.06	91.40
Dry yield as % of fresh ripe (%)	25.62	24.84	94.04	9.53	49.63
Ascorbic acid (mg/100g)	43.43	43.26	99.23	53.47	88.78
Oleoresin content (%)	29.85	29.03	94.61	5.86	58.17
Capsaicin content (%)	40.22	39.96	98.68	0.23	81.77

ity and genetic gain, making them suitable candidates for the selection process in crop improvement programs.

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