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Morphological characterization and genetic variability of Bird's Eye chilli – an underutilized spice crop

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ABSTRACT

Thirty-five genotypes of *Capsicum frutescence* collected from the wild were evaluated during 2018-2019. The morphological characterization was done as per the specifications of the International Union for the Protection of New Varieties of Plants (UPOV) for hot peppers. Analysis of variance for various growth and yield characters was statistically tested. Higher level of GCV and PCV (>20%) was observed for the number of primary branches per plant, the weight of seeds per fruit, fruit yield per plant, fresh and dry weight of ten fruits, fruit width, number of seeds per fruit, width and length of the fruit stalk and fruit length. Most of the characters showed very high heritability (>90%) coupled with high GAM (>40%). Higher variability was found in the genotypes. High heritability coupled with high GAM was noticed for most of the yield traits, indicated that the selection for these traits will be effective.

Keywords: *Capsicum frutescens* L., Spices, Genetic variability, Bird's eye chilli.

INTRODUCTION

Bird's Eye chilli is a common name of one of the semi wild species of capsicum *i.e. Capsicum frutescens* L. This species is found growing in the Southern states of India *viz*., Karnataka, Kerala, Tamil Nadu and parts of North Eastern states of Manipur and Mizoram (Dutta *et al*., 1). The dried fruits are extensively used as spice in curries, pickles, curry powders, seasonings etc. As medicine, the fruits are used as functional ingredients in ointments for rheumatism and joint pains due to its counter irritant property. Capsicum species are known for the pungent fruits and that is mainly attributed to the presence of capsaicinoids. The measure of pungency in terms of Scoville Heat Units (SHU) in chillies is reported to range from 0 to 3,00,000 or even more (Zewdie and Bosland, 2). Considerable variation occurs in morphological traits of the plant *viz*., plant stature/ habit, fruit colour, size, shape and quality parameters (Zhani *et al*., 7; Vaishnavi *et al*., 6). Very few studies have been undertaken on the crop improvement of bird's eye chilli. The assessment of nature and magnitude of variability in the available germplasm is the prerequisite of any breeding program. The effectiveness of selection and development of improved varieties depends on the nature of variability expressed for yield and its contributing characters in the gene pool. Hence, the present study was undertaken to characterize the local wild collections of bird's eye chilli genotypes and assess the variability in the population for utilization in future breeding programmes.

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MATERIALS AND METHODS

The study was carried out at the Department of Plantation, Spices, Medicinal and Aromatic Crops, College of Horticulture, Mudigere, University of Agricultural and Horticultural Sciences, Shivamogga during 2018-19. The experimental material for the study comprised of 35 bird's eye chilli genotypes collected from different locations of Karnataka. The experiment was laid out in open field with Randomized Complete Block Design (RCBD) with three replications. Nursery raised seedlings were transplanted in the field at a spacing of 60cm X 45 cm. The plants were taken care by performing the recommended cultural operations. Observations on morphological, growth and yield parameters were recorded from five plants per plot selected randomly. Morphological characterization was done and scoring was given to each descriptor as per the International Union for the Protection of New Varieties of Plants (UPOV) guidelines for various plant, leaf, inflorescence and fruit characters. The data was subjected to statistical analysis using software, Windostat version 9.2 and frequency distribution curves obtained using SPSS version 16.0 software.

RESULTS AND DISCUSSION

Accessions were grouped based on the morphological similarity after characterization.

Frequency distribution analysis showed that out of 30 characters studied, 10 characters could not be differentiated between the accessions so they were classified as monomorphic, 11 characters were dimorphic, as they classified the accessions into two groups and remaining 9 characters could classify the accessions into more than two groups. Hence, these characters are said to be polymorphic (Table 1 and 2). Considerable variation was recorded for all morphological traits under study (Fig. 1 and 2).

Table 1. Frequency distribution for agro-morphological characters in bird's eye chilli accessions

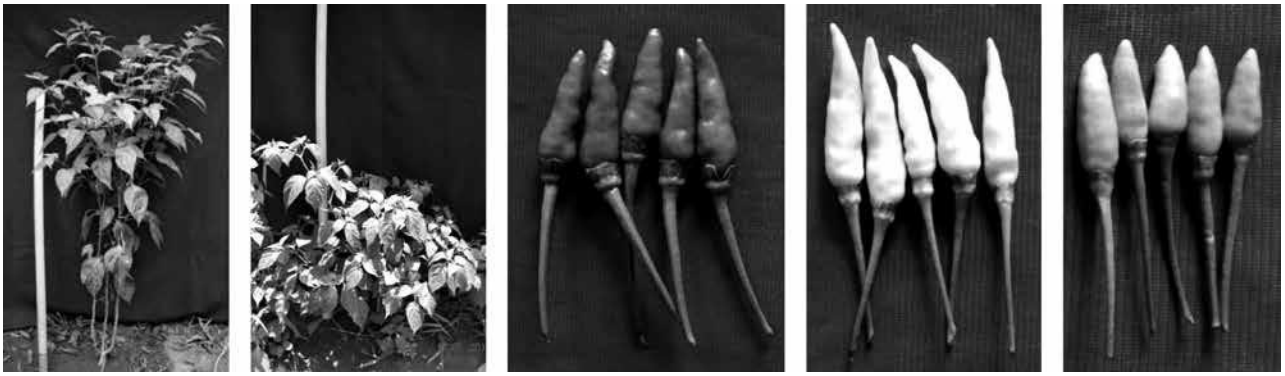
S. No.	Character	Status	No. of genotype	Frequency (%)
I	Plant characters			
1.	Anthocyanin coloration of hypocotyls	Absent	35	100.00
2.	Plant growth habit	Upright	33	94.30
		Semi-upright	2	5.70
3.	Anthocyanin coloration of nodes	Absent	35	100.00
4.	Intensity of anthocyanin coloration of nodes	Very weak	35	100.00
5.	Hairiness of stem nodes	Absent or very weak	35	100.00
II	Leaf characters			
6.	Intensity of green color	Light	11	31.40
		Medium	19	54.30
		Dark	5	14.30
7.	Leaf shape	Ovate	35	100.00
8.	Undulation of leaf margin	Absent or very weak	26	74.30
		Weak	27	20.0
		Medium	2	5.70
9.	Blistering of leaf	Very Weak	34	97.10
		Weak	1	2.90
10.	Glossiness of leaf	Very Weak	1	2.80
		Weak	5	14.30
		Medium	29	82.90
III	Inflorescence characters			
11.	Anthocyanin coloration in anther	Present	13	37.10
		Absent	22	62.90
12.	Corolla colour	Not white	35	100.00
13	Peduncle attitude	Erect	35	100.00

(a) Present (b) Absent (a) Present (b) Absent

Fig. 1. Variability in anthocyanin colouration of flowers and fruits of bird's eye chilli accessions

Table 2. Frequency distribution for fruit characters in bird's eye chilli accessions

Sl. No.	Fruit characters	Status	No. of genotype	Frequency (%)
1.	Colour of fruit before maturity	Greenish white	5	14.30
		Yellow	10	28.60
		Green	20	57.10
2.	Intensity of fruit colour	Light	4	11.40
		Medium	31	88.60
3.	Anthocyanin coloration of fruit	Present	6	17.10
		Absent	29	82.90
4.	Sinuation of pericarp at basal part	Absent or very weak	23	65.70
		Weak	10	28.60
		Medium	1	2.90
		Strong	1	2.90
5.	Sinuation of pericarp excluding basal part	Absent or very weak	16	45.70
		Weak	13	2.90
		Medium	5	14.30
		Strong	1	2.90
6.	Texture of fruit surface	Smooth or very slightly wrinkled	34	97.10
		Slightly wrinkled	1	2.90
7.	Fruit attitude	Erect	35	100.00
8.	Fruit colour in mature stage	Orange	10	28.60
		Red	25	71.40
9.	Intensity of fruit colour at maturity	Light	33	94.30
		Medium	2	5.70
10.	Fruit glossiness	Weak	2	5.70
		Medium	30	85.70
		Strong	3	8.60
11.	Fruit stalk cavity	Present	1	2.90
		Absent	34	97.10
12.	Shape of fruit apex	Very acute	8	22.9
		Moderately acute	25	71.40
		Moderately depressed	2	5.70
13.	Number of locules in fruit	Predominantly two	33	94.30
		Equally two and three	2	5.70
114.	Fruit shape in cross section	Angular	22	62.90
		Circular	13	37.10
15.	Fruit shape in longitudinal section	Trapezoidal	2	8.60
		Moderately triangular	20	5.70
		Narrowly triangular	11	31.40
		Horn-shaped	2	5.70
16.	Calyx aspect	Enveloping	35	100.00
17.	Pungency (by tasting in the placenta area)	Pungent	35	100.00



(a) Upright (b) Semi-upright (c) Green (d) White (e) Greenish white

Fig. 2. Variability in plant growth habit (a and b) and fruit colour before maturity among the accessions of bird's eye chilli (c, d, e)

Table 3. Estimates of mean, range, components of variance, heritability and genetic advance for growth, yield and quality parameters in bird's eye chilli accessions.

Sl. No.	Traits	Mean ± SEm	Range		GCV (%)	PCV (%)	h^2 (%)	GAM (%)
			Min.	Max.				
1.	Plant height (cm) at 90 DAT	34.18 ± 0.82	26.48	50.60	14.42	15.02	86.10	28.50
2.	Number of primary branches per plant at harvest	4.75 ± 0.35	2.17	7.17	23.45	26.83	76.40	42.23
3.	Plant spread (cm^2) at 90 DAT	27.29 ± 1.46	21.39	36.46	10.65	14.19	56.34	16.47
4.	Days to 50% flowering	83.66 ± 2.85	53.33	100.00	9.24	11.01	70.36	15.96
5.	Days taken for physiological maturity	32.55 ± 1.45	26.67	38.67	8.89	11.83	56.49	13.77
6.	Fruit length (cm)	2.03 ± 0.17	1.18	2.92	22.61	26.98	70.23	39.03
7.	Fruit width (cm)	0.68 ± 0.02	0.31	1.68	39.89	40.27	98.00	81.40
8.	Fresh weight of 10 fruits (g)	6.80 ± 0.53	3.10	15.67	45.44	47.44	91.75	89.67
9.	Dry weight of 10 fruits (g)	1.24 ± 0.13	0.43	3.46	48.13	51.59	87.02	92.49
10.	Number of seeds per fruit	20.08 ± 1.40	9.67	51.00	43.75	45.43	92.74	86.79
11.	Weight of seeds per fruit (mg)	0.11 ± 0.005	0.02	0.24	41.45	42.11	96.89	84.05
12.	Fruit to seed ratio	2.18 ± 0.21	0.99	4.33	27.38	32.18	72.39	48.00
13.	Fruit yield per plant (g)	456.08 ± 31.45	244.42	1011.72	49.03	50.50	92.24	98.05
14.	Ascorbic acid content (mg/100gm)	73.24 ± 1.39	61.36	120.17	16.67	17.00	94.13	33.67
15.	Capsaicin content (%)	1.60 ± 0.04	0.88	2.16	18.11	18.57	95.09	36.38

Note: DAT – Days After Transplanting, GCV- Genotypic Coefficient of Variation, PCV- Phenotypic Coefficient of Variation, h^2– Broad sense heritability, GAM – Genetic advance over per cent mean

High range of variation was recorded for all growth parameters (Table 3) *viz*., plant height (26.48-50.60cm), number of branches (2.17-7.17) and plant spread (21.39-36.46cm^2). Similarly, higher variations were also observed for the yield and quality parameters *viz*., days to 50% flowering (53.33-100), days taken for maturity (26.67 -38.67), fruit length (1.18 – 2.92cm), fruit width (0.31 - 1.68 cm), average fresh (3.10-15.7g) and dry weight (0.43-3.46g) of 10 fruits, Number (9.67-51.00) and weight of seeds per fruit (0.02-0.24g), fruit to seed ratio (0.99-4.33) and fruit yield per plant (244.42-1011.72g). Similar results were reported earlier by Chowdhury *et al.* (4). Ascorbic acid content (63.36 to 120.17 mg/100g) and capsaicin content (0.88-2.16%) in fruits also exhibited wider range (Vaishnavi *et. al*., 5).

The phenotypic coefficients were higher than the genotypic coefficients for all the traits under study indicating the dominance of environmental factors on the expression of these traits. Narrow

difference between GCV and PCV was observed for the traits *viz*., plant height, fruit width, seed weight per fruit, fruit yield per plant, ascorbic acid and capsaicin content indicating the lesser influence of environment on these traits and selection for the traits on phenotype to be effective. As the GCV and PCV values more than 20 are regarded as high (Deshmukh *et al*., 6), the traits like number of primary branches, fruit length, fruit width, fresh and dry weight of 10 fruits, seed weight per fruit and yield per plant recorded high GCV and PCV, selection based on these characters would be a good indication of genetic potential (Sran and Jindal, 7). Heritability and genetic advance as percent mean (GAM) were noted for plant height, fruit width, fresh and dry weight of seeds, number of seeds per fruit, weight of seeds per fruit, fruit yield per plant, ascorbic acid and capsaicin contents in fruit. These results are in accordance with the findings of Jyothi *et al.* (4). The present study helped in identifying the traits on which the selection for higher yield can be based upon in crop improvement programmes.

AUTHORS' CONTRIBUTION

Conceptualization of research (HRB); Designing of the experiments (HRB); Contribution of experimental materials (HRB); Execution of field/lab experiments and data collection (HRB, SS, DBM); Analysis of data and interpretation (SS, DBM); Preparation of the manuscript (HRB, SS, DBM).

DECLARATION

The authors declare no conflict of interest.

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