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Research Article

Evaluation of Genetic Variability, Heritability and Genetic gain in *Bhut jolokia*' (*Capsicum chinense* Jacq.) from North East India

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Abstract

The present work was carried out with 16 genotypes of *Bhut jolokia*' (*Capsicum chinense* Jacq.) to estimate variability, heritability and genetic advance over mean for fruit yield and yield component characters. A wide range of variability along with high estimates of PCV and GCV was observed for weight of ripe fruit, fruit length, fruit yield per plant, weight of dry fruit, dry fruit yield per plant, shelf life at ambient temperature, ascorbic acid content, capsaicin content and β- and α-carotene content. It is concluded that selection on the basis of these characters will be more useful for the improvement of this crop towards attaining higher fruit yield per plant.

Keywords: Bhut jolokia, capsaicin, GCV, heritability, North East India

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Introduction

Bhut jolokia (*Capsicum chinense* Jacq.) shows a great range of variability in North East India. The portioning of the total variability into heritable and non-heritable components should enable to know whether the superiority of selection is inherited to the progenies or not [1]. Further, estimates of heritability and genetic advance expected after selection indicate the possibilities and extent to which improvement is possible through selection. The effectiveness of selection depends upon genetic advance of the character selected along with heritability [2-3].

High heritability with high genetic advance indicated that most likely the heritability is due to additive gene effect [4] and would respond well to selection. High value of genetic coefficients of variation and heritability estimates supplemented with greater genetic gains also indicate additive gene effect regulating the inheritance of such traits [5]. High heritability for different traits indicated that large proportion of phenotypic variance has been attributed to genotypic variance and suggested that selection could be made for these traits on the basis of phenotypic expression. Genotypic coefficient of variation along with high heritability gives clear picture of gain to be expected from selection [6].

Materials and Method

The experiment was carried out in polyhouse complex at Vegetable Research Farm, College of Horticulture and Forestry, Central Agricultural University, Pasighat, Arunachal Pradesh. Sixteen genotypes of king chilli were collected from different parts of North East India (**Table 1**). The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications and with a spacing of 60 x 50 cm.

The observations were recorded on five randomly selected plants of each genotype from each replication and the average was worked out in each replication for different traits.

Statistical Analysis

Data were analysed as suggested by Singh and Chaudhary [7] for analysis of variance (ANOVA) and components of variance for individual character. The phenotypic and genotypic coefficient of variability was calculated as per formula given by Burton and de Vane [8].

$$\text{Phenotypic coefficient of variability (\%)} = \frac{\sqrt{\text{Phenotypic variance } (\sigma_p^2)}}{\text{General mean of the character } (\bar{Y})} \times 100$$

Table 1 List of chilli genotypes with their sources of collection

Sl. No.	Genotype	Source
1	CHFKC-1	A landrace of Along (Arunachal Pradesh)
2	CHFKC-2	A landrace of Palin (Arunachal Pradesh)
3	CHFKC-3	A landrace of Yazali (Arunachal Pradesh)
4	CHFKC-4	A landrace of Kurungkumey (Arunachal Pradesh)
5	CHFKC-5	A landrace of Mebo (Arunachal Pradesh)
6	CHFKC-6	A landrace of Pasighat (Arunachal Pradesh)
7	CHFKC-7	A landrace of Kiyit (Arunachal Pradesh)
8	CHFKC-8	A landrace of Imphal (Manipur)
9	CHFKC-9	A landrace of Tseipama (Nagaland)
10	CHFKC-10	A landrace of Daporijo (Arunachal Pradesh)
11	CHFKC-11	A landrace of Mariyang (Arunachal Pradesh)
12	CHFKC-12	A landrace of Pasighat (Arunachal Pradesh)
13	CHFKC-13	A landrace of Dimapur (Nagaland)
14	CHFKC-14	A landrace of Mariyang (Arunachal Pradesh)
15	CHFKC-15	A landrace of Pasighat (Arunachal Pradesh)
16	CHFKC-16	A landrace of Along (Arunachal Pradesh)

$$\text{Genotypic coefficient of variability (\%)} = \frac{\sqrt{\text{Genotypic variance } (\sigma_g^2)}}{\text{General mean of the character } (\bar{Y})} \times 100$$

PCV and GCV were classified as suggested by Shivasubramanian and Menon [9] as follows: 0-10% = low, 10-20% = Moderate and > 20% = High

Heritability (h^2bs) was calculated as per formula given by Burton and de Vane [8].

$$\text{Heritability } (h^2\text{bs})\ \% = \frac{\text{Genotypic variance}(\sigma_g^2)}{\text{Phenotypic variance } (\sigma_p^2)} \times 100$$

Where, h^2= Heritability (%), σ_g^2= Genotypic variance [σ_g^2 = (Mg - Me) / r] and σ_p^2= Phenotypic variance ($\sigma_g^2 + \sigma_e^2$)

Heritability percentage was categorised as demonstrated by Robinson [9]. 0 – 30% = Low, 30– 60% = Moderate and > 60% = High.

The expected genetic advance resulted from selection of 5 percent superior individuals were worked out as suggested by Johnson [10].

Genetic advance (GA) = h^2 (bs) x σ p x k. Where, h^2= Heritability, σ_p= Phenotypic standard deviation of the character, k = Selection differential at 5 per cent selection intensity *i.e.* 2.06.

Genetic gain is the percentage ratio of genetic advance and population mean as suggested by Johnson [10].

$$\text{Genetic gain (\%)} = \frac{\text{Genetic advance (GA)}}{\text{General mean of the character}} \times 100$$

The genetic advance as percentage of mean was categorized into low, moderate and high [10].

Result and Discussion

Genetic Variability

A wide range of variability was observed in the genotypes. The information based on the range provides rough estimates of the degree of the variation present in the materials. The phenotypic coefficients of variability were higher in magnitude than their corresponding genotypic coefficients of variability for all the characters (**Table 2**). Phenotypic and genotypic variance was highest observed (3943.25 and 4718.76, respectively) for ascorbic acid content and lowest for fruit yield per plant and dry fruit yield per plant (Table 2).

The highest estimate of phenotypic (PCV) and genotypic (GCV) coefficient of variation were observed in capsaicin content (PCV=55.62%, GCV=53.74%). Low estimates of PCV and GCV were recorded in case of days to 50% flowering (PCV=9.83%, GCV=7.30%) and days to first picking (PCV=6.47%, GCV=4.78%) (Table 2).

In case of number of fruits per plant, the PCV was found to be moderate (16.13%) and low GCV was recorded (8.67%) (Table 2). The characters like weight of ripe fruit, fruit length, fruit yield per plant, weight of dry fruit, dry fruit yield per plant, ascorbic acid content, capsaicin content, β- and α-Carotene content showed high coefficients of variability at genotypic level. These results were in conformity with Manju and Sreelathakumary [11], Arunkumar [12], Hazarika [13], Krishnamurthy [14] and Amit [15]. Ample variability present in experimental materials suggested that there was ample scope for bringing out improvement in these characters.

Table 2 Genetic parameters of yield and its component characters in king chilli

S. No	Characters	Mean ± SE(m)	Range		Variance		Coefficient of variability (%)		H %	G A	Genetic gain
			Min	Max	Phenotypic	Genotypic	PCV	GCV			
1	Plant height (cm)	94.67±6.21	61.33	117.50	268.24	152.58	17.30	13.05	57	19.19	20.27
2	Number of branches per plant	1.49±0.13	1.07	2.06	0.11	0.06	22.26	16.63	56	0.38	25.61
3	Days to 50% flowering	69.92±2.66	62	79.67	47.28	26.01	9.83	7.30	55	7.79	11.15
4	Days to first picking	97.54±2.46	90.7	106.93	39.85	21.70	6.47	4.78	54	7.08	7.26
5	Weight of ripe fruit(g)	4.70±0.22	2.11	8.29	3.06	2.92	37.22	36.35	95	3.44	73.11
6	Fruit Length (cm)	5.36±0.30	3.00	8.2	2.85	2.57	31.49	29.94	90	3.14	58.65
7	Number of fruits per plant	40.00±3.14	31.67	47.00	41.64	12.03	16.13	8.67	29	3.84	9.60
8	Fruit yield per plant (Kg)	0.18±0.02	0.10	0.26	0.00	0.00	35.16	31.72	81	0.11	58.97
9	Weight of dry fruit (g)	0.72±0.04	0.24	1.02	0.06	0.06	34.22	32.95	93	0.47	65.38
10	Dry fruit yield per plant (Kg)	0.03±0.003	0.01	0.04	0.00	0.00	35.63	30.98	76	0.02	55.50
11	Shelf life at ambient temperature	6.73±0.31	5.33	7.67	0.57	0.86	13.78	11.27	67	1.28	18.98
12	Ascorbic acid content (mg/100g)	165.41± 16.08	92.07	301.11	3943.25	4718.76	41.53	37.96	84	118.25	71.49
13	Capsaicin content (%)	1.86±0.15	0.75	4.65	0.99	1.07	55.62	53.74	93	1.98	106.96
14	β – Carotene (mg/L)	2.68±0.11	1.02	5.26	0.98	1.02	37.73	37.07	97	2.01	75.04
15	α – Carotene (mg/L)	2.78±0.13	0.97	4.45	0.7.	0.75	31.19	30.04	93	1.66	59.61

Heritability (%)

Heritability (bs) estimated ranged from 29% to 97%. Maximum heritability was observed for β-carotene (97%) followed by weight of ripe fruit (95%), weight of dry fruit (93%) and capsaicin content (93%), α-carotene content (93%), ascorbic acid content (90%), fruit yield per plant (84%), dry fruit yield per plant (81%), and shelf life at ambient temperature (67%).

Moderate heritability was recorded for plant height (57%), number of branches per plant (56%), days to 50% flowering (55%) and days to first picking (54%) while, number of fruits per plant had low heritability (29%) (Table 2).

High heritability for different traits indicated that large proportion of phenotypic variance has been attributed to genotypic variance and suggested that selection could be made for these traits on the basis of phenotypic expression [6]. The high heritability values for yield and component characters corroborates with the findings of Manju and Sreelathakumary [2], Chattopadhyay [16], Hasanuzzaman [17], Hazarika [13] and Yatung [18].

Genetic Gain

Genetic gain is the genetic advance expressed as percent of population mean. Genetic gain was high for capsaicin content (106.96%), β-carotene (75.04%), weight of ripe fruit (73.11%), ascorbic acid content (71.49%), weight of dry fruit (65.38%), α-carotene content (59.61%), fruit yield per plant (58.97%), fruit length (58.65%), dry fruit yield per plant (55.50%), number of branches per plant (25.61%), plant height (20.27%) (Table 2). Moderate genetic gain was observed for shelf life at ambient temperature (18.98%) and days to 50% flowering (11.15%). However, low genetic gain was recorded for number of fruits per plant (9.60%) and days to first picking (7.26%) (Table 2).

High heritability estimates along with high genetic gain are useful than heritability alone for effective selection [7]. Similarly, in the present study the characters like plant height and number of branches per plant recorded high genetic gain with moderate heritability while, weight of ripe fruit, fruit length, fruit yield per plant, weight of dry fruit, dry fruit yield per plant, ascorbic acid content, capsaicin content, β- and α-carotene recorded high heritability with high genetic advance and indicated that most likely the heritability is due to additive gene effect [1] and would respond well to selection. These findings were in agreement with Manju and Sreelathakumary [2] Datta and Jana [19], Hazarika [13] and Yatung [18].

Conclusion

The characters under study like, weight of ripe fruit, fruit length, fruit yield per plant, weight of dry fruit, dry fruit yield per plant, shelf life at ambient temperature, ascorbic acid content, capsaicin content and β- and α-carotene content exhibited high heritability coupled with high genetic advance as percent of mean. Therefore these characters are governed by additive gene effects. It may also be concluded that selection on the basis of these characters will be more useful for the improvement of this crop towards attaining higher fruit yield per plant.

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