



## Assessment of genetic variability among different genotypes of Cape gooseberry (*Physalis peruviana* L.) in India

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**Abstract:** The field experiment was carried out at the research farm of Horticulture Garden, Bihar Agricultural College, Sabour, Bhagalpur during 2014-15 for assessment of genetic variability among different genotypes of cape gooseberry in India. The experiment was laid out in Randomized Block Design with three replications having twelve genotypes. Analysis of variance revealed significant differences among genotypes for all the traits studied which suggesting sufficient variability for yield and quality parameters. The overall values of phenotypic coefficient of variation (PCV) were higher than those of genetic coefficient of variation (GCV). Higher magnitude of GCV and PCV were recorded for fruit per plant percent (33.30 and 36.61) followed by fruit diameter, fruit weight and flowers per branch. The maximum GCV (33.30) and PCV (36.61) were recorded in fruits/plant respectively. The high values of GCV are the indication of excess variability among the genotypes and thus the scope for crop improvement depends on the selection of superior parents for crossing to get better parents for hybridization. In present study, the magnitude of heritability ranged from 37% to 98% indicating that these traits are controlled by additive gene action which is very useful in selection. The traits like plant girth, plant height, inter nodal length, appearance of 50% of flowering, bud break to full bloom, number of flowers per branch, number of fruits set per branch, duration of fruit set to maturity, fruit weight, fruit diameter and number of fruits per plant with high GCV, PCV, heritability and genetic advance as percentage of mean, indicating that these characters are under additive gene effects and more reliable for effective selection.

**Keywords:** Cape gooseberry, GCV, Genetic advance, Heritability, PCA

### INTRODUCTION

Cape gooseberry is botanically known as *Physalis peruviana* L. which belong to family *Solanaceae*. It is commonly called as “Poha” in Hawaii, Golden Berry in South Africa, and Rasbhari, Makoi or Tepari in India (Gupta and Roy, 1980). The first description of *Physalis* genus was made by Linnaeus in 1753. The genus *Physalis* having approximately more than 120 species (Licodiedoff *et al.*, 2013). such as, clammy ground cherry (*P. heterophylla*), tomatillo (*P. ixocarpa*), purple ground cherry (*P. philadelphica*), strawberry tomato (*P. pruinosa*), husk tomato (*P. pubescens*) and sticky ground cherry (*P. viscosa*) etc, which have distributed in warm and temperate climates of Africa, Asia and the America (Bala and Gupta, 2011). Menzel (1951) suggested that Cape gooseberry is tetraploid in nature and having chromosome number  $2n = 48$ . *Physalis* is a climacteric fruit which shows a

clear rise in ethylene production during ripening (Trinchero *et al.*, 1999; Majumder and Mazumdar, 2002 and Gutierrez *et al.*, 2008).

The fruit is small in size and round in shape which gives the bright orange in colour and sweet in taste. A number of species in the genus are of horticultural and economic importance due to their high nutritional value in vitamin A, C and B complex, minerals and antioxidants as well as potential medicinal properties including anti-bacterial, anti-inflammatory, and anti-cancer properties (Strik, 2007).

The crop improvement programme mainly depends on the selection of superior parents for crossing to get better parents for hybridization and the knowledge of compatibility and magnitude of gene action which involved in the expression of important traits. Genetic variability is essentially the first step of plant breeding for crop improvement which is considered as the reservoir of variability for different characters (Vavilov,

1951). High variations of morphological characteristics have been observed which used to identify the variability among different genotypes in *Physalis*. However, phenotypic characters are generally influenced by environments as well as plant developmental stages. In addition, species with similar morphological characters cannot be easily distinguished. Heritability and genetic advance help in determining the influence of environment in expression of characters and the extent to which improvement is possible after selection (Robinson *et al.*, 1949). Heritable variation can be effectively studied in conjunction with genetic advance. High heritability alone is not enough to make efficient selection in segregating generation and needs to be accompanied by a substantial amount of genetic advance (Johanson *et al.*, 1955). Identification of genotypes based on morphological characters implies culture inspection at different stages and is not very reliable because many traits of interest have low heritability and are genetically very complex. Hence, an insight into the magnitude of variability present in available accessions of *physalis*. It is importance to a plant breeder for starting a judicious breeding programme (Kaushik *et al.*, 2011). By keeping the above facts in the mind, the present investigation was carried out for analyzing the amount of genetic variation in cape gooseberry accessions and categorizing to assist in selection of genotypes in a breeding programme.

## MATERIALS AND METHODS

The present investigation was carried out at the research farm of Horticulture Garden, Bihar Agricultural College, Sabour, Bhagalpur (87°2'42" E, 25°15'40" N) at an altitude of 46 m above mean sea level in the heart of vast Indo-Gangatic plains of north India. The climate of this place is sub-tropical in nature which characterized by dry summer, moderate rainfall and cold winter. January and February are usually the coldest months whereas the mean temperature normally falls as low as 10.4°C and April & May are generally the hottest months having the maximum

average temperature of 37°C. The experiment was laid out in Randomized Block Design with three replication. The experimental material consists of twelve genotypes of Cape gooseberry (*Physalis peruviana* L.) viz., CITH Sel-1, CITH Sel-3, CITH Sel-5, CITH Sel-7, CITH Sel-9, CITH Sel-11, CITH Sel-15, CITH Sel-16, SS/VK/301, SS/VK/401, SS/VK/501 and SS/VK/601. Seeds are sown in the protray that consist Cocopeat: vermicompost: sand with ratio 2:1:1/2 in the month of August of 2014. The field was irrigated immediately after planting. All the recommended agronomic package of practices was followed. These seedlings were ready for transplanting after 3-4 weeks and transplanting was done after one month. Each genotype is planted at a spacing of 60cm between row-to-row and 60cm between plant-plant. Planting of rooted seedling was done in the evening. The observation were recorded on five randomly selected plants per replication for each germplasm on eleven quantitative characters, viz., plant girth, plant height, inter nodal length, appearance of 50% of flowering, bud break to full bloom, number of flowers per branch, number of fruits set per branch, duration of fruit set to maturity, fruit weight, fruit diameter and number of fruits per plant of twelve cape gooseberry genotypes collected from CITH Srinagar (8 genotypes) and other local (4 genotypes) collected from Bihar region. Recorded values were subjected to statistical analysis of variance and co-variance as prescribed by Burton and Devane (1953). Heritability ( $h^2$ ) in broad sense (Lush, 1949) being the ratio of genotypic variance to phenotypic variance was calculated. Broad sense heritability ( $h^2$ ) estimates were classified as low, moderate and high as below given by Robinson *et al.* (1966). The expected genetic advance was worked out as suggested by Johnson *et al.* (1955).

## RESULTS AND DISCUSSION

**Variability parameters:** The extent of variability with respect to eleven quantitative characters in twelve genotypes measured in term of mean performance,

**Table 1.** Analysis of variance for eleven characters in cape gooseberry.

S. N.	Characters	Mean sum of squares		
		Replication d.f.:2	Treatments 12	Error's
1.	Height of plant (cm)	244.08	433.33**	104.25
2.	Plant girth (cm)	0.03	0.11*	0.04
3.	Inter nodal length (cm)	0.32	23.01**	1.09
4.	Period of 50% of flowering (days)	0.27	562.02**	23.47
5.	Period of bud break to full bloom(days)	0.19	0.79**	0.19
6.	Number of flower per branch	0.01	26.03**	0.44
7.	Number of fruit set per branch	0.70	15.11**	0.96
8.	Duration of fruit set to maturity(days)	16.08	78.96**	8.81
9.	Fruit weight(g)	0.09	50.40**	3.29
10.	Fruit diameter (mm)	1.90	192.97**	2.04
11.	Number of fruits per plant	26.00	1948.26**	126.82

\*, \*\* Significant at 0.05% and 0.01% probability level, respectively

**Table 2.** Mean performance and variability parameters for different characters of Cape gooseberry.

Particulars	Plant girth (cm)	Plant height (cm)	Inter nodal length(cm)	Period of appearance of 50% flowering (days)	Period of bud break to full bloom (days)	flowers/branch	fruits set/branch	Duration of fruit set to maturity (days)	Fruit weight (g)	Fruit Diameter (mm)	Fruits/Plant
GV	0.02	109.69	7.31	179.51	0.20	8.53	4.72	26.12	15.70	63.64	607.15
GCV (%)	3.58	10.20	24.67	23.43	6.04	25.62	23.55	9.39	28.34	30.98	33.30
PV	0.06	213.95	8.40	202.99	0.39	8.98	5.68	26.73	19.00	65.69	733.97
PCV (%)	5.91	14.25	26.45	24.92	8.46	26.29	25.84	9.50	31.17	31.47	36.61
EV	0.04	104.25	1.09	23.48	0.19	0.45	0.96	0.61	3.30	2.04	126.82
ECV (%)	4.70	9.95	9.54	8.47	5.92	5.86	10.63	1.43	12.99	5.55	15.22
h <sup>2</sup> (Broad Sense)%	36.78	51.27	86.98	88.43	51.07	95.0	83.06	97.73	82.63	96.89	82.72
Genetic Advancement 5%	0.19	15.45	5.19	25.96	0.66	5.87	4.08	10.41	7.42	16.18	46.17
G.A as % of Mean 5%	4.48	15.05	47.40	45.39	8.90	51.46	44.21	19.12	53.07	62.81	62.39
General Mean	4.28	102.67	10.96	57.18	7.42	11.40	9.22	54.43	13.98	25.75	74.00
Range lowest	4.00	85.22	8.48	42.50	6.33	7.00	5.88	49.11	7.40	14.90	34.66
Range highest	4.68	120.55	17.51	76.33	8.33	15.33	12.33	66.11	22.39	34.36	112.83

phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability, genetic advance and genetic advance as percent of mean are given in Table 2. The advancement of variability which denotes a genotype tends to vary between among genotypes and response to environmental and genetic factors. The analysis of variance for design of experiment was done for portioning the variance into treatments and replications according to procedure given by Panse and Sukhatme (1967). The analysis of variance indicated significantly higher amount of variability among the genotypes for all the characters studied Table 1.

Estimates of different genetic variability parameters are presented in Table 2. Results showed that The range of variation was high for fruit per plant (34.66-112.83), also reported in tomato by Ghosh *et al.* (2010) and Kaushik *et al.* (2011), Basavaraj *et al.* (2015) and Kumar *et al.* (2016) and followed by period of 50% of flowering (42.50-76.33 cm) and plant height (85.22-120.55 cm) and the lowest genotypic variance was that of plant girth (4.00-4.68cm). In present investigation, highest genotypic and phenotypic variance were recorded for fruit per plant (607.15 and 733.97) followed by period of 50% flowering (179.51) in genotypic variance and plant height (213.95 cm) in phenotypic variance respectively, whereas, the lowest for plant girth (0.02 cm and 0.06 cm). High genotypic coefficient of variation (GCV) indicating more contribution of genetic component for the total variation. Therefore, these characters could be considered and exploited for selection purpose whereas high phenotypic variance indicating the strong influence of environmental factors for their expression. The phenotypic coefficient of variation (PCV) were higher than genotypic coefficient of variation (GCV) for all the traits studies which is an indicator of additive effect of the environment on the expression of the trait. Higher magnitude of GCV and PCV, respectively were recorded for fruit per plant (33.30 and 36.61) followed by fruit diameter (30.98 mm and 31.47 mm) whereas lowest for plant girth (3.58 cm and 5.91 cm) which indicating higher magnitude of variability for these characters. Moderate range was found for plant height (10.20 cm and 14.25 cm) which were manifested by Singh and Kumar (2005) and they concluded that moderate phenotypic and genotypic coefficient of variation (10 to 19%) were observed for plant height in brinjal. however, narrow range of genotypic coefficient of variance were recorded in characters like, plant girth (3.58 cm and 5.91 cm), bud break to full bloom (6.04 and 8.46) and fruit set to maturity (9.39 and 9.50). Pradeep *et al.*, 2001 reported in tomato that high genotypic coefficient of variance and phenotypic coefficient of variance was for number of fruits/

plant (58.07 and 68.21). The moderate amount of GCV and PCV, respectively were recorded for plant height (10.20 cm and 14.25 cm). High values of GCV are an indication of high genetic variability among the genotypes and thus the scope for improvement of these characters through simple selection would be better. The differences between GCV and PCV was minimum for fruit set to maturity (9.39 and 9.50) and other traits having scanty variation found which are suggesting that these traits were least affected by environment.

**Heritability and genetic advance:** Heritability ( $h^2$ ) is the in broad sense (Lush, 1949) being the ratio of genotypic variance to phenotypic variance was calculated as per formula suggested by Burton and Devane (1953). In present study, all the characters showed high heritability, the magnitude of heritability ranged from 37 % to 98 % indicating that these traits are controlled by additive gene action. The highest heritability was recorded on duration of fruit set to maturity (97.73%) followed by fruit diameter (96.89%), number of flower per branch (95.03%), period of appearance of 50% of flowering (88.43%), inter nodal length (86.98%), fruit set per branch (83.06%), fruits per plant (82.72%), plant height (51.27%), period of bud break to full bloom (51.07%) and plant girth (36.78%). High heritability in tomato was exhibited for number of fruits per plant (84 to 99.5%) which was reported by Basavaraj *et al.* (2015), Nagariya *et al.* (2015) and Kumar *et al.* (2016). The high values of heritability estimates in broad sense indicated that sustainable improvement can be made using standard selection procedures. The estimate of genetic advance showed a wide range from 0.19 cm for plant girth to 46.17 for fruit per plant.

## Conclusion

The genetic architecture of fruits per plant is based on the balance or overall net effect which produced by various characteristics components interacting with one another characteristics of *Physalis* genotypes. Based on the studies on genetic variability, it may be concluded that, the characters such as fruits per plant (33.30), fruit diameter (30.98), fruit weight (28.34), flowers per branch (25.62), inter nodal length (24.67), fruit set per branch (23.55) and period of 50% of flowering (23.43) recorded high amount of genetic variability along with heritability and genetic advance. However, the difference between GCV and PCV was low in most of the character studied. It reveals that there is a greater scope for improving these characters by simple phenotypic selection. For breeding point of view, heterosis is the best way to improve this trait for future.

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