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GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE FOR YIELD AND YIELD ATTRIBUTE TRAITS IN IVY GOURD [*COCCINIA GRANDIS* (L.) VOIGT]

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ABSTRACT

The present study was undertaken with thirty six genotypes of ivy gourd for genetic variability, heritability, genetic advance and genetic gain as percent of mean for thirteen characters during the 2014-15. Widest range of variation was observed in number of fruits per plant followed by vine length, fruit yield per plant, fruit volume and average fruit weight. Maximum genotypic and phenotypic coefficient of variation (GCV and PCV) was observed for fruit yield per plant followed by number of fruit per plant, petiole length and vine length. High magnitude of heritability was observed for fruit yield per plant (94.8 %) followed by TSS (89.0 %) and number of fruits per plant (88.6 %). The maximum genetic gain as percent of mean was observed for fruit yield per plant (88.47 %) followed by number of fruits per plant (79.33 %). On the basis of this investigation selection criteria are number of fruits per plant, fruit yield per plant, vine length and TSS of the fruit, bring out the improvement in ivy gourd because they appearance with high value of GCV, PCV, heritability and genetic advance.

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INTRODUCTION

Little gourd [*Coccinia grandis* (L.) Voigt] is a one of the important minor perennial cucurbitaceous vegetable crop, also known as kundru in hindi, it is indigenous to India (Nath, 1966), is the underexploited perennial vegetable crops. It is an aggressive climbing vine that spread quickly over trees, shrubs, fences or other supports. It is grown throughout the year except winter because in winter its goes to dormancy and after winter its start the sprout from their tuberous root and produced fruits. Its immature fruits, which taste like cucumber and used as salad or various dish preparation. In South-east Asia, ivy gourd is cultivated for its slender edible young shoots and fruits (PIER, 2003). Young leaves are cooked and used for making soup (Bharathi *et al.*, 2008). Ripe scarlet fruit are eaten and sometime preserved. In Ethiopia species *Coccinia abysinica* is cultivated for its edible tuberous roots (Wondimu *et al.*, 2014).

Ivy gourd is an underutilized vegetable crop and widest variability is present which can be used for improvement for different characters. Planning of breeding programme for subsequent improvement in different qualitative and quantitative traits depends, to the great extent upon the genetic magnitude of genetic variability. Selection may not be effective in population without variation in a population.Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) gives an idea about the magnitude of variability present in a population whereas, the heritability provide the information regarding the amount of transmissible genetic variation to total variation and determine genetic improvement and response to selection.

Estimation of direct selection programme like coefficient of variation, heritability, genetic advance are useful tool for selection strategies for higher yield in ivy gourd. Estimate of direct selection parameter coefficient of variation, heritability and genetic advance are effective tools for improved the yield (Jat *et al.*, 2014). Ivy gourd variability has been studied by many authors Sarnaik *et al.* (2002) and Bharathi *et al.* (2008). The objective of the present investigation was to evaluated genetic variability for heritable and non-heritable character in ivy gourd genotypes based on different quantitative and qualitative traits.

MATERIALS AND METHODS

Location of experiment

The genotype were planted in summer-*kharif* season in randomized block design (RBD), during the year 2014-15 at Horticultural Farm, Department of Horticulture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). Each entry was planted in a distance of 3 m both row to row and plant to plant with three replication, three plants were selected from each replication.

Plant material and source

The genotype in investigation comprised 36 genotypes of ivy gourd available in Department of Horticulture, IGKV Raipur.

Observations

Observations on three plant basis from each replication were recorded for vine length (cm), internodal length (cm), petiole length (cm), leaf length (cm), leaf width (cm) fruit length (cm), fruit diameter (cm), average fruit weight (g), number of fruits per plant, fruit yield per plant (kg), TSS (°Brix), fruit volume (cc), specific gravity (cc).

Statistical analysis

Genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), Heritability (broad sense), genetic advance (GA) and Genetic advance as percentage of mean were calculated as per standard formula.

Variability

Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) in percentage were calculated according to Burton and De Vane (1953).

$$\sigma^2 g = \frac{Mg - Me}{r}$$

Where,

$\sigma^2 g$ = Genotypic Variance

Mg = Treatment Mean Square

Me = Error Mean Square ($\sigma^2 e$)

Phenotypic coefficient of variation (PCV)

The phenotypic variation existingin traits was estimated by the formula given by Burton and De Vane (1953).

$\sigma^2 p = \sigma^2 g + \sigma^2 e$

$$PCV = \frac{\sigma p}{\bar{X}} \times 100$$

$$\{\sigma p = \sqrt{\sigma^2 p}\}$$

Where,

$\sigma^2 p$ and σp = phenotypic variance and its standard deviation,

$\sigma^2 g$ and σg = Genotypic variance and its standard deviation,

$\sigma^2 e$ = Environmental variance

$\bar{X}$ = General Mean

Genotypic coefficient of variation (GCV)

The phenotypic variation existingin a traits was estimated by the formula given by Burton and De Vane (1953).

$$GCV = \frac{\sigma g}{\bar{X}} \times 100$$

$$\{\sigma p = \sqrt{\sigma^2 g}\}$$

The estimates of PCV and GCV were classified as low (< 10 %), moderate (10-20 %) and high (> 20 %) according to Sivasubramanian and Madhavamenon (1973).

Heritability

Heritability in broad sense ($h^2 b$) was estimated by using the formula given by Hansen *et al.* (1956).

$$h^2 b = \frac{\sigma^2 g}{\sigma^2 p} \times 100$$

The broad sense heritability estimates were classified as low (>50%), moderate (50-70%) and high (<70%) as suggested by Robinson (1966).

Genetic advance

Expected genetic advance (GA) was calculated as per the method suggested by Johnson *et al.* (1955).

$$GA = K.\sigma p h^2$$

Where,

K = Constant (Standard selection differential) having value of 2.06 at 5% selection intensity.

σp = Phenotypic standard

h^2 = Heritability estimates

Genetic advance as percentage of mean

Genetic advance as percentage of mean was calculated by the following formula.

$$\text{Genetic advance as percentage of man} = \frac{\text{Genetic advance}}{\bar{X}} X\ 100$$

Where,

GA = Genetic advance

$\bar{X}$ = Mean of character

The magnitude of genetic advance as percent of mean was categorized as high (<20%), moderate (20% - 10%) and low (>10%).

RESULTS AND DISCUSSION

The investigation for present of variability in thirty six genotypes of ivy gourd was measured in term of range, phenotypic coefficient of variation (PCV), genotypic coefficient of variance (GCV), heritability (broad sense) and genetic advance (Table 2). The analysis of variance for all the thirteen characters under study is presented in (Table 1). Analysis of variance worked out for fruit yield and its component characters indicated that mean sum of squares due to genotypes were highly significant for all characters. Wide range of variation observed for all the characters. The wide range was recorded for number of fruits per plant (209.07-1256.3) followed by vine length (cm) (197.31 - 435.59), fruit yield per plant (3.18-22.3 kg), fruit volume (cc) (12.00-21.66), average fruit weight (g) (11.46-20.67) indicating that presence of sufficient variability among the genotypes these are used for selecting desirable characters. But specific gravity of fruit (cc) (0.90-1.02), fruit diameter (cm) (1.8 - 2.82), total soluble solids (°Brix) (1.47-3.40) was recorded minimum variation and less scope for selection of this character from the present collection. Similar result has been found by Dora *et al.* (2002), Malek *et al.* (2007), Khan *at al.* (2009), Ara *et al.* (2012) in pointed gourd, Nag *et al.* (2012) in ivy gourd, Bharathi *et al.* (2006), Basumatary *et al.* (2014) in spine gourd, Ahmad *et al.* (2000), Sharma *et al.* (2013) in bottle gourd and Jat *et al.* (2014) in valankakri.

Phenotypic coefficient of variance (PCV) was higher than the genotypic coefficient of variance (GCV) for all the traits that indicating environmental factor was influencing their expression. Maximum range was recorded for number of fruits

Table 1: Analysis of variance for fruit yield and its component characters in ivy gourd.

Source of variance	Mean sum of squares												
	DF	VL	IL	PL	LL	LW	FL	FD	AFW	NF	TSS	FV	SG	YPP
Replication	2	1356.78	0.22	0.51	0.65	0.96	0.002	0.04	2.03	10137.5	0.04	1.62	0.002	1.20
Treatment	35	10951.04**	4.37**	1.55	2.89**	3.28**	1.21**	0.16**	20.20**	312597.3**	0.72**	19.92**	0.002*	83.46**
Error	70	3212.03	1.19	0.24	0.55	0.47	0.01	0.01	104	12895.3	0.03	1.41	0.001	1.50

**1%level of significance, *5% level of significance; DF = Degree of freedom, VL = Vine length (cm), IL = Internodal length (cm), PL = Petiole length, LL = Leaf length (cm), LW = Leaf width, FL = Fruit length (cm),FD = Fruit diameter (cm), AFW = Average fruit weight (g), NF = Number of fruits per plant, TSS = Total soluble solid (^{0}Brix), FV = Fruit volume (cc), SG = Specific gravity (cc), YPP = Yield per plant (kg)

Table 2: variability, heritability, genetic advance and genetic gain of different characters in ivy gourd

Sr. No	Characters	Mean	Range		Coefficient of Variation		Heritability (%)	Genetic advance	GA as % of Mean
			Minimum	Maximum	GCV (%)	PCV (%)			
01	Vine length (cm)	301.91	197.31	435.59	16.82	25.21	44.5	69.83	23.129
02	Internodal length (cm)	8.359	5.86	11.00	12.19	18.05	45.6	1.42	16.987
03	Petiole length (cm)	2.977	1.62	4.86	22.13	27.75	63.6	1.08	36.278
04	Leaf length (cm)	9.027	6.67	11.04	9.80	12.79	58.7	1.40	15.509
05	Leaf width (cm)	8.592	6. 26	11.38	11.22	13.87	65.5	1.61	18.738
06	Fruit length (cm)	4.922	3.34	6.41	12.45	13.55	84.5	1.16	23.567
07	Fruit diameter (cm)	2.261	1.88	2.82	9.79	11.55	71.9	0.39	17.249
08	Average fruit weight (g)	15.395	11.46	20.67	16.26	17.99	81.7	4.66	30.269
09	No. of fruits per plant	772.394	209.07	1256.3	40.92	43.48	88.6	612.76	79.332
10	TSS (^{0}Brix)	2. 568	1.47	3.40	18.97	20.11	89.0	0.95	36.993
11	Fruit volume (cc)	16.074	12.00	21.66	15.46	17.13	81.4	4.62	28.742
12	Specific gravity (cc)	0.952	0.907	1.02	1.89	4.09	24.3	0.02	2.100
13	Fruit yield per plant (kg)	11.856	3.183	22.3	44.09	45.29	94.8	10.49	88.478

per plant (209.07-1256.3), vine length (197.31-435.59), fruit yield per plant (3.18-22.3) showed maximum variability present in these traits which showed great scope for selection of the present collection however narrow range was observed in specific gravity, fruit diameter (Table 2) which showed little scope for selection of the present collection. High value of PCV and GCV were exhibited (Table 2) for fruit yield per plant (44.09 % and 45.29 %), number of fruits per plant (40.92 % and 43.48 %), petiole length (22.13 and 27.75 %) and vine length (16.82 % and 25.21 %) respectively. Thereby, high value of GCV and PCV further revealed that wide range of variability was found in these characters, suggesting exhibited good scope for improvement by selection of these characters in this crop. Similar result has been also found by Sarnaik *et al.* (2002), Bharathi *et al.* (2008) in ivy gourd, Srivastava *et al.* (2005), Malek *et al.* (2007) in pointed gourd and Bharathi *et al.* (2006), Basumatary *et al.* (2014) in spine gourd.

The estimation of genetic coefficient of variation indicates the amount of genetic variation present for different traits while the heritability gives an insight into the proportion of variation which is inherent. Heritability estimate provide the information regarding the amount of transmissible genetic variation to total variation and determine genetic improvement and response to selection.Heritability estimate along genetic advance are normally more useful in predicting the gain under selection than that of heritability alone. However, it is not necessary that a characters showing high heritability will also exhibit high genetic advance (Johnson *et al.*, 1955).

In the present study, all the traits expressed high heritability which range from the 24.3 % (specific gravity) to 94.8 % (fruit yield per plant) (Table 2). High magnitude of heritability was recorded for most of the characters. The highest heritability were recorded for fruit yield per plant (94.8 %) followed by TSS (89.0 %), number of fruits per plant (88.6 %), fruit length (54.5 %), average fruit weight (81.7 %), fruit volume (81.4 %) and fruit diameter (71.9 %) suggesting the important role of genetic constitution in the expression of the traits. The above heritability estimation, it is clear that these traits are less influence by the environment and controlled by the additive gene action The moderate heritability was observed for leaf width (65.5 %), petiole length (63.6 %) and leaf length (58.7 %), and low heritability was observed for internodal length (45.5 %), vine length (44.5 %) and specific gravity (24.3 %), high heritability characters are suggesting the important role of genetic constitution in the expression of the characters and these traits are considered to be dependent from breeding point of view. All the estimated heritable characters are less influence by environmental factors and control by additive gene. Similar results were also reported by Srivastava *et al.* (2005) and Malek *et al.* (2007) in pointed gourd found high heritability character is yield, number of fruits per plant reported by many other researcher Jat *et al.* (2014) in valankakri, Sharma *et al.* (2013) in bottle gourd, Choudhary *et al.*(2011) found high heritability for all characters, Singh *et al.* (2014) in bitter gourd.

Out of thirteen characters studied, in the present study high genetic over mean coupled with number of fruits per plant, yield per plant. However, the estimates were moderate for fruit length, average fruit weight, fruit volume. Therefore, the present finding variability found due to additive gene Panse (1957). Therefore, they are more reliable for effective selection. Heritability estimates were accompanied by lower genetic advance over the mean for specific gravity of fruit, total soluble solid. This suggests that selection is not successful for these

characters because of narrow range of genetic variation among the genotypes in respect to those characters. The maximum genetic gain in per cent was recorded for fruit yield per plant and number of fruits per plant.

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