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Genetic Variability Analysis in Local Germplasm of Ivy Gourd (*Coccinia grandis* L.) in Southern Rajasthan Conditions

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Authors' contributions

This work was carried out in collaboration among all authors. Author JKT designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SP and RAK managed the analyses of the study. Authors SSL, MKM, KSR managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

An experiment was carried out on study of genetic variability in 30 genotypes of ivy gourd at Horticulture Department of Rajasthan College of Agriculture, MPUAT, Udaipur during July to September 2017. Twelve Growth and quality characters were studied. The analysis of variance indicated that the mean sum of square due to genotypes were highly significant for all the

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characters suggesting the presence of good deal of variability in material studied. High magnitude of genotypic as well as phenotypic coefficient of variations were recorded for traits *viz.*, petiole length (27.63% and 29.93%), inter nodal length (22.73% and 23.40%), leaf width (22.63% and 23.35%) and leaf width (22.52% and 23.56%) and highest heritability recorded for inter nodal length (94.30%) followed by leaf length (93.92%), leaf width (91.37%), ascorbic acid (89.48 %), petiole length (85.17%), fruit weight (82.10%), fruit length (79.98%) and chlorophyll content in leaves (78.23%).The highest genetic gain was recorded for petiole length (52.52%) followed by viz., inter nodal length (45.47%), leaf length (45.17%), leaf width (44.34%), fruit weight (34.21%), fruit length (28.24%) fruit diameter (23.31%) & genetic advance were also higher for some characters. Availability of high GCV & PCV shows presence of sufficient genetic variability for evaluated traits. This indicates that there is an ample scope of selection in the present gene pool for yield and its components.

Keywords: Genetic variability; Coccinia grandis; heritability; germplasm; GCV; PCV; genetic gain etc.

1. INTRODUCTION

Vegetables are an important part of balance diet for human being. These are natural protective food and rich in vitamins and minerals. In India vegetables are cultivated in 10.29 million hectares and production of vegetables in India is 175 million tonnes [1]. India has varied agro climate zones making the country more suitable for production of various vegetable crops. The production of vegetables in India has been second highest in the world [1]. However, there is a great scope of increasing the production and consumption of vegetable, to ensure balanced diet for the masses [2,3]. Ivy gourd (*Coccinia grandis*) is a dioecious perennial crop of cucurbitacae family and having chromosome no. 2n=24. Ivy gourd is important due to its nutritive value. It contains 94% water, 1.6 g dietary fibre, 1-2 g protein, 0.4 g fat, 3.1 g CHO,156 µg carotene, 14 mg iron, 260 IU vitamin-A, 28 mg Ascorbic acid and 18 kcal energy per 100 g fruits. Consumption of immature fruits is effective for diabetic patients. It is rich in vitamin C, which is beneficial for bones. It also provides vitamin B_1 and B_2. These vitamins are good for immune system [4]. Tendrils of ivy gourd are also rich in mineral like potassium, calcium and iron, which is beneficial to function of body properly. Various parts of *Coccinia grandis* have specific medicinal values leaf extract active against *Shigella flexneri, Bacillus subtilis, Escherichia coli, Salmonella choleraesuis* [5]. This crop is propagated vegetatively by root cutting, which provides unique advantage in improving the crop through clonal selection. In southern Rajasthan condition in this crop clonal variation is available. However, very little work has been done. It is a cross pollinated, high genetic variation is available in this crop. Hence, the present investigation was carried out to elicit information on the nature and magnitude of variability existing in the genotypes collected from the Udaipur district so that locally available germplasm can be evaluated to develop new improved cultivars for the farmers.

2. MATERIALS AND METHODS

The experimental material comprising 30 genotypes of ivy gourd were collected from different forest location around the Udaipur district of Rajasthan and the quality parameters were studied at the Department of Horticulture, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur during July to September month of 2017.For in-situ study, fruits, leaves were collected from each selected plant from 30 different forest locations of Udaipur district of Rajasthan (Table 1). Three samples were collected randomly during rainy season from each location having high density of ivy gourd plants. The observations were recorded on different growth and quality characters viz., inter nodal length, petiole length, leaf length, leaf width, fruit length, fruit diameter, fruit weight, fruit volume, moisture content, ascorbic acid, protein content and total chlorophyll content in leaves. Three randomly selected plants for each genotype were considered for observations of different characters. The data were statistically analyzed to calculate various genetic parameters *viz.*, genotypic and phenotypic coefficients of variation (GCV and PCV), heritability in broad sense and expected genetic gain. Variability that existed in the population for various characters was estimated by the method suggested by Burton [6]. Heritability in broad sense was estimated by the formula given by Devane and Burton [7]. The genetic advance of the genotypes at 5% selection pressure was calculated using the formula suggested by Johnson [8].

Table 1. Germplasm locations

Germplasm No.	Location	Longitude (°)	Latitude (°)
G-1	MANVA KA KHEDA	73.74	24.55
G-2	KALDWAS	73.75	24.56
G-3	KALDWAS, POST OFFICE	73.76	24.56
G-4	DANGIYO KI PANCHAULI	73.78	24.59
G-5	MALA THALAI	73.66	24.59
G-6	BUJRA	73.63	24.57
G-7	NAYA KHERA	73.73	24.34
G-8	SISARMA	73.65	24.55
G-9	KEMRI	73. 98	24.53
G-10	UNDARI KHURD	73.62	24.50
G-11	BALEECHA	73.81	24.34
G-12	KANPUR KA KHEDA	73.76	24.55
G-13	Kanpur	73.76	24.56
G-14	BHEELON KA BEDLA	73.72	24.67
G-15	KARELON KA GURHA	73.76	24.69
G-16	BHOEYON KI PANCHOLI	73.79	24.56
G-17	CHEERWA	73.67	24.58
G-18	BAMORA	74.04	24.38
G-19	BATHEDA	73.97	24.57
G-20	KHERODA	73.99	24.58
G-21	BAMANIYA	74.12	24.56
G-22	KUNTHWAS	74.12	24.52
G-23	MEETHA NEEM	73.90	24.56
G-24	PHALET	73.91	24.50
G-25	UMARDA	73.77	24.51
G-26	BERWAS	73.75	24.58
G-27	KHARSAN	74.03	24.59
G-28	BHATEWAR	74.00	24.61
G-29	UDAISAGAR LAKE	73.80	24.56
G-30	DODAWALI	73.55	24.56

3. RESULTS AND DISCUSSION

The analysis of variance for characters under study is presented in Table 2. Analysis of variance indicated that mean squares due to genotypes were highly significant for all characters except fruit volume. Significant mean revealed existence of considerable variability in material studied for improvement of various traits. Average observation of three plants taken randomly from each genotype was averaged for mean performance.

Table 2. Analysis of variance for all the characters

SN	Characters	Genotype	Error
		[29]	[60]
1	Inter nodal length (mm)	1321.00**	25.21
2	Petiole length (mm)	288.13**	15.28
3	Leaf length (cm)	10.40**	0.21
4	Leaf width (cm)	9.89**	0.29
5	Fruit length (cm)	2.6860**	0.2
6	Fruit diameter (cm)	0.35**	0.06
7	Fruit weight (g)	33.09**	2.17
8	Fruit volume (cc)	0.0013	0.001
9	Moisture (%)	1.55**	0.64
10	Ascorbic acid (mg/g)	0.02**	0.001
11	Total chlorophyll content (mg/g)	0.01**	0.001
12	Protein content (mg/100 g edible portion)	5901.1**	2235.00

Table 3. Mean values for growth parameters

SN	Geno-type	Inter nodal length (mm)	Petiole length (mm)	Leaf length (cm)	Leaf width (cm)	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Fruit volume (cc)
1	G1	90.00	23.33	6.50	7.73	5.50	2.40	21.20	1119.7
2	G2	72.33	25.00	10.43	9.50	4.53	2.70	17.80	15.6
3	G3	109.67	46.67	10.10	9.37	6.33	2.03	18.30	16.3
4	G4	147.33	70.33	12.27	10.27	4.53	2.00	17.10	14.7
5	G5	88.67	29.67	9.10	11.57	6.70	2.10	21.40	19.4
6	G6	72.33	23.33	5.17	7.50	5.67	1.97	22.30	20.5
7	G7	61.00	28.67	6.13	6.87	6.47	1.83	16.80	14.8
8	G8	94.33	31.33	8.93	10.70	4.73	1.57	12.83	11.2
9	G9	98.67	36.33	9.23	10.13	5.63	1.53	18.10	16.6
10	G10	52.33	30.00	5.63	7.50	4.50	1.97	19.70	17.6
11	G11	91.67	28.67	6.67	8.53	5.83	2.37	18.10	16.7
12	G12	94.00	32.67	7.87	9.97	4.87	2.43	15.50	13.6
13	G13	93.00	54.33	8.83	9.80	5.60	2.10	15.73	13.7
14	G14	55.67	35.33	5.53	7.00	5.57	2.17	13.75	11.8
15	G15	60.00	38.00	5.10	6.83	6.23	2.17	25.70	22.7
16	G16	100.33	35.00	12.20	11.30	7.37	2.67	20.60	19.6
17	G17	120.00	28.67	7.57	8.90	6.27	2.53	11.50	10.1
18	G18	66.33	25.67	6.37	5.50	5.50	2.37	12.30	10.7
19	G19	74.67	44.33	7.30	4.97	5.60	1.87	14.37	12.8
20	G20	99.00	35.67	6.90	7.27	6.43	1.60	16.20	10.7
21	G21	102.00	28.67	8.57	6.50	5.30	1.50	18.30	16.6
22	G22	94.00	26.00	8.90	6.80	5.57	1.93	21.30	19.3
23	G23	91.67	25.00	6.87	5.57	6.43	2.20	17.90	15.0
24	G24	87.67	34.00	8.83	7.13	6.47	1.87	13.30	11.9
25	G25	99.00	32.33	8.50	6.77	6.50	1.97	14.80	12.5
26	G26	105.33	35.33	9.63	8.27	6.53	2.03	16.07	14.0
27	G27	89.00	33.33	8.67	7.40	6.47	1.50	15.30	13.6
28	G28	94.33	38.00	9.93	6.47	4.63	1.67	21.40	19.5
29	G29	118.67	40.67	8.00	5.87	8.10	2.27	17.60	14.6
30	G30	119.33	38.33	8.53	6.17	8.07	2.40	19.57	17.6
	GM	91.41	34.49	8.14	7.94	5.93	2.06	17.49	15.4
	SEm	2.90	2.26	0.27	0.31	0.26	0.15	0.85	0.02
	CD 0.05	8.20	6.38	0.75	0.88	0.73	0.41	2.40	0.05
	CD 0.01	10.91	8.49	1.00	1.17	0.97	0.55	3.20	0.07
	CV	5.49	11.33	5.66	6.80	7.54	12.32	8.42	2.89

Tak et al. [4]

According to Tables 3& 4 maximum performance of all the parameters recorded viz., Internodal length in G-4 (147.33 mm), petiole length in G-4 (70.33 mm), leaf length in G-4 (12.27 cm), leaf width in G-5 (11.57 cm), fruit length in G-29 (8.10 cm), fruit diameter in G-2 (2.70 cm),fruit weight in G-15 (25.70 g), fruit volume (cc) in G-15 (22.7), moisture content in G-13 (94.90%), ascorbic acid in G-10 & G-26 (0.145 mg/g), chlorophyll content in leaves in G-15 (1.06 mg/g) and protein in G-13 (1241.33 mg/100 g). Data of table no. 3&4 has been taken from own publication to strengthen the content for benefits of reader and better presentation of results [4].

Table 4. Mean value for quality parameters

SN	Genotype	Moisture (%)	Ascorbic acid (mg/g)	Total chlorophyll content in leaves (mg/g)	Protein (mg/100 g) edible portion)
1	G-1	92.13	0.125	0.94	1185.67
2	G-2	94.17	0.136	0.92	1109.00
3	G-3	93.30	0.144	0.87	1117.33
4	G-4	93.77	0.134	0.77	1116.00
5	G-5	92.40	0.142	0.93	1095.33
6	G-6	93.80	0.129	0.92	1210.33
7	G-7	93.27	0.139	0.86	1226.00
8	G-8	93.87	0.123	0.77	1110.00
9	G-9	92.00	0.135	0.93	1207.00
10	G-10	93.80	0.145	0.94	1098.00
11	G-11	92.30	0.138	0.77	1109.67
12	G-12	93.03	0.130	0.81	1236.00
13	G-13	94.90	0.123	0.90	1241.33
14	G-14	92.73	0.143	0.84	1167.33
15	G-15	94.17	0.144	1.06	1204.33
16	G-16	93.43	0.139	0.76	1196.67
17	G-17	92.67	0.127	0.93	1157.00
18	G-18	93.87	0.126	0.92	1139.00
19	G-19	93.00	0.122	0.88	1128.00
20	G-20	93.97	0.144	0.81	1190.33
21	G-21	93.07	0.136	0.92	1192.33
22	G-22	92.80	0.129	0.92	1125.00
23	G-23	92.50	0.129	0.82	1126.00
24	G-24	93.33	0.125	0.79	1151.67
25	G-25	92.57	0.143	0.92	1100.33
26	G-26	92.90	0.145	0.86	1162.67
27	G-27	93.17	0.140	0.89	1145.67
28	G-28	93.03	0.131	0.80	1109.33
29	G-29	92.03	0.135	0.90	1142.33
30	G-30	92.43	0.129	0.94	1139.00
	GM	93.15	0.134	0.88	1154.62
	SEm	0.46	0.01	0.02	27.29
	CD at 0.05	1.30	0.04	0.06	77.21
	CD at 0.01	1.73	0.05	0.08	102.71
	CV	0.86	1.85	3.99	4.09

Tak et al. [4]

High magnitude of genotypic as well as phenotypic coefficient of variations were recorded for traits viz., petiole length (27.63% and 29.93%), inter nodal length (22.73% and 23.40%), leaf width (22.63% and 23.35%) and leaf width (22.52% and 23.56%), moderate GCV and PCV were recorded for average weight per fruit (18.33% and 20.23%), fruit length (15.33% and 17.14%) and fruit diameter (14.82% and 19.41%). Remaining characters like total chlorophyll content (7.69% and 8.70%), ascorbic acid content (5.50% and 5.81%), protein content (3.00% and 5.13%), fruit volume (0.89% and 3.07%) and moisture content (0.59% and 1.05%) were recorded low genotypic and phenotypic coefficient of variation (Table 5). The findings of these characters are supported by petiole length [9] in ivy gourd, inter nodal length [10], leaf width

Table No. 5 Variability parameters

SN	Characters	GCV (%)	PCV (%)	ECV (%)	h^2 (%)	GA (%)	GG (%)
1	Inter nodal length (mm)	22.73	23.40	5.59	94.30	41.56	45.47
2	Petiole length (mm)	27.63	29.93	11.53	85.17	18.11	52.52
3	Leaf length (cm)	22.63	23.35	5.76	93.92	3.68	45.17
4	Leaf width (cm)	22.52	23.56	6.92	91.37	3.52	44.34
5	Fruit length (cm)	15.33	17.14	7.67	79.98	1.67	28.24
6	Fruit diameter (cm)	14.82	19.41	12.53	58.30	0.48	23.31
7	Weight per fruit (g)	18.33	20.23	8.56	82.10	5.98	34.21
8	Fruit volume (cc)	0.89	3.07	2.94	8.36	0.01	0.53
9	Moisture (%)	0.59	1.05	0.87	31.13	0.63	0.67
10	Ascorbic acid (mg/g)	5.50	5.81	1.89	89.48	0.14	10.72
11	Total chlorophyll content of leaves (mg/g)	7.69	8.70	4.06	78.23	0.12	14.02
12	Protien (mg/100 g edible portion)	3.00	5.13	4.16	34.10	41.61	3.60

GCV= Genotypic Coefficients of Variation, PCV= Phenotypic Coefficients of Variation, ECV= Environmental Coefficients of Variation, h^2= Heritability, GA= Genetic Advance &GG= Genetic Gain

and leaf width [11] in pointed gourd, Moderate GCV and PCV were recorded for average fruit weight [10] in spine gourd, fruit length and fruit diameter [12] in sponge gourd. In the present investigation, the phenotypic variance was higher than genotypic variance and both were greater than environmental variance for all the characters. This implied that phenotypic variance may be considered as a reliable measure for genotypic variability. The phenotypic and genotypic variances were greater than environmental variance for all the characters understudy, which directed that influences of environment on expression of traits was lower or negligible, which indicated wide diversity for these characters and the selection for these traits would be effective as well as high scope for improvement and true selection could be effective. However, narrow differences observed between the PCV and GCV in certain cases indicated that these characters were less influenced by the environment.

High magnitude of heritability was recorded for most of the characters. The highest heritability recorded for inter nodal length (94.30%) followed by leaf length (93.92%), leaf width (91.37%), ascorbic acid (89.48%), petiole length (85.17%), fruit weight (82.10%), fruit length (79.98%) and chlorophyll content in leaves (78.23%). Moderate heritability was recorded for fruit diameter (58.30%). Remaining characters like total protein (34.10%), moisture (31.13%) and fruit volume (8.36%) were recorded low heritability (Table 5).

Heritability is an important genotypic parameter, which serves as an index of transmissibility of the characters in the next generation. High magnitude of heritability was recorded for most of the characters. The highest heritability were recorded for inter nodal length, followed by viz., leaf length, leaf width, ascorbic acid content, petiole length, fruit weight and fruit length and finding of these characters are supported by [13] in snake gourd. The knowledge of heritability along with genetic advance estimates provides a better picture of genetic improvement through selection. Heritability is due to additive gene action and thus the chances of fixing by selection will be more to improve such traits through pure line selection in the evaluated genotypes. The highest genetic advance was recorded for protein content (41.61%) followed by inter nodal length (41.56%), petiole length (18.11%), fruit weight (5.98%), leaf length (3.68%), leaf width (3.52%) and fruit length (1.67%) and remaining characters recorded <1 genetic advance (Table 3). The highest genetic gain was recorded for petiole length (52.52%) followed by viz., inter nodal length (45.47%), leaf length (45.17%), leaf width (44.34%), fruit weight (34.21%), fruit length (28.24%) fruit diameter (23.31%), chlorophyll content (14.02%) ascorbic acid content (10.72%), protein content (41.61%), moisture content (0.67%) and fruit volume (0.53%) (Table No. 5). Highest genetic gain among the genotype may be effective for improvement in ivy gourd. The finding of these characters are supported by [14,15,16] in pointed gourd and [9] in ivy gourd.

4. CONCLUSION

Availability of high GCV & PCV indicates that there is an ample scope of selection in the present gene pool for yield and its components. Crop improvement depends on the magnitude of genetic variability and the extent to which the desirable characters are heritable. High heritability is not enough to make efficient selection in segregating generation unless the information is accompanied with substantial amount of genetic advance. Heritability and genetic advance, when calculated together, would prove more useful in predicting the resultant effect of selection on phenotypic expression, without genetic advance the estimation of heritability will not be of practical value and emphasized the concurrent use of genetic advance along with heritability. Therefore, priority should be given to those traits which showed higher estimates of genetic advance as percent mean while deciding selection strategies and selection based on these characters may be useful in realizing better gain by selection.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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