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

Jitendra Kumar Tak¹*, Shalini Pilania¹, Ram Avtar Kaushik¹, S. S. Lakhawat¹, Mithlesh Kumari Meena², Kuldeep Singh Rajawat¹, Gajanand Jat³ and Devendra Jain⁴

¹Department of Horticulture, Rajasthan College of Agriculture, MPUAT, Udaipur (Rajasthan)-313001, India.
²Division of Horticulture, Rajasthan Agricultural Research Institute, Durgapur, Jaipur (Rajasthan)-302018, India.
³Department of Agricultural Chemistry and Soil Science, Rajasthan College of Agriculture, MPUAT, Udaipur (Rajasthan), India.
⁴Department of Molecular Biology and Biotechnology, Rajasthan College of Agriculture, MPUAT, Udaipur (Rajasthan)-313001, India.

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 characters studied.
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 vegetables, to ensure balanced diet for the masses [2,3].

Ivy gourd (Coccinia grandis) is a dioecious perennial crop of cucurbitaceae 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 human being. These are natural protective and curative for yield and its components.

### 2. MATERIALS AND METHODS

The experimental material comprising 30 genotypes of ivy gourd were collected from different forest locations around the Udaipur district of Rajasthan and the quality parameters were analyzed by the method suggested by Devane [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.
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          | BUIRA                 | 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         | BALEEECHA             | 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 |
|-----|------------------------------------|----------|-------|
|     | Inter nodal length (mm)            | 1321.00**| 25.21 |
| 1   | Petiole length (mm)                | 288.13** | 15.28 |
| 2   | Leaf length (cm)                   | 10.40**  | 0.21  |
| 3   | Leaf width (cm)                    | 9.89**   | 0.29  |
| 4   | Fruit length (cm)                  | 2.6860** | 0.2   |
| 5   | Fruit diameter (cm)                | 0.35**   | 0.06  |
| 6   | Fruit weight (g)                   | 33.09**  | 2.17  |
| 7   | Moisture (%)                       | 0.0013   | 0.001 |
| 8   | Ascorbic acid (mg/g)               | 0.02**   | 0.001 |
| 9   | Total chlorophyll content (mg/g)   | 0.01**   | 0.001 |
| 10  | Protein content (mg/100 g edible portion) | 5901.1** | 2235.00 |
Table 3. Mean values for growth parameters

| SN | Genotype | 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  | 8.20 | 6.38                   | 0.75             | 0.88            | 0.73             | 0.41               | 2.40            | 0.05             |
| 0.05|         |                     |                  |                 |                 |                    |                 |                  |
| CD  | 10.91  | 8.49                   | 1.00             | 1.17            | 0.97             | 0.55               | 3.20            | 0.07             |
| 0.01|         |                     |                  |                 |                 |                    |                 |                  |
| CV  | 5.49    | 11.33                   | 5.66             | 6.80            | 7.54             | 12.32              | 8.42             | 2.89             |

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                            |

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 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...
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 studied, 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 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.

Table No. 5 Variability parameters

| SN | Characters                                | GCV (%) | PCV (%) | ECV (%) | h² (%) | 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 | Protein (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, h²= Heritability, GA= Genetic Advance & GG= Genetic Gain.
4. CONCLUSION

Availability of high GCV & PCV indicates that there is 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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