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Phenotypic variability and heritability of veldt grape (*Cissus quadrangularis* Linn.) ecotypes

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Abstract

Veldt grape or adamant creeper is one of the nutritionally rich plant, the potential of which as a vegetable crop is still under explored. The lack of genetic information regarding the variability parameters of this crop is a limitation for the breeding programme. Hence the present study was conducted in ten veldt grape ecotypes collected from different geographical regions and were raised in randomized block design with three replications. Nine key biometrical traits were recorded and were statistically analyzed. The analysis revealed that phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the traits. High heritability coupled with high genetic advance as percent of mean was observed for the characters *viz.*, Vine length, number of primary branches, internodes, leaves, leaf length, width, stem weight and single plant yield. The results obtained from the genetic analysis of veldt grape in the present study can be utilized for yield improvement in the crop and mapping out suitable selection procedure for further breeding programmes.

Keywords: *Cissus quadrangularis*, GCV, PCV, genetic variability, heritability, genetic advance

Introduction

Vegetables add an immense amount of nutrition to our daily diet. Although several vegetables are consumed for the nutrients they provide, still there are many indigenous vegetables which are underutilized. *Cissus quadrangularis* is one such plant, the potential of which to be used as a vegetable still remains unexplored. *Cissus quadrangularis* is a succulent vine that is distributed throughout India particularly in the tropics. It belongs to the family Vitaceae. Regarding the morphology, it is a vine with simple tendrils that arises opposite to the leaves. The leaves are glabrous, simple, lobed, cordate, serrate or trifoliate. The flowers are arranged in umbellate cyme and the fruit is a single seeded berry, black to purple in colour. The plant looks like the joints in the body (Raj *et al.*, 2011) [8]. The plant is propagated using stem cuttings. Being a potential source of dietary calcium, the plant is also known by the name bone setter as it is used in the quick healing of bone fracture. It was revealed from the phytochemical analysis that the plant contains high amount of ascorbic acid, carotene, calcium and anabolic steroidal substances. Also, the presence of δ - amyron, δ -amyrin, β -sitosterol and flavonoids having different metabolic and physiological effect were reported (Jakikasem *et al.*, 2000) [4].

To improve any population, selection of superior genotypes is the most important aspect and effectiveness of selection is based on the genetic variability present in the population (Dixit *et al.*, 1971; Rao, 1972; Tikka *et al.*, 1974) [2, 9, 10]. Hence, variability is a pre – requisite for population improvement. In order to develop suitable selection strategy, one requires knowledge regarding the genetic variability among the population. Genetic variability can be assessed by computing phenotypic coefficient of variation, genotypic coefficient of variation, heritability and genetic advance. The potential of the genotypes can be exploited only when the extent of variability and heritability of the characters among the genotypes are known. Hence the present study was carried out in the Department of Vegetable Science, Horticultural college and Research Institute, TNAU, Coimbatore to understand the variability among the *Cissus quadrangularis* ecotypes for population improvement.

Methods and Material

The experiment was conducted at the Orchard, Department of Vegetable Science Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. The experimental material consists of ten *Cissus quadrangularis* ecotypes among which eight were collected from different regions in Tamil Nadu and one each from Karnataka and Kerala. These ecotypes were raised in Randomized Block Design with three replications each.

The cuttings were planted at a distance of 1.5×1.5 m and the agronomic practices were carried out timely to maintain the crop. Five plants from each replication were selected randomly to record the observations viz., vine length (cm), number of primary branches, number of internodes on the main stem, internodal length (cm), number of leaves, leaf length (cm), leaf width (cm) and stem weight (g). The mean value of five plants were taken for statistical analysis viz., mean and range (Panse and Sukhatme, 1961) [7] phenotypic and genotypic variances phenotypic (Goulden, 1952) [3] and genotypic coefficient of variance (Burton, 1952) heritability (Lush, 1940) [6] genetic advance (Johnson *et al.*, 1955) [5] and genetic advance as percent of mean. The statistical analysis was done using the assistance of SPSS.

Result and Discussion

Analysis of Variance (ANOVA) for ten ecotypes of *Cissus quadrangularis* had highly significant values for all the nine biometrical traits (Table 1). Wide variability was observed among the ecotypes with respect to various traits. The mean value of each trait along with its range is presented in Table 2.

Phenotypic values

A wide range of variation was observed for all the nine biometrical traits viz., Vine length (76.36 – 208.42), Number of internodes (10.85 - 22.83), internodal length (7.95 - 13.54), Number of leaves (12.58 - 34.06), leaf length (4.08 - 6.05), leaf width (4.15 - 8.53), Number of primary branches (3.56 – 9.89), stem weight (91.40 -301.43) and single plant yield (24.98 – 38.53). From this it can be inferred that there is significant variation among the ecotypes for the above characters. This shows that there is a greater opportunity to improve the population in *Cissus quadrangularis*.

Genetic Variability

For all the characters under study, the estimates of phenotypic coefficient of variation (PCV) were higher than the estimates of genotypic coefficient of variation (GCV). This reflects the influence of environment over the traits. High estimates of GCV were observed in the following characters i.e., Vine length (31.43), number of internodes (24.79), number of leaves (28.23), leaf width (20.21), number of primary branches (29.29) and stem weight (35.52). High PCV was observed in case of vine length (31.66), number of internodes (25.13), internodal length (21.65), number of leaves (29.16),

leaf width (21.17), number of primary branches (30.10) and stem weight (35.65). Moderate GCV was observed for the characters viz., Internodal length (16.25), leaf length (13.46) and single plant yield (16.40). The PCV was moderate for the characters viz., leaf length (16.88) and single plant yield (17.53).

Heritability and Genetic advance

For effective selection of desirable genotypes, heritability along with genetic advance should be considered. The estimates of broad sense heritability and genetic advance as percent of mean for the nine characters are mentioned in Table 2. The estimates of heritability ranged from 56.37 – 99.27. The heritability was high for the characters viz., Vine length (98.60), number of internodes (97.31), number of leaves (93.73), leaf length (63.57), leaf width (91.19), number of primary branches (94.67), stem weight (99.27) and single plant yield (87.50). Moderate heritability was observed in case of internodal length (56.37). Wei *et al.* (2002) reported high heritability for berry weight, bunch weight and bunch number.

Genetic advance as a percent of mean for different traits varied from 22.10 to 72.90. The genetic advance as percent of mean was high but differed among all the characters. High heritability coupled with high genetic advance was exhibited by the following characters viz., Vine length (98.60, 64.30), number of internodes (97.31, 50.38), number of leaves (93.73, 56.31), leaf length (63.57, 22.10), leaf width (91.19, 39.76), number of primary branches (94.67, 58.70), stem weight (99.27, 72.90) and single plant yield (87.50, 31.60). So, these characters can be selected for crop improvement.

Conclusion

The present study reflects that there exists considerable genetic variability among the ecotypes selected for the characters studied. Hence selection can be done on the basis of characters which shows high heritability with high genetic advance as percent of mean viz., Vine length, number of primary branches, number of internodes, number of leaves, leaf length, leaf width, stem weight and single plant yield. These traits can be used in the selection of potential parental lines and better breeding strategies can be mapped out for further breeding programmes

Table 1: Analysis of variance for the biometrical traits

Source of Variation	df	Vine length	Number of Internodes	Internodal length	No. of leaves	Leaf length	Leaf width	No. of primary branches	Stem weight	Single plant yield
Replication	2	15.19	0.37	3.69	0.17	0.15	0.12	0.20	19.28	3.40
Treatment	9	4159.7104**	40.1447**	10.6547**	143.5603**	1.6176**	4.9477**	11.1301**	12538.3682**	82.5499**
Error	18	19.53	0.37	2.19	3.13	0.26	0.15	0.20	30.80	3.75

*significance at 5% level, **significance at 1% level

Table 2: Coefficient of variation, heritability (broad sense), genetic advance as percent of mean for the biometrical traits observed

S. No.	Traits	Mean	Range	GCV (%)	PCV (%)	Heritability (%)	GA as percent of mean
1.	Vine length	118.18 ± 3.60	76.36 - 208.42	31.43	31.66	98.60	64.30
2.	No: of primary branches	6.52 ± 0.37	3.56 - 9.89	29.29	30.10	94.67	58.70
3.	Number of Internodes	14.69 ± 0.49	10.85 - 22.83	24.79	25.13	97.31	50.38
4.	Internodal length	10.34 ± 1.20	7.95 - 13.54	16.25	21.65	56.37	25.13
5.	Number of leaves	24.23 ± 1.44	12.58 - 34.06	28.23	29.16	93.73	56.31
6.	Leaf length	5.00 ± 0.41	4.08 - 6.05	13.46	16.88	63.57	22.10
7.	Leaf width	6.25 ± 0.32	4.15 - 8.53	20.21	21.17	91.19	39.76
8.	Stem weight	181.80 ± 4.53	91.40 - 301.43	35.52	35.65	99.27	72.90
9.	Single plant yield	31.26 ± 1.58	24.98 - 38.53	16.40	17.53	87.50	31.60

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