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**Variability, heritability and genetic advance for yield and yield contributing characters in *Embelia ribes* Burm f. – An endangered medicinal plant**

**Shruthi AM, Raviraja Shetty G and PE Rajasekharan**

**Abstract**

The experiment was conducted during 2015-2016 at Division of Plant Genetic Resources, ICAR-Indian Institute of Horticultural Research (ICAR-IIHR), Hessarghatta, Bengaluru. Genotypic variability, heritability and genetic advance for yield and yield contributing traits were studied in five *Embelia ribes* Burm f. accessions. Data were recorded for plant height (m), leaf length (cm), leaf width (cm), petiole length (cm), leaf area (cm<sup>2</sup>), number of inflorescence per plant, fruit length (cm), fruit diameter (cm), seed length (cm), seed weight, fruit yield (kg/plant). Among different yield attributing characters studied, the highest magnitude of PCV and GCV were recorded in leaf area (6.43 and 5.73 %), number of inflorescence per plant (46.35 and 45.10 %) and fruit yield per plant (48.67 and 48.24 %). High heritability coupled with high genetic advance as per cent over mean was recorded for the characters viz., leaf width (99.00 %), petiole length (91.00%), plant height (95.20 %), number of inflorescence per plant (95.00 %), fruit weight (91.02) and fruit yield per plant (98.22 %). Hence, these characters were predominantly governed by additive gene action and could be used as a selection criterion for breeding programmes in the future.

**Keywords:** *Embelia ribes*, Variability, Heritability, Genetic advance

**Introduction**

*Embelia ribes* Burmf. a medicinal woody climber belongs to the Myrsinaceae family. It is also commonly known as false black pepper or vidanga. *E. ribes* is one of the 32 medicinal plant species identified by the Medicinal Board, Govt. of India, New Delhi, as being important for large-scale cultivation because of its commercial use (Anonymous, 2008) [2]. The plant is a scandent shrub, whose fruits are used in a large number of ayurvedic formulations. This shrub is slender, branched with elliptic-lanceolate and gland-dotted leaves. The fruit is globular and wrinkled, varying in colour from dull red to nearly black; a short pedicel is often present; the pericarp is brittle enclosing a single seed covered with a membrane. Flowers are dull white in colour with violet red fruits. Mature fruits turn brown or black. Root is deeply penetrating in the soil and takes help of trees for their climbing habit.

It is an endangered medicinal plant valued for its digestive, thermogenic, carminative, depurative, anthelmintic and laxative property since time immemorial. It is also used in the treatment of tumours, asthma, bronchitis, diabetes, heart related problems, neural disorders, cancerous tumors and liver disorders (Harish *et al.*, 2012) [6]. *E. ribes* contain quinine derivative Embelin which has various pharmacological and medicinal properties. It helps to bring a medicinal plants revolution in our country good health and prosperity to people (Guhabakshi *et al.*, 2001) [5].

Propagation of the species is possible through seeds as well as vegetative means, although both methods are unreliable and difficult. The embryos are small when present and most of the seeds are abortive (Anonymous, 1990) [1]. Based on the preliminary studies conducted on seed and vegetative propagation, specific habitat conditions are required for its survival and growth. Regeneration is also very slow. All such factors, coupled with unsustainable and indiscriminate harvesting from the wild, have posed threats to this species. Thus, conventional propagation through seeds and vegetative cuttings is not sufficiently reliable or adequate to meet the demand for planting material.

Due to over demand this species is extensively wild harvested from the protected and conserved areas also. So the conservation of this important medicinal plant requires special attention. Traditional propagation techniques are not successful in the largescale production of this valuable species.

### Materials and Methods

The experiment on *Embelia ribes* Burm f. was carried out during 2015-16 at Division of Plant Genetic Resources, ICAR-Indian Institute of Horticultural Research (ICAR-IIHR), Hessarghatta, Bengaluru to find out variability, heritability and genetic advance in *Embelia ribes* Burm f. accessions. Five accessions collected from different places of Karnataka. Randomised block design (RBD) was adopted with four replications. The fertilizer applications and other cultural practices were followed as per the recommendations. Parameters studied in the experiment were plant height (m), leaf length (cm), leaf width (cm), petiole length (cm), leaf area (cm<sup>2</sup>), number of inflorescence per plant, fruit length (cm), fruit diameter(cm), seed length(cm), seed weight, fruit yield (kg/plant). Observations were recorded on an individual plant basis from three randomly selected plants per genotype in a replicate. The Phenotypic and Genotypic Coefficient of Variation was worked out as per the methods suggested by Burton and (Devane 1953) [3].

Genotypic co-efficient of variation (GCV) (%)

$$= \frac{\sqrt{\sigma^2_g}}{\bar{x}} \times 100$$

Phenotypic co-efficient of variation (PCV) (%)

$$= \frac{\sqrt{\sigma^2_p}}{\bar{x}} \times 100$$

Where,

$\bar{x}$  = General mean

R = Number of replications

$\sigma^2_g$  = Genotypic variance

$\sigma^2_p$  = Phenotypic variance

The PCV and GCV are classified as follows (Subramanian and Menon, 1973) [11].

0 - 10%: Low

10 - 20%: Moderate

Above 20%: High

Broad sense heritability was estimated as the ratio of genotypic variance to the phenotypic variance and expressed in percentage (Falconer, 1981) [4].

$$h^2 = \frac{\sigma^2_g}{\sigma^2_p} \times 100$$

Where,

$h^2$  (%) = Heritability (Broad sense)

$\sigma^2_g$  = Genotypic variance

$\sigma^2_p$  = Phenotypic variance

As suggested by (Johnson *et al.*, 1955) [8], heritability values are categorized as follows:

Low: Less than 30 %

Moderate: 30 – 60 %

High: More than 60 %

Genetic advance (GA) was computed using the formula given by (Robinson *et al.*, 1949) [10]

$$GA = i.P. h^2$$

Where,

i = Selection differential (2.06) at 5 per cent selection intensity

P = Phenotypic standard deviations

$h^2$  = Heritability at broad sense

Genetic advance as percentage over mean was worked out as suggested by Johnson *et al.*, (1955) [5].

$$\text{Genetic advance over mean (GAM)} = \frac{GA}{\bar{x}} \times 100$$

Where,

GA = Genetic advance

$\bar{x}$  = General mean

The genetic advance as per cent of mean was categorized as suggested by (Johnson *et al.*, 1955) [8] and the same is given below.

0-10%: Low

10-20%: Moderate

Above 20%: High

### Results and Discussion

The amount of genetic variation present for different desirable traits was indicated by the estimation of genetic co-efficient of variation. Genetic variability in the breeding material is important for the improvement of a plant species. Hence, in order to make selection of superior plants, it is essential to study and partition the total variability existing in a germplasm into genetic, phenotypic and environmental variability.

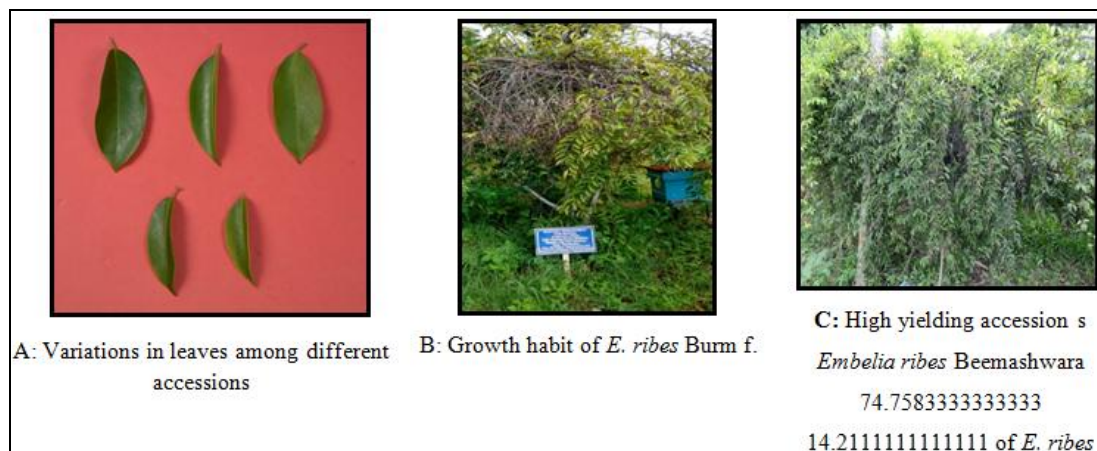
In the present investigation, high GCV and PCV were observed for plant height, petiole length, leaf width, fruit length, number of inflorescence per plant and fruit yield per plant. This indicated that genetic component in total variation is more and environmental influence is less in case of these traits. Thus, selection scheme planned based on these characters will have high selection response. Moderate GCV and PCV were observed for leaf length, leaf area, fruit length, seed length and seed diameter. (Table 1). This indicated the narrow genetic base and hence variability has to be generated in these characters either through introduction or hybridizing divergent genotypes to recover transgressive segregants or by mutation breeding. The estimates of phenotypic co-efficient of variation and genotypic co-efficient of variation were quite closer to each other for most of the traits. This reveals that influence of the environment for these characters is negligible and the role of the genotypic performance for the full expression of the phenotype (Jicinska, 1981) [7].

**Table 1:** Estimates of mean, range, components of variance, heritability and genetic advance for growth and yield parameters of *E. ribes* Burm f.

Sl. No.	Characters	Mean $\pm$ S.Em	Range	GV	PV	GCV (%)	PCV (%)	h <sup>2</sup> (%)	GA	GAM (%)
1	Plant height (m)	14.35 $\pm$ 0.29	11.8-18.8	7.97	8.37	19.67	20.16	95.20	5.67	39.53
2	Petiole length (cm)	1.19 $\pm$ 0.04	0.76-1.58	0.086	0.095	24.62	25.87	91.00	0.58	48.27
3	Leaf length (cm)	5.38 $\pm$ 0.08	4.90-6.00	0.22	0.25	8.65	9.35	86.00	0.89	16.47
4	Leaf width (cm)	2.82 $\pm$ 0.04	1.75-3.76	0.60	0.61	27.53	27.72	99.00	1.59	56.31
5	Leaf area (cm <sup>2</sup> )	15.69 $\pm$ 0.21	14.44-16.89	0.81	1.02	5.73	6.43	80.00	1.65	10.54
6	Number of inflorescence per plant	104.75 $\pm$ 5.58	50.00-171.3	1993.33	2105.63	45.10	46.35	95.00	89.50	90.40
7	Fruit length (cm)	0.352 $\pm$ 0.07	0.15-0.53	0.018	0.045	38.45	60.45	40.45	0.18	50.38
8	Fruit diameter (cm)	0.981 $\pm$ 0.03	0.64-1.19	0.041	0.05	20.71	22.41	85.44	0.39	39.44
9	Fruit weight(gram)	0.08 $\pm$ 0.005	0.043-0.130	0.0011	0.0012	39.56	41.46	91.02	0.06	77.74
10	Fruit yield(kg/plant)	4.73 $\pm$ 0.16	2.21-8.44	5.21	5.30	48.24	48.67	98.22	4.66	98.50
11	Seed length (cm)	0.19 $\pm$ 0.018	0.071-0.330	0.010	0.011	50.90	55.15	85.19	0.19	96.80
12	Seed diameter(cm)	0.33 $\pm$ 0.06	0.65-0.33	0.03	0.05	53.20	66.48	64.05	0.29	87.71
13	Seed weight(gram)	0.063 $\pm$ 0.003	0.027-0.88	0.0007	0.0007	40.43	41.82	93.47	0.052	80.52
14	Number of flower per inflorescence	146.00 $\pm$ 2.79	140.00-157.50	35.62	78.80	4.09	6.09	45.24	8.27	5.66

GV- Genotypic variance, PCV- Phenotypic co-efficient of variation, PV- Phenotypic variance h<sup>2</sup>- Broad sense heritability

GCV- Genotypic co-efficient of variation, GAM- Genetic advance as per cent of mean, GA- Genetic advance

**Plate 1:** Morphological characterization of *E. ribes*

a: Variations in leaves among different accessions

b: Growth habit of *E. ribes* Burm f.C: High yielding accession s *Embelia ribes* Beemashwara 74.75833333333333 14.21111111111111 of *E. ribes* Burm f.**Plate 2:** Morphological characterization of *E. ribes* Burm f.a: Flowering of *E. ribes* Burm f.b: Fruiting of *E. ribes* Burm f.C: Different growing stages of *E. ribes* Burm f fruits.D: Cross sectional view of *E. ribes* fruits.

### Heritability and genetic advance

The estimation of genetic coefficient of variation indicates the amount of genetic variation present for different desirable traits. While, the heritability gives an insight into the proportion of variation which is inherent, the heritability estimates give an idea about the proportion of observed variability, which is attributed to genetic difference (Tuppad *et al.*, 2017) [12].

Heritability in broad sense may play greater role about information of relative value of selection in the material on the hand (Jhonson *et al.*, 1955) [8] showed that heritability and genetic advance should be jointly considered for reliable conclusion.

Heritability estimates were high for characters like leaf width (99.00 %), petiole length (91.00%), plant height (95.20 %), number of inflorescence per plant (95.00 %), fruit weight (91.02) and fruit yield per plant (98.22 %). From the heritability estimates it is clear that these characters are less influenced by the environmental factors and controlled by additive gene effect.

### Conclusion

In the present study, high heritability coupled with high genetic advance as per cent over mean was recorded for the characters *viz.*, leaf width, petiole length, plant height, number of inflorescence per plant, fruit weight and fruit yield per plant. Hence, the higher heritability coupled with moderate to high genetic advance values observed for these traits in the present finding suggest that the existing variability among the accessions with respect to the traits is mainly due to additive type of genes (Panse, 1957) [2] and could be used as a selection criterion for breeding programmes in the future.

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