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Variability, heritability and genetic advance for yield and yield contributing characters in *Oroxylum indicum* (L.) Vent: A threatened medicinal tree

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Abstract

The experiment was conducted during 2016-2017 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 ten *Oroxylum indicum* (L.) Vent. accessions. Data were recorded for plant height (m), stem girth (cm), leaf length (cm), leaf width (cm), petiole length (cm), leaf area (cm²), number of pods per tree, pod length (cm), width of pod (cm), number of seeds per pod, pod yield (kg/plant). Among different yield attributing characters studied, the highest magnitude of PCV and GCV were recorded in leaf area (26.869 and 27.827 %), number of pods per plant (36.593 and 37.610 %) and pod yield per plant (46.319 and 46.912 %). High heritability coupled with high genetic advance as per cent over mean was recorded for the characters viz., leaf length (90.30 %), petiole length (85.20%), leaf area (93.20 %), number of pods per tree (94.70 %) and pod yield per plant (97.50 %). 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: *Oroxylum indicum*, Variability, Heritability, Genetic advance

Introduction

Oroxylum indicum (L.) Vent. Belongs to the family Bignoniaceae described as a medium sized, deciduous tree. This plant is widely found in India, Sri Lanka, China, Philippines and Malaysia (Bennet *et al.*, 1992) ^[1]. *Oroxylum indicum* is commonly known as Broken bones tree, Indian trumpet flower, Midnight horror (Rajurkar *et al.*, 2011) ^[7]. Pods of the plant make huge noise in the night which makes fear in human beings so plant is called Midnight horror. Root extract of this plant has been used in Ayurvedic preparations like Dashmularisht and Chyawanprash (Yasodha *et al.*, 2004) ^[12].

This species is included in the Red Data List and categorized as vulnerable (Ravikumar and Ved 2000) ^[8], due to indiscriminate collection, over exploitation and uprooting of whole plants for pharmacological usage. Production of quality seedlings for commercial plantation is one of the main Objectives to conserve and also have a continuous supply of this species for its medicinal preparations. Hence, the present investigation is carried out to study the vegetative propagation in *Oroxylum indicum* (L.) Vent.

Materials and Methods

The experiment on *Oroxylum indicum* (L.) Vent. was carried out during 2016-17 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 *Oroxylum indicum* (L.) Vent. accessions. Ten 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), stem girth (cm), leaf length (cm), leaf width (cm), petiole length (cm), leaf area (cm²), number of pods per tree, pod length (cm), width of pod (cm), number of seeds per pod, pod 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

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suggested by Burton and (Devane 1953).

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

σ^2_g = Genotypic variance

σ^2_p = Phenotypic variance

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

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) [3].

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

Where,

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

σ^2_g = Genotypic variance

σ^2_p = Phenotypic variance

As suggested by (Johnson *et al.*, 1955) [5], 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) [9]

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

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) [5] 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 leaf length, petiole length, leaf area, number of pods per tree and pod 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 plant height, stem girth, leaf width, pod length, pod width and number of seeds per pod. (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) [4].

Table 1: Variability, heritability and genetic advance for growth and yield parameters in *Oroxylum indicum* (L.) Vent. Accessions

Sl. No.	Characters	Mean	Range	GV	PV	GCV (%)	PCV (%)	h^2 (%)	Genetic advance as per cent of mean
1	Plant height (m)	6.27 ± 0.19	5.32-7.23	0.399	0.547	10.074	11.791	73.00	17.73
2	Stem girth (cm)	50.25 ± 1.99	43.43-56.38	16.41	32.174	8.061	11.287	51.00	11.86
3	Leaf length (cm)	13.46 ± 0.43	10.10-18.57	7.015	7.768	19.677	20.706	90.30	38.52
4	Leaf width (cm)	9.01 ± 0.30	7.10-10.45	0.911	1.273	10.592	12.524	71.50	18.455
5	Petiole length (cm)	1.54 ± 0.06	1.10-2.01	0.083	0.097	18.729	20.293	85.20	35.609
6	Leaf area (cm ²)	69.32 ± 2.51	46.00-109.50	346.86	372.041	26.869	27.827	93.20	53.444
7	Number of pods per tree	11.45 ± 0.50	4.75-19.25	17.556	18.544	36.593	37.61	94.70	73.345
8	Pod length (cm)	75.29 ± 3.24	56.77-92.20	65.677	107.574	10.763	13.775	61.10	17.325
9	Width of pod (cm)	9.54 ± 0.39	7.37-11.18	1.422	2.038	12.502	14.969	69.80	21.51
10	Number of seeds per pod	426.05 ± 12.83	350.75-492.50	1414.333	2072.544	8.827	10.685	68.20	15.021
11	Pod yield (kg/ plant)	2.10 ± 0.08	0.93-4.10	0.949	0.974	46.319	46.912	97.50	94.212

GV- Genotypic variance

GCV- Genotypic co-efficient of variation

h^2 - Broad sense heritability

PV- Phenotypic variance

PCV- Phenotypic co-efficient of variation

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) [11].

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) [5] showed that heritability and genetic advance should be jointly considered for reliable conclusion.

Heritability estimates were high for characters like pod yield per plant (97.50 %), number of pods per tree (94.70 %), leaf area (93.20 %), leaf length (90.30 %), petiole length (85.20 %), plant height (73.00 %), leaf width (71.50 %), width of pod (69.80 %), number of seeds per pod (68.20 %), pod length (61.10 %) From the heritability estimates it is clear that these characters are less influenced by the environmental factors and controlled by additive gene effect.



Plate 1: (a) Field view of *Oroxyllum indicum* (L.) Vent. (b) inflorescence (c) Pod



Plate 2: *Oroxyllum indicum* (L.) Vent. a. developmental stage of pods b. mature cut opened pod with seed c. stem bark

Conclusion

In the present study, high heritability coupled with high genetic advance as per cent over mean was recorded for the characters *viz.*, leaf length, petiole length, leaf area, number of

Pods per tree and pod 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) [6] and could be used as a selection criterion for breeding programmes in the future.

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