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Genetic variability, heritability and genetic advance for pulp quality parameters of *Melia dubia* genetic resources

T. M. Akhilraj and K.T. Parthiban

ABSTRACT : We conducted a study to analyse the genetic variability, heritability and genetic advance for pulp quality parameters of *Melia dubia*. For this, 30 *Melia dubia* genetic resources were taken to analyse its physical, chemical and strength properties. Further these properties are subjected for genetic estimates. Current study shows the estimates of low GCV and PCV for many traits indicating the role of environment in the expression of the traits. Hence, the high heritability coupled with low genetic gain for all the parameters in the current study indicated that this character is strongly under genetic control as well as environmental conditions.

KEY WORDS : Genetic variability, Heritability, Genetic advance , Pulp quality, *Melia dubia*

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INTRODUCTION

Melia dubia is commonly known as Malabar *Neem* and vernacularly called as Malaivembu in Tamil is a member of the family Meliaceae. *Melia dubia* is distributed In India, Sri Lanka, Malaysia, Bhutan, Burma, Australia and Africa. It is a large deciduous perennial tree growing from 6 to 30 metres in height. *Melia dubia* is an industrially and economically importantfast growing multipurpose tree with its multi uses like pulpwood, timber, fuel wood and plywood can fit as a suitable species for agro and farm forestry plantation programs. In the present scenario,India is under tremendous pressure to meet the growing demand of wood and wood based products such as pulp and paper. The current production of raw materials for pulp and paper is 2.76 million tonnes, against the demand of 5.04 million tones, a shortfall of 45 per cent. The projected demand by 2020 is 13.2 million tonnes, which is still more staggering (Palsaniya *et al*., 2009). Hencein order to meet this demand we need good quality of material. It has been

MEMBERS OF RESEARCH FORUM

Address of the Correspondence : T. M. Akhilraj, Department of Agroforestry, Forest College and Research Institute (TNAU), **Mettupalayam (T.N.) India** Email: akhil.rajtm@gmail.com

Address of the Coopted Authors : K.T. Parthiban, Department of Agroforestry, Forest College and Research Institute (TNAU), **Mettupalayam (T.N.) India**

well recognized that better management alone will not yield maximum return unless genetically superior planting material is used. Hence, it is important to assess the genetic worth of plant material. It is generally experienced that plus trees usually produce good quality progeny. But phenotype is the joint action of the genotype and environment, so it is not easy to assess from the external appearance of a tree as to what would be its genetic worth.

Heritability is of key importance in estimating gains that can be obtained from selection programmes. The present study aims at understanding the variability, heritability and genetic advancement in physical, chemical, strength and pulp quality properties of this *Melia* genetic resources.

EXPERIMENTAL METHODS

30 *Melia dubia* genetic resources established as progeny evaluation trialduring 2010 were used as experimental material. Wood samples of all the 30 *Melia dubia* genetic resources were collected at the time of harvesting in 2016. Trees were felled at stump height of 15-20 cm using axe and cross-cut sawing by two men. About one metre length billets from the felled sample trees were collected from each tree for analysis of pulp wood properties. The billets were debarked, cleaned and labeled for analysis.

The wood samples were subjected to analysis of physical, chemical and strength properties in the Research and development laboratory of Forest College and Research Institute, Mettupalayam. The observations were recorded from the physical, chemical and strength properties of 30 progenies in *Melia dubia* genetic resources. The following physical, chemical and strength properties were recorded as detailed in (Table A).

Estimation of genetic parameters were followed using the below parameters:

Variability studies:

These parameters were estimated as per the method described by Johnson *et al.* (1955).

Phenotypic co-efficient of variability:

Phenotypic co-efficient of variation (PCV)was arrived by using the formula as described by Burton (1952).

Genotypic co-efficient of variability:

Genotypic co-efficient of variation (GCV)was arrived by using the Burton's (1952) formula:

Heritability (h^2):

Broad sense heritability (h^2) was calculated according to Lush (1940).

Heritability percentage = h^2 x 100

Genetic advance:

Genetic advance was worked out after Johnson *et al.* (1955).

Table A : Details of physical, chemical, strength and pulp quality properties of *Melia dubia* genetic resources

Physical properties	Chemical properties	Strength properties	Pulp quality properties
Moisture content	Ash content	Tensile index	Kappa number
Bulk density	Hot water solubility	Tear index	Pulp yield
Basic density	1% NaOH	Burst index	
	A-B extractive		
	Acid insoluble lignin		
	Pentosans		
	Holocellulose		

Table B : Classification of genetic estimates for physical, chemical, strength and pulp quality properties of *Melia dubia* genetic resources

Genetic parameter	Low	Moderate	High
GCV and PCV	<20	20-30	>30
Heritability	<30	30-60	>60
GA as % of mean	<30	30-60	>60

The genetic estimates for physical, chemical, strength and pulp quality properties were classified in Table B.

Statistical analysis:

The data were subjected to statistical scrutiny through an analysis of variance and treatment differences tested by 'F' test (Panse and Sukhatme, 1978). The stage wise data were analyzed separately in single factor analysis, using AGRES software.

EXPERIMENTAL RESULTS AND ANALYSIS

The observations were recorded from the physical, chemical and strength properties of 30 *Melia dubia* genetic resources. The present investigation was carried out from the 30 *Melia dubia* genetic resources, wood samplesin the progeny evaluation trial at Forest College and Research Institute, Mettupalayam. The physical, chemical and strength properties were analyzed and are presented below.

Variability and heritability parameters:

The variability estimates *viz.*, phenotypic co-efficient of variation (PCV) genotypic co-efficient of variation (GCV), heritability and genetic advance as per cent of mean are presented in Tables 1-3.

Physical properties:

The moisture content exercised phenotypic and genotypic co-efficient of variations of 2.94 and 2.97 per cent, respectively. Moisture content recorded a higher heritability of 98.13 per cent and the genetic advance as percent of mean was 6.01. The PCV and GCV for bulk density were 7.24 and 7.31 per cent, respectively. The bulk density recorded higher heritability of 98.20 per cent and the genetic advance as percentage of mean was 14.78. Basic density exhibited the phenotypic and genotypic co-efficients of variations of 1.89 and 1.90 per cent, respectively. It recorded high heritability value of 99.10 per cent. The genetic advance as percent of mean recorded by this trait was 3.88 (Table 1).

Chemical properties:

The phenotypic and genotypic co-efficients of variation for ash content were 4.89 and 5.18, respectively. It recorded a high heritability value of 89.08. The genetic advance as per cent of mean recorded by this trait was 9.50. The hot water solubility recorded low phenotypic (5.52 %) and low genotypic (5.55%) co-efficient of variations. High heritability (98.92%) and low genetic advance (11.31%) were also recorded for this trait. 1 per cent NaOH solubility exhibited the phenotypic and genotypic co-efficients of variations of 4.25 and 4.27 per cent, respectively. It recorded high heritability value of 99.17. The genetic advance as per cent of mean recorded by this trait was 8.71.The PCV and GCV for AB Extractive trait were 2.11 and 2.16 per cent, respectively. AB Extractive recorded higher heritability value of 95.38 and the resultant genetic advance as per cent of mean

Table 1: Genetic estimates of physical properties of *Melia dubia* genetic resources

Parameter	GCV	PCV	Heritability	GA as %
Moisture content	2.94	2.97	98.13	6.01
Bulk density	7.24	7.31	98.20	14.78
Basic density	1.89	1.90	99.11	3.88

Table 2 : Genetic estimates of chemical properties of *Melia dubia* genetic resources

Parameter	GCV	PCV	Heritability	GA as %
Ash content	4.89	5.18	89.08	9.50
Hot water solubility	5.52	5.55	98.92	11.31
1% NaOH	4.25	4.27	99.17	8.71
AB extractive	2.11	2.16	95.38	4.24
Acid insoluble lignin	2.23	2.25	98.82	4.57
Pentosans	0.81	0.82	96.60	1.63
Holocellulose	1.02	1.02	99.06	2.09

was 4.24 (Table 2).

The acid insoluble lignin recorded low phenotypic and genotypic co-efficient of variation of 2.23 and 2.25 per cent, respectively. Acid insoluble lignin recorded a high heritability of 98.82 and the resultant genetic advance, as per cent of mean was 4.57. Pentosans exhibited the phenotypic and genotypic co-efficients of variations of 0.81 and 0.82 per cent, respectively. It recorded high heritability value of 96.60. The genetic advance as per cent of mean recorded by this trait was 1.63. The holocellulose recorded low phenotypic co-efficient of variation (PCV) (1.02 %) and high genotypic co-efficient of variation (GCV) (1.02 %). Higher heritability (99.06%) and low genetic advance as (2.09 %) of mean were recorded by this trait (Table 2).

Strength properties:

The PCV and GCV for tensile index were 1.54 and 1.67 per cent, respectively. The tensile index recorded higher heritability of 85.88 per cent and the genetic advance as percentage of mean was 2.95. The tear index recorded phenotypic and genotypic co-efficient of variation of 0.76 and 0.84 per cent, respectively. The tear index recorded higher heritability of 81.02 and the resultant genetic advance as per cent of mean was 1.40. The burst index registered a low phenotypic and genotypic co-efficient of variations of 1.64 and 1.94 per cent, respectively. Burst index also recorded higher heritability of 70.89 per cent and low genetic advance as per cent of mean of 2.84 per cent (Table 3).

Pulp quality properties:

The kappa number recorded low phenotypic (2.84 %) and low genotypic (3.25 %) co-efficient of variations. Higher heritability (76.29 %) and low genetic advance (5.10 %) were also recorded for this trait. The phenotypic co-efficient of variation (PCV) and genotypic co-efficient of variation (GCV) for pulp yield were 2.49 and 2.53 per cent, respectively. The pulp yield recorded higher heritability of 97.27 per cent and low (5.07 %) genetic advance as percentage of mean (Table 4).

Variability parameters:

In the current study, all the physical, chemical, strength and pulp quality properties registered the low PCV and GCV. Similarly low GCV and PCV for growth attributes were also reported in *Bambusa pallida* (Singh and Beniwal, 1993) and low GCV for height in the same species were earlier reported (Surendran and Chandrasekaran, 1984 and Paramathma, 1992). The exhibition of low PCV and GCV for all the parameters in the present study is in conformity with the above assertions.

The relative values of PCV and GCV give an idea about the magnitude of variability present in a genetic population. In the current study, the estimates of GCV were less than PCV for many traits indicating the role of environment in the expression of the traits. The variability parameter estimates in the study are in close approximation with the findings of genetic parameters in *Azadirachta indica* (Dhillon *et al*., 2003) and also in progenies of *Dalbergia sissoo* (Dogra *et al*., 2005) which lend support to the findings of current investigation.

Heritability and genetic advance:

Heritability has an important place in tree improvement programme as it provides an index of relative strength of heredity versus environment. It is also useful for ranking importance of each trait in cross breeding programme. Estimation in broad sense heritability

Table 3 : Genetic estimates of strength properties of *Melia dubia* genetic resources

Parameter	GCV	PCV	Heritability	GA as %
Tensile index	1.54	1.67	85.88	2.95
Tear index	0.76	0.84	81.02	1.40
Burst index	1.64	1.94	70.89	2.84

Table 4 : Genetic estimates of pulp properties of *Melia dubia* genetic resources

Parameter	GCV	PCV	Heritability	GA as %
Kappa number	2.84	3.25	76.29	5.10
Pulp yield	2.49	2.53	97.27	5.07

for various characters showed high heritability for all the parameters. The results are in agreement with the studies carried out by Gera and Sharma (2001) in *Tectonagrandis* which showed high heritability in growth attributes. Studies on *Pongamiapinnata* showed that heritability varies with changing environment and age (Rao *et al.*, 2011).

In the current study, high heritability was recorded by all the parameters which might be due to the complexity of quantitative trait and confounding influence of different components of heritability. The maximum heritability estimate recorded for all the parameters in the current study indicated the predominance of addictive gene action for this character as reported in teak (Anmol *et al.*, 1997). In the current study, the trend of genetic advance as per cent of mean was low in all the parameters indicating a wide scope of genetic improvement possibility in the species.

The best gains could be achieved for the characteristics that are strongly under genetic control and have wide range of variability. The characters with high heritability coupled with low genetic gain could act as a reliable indicators as evidenced in *Prosopis cineraria* and also in poplars (Tewari and Sihghania, 1994 and Singh *et al.*, 2001). Hence, the high heritability coupled with low genetic gain for all the parameters in the current study indicated that this character is strongly under genetic control as well as environmental conditions.

The genetic variation which is heritable can be exploited for further improvement programmes. The relative values of PCV and GCV give an idea about the magnitude of variability present in a genetic population. In the current study, the estimates of low GCV and PCV for many traits indicating the role of environment in the expression of the traits.

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