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Phenotypic evaluation of growth attributes in *Melia dubia* Cav. F₁ progenies for tree improvement

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Abstract

Early-stage phenotypic selection is a cornerstone of tree improvement programmes in fast-growing species. The present investigation assessed variability in growth attributes among F₁ progenies of *Melia dubia* Cav. with the objective of identifying superior genotypes using an index-based selection method. Thirty-six five-year-old progenies were evaluated for height, diameter at breast height (DBH), clear bole height (CBH), stem straightness and branching habit at Pasighat, Arunachal Pradesh. Considerable inter-progeny variation was recorded for all traits. Based on a composite phenotypic index, fifteen progenies were selected as plus trees, exhibiting substantial improvement over the population mean for height, DBH and CBH. The study confirms the effectiveness of phenotypic index selection at juvenile stages and provides a basis for further genetic improvement and deployment of superior *M. dubia* planting material.

Keywords: *Melia dubia*, growth variability, plus tree selection, phenotypic index, tree improvement

Introduction

The increasing demand for industrial wood and the need to reduce pressure on natural forests have emphasized the importance of fast-growing tree species in plantation forestry and agroforestry systems. *Melia dubia* Cav., a deciduous and rapidly growing species native to peninsular India, has emerged as a promising alternative raw material for plywood, pulp and light construction industries. Its short rotation period and wide adaptability make it particularly suitable for intensive plantation programmes.

Genetic improvement through selection of superior trees remains a key strategy for enhancing productivity and wood quality in such species. Growth traits such as height, diameter at breast height and clear bole height are primary indicators of productivity and economic value. Phenotypic index-based selection, integrating multiple quantitative and qualitative traits, has been widely adopted in forestry improvement programmes under ICAR and ICFRE systems due to its simplicity and effectiveness at early ages.

Despite the commercial importance of *M. dubia*, systematic information on growth variability within F₁ progenies under northeastern Indian conditions is limited. The present study was therefore undertaken to evaluate growth variation and identify superior progenies using a standardized phenotypic index approach.

Materials and Methods

Experimental site

The study was conducted at the College of Horticulture and Forestry, Central Agricultural University, Pasighat, Arunachal Pradesh (155 m above mean sea level). The site experiences a humid subtropical climate with high annual rainfall and moderate temperature fluctuations.

Plant material and growth assessment

A total of 36 five-year-old F₁ progenies of *Melia dubia* were selected for evaluation. Growth parameters recorded included total height (m), diameter at breast height (DBH, m) and clear bole height (CBH, m). Stem straightness and branching habit were assessed visually and scored on a 1-5 scale following standard tree improvement protocols. Inferior and diseased individuals were excluded from selection.

Index-based plus tree selection

A phenotypic index integrating height, DBH, CBH, straightness and branching was used for ranking progenies. Weighted scores were assigned to each trait, and progenies

attaining an index value of ≥ 40 were designated as plus trees. Descriptive statistics were used to assess variability before and after selection.

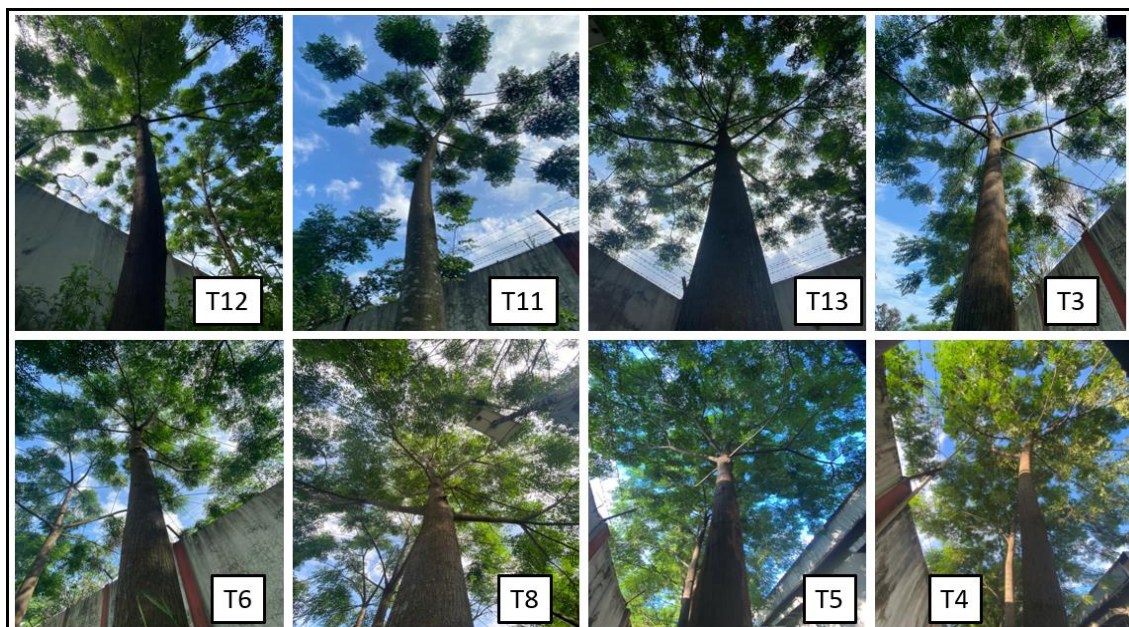


Fig 1: Selected plus trees for anatomical studies

Results and Discussion

Variation in growth attributes

Marked variation was observed among progenies for all growth traits (Table 1). Height ranged from 4.0 to 14.54 m,

DBH from 0.14 to 0.74 m and CBH from 1.2 to 4.4 m, indicating substantial phenotypic diversity within the population. Such variability among same-aged progenies provides ample scope for effective selection.

Table 1: Descriptive statistics of growth attributes of *Melia dubia* F₁ progenies (n = 36).

Trait	Minimum	Maximum	Mean
Height (m)	4.00	14.54	10.55
DBH (m)	0.14	0.74	0.41
Clear bole height (m)	1.20	4.40	3.18

Following index-based screening, fifteen progenies were identified as plus trees (Table 2). The selected group showed clear improvement over the base population, with mean height increasing from 10.55 to 11.89 m, DBH from 0.41 to 0.56 m and CBH from 3.18 to 3.57 m (Table 3). The

selection differential highlights the advantage of multi-trait indices over single-trait selection, as emphasized in earlier tree improvement studies.

Table 2: Selected plus trees based on phenotypic index values (≥ 40).

Progeny code	Height (m)	DBH (m)	CBH (m)	Index value
T12	14.00	0.61	4.20	97
T11	14.50	0.65	4.40	87
T13	13.50	0.60	4.30	87
T6	14.54	0.65	4.30	85
T8	14.54	0.63	4.20	85

Table 3: Mean growth attributes before and after selection.

Trait	Before selection	After selection
Height (m)	10.55	11.89
DBH (m)	0.41	0.56
Clear bole height (m)	3.18	3.57

Relevance to tree improvement programmes

Early identification of growth-superior genotypes is particularly important for short-rotation species such as *M. dubia*. The observed gains in growth traits among selected progenies indicate the potential for enhanced productivity

through systematic phenotypic selection. The plus trees identified in the present study can serve as candidate material for clonal multiplication, progeny testing and further genetic improvement.

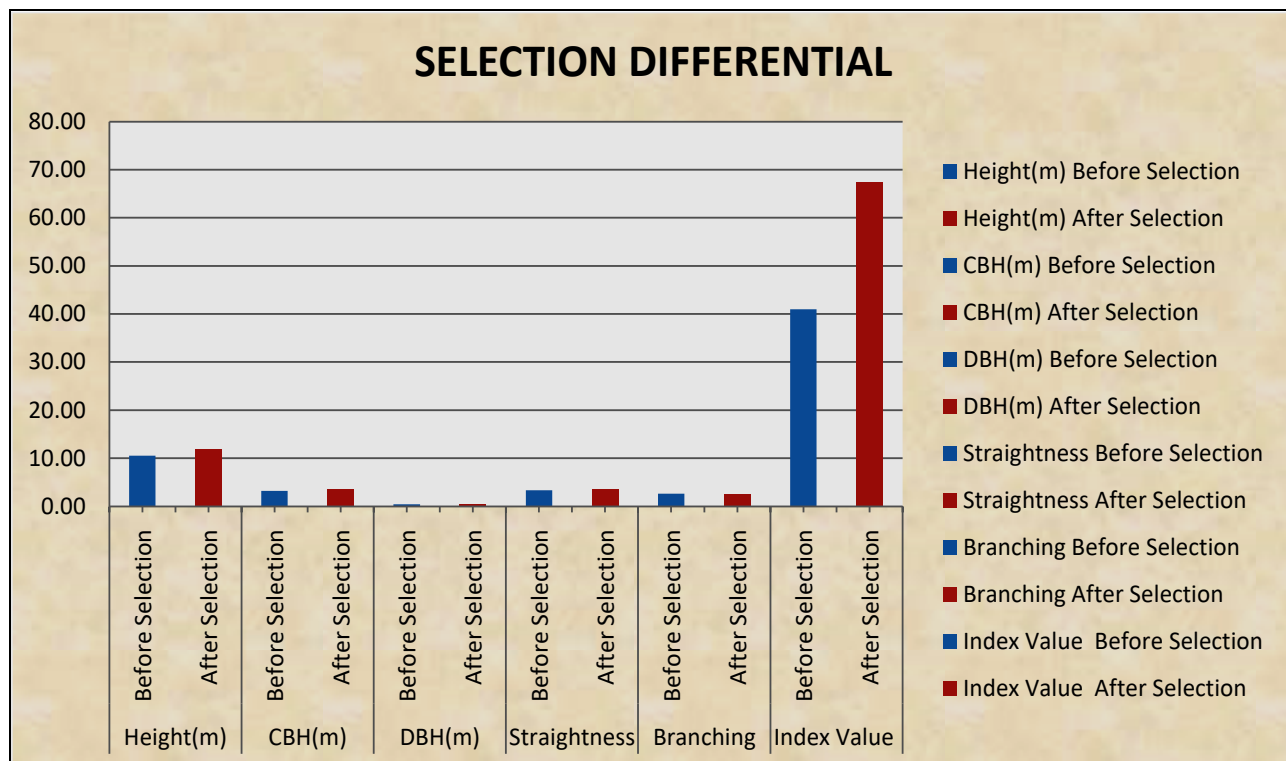


Fig 2: Selection Differential of the growth attributes

Conclusion

The study demonstrated significant inter-progeny variation in growth attributes of *Melia dubia* F₁ progenies at five years of age. Phenotypic index-based selection proved effective in identifying superior genotypes with enhanced height, DBH and clear bole height. These findings support the use of early-stage growth screening in *M. dubia* improvement programmes and provide a foundation for developing high-yielding planting material for commercial plantations.

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