



Plus Trees Selection for Timber quality: Foundation of Genetic Improvement

Rakesh Kumar Prajapat
Prem Chand Gyani
Amitava Roy
Rekha Mahato

Division of Genetics & Tree
Improvement, ICFRE-Rain
Forest Research Institute
Jorhat-785010



*Corresponding Author
Rakesh Kumar Prajapat*

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INTRODUCTION

Timber-producing tree species constitute an important component of India's forest-based economy and provide raw material for construction, furniture, plywood, veneer, handicrafts, packaging and other wood-based industries. Increasing urbanisation, infrastructure development, housing, furniture consumption and industrialization have resulted in a steadily increasing demand for quality timber. At the same time, the availability of suitable domestic timber is constrained by the long rotation period of trees, limited availability of high-quality planting material and increasing pressure on natural forests.

India's wood sector is therefore increasingly dependent on trees outside forests, farm forestry, plantations and imported timber. The India State of Forest Report 2023 reported an estimated 6,430 million m³ of total growing stock in forests and trees outside forests, including 1,951 million m³ outside forest areas. The annual potential production of timber from trees outside forests was estimated at approximately 91.51 million m³.

The country's dependence on imported wood also illustrates the magnitude of the demand-supply gap. According to the USDA Foreign Agricultural Service, India's annual imports of logs, lumber and wood products increased to approximately US\$2.3 billion, compared with about US\$630 million two decades earlier. Limited domestic supplies, together with expanding furniture, construction, handicraft and hospitality sectors, are important drivers of this demand. In this context, genetic improvement of important timber species is essential for increasing productivity as well as improving the quality and economic value of wood produced per unit area. Selection of superior or candidate plus trees is the first and one of the most important steps in such a programme.

Timber Demand and Economic Importance in India

India has a large and growing market for wood and wood products. The monetary value of timber demand is difficult to express through a single figure because different reports use different definitions, including roundwood, logs, sawn timber, plywood, veneer, furniture and other processed wood products. A useful indicator is India's import dependence. India's annual imports of logs, lumber and wood products have reached approximately US\$2.3 billion according to USDA's 2024 India Wood and Wood Products Update. At an exchange rate of approximately ₹96.6 per US\$1 in October 2026, this is equivalent to roughly ₹222 billion (₹22,200 crore). Another estimate places the value of India's wood and wood-product imports at more than ₹531 billion (₹53,100 crore) in FY 2024, although this broader figure covers a wider range of wood products than the USDA's logs/lumber/wood-products estimate. Therefore, these figures should not be directly added together; rather, they demonstrate the substantial economic scale of India's wood sector.

Recent research also indicates that timber consumption is growing faster than domestic production in several regions. A 2025 study on timber markets in Tamil Nadu reported that consumption grew at approximately 5.20% annually compared with 1.97% growth in domestic production, with timber demand projected to reach 36.70 million m³ by 2030 in the study area/context.

Candidate Plus Tree:

A candidate plus tree (CPT) is an individual tree that exhibits superior phenotypic characteristics compared with neighboring trees and is identified for detailed evaluation as a potential parent in a tree-improvement programme. The Indian Council of Forestry Research and Education describes plus-tree selection as a basic component of tree improvement because it exploits naturally occurring variation within a species. However, phenotypic superiority alone

does not prove genetic superiority; the genetic worth of selected trees must subsequently be evaluated through progeny testing or clonal testing.

For timber species, the selection objective should not be restricted to rapid growth alone. A tree having a large diameter but a crooked, highly tapered or heavily branched stem may produce less valuable sawn timber than a moderately fast-growing tree with a long, straight and cylindrical bole. Therefore, stem quality should be considered a major selection criterion along with growth, health, adaptability and wood properties.

Steps for Selection of Candidate Plus Trees for Timber Quality

The selection of Candidate Plus Trees (CPTs) should be end-use oriented rather than based only on tree size.

1. Select Suitable Stands and Populations

Candidate trees should preferably be identified from:

- Mature or adequately aged stands
- Healthy and well-managed plantations
- Natural populations representing different geographical regions
- Different agro-climatic or ecological zones
- Populations with sufficient genetic variability

2. Identify Candidate Trees by Preliminary Screening

During the initial survey, trees showing outstanding growth and stem form should be identified.

Following preliminary observations or morphometric parameters may be recorded during CPTs selection in the field:

- ❖ Total tree height
- ❖ DBH/GBH
- ❖ Clear bole height
- ❖ Stem straightness
- ❖ Stem cylindricality/roundness
- ❖ Branching pattern

- ❖ Crown characteristics
- ❖ Health status of tree
- ❖ Pest and disease resistance
- ❖ Age and site characteristics

3. Compare with Check Trees

A candidate tree should not be judged in isolation. It should be compared with suitable neighboring dominant or co-dominant trees of the same species and comparable age and site conditions. The comparison-tree method is

widely used in forest-tree improvement. FAO/IUFRO guidance recommends comparison with superior neighbouring trees under similar site conditions.

For Indian timber species, comparison with approximately 4–5 suitable dominant/co-dominant check trees around the candidate tree can provide a useful basis for determining phenotypic superiority. Similar approaches have been used in Indian studies on teak, shisham and other timber species.

4. Measure Quantitative Growth Traits

The following measurements should preferably be recorded:

Trait	Importance for timber improvement
Total height	Indicates growth potential and merchantable stem length
DBH/GBH	Indicates diameter growth and timber volume
Clear bole height	Directly related to production of knot-free timber
Crown length	Indicates growth vigour and competition response
Crown width	Indicates crown architecture
Bole volume	Important for productivity
Annual diameter increment	Indicates growth rate
Age	Required for meaningful comparison

5. Evaluate Stem Straightness and Bole Form

Stem form is one of the most important characteristics for timber production.

A preferred candidate tree should have:

- ❖ A single dominant stem;
- ❖ Minimum basal sweep;
- ❖ Minimum trunk bends;
- ❖ No major curvature;
- ❖ No spiral or twisted stem;
- ❖ Minimum taper;
- ❖ Circular or near-circular cross-section;
- ❖ No abnormal swelling;
- ❖ No fork in the merchantable bole.

A long, straight and cylindrical bole produces a greater proportion of high-grade sawn timber and veneer compared with a short, crooked or highly tapered bole. The Odisha Forest Department's Standard Operating Procedure for

Plus Tree Selection similarly emphasizes bole straightness, cylindrical form, taper, clear bole and branching characteristics in timber-tree selection.

6. Evaluate Clear Bole Height

Clear bole height is the height of the merchantable stem free from large branches and major defects. Trees having a high proportion of clear bole should be preferred because knots and branch-related defects substantially reduce the quality and value of sawn timber and veneer.

The ratio: **Clear bole height / Total tree height**

may be used as an important selection index. For example, a tree with a 12 m total height and 8 m clear bole height has a clear-bole ratio of:

$$8/12 \times 100 = 66.7\%$$

Such a tree would generally be more desirable for high-quality timber production than a tree of similar height having only 4-5 m of clear bole.

7. Evaluate Branching Characteristics

Branching characteristics strongly influence timber quality because branches produce knots and irregular grain.

Preferred trees should have:

- ❖ Fewer branches
- ❖ Small branch diameter
- ❖ Thin branches
- ❖ Regular branch distribution
- ❖ Good natural pruning
- ❖ Wider/appropriate branch angles depending on species
- ❖ Minimum epicormic branching
- ❖ No heavy persistent branches on the merchantable bole

FAO/IUFRO selection guidelines specifically include branch thickness, branch angle and

number of branches among the characteristics used in plus-tree quality assessment.

8. Evaluate Tree Health and Resistance

A candidate plus tree should be:

- ❖ Free from serious insect attack;
- ❖ Free from fungal diseases;
- ❖ Free from major stem cankers;
- ❖ Free from severe mechanical damage;
- ❖ Vigorous and healthy;
- ❖ Capable of maintaining good growth under local environmental conditions.

Trees showing repeated pest or disease damage should normally be excluded unless resistance itself is a specific breeding objective.

9. Weighted Scoring System

A practical scoring system can be developed by assigning weights to economically important traits.

Table: Suggested scoring framework for timber-quality CPT selection

Characters	Suggested weight (%)
Stem straightness and bole form	20
Clear bole height	15
DBH/GBH and volume	15
Total height/growth rate	10
Stem cylindricality and taper	10
Branching habit and branch angle	10
Crown architecture	5
Health and pest/disease resistance	5
Wood density/wood quality	5
Natural pruning ability	5
Total	100

These weights are indicative rather than universal. They should be modified according to the species, rotation age, site and final timber product. The point-grade approach is already used in Indian tree-improvement programmes. For example, plus-tree selection in *Pinus kesiya* in Meghalaya emphasised stem, bole and branching characteristics and reported substantial phenotypic superiority of selected trees over checks.

CONCLUSION

Selecting candidate plus trees is an important first step in improving timber species. As India imports wood products worth about US\$2.3 billion annually, developing better domestic timber is essential. Selection should consider not only tree size and growth but also stem straightness, clear bole, cylindrical form, branching, wood density and health. Progeny or clonal testing is then needed to confirm genetic

superiority. The best trees can support breeding programmes, seed orchards and improved plantations, helping increase timber quality and productivity while reducing imports and maintaining genetic diversity.

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