Is teak improving?

A study finds that some basic work is being done in Asia to improve teak growing stock, but not yet at a scale to impact timber production

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Seed sources: a teak seed production area in Myanmar. *Photo: H. Nakata*

TEAK (*Tectona grandis*) is an increasingly important plantation species in the tropics. It is being grown in at least 36 countries across the three tropical regions and constitutes an estimated 75% of the world's high-quality tropical hardwood plantations (Bhat & Ma 2004). Much has been done to improve the seedstock of teak since it was first planted in the mid 1800s; several publications (eg Ball et al. 2000) summarise trends and accomplishments in tree improvement among the major teak producers. However, in some producing countries, major policy changes in the late 1980s and the 1990s—such as logging bans and the restructuring of forestry departments—have affected improvement programs and their status has sometimes been obscured.

In the past decade, regional and global initiatives (such as Teaknet, based in Myanmar) have been launched to promote integrated and efficient approaches to (among other things) teak improvement. Several projects have commenced—funded by ITTO, among others—to initiate or expand improvement programs. At an international conference on teak in late 2003, a wide range of stakeholders issued a statement called the Kerala Call for Action, which urged governments, funding agencies, investors and others to, among other things, evaluate and document the present condition of the teak crop/resource and critically appraise the technology in use in the context of new developments in research.

This study was undertaken by Japan's Forest Tree Breeding Center (FTBC) to consolidate information on teak improvement programs in major producing countries and regions, with the aim of strengthening teak development networks.

Methodology

A series of consultations was conducted between the authors and relevant international organisations in order to better understand the global picture and recent trends in teak improvement. Information obtained from ITTO, the Center for International Forestry Research and the Regional Office for Asia and the Pacific of the Food and Agriculture Organization of the United Nations (RAP/FAO) revealed that Thailand, Myanmar and the Indian state of Kerala are the keys because of their existing natural and planted teak forests and their historical timber production. Improvement programs in other regions are of secondary importance because they are mostly relatively recent and based on stock introduced from one of the source regions (although there is some debate over whether the teak forests on the island of Java in Indonesia are derived from natural or imported stock). Thus, the focus of this study was on activities in Thailand, Myanmar and Kerala.

Significant changes in teak improvement work have taken place over the last ten years due to institutional restructuring and major policy changes. Given the dynamic situation, available publications did not sufficiently reflect such changes. Visits were made to Thailand, Myanmar and Kerala in September 2005 to ensure that the most up-to-date information was used in the study; priority was given to Myanmar, for which it was more difficult to obtain recent information by electronic means.

The essential elements for assessing the current status of teak improvement were:

- institutional arrangements and policy/plans for teak plantation development and improvement;
- existing teak resources;
- improvement efforts; and
- propagation and production of improved materials.

These formed the basic parameters of the study.

Progress in teak improvement

Table 1 summarises the major indicators relevant to tree improvement as of 2005 in Thailand, Myanmar and Kerala based on the data collected by this study. *Table 2* shows the progress in improvement activities to date.

Keyword

Plus-tree

A phenotype (ie individual tree) judged (but not proved by test) to be unusually superior in some quality or quantity, eg exceptional growth rate, desirable growth habit, high wood density, exceptional apparent resistance to disease and insect attack or to other adverse environmental factors.

*Source: Nieuwenhuis, M. 2000.*Terminology of Forest Management. *IUFRO, Vienna, Austria*

Teak improvement

Table 1: Status of the major indicators of teak improvement, 2005

			THAILAND	MYANMAR	KERALA
INSTITUTIONS AND POLICY/PLANNING					
Relevant organisations in teak plantation development	Public sector	Department(s)	National park/Forestry	Forest	Forest
		Enterprise(s)	Forest Industry Organisation (FIO)	Myanmar Timber Enterprise (MTE)	
		Research institute(s)	Teak Improvement Centre (TIC)	Forest Research Institute (FRI)	Kerala Forest Research Institute (KFRI)
		University(ies)	Many	Myanmar Forestry University	Many
	Private sector	Private companies	Many	None	Many
		Local communities	Negligible	Negligible (?)	Yes
	Dominant executing agency		FIO	Forest Department	Forest Department
	Executing agency of improvement activities		TIC	FRI	KFRI
Human resources	Researchers in teak improvement		Some	Few	Many
	Practitioners/experts in teak		Many	Many	Many
Endorsed teak improvement plans			None	None	None
TEAK RESOURCES					
Natural forests	Trends		Decreasing	Decreasing/large	Decreasing
	Production		None	Selective cutting	None
Planted forests	Most advanced rotation		Second	Second	Third
	Major executing agency		Government company	Forest Department	Forest Department
	Dominant planting methodology		Industrial	Taungya system	Industrial
	Future development opportunities		Limited	Large	Limited
IMPROVEMENT EFFORTS					
Plus-trees	Estimated existing number		Around 500	Few	94
	Criteria for selection		Developed by TIC	Under development	Developed by KFRI
Provenance trials	Type		International	National	International
	Number of provenances tested		3	10	n.d.
	Number of test sites		1	4	n.d.
	Starting year		1974	1998	1960
	Publications		Yes	Yes	No
Progeny tests			Pilot scale	None	Pilot scale
Clonal tests			None	None	Yes
PROPAGATION/PRODUCTION					
Seed production areas			1000 hectares	650 hectares	Yes
Seed orchards	Type		n.d.	Clonal	n.d
	Number of locations		n.d.	2	n.d.
	Scale		n.d.	20 hectares	n.d.
	Production		none	None	none
Hedge gardens			Pilot scale	Pilot scale	Production scale
Nurseries			Yes	Yes	Yes
Tissue culture			For research purposes	Test scale	For research purposes

n.d. = no data

Improvement activities in general

All three producers have made progress in teak improvement. However, the improved genetic materials are not yet ready for large-scale supply.

Executing agencies of plantation development and improvement

The production and improvement of teak generally rely on the public sectors of each country/state. Taungya, a farmer-based agroforestry system, is widely practised in Myanmar using teak.

Potential for the use of improved materials

Myanmar has the largest potential for the use of improved materials because more plantation development is expected there. To date, the selective cutting of natural-forest teak has been the predominant form of production but the Myanmar Forest Department intends now to promote plantations over

Areas for improvement

Table 2: Level of development in teak improvement

	COUNTRY/LOCALITY		THAILAND		MYANMAR		KERALA	
INDICATORS	**PROPAGATION SCALE**		*Development*	*Production*	*Development*	*Production*	*Development*	*Production*
Selection of sources	Populations	Seed production area(s)	•	•	•	•	•	•
		Provenance(s)	•		•		•	
	Individuals	Plus-trees	•		•		•	•
Breeding	Open-pollination		•				•	
	Controlled-pollination		•					

natural forest production. In Thailand and Kerala, the large-scale expansion of the teak plantation estate is not foreseen; prevailing policies in Thailand even discourage harvesting in the existing teak plantations. The use of such improved materials is expected when existing plantations are harvested and re-planted, or when new private plantations are established.

Selection of superior sources

Each of the three (Myanmar, Thailand and Kerala state) has initiated improvement through selection, such as phenotypic thinning in seed production areas, provenance trials, and the selection of plus-trees. In Kerala and Thailand, a number of plus-trees have been selected based on the criteria established by their research organisations. These agencies established provenance trials in the 1960s and 1970s respectively using provenances from across the species's natural range. Myanmar set up provenance trials in the late 1990s using genetic material from a wide range of sub-national locations. The ITTO project 'Ex-situ and in-situ conservation of teak (*Tectona grandis L.F.*) to support sustainable forest management' (PD 270/04 REV.2 (F)) is expected to promote the establishment of seed production areas/ provenance trials and the selection of plus-trees in Myanmar.

Breeding

Some research has been conducted in Thailand and Kerala into teak breeding through pollination among the selected trees. However, the seed orchards in both have not given satisfactory quantities of open-pollinated product. A recent study by the Kerala Forest Research Institute (KFRI) indicated that artificial cross-pollination could increase fruit productivity by about tenfold (Indira et al. 2002). Controlled pollination trials have been initiated recently in Thailand. The extent to which breeding efforts could contribute to teak forestry in the near future remains unclear because research results are still limited.

Propagation

Seed production areas have been established to support field operations in Myanmar, Thailand and Kerala. However, one of the main hindrances to high-quality teak plantation development remains the insufficient production of seed. In all of the three major producers, some kind of tissue culture technique has been applied. In Thailand and Kerala, tissue culture is used mainly to duplicate individuals for research purposes. Nevertheless, some private and public organisations in Thailand have used tissue-culture facilities to produce and sell seedlings of plus-trees; it is estimated that more than 500 hectares of teak plantations have been developed with materials derived using tissue culture by private companies to date. In Kerala, recent research efforts have been directed towards the practical development of clonal propagation of superior individuals and cost-effective tissue-culture techniques. However, the extent to which tissue-culture techniques will substitute for more conventional propagation practices such as cuttings and seedlings for the large-scale production of improved materials remains unclear.

Conclusion

Various teak improvement efforts have been made in each of the three main teak-growing areas studied. The focus has mainly been on improvement through selection, represented by the establishment of provenance trials/seed production areas and the selection of plus-trees. At the same time, wood production has not yet benefited much from such improvement. The key next step is to establish and execute strategically focused, integrated and actionable teak improvement plans to support potential teak plantation/ planting development in the future.

The standardisation of research methodologies and coordinated research planning would be of enormous benefit by allowing major producers to share and benefit from results. The main international provenance trials set up to date are those in Thailand and Kerala, while the trials in Myanmar are national; the results could have been compared if the designs had been standardised. Research information on genetic variation in Myanmar, Thailand and Kerala could possibly help in the improved design of breeding trials and the scientific determination of provenances.

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