

“Teak Improvement Program in Perhutani Area”

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Introduction

The productivity of trees is very important for the establishment of successful plantations. Trees should be “improved” to obtain the good quality and quantity of wood. If timber production is aimed, the timber quality must be improved for better growth & form. On the other hand, methods are unavailable for many potential plantation species to produce and store suitable reproductive material in sufficient quantities due to irregular and sporadic seed production. Finkeldey (1997) stated the main problem for those species is frequently not the choice of genetically suitable reproductive material but rather the production of a sufficiently large number of plants.

Tree improvement is a process of managing genetic resources. Through this process the inherent amount and organization of genetic variability in a particular population is managed by recurrent cycles of selection and breeding. These activities involve conservation, selection, breeding, and propagation (Puri, 1998). One of the most important considerations in tree improvement is to divide the phenotypic variance into its main components: *the genotypic portion* and *the environmental fraction*.

The Indonesian Ministry of Forestry encourages the activities and dedication of forest tree improvement in Indonesia since the 1980's. P.T. Perhutani (Persero), one of the privat forest companies in Indonesia (previously State Owned Forest Enterprise) is involved in these activities. In order to carry out tree improvement program, since 1981 P.T. Perhutani has collected “Plus Trees“ and established a Clone Bank, Clonal Seed Orchard (CSO), Seedling Seed Orchard (SSO), and Seed Production Areas (SPAs). The development of activities in biotechnology of forest plantation started in 1986 to support tree improvement activities.

A Glance at Perhutani

P.T. Perhutani (Persero) is one of the privat forest companies in Indonesia, with the working area in Java, Madura, West and East Kalimantan islands (mainly in Java island). Forest area in Java is about 2.5 million ha which is roughly 23% of the total land of Java, consist of 1,963,880 ha production forest and 629,385 ha protected forest. Furthermore, Perhutani is in charge with the service for social welfare and profit earning simultaneously based on the business economic principles and the management of forest resource.

The composition of forest management and annual allowable cut are comprise of *teak* 8,669 ha (from a total area 1,106,189 PFA¹), *pine* 7,097 ha (from a total area 597,744 ha PFA), *agathis* 603 ha (from 84.070 ha PFA) and *other forest* 881 ha (from 175,877 ha PFA). The main wood product is *a teak log* with the average production of about 700,000 m³ per year.

¹ PFA: Production Forest Area

As one of the major players in the teakwood market, Perhutani has to respond to the increasingly competitive market. The demand of wood tends to increase both domestic and global market; therefore the wood market is become more severe. One of the strategies to respond this situation is to develop the good quality and quantity of wood through well-planned improvement programs. It is expected that all activities contribute to a more intensive improvement. Presently, the highest priority for research is given to teak (*Tectona grandis L.f*) and pine (*Pinus merkusii*).

General View of *Tectona grandis L.f*

Teak, *Tectona grandis L.f.*, is one of the most important timber species in the world. According to Troup (1921) teak is indigenous to India, Myanmar, the Indian Peninsula, Siam, and other island inclusive “Java”. Kartasubrata (1993) argued that in Java, clear cutting with artificial regeneration has been employed in the management of teak forest. As a consequence, most of the teak forests now are plantation. Moreover, the teak forests (mainly all the production forest in Java) have been planted and managed since the Dutch colonial times (1874). Due to its unique wood properties, it also has been extensively planted outside its natural region.

Unimproved Stand

In former time (1874) the Colonial Dutch Government managed teak forests in Indonesia. A series of silviculture techniques of teak were developed and still used to manage teak forests in Indonesia (mostly in Java). Suseno (1996) stated it is one of the best examples of forest management system in the world. Teak forests normally grow quite well even unimproved planting stocks are used. Nevertheless, the existing teak plantation could be even better if using genetically improved planting materials are used.

Provenance Trial

Site is very important for teak growing. Troup (1921) stated that one of the most important factors affecting in the establishment of natural reproduction of teak is light. Teak seedlings are intolerant of shade, and thrive best entirely in the open. Another factors influencing the establishment of natural reproduction are soil-aeration, soil-moisture, weed-growth, and grazing. In order to get the information of suitable site for teak growth, provenance test of teak was established in 1932 on four sites in Java, involving 14 provenances and 4 local varieties. Java provenances was found to perform relatively similar with the best provenance trial, i.e Malabar provenance (Perum Perhutani, 2000).

Tree Improvement Program

These tree improvement activities consist of the establishment of Seed Production Area (SPAs), Seedling Seed Orchards (SSO), collection of “Plus Trees”, the improvement of genetic resources in Clone Banks (CB) and Clonal Seed Orchards (CSO). Besides of those activities, tissue culture and conventional shoot rooted cutting are also developed, especially genetic materials from plus trees.

Seed Production Area (SPAs)

The simplest way to produce seeds used for commercial plantations as part of a breeding program is the establishment and management of Seed Production Areas (SPAs). Natural populations and plantation may be converted to SPAs. The establishment of SPA is particularly recommended within region which proved to be suitable for the procurement of seeds, e.g. in provenance trials. Moreover, the choice of stands that are recommended for the production of selected reproductive material and transformed to a SPA is usually based on phenotypic criteria. Stands are selected because most of the trees exhibit superior phenotypic trait expressions (e.g. fast growth, good stem quality, no diseases). (Finkeldey, 1997).

Since 1981 Perhutani has established more than 4,000 ha of teak SPAs, in which more than 400,000 trees were selected. Normally, each tree produces about 500 seeds. Overall, the available SPAs can produce 200 million teak seeds. The seeds can be immediately used and replace uncontrolled harvested reproductive materials. Nevertheless, the seeds of teak SPAs are genetically untested. Therefore, progress of the breeding programs, which include genetic tests, is hoped to replace the seeds of SPAs gradually. The annual target and result of seeds procurement of several trees species managed in Perhutani area is shown in Table 1.

Table 1. Target and Result of Seeds Procurement

No.	Description	Annual Target of 1998 (Ha)	Result (kg)	
			1997	1998
1.	Teak	105.261	122.282	157.136
2.	Pine	2.940	5.500	4.014
3.	Agathis	1.018	1.240	399
4.	Mahogany	43.193	31.549	29.660
5.	Sonokeling	113	20	98
6.	Other species	973.194	910.259	2.248.398
	Total	1.125.719	1.070.850	2.439.705

Source: Perum Perhutani (1999)

Selection of Plus Trees

In order to carry out tree improvement program in Java, selection of Plus Trees is one of the major activities. Selection led to great improvements in domesticated plants. Though selection cannot produce new genes, it can isolate cultivars or groups of individuals that are carriers of the desired genes. Selection can be effective in changing the genetic constitution of a population or of a group of individuals, if the genetic differences of the group are expressed in phenotypes (Andersson, 1965).

The candidate “plus trees” are compared to at least 5 neighbor trees, which appear to be superior with respect to certain phenotypic characters (Perhutani, 1985). The phenotypic characteristics recorded and scored are: *height, diameter at breast height (dbh), volume, crown form, stem form, self-pruning, branch diameter, health (free from pest and disease), age, and basal area*. An example of the performance of teak plus tree is shown in Figure 1.

Figure1. The performance of teak Plus Tree at Perhutani area

Table 2. An example of description of teak plus trees

Year of planting	Height (m)	Height of the lowest branches (m)	Diameter (cm)	Volume (m ³)	Date of scoring
1921	34	13	68	2.87	1985
1937	36	15	61	2.41	1995
1924	34	18	72	3.67	1996
1940	31	15	54		1998
1935	34	9	69	4.10	1996
1935	34	12	59	2.30	1995

As of July 2000, 600 teak plus trees were selected, where most of them scattered in Java. Some of the selected plus trees are multiplied through vegetative propagation techniques such as grafting and tissue culture. The copy of plus trees was replanted on a number of site as clonal tests. Other activities are the establishment of Clone Bank, CSO, progeny test and provenance trial.

Clonal Seed Orchard (CSO)

Clonal Seed Orchards (CSOs) are established in order to produce large quantities of seeds from a limited number of selected genotypes. Selected genotypes are cloned and in many copies assembled to a population. The most important consideration regarding the design of a CSO refers to the number of clones represented in the orchard.

From the selected of Plus Trees Perhutani has established more than 1300 ha CSO involving 143 trees. The orchards are able to produce improved teak seeds about 6 tons or equivalent with 7 million seedlings annually. It is expected that the improve seed production of the CSOs is increasing rapidly.

Seedling Seed Orchards (SSO)

The establishment of Seedling Seed Orchard (SSO) resembles the establishment of a Provenance Resources stand. However, the establishment of a SSO is not spatially separated from a field trial, but usually combined with a test of a single tree progenies after open pollination (Finkeldey, 1997).

In order to establish a progeny test, two periods of progenies have been tested in three locations (Kendal, Cepu, and Saradan FMD²). The first period was 1987 and the second period was 1999. Meanwhile, the companies still wait for the result.

Genetic Conservation

Genetic conservation is extremely important for preserving the existing genetic materials from unwanted loss such as illegal felling, fire and disease. For this purpose, Perhutani establish an arboretum and Clone Bank. The conserved genetic materials could also be used for future breeding program for certain desirable traits not available in the current breeding population (Perum Perhutani, 2000).

Center of Forest Research & Development

In order to coordinate the R&D activities, Perhutani has established a center of forest resource development in 1997. The center is located in Central Java. It is expected that all the R&D programs of forest resources within Perhutani area are managed and organized by this center.

To support the genetic analysis and the method of *in vitro* propagation (tissue culture), biotechnology laboratory was developed in this center. On the other hand, the method of conventional plant regeneration such as grafting and shoot rooted cutting also developed within the center.

² FMD:Forest Management District

Conclusion

Tree improvement program is one of the process of managing forests to achieve the good quality and quantity of wood. Perhutani is committed to carry out the teak improvement programs through several activities such as provenance trials, establishment of Seed Production Area, plus tree selection, establishment of CSO, Clone Bank, conventional and modern methods are used to support the programs.

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