Final Report

Establishment of an ex situ conservation area and domestication of Shorea spp. and Calamus spp. (Activity 3.2.)

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I. INTRODUCTION

1.1. Rationale

Forest genetic resources in Indonesia are significantly depleting due mainly to human activities such as forest conversion, illegal logging, forest fires etc. With regards to these facts, physical conservations of forest plant genetic resources have become important rescuing steps to be carried out. Dipterocarps and rattans are examples of forest plants facing problems of declining populations and have a wide range of natural distribution in ASEAN countries. Apart from producing timber, rattans and species of the genus *Shorea* (Dipterocarpaceae) produce non-timber forest products (NTFPs) of significant economic importance. Nowadays, the diversity of these forest plant species is under assault from deforestation and habitat alteration. Effective in-situ and ex-situ conservation strategies are required to conserve thee existing genetic resources. To conserve genetic resources, it is essential not only to maintain existing diversity, but also to understand the other biological aspects of the species of interest. In addition, a conservation effort needs to be exposed as easy as possible to other interested stakeholders for effective dissemination. Therefore, establishment of demonstration plots which are accessible and can serve as a place for eco-edu-tourism is necessary to be carried out.

1.2. Objectives

Objectives of this activity are:
1. To establish demonstration plot (demplot) for *ex situ* conservation of Meranti (*Shorea* spp) and Rattan in Gunung Walat Educational Forests (GWEF),
2. To study genetic and phenotypic variations (growth) of meranti and rattan in demplots of *ex situ* conservation.

II. METHODOLOGY

2.1. Location

Demplots are located in Gunung Walat Educational Forest of Faculty of Forestry, Bogor Agricultural University (IPB), which is around 60 km from IPB campus, Darmaga, Bogor (Figure 1).

Gunung Walat Educational Forest (GWEF) is a 359 ha mature plantation forest managed by the Faculty of Forestry, Bogor Agricultural University since 1968. It is located at the District of Sukabumi (40 km South East of Bogor), at 500-700 m asl altitude with 2000 mm annual rainfall and temperature of 18-22^{o}C. Infrastructures, such as guesthouses, office, classrooms, and common kitchen have been built in 1985. The initial condition of the forest area was mostly bare land. The students and staff of the Faculty of Forestry frequently visited the area to do reforestation programme including the establishment of ex-situ conservation demplots of Shora spp. and rattan

Fig. 1. Approximate location of demplot in GWEF, West Java as marked in red dot (left) and general condition of forests in GWEF (right)

2.2. Demplot establishment

Demplot establishments were divided into two phases, i.e. Phase 1 in 2004 and Phase 2 in 2005. In general, the establishment of demplots followed a procedure as described in Figure 2 and 3.

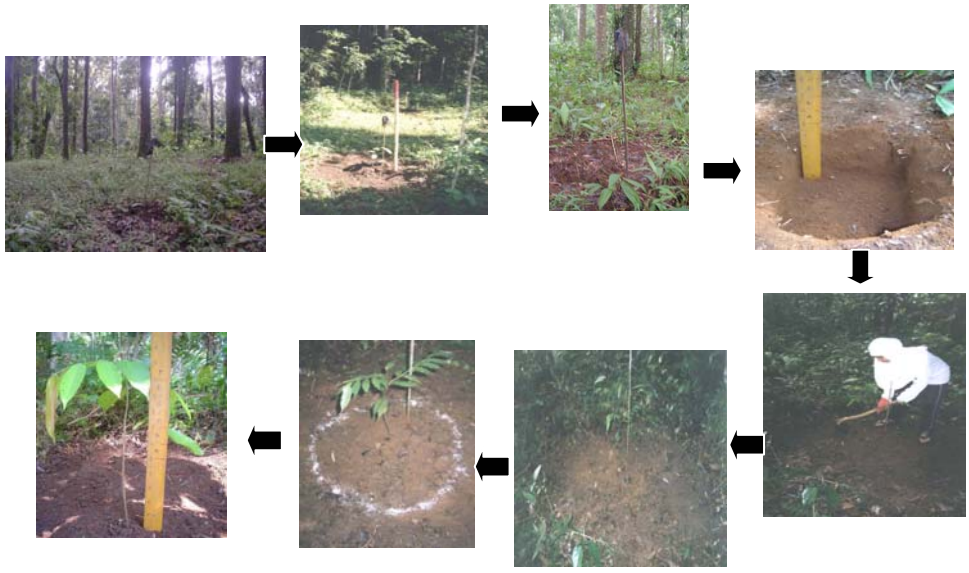

Fig. 2. Planting activities of Shorea demplot-Phase 2 (2005)

2.3. Genetic study

Apomixis has been reported in several taxa of the family Dipterocarpaceae. There is embryological evidence for the existence of multiple embryos originating from a single ovule in genus Shorea (Kaur et al., 1978). However, genetic evidence for the existence of multiple seedlings from a single fruit, indicative of

polyembryony, is still little. This study is aimed at revealing the genotypes of multiple seedlings from a single fruit of *S. mecistopteryx* observed during handling of seedlings by means of genetic marker, i.e. RAPD. The results would benefit the current understanding of apomixis and polyembryony in Dipterocarpaceae.

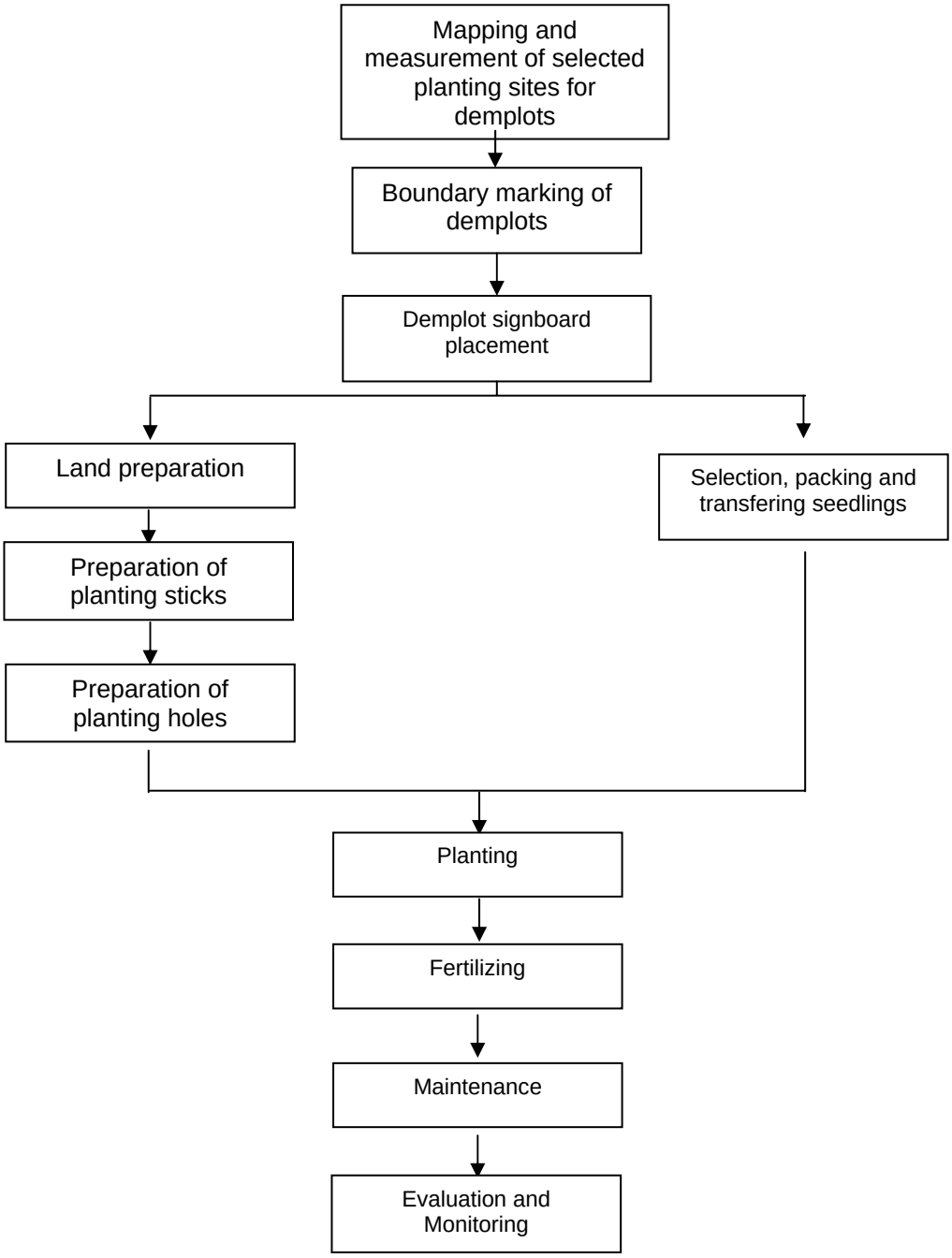

Fig. 3. Steps in demplot establishment

III. RESULTS OF ACTIVITY (2003-2005)

3.1. Demplot size and species

Total sizes of demplot already established in two phases were ± 1.2 ha and ± 2.8 ha for meranti (*Shorea* spp.) and rattans, respectively. Nine meranti species, planted under moderate density of *Agathis loranthifolia* stands, were *S. palembanica*, S. *mecistopteryx*, *S. pinanga*, *S. stenoptera*, S. *leprosula, S.johorensis, S. platyclados, S. javanica and S. ovalis.*

On the other hand, rattan species which were planted under high density of mixed *Pinus merkusii*, *Agathis loranthifolia* and *Schima wallichii*, were *Calamus manan, Calamus trachyceoleus, Calamus caesius* and *Daemonorops melanochaetes*. Rattan was planted at irregular distances close to positions of each individual tree (as climbing places for mature growing rattan) of the three mixed species within the demplot.

Summary of demplot establishment according to species is presented in Table 1 and 2.

Table 1. Original number of seedlings in Shorea demplot.

Species	**Number of seedling**	
	Phase # 1 (±0.6 ha)	**Phase # 2 (±0.6 ha)**
Shorea mecistopteryx	80	-
Shorea pinanga	80	150
Shorea stenoptera	80	-
Shorea palembanica	80	-
Shorea leprosula	80	-
Shorea johorensis	-	100
Shorea platyclados	-	50
Shorea javanica	-	50
Shorea ovalis	-	50
Total number	400	400

Table 2. Original number of seedlings in rattan demplot

Species	**Number of seedling**	
	Phase # 1 (±1.4 ha)	**Phase # 2 (±1.4 ha)**
Calamus manan	200	150
Daemonorops melanochaetes	200	100
Calamus trachyceoleus	-	250
Calamus caesius	-	18
Total number	400	518

Map of *Shorea* spp. positions and individual rattans of each species in the demplots of phase 1 are shown in Figure 4 and Figure 5, respectively, while for demplot of phase 2 is illustrated in Figure 6 & 7.

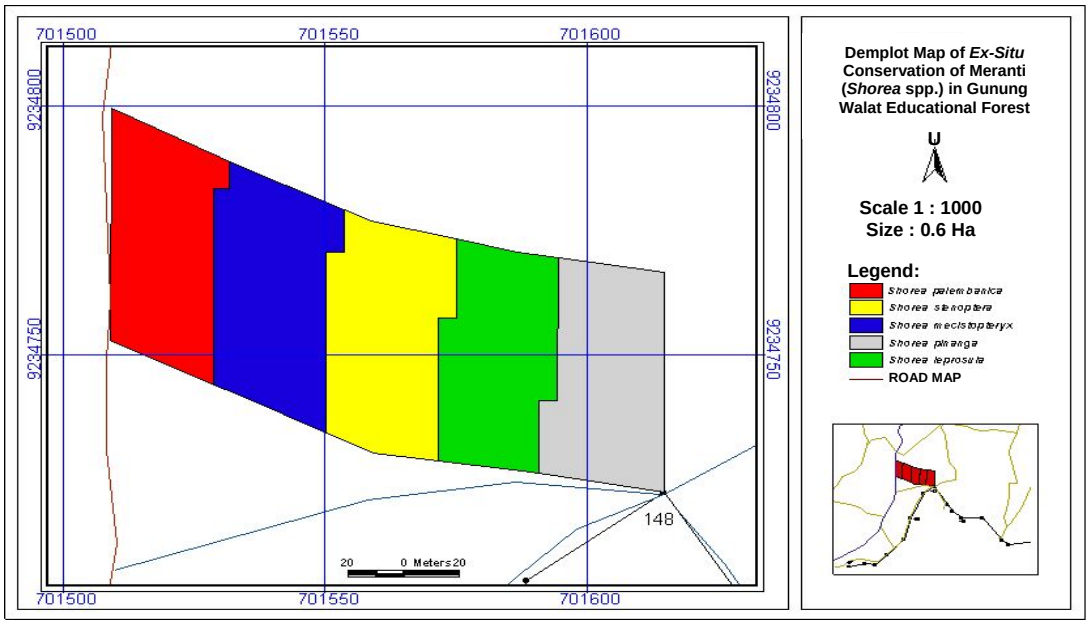

Fig.4. Arrangement of five meranti species (*Shorea* spp.) within demplot-Phase 1

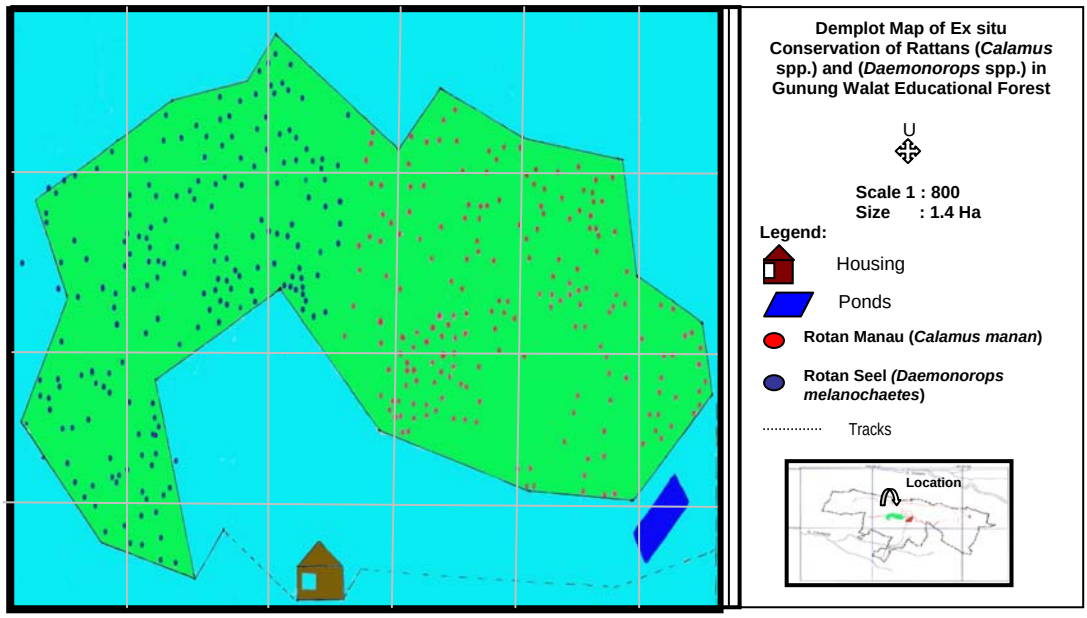

Fig. 5. Map showing individual plants of rattans (*Calamus* spp. and *Daemonorops* spp.)-Phase 1.

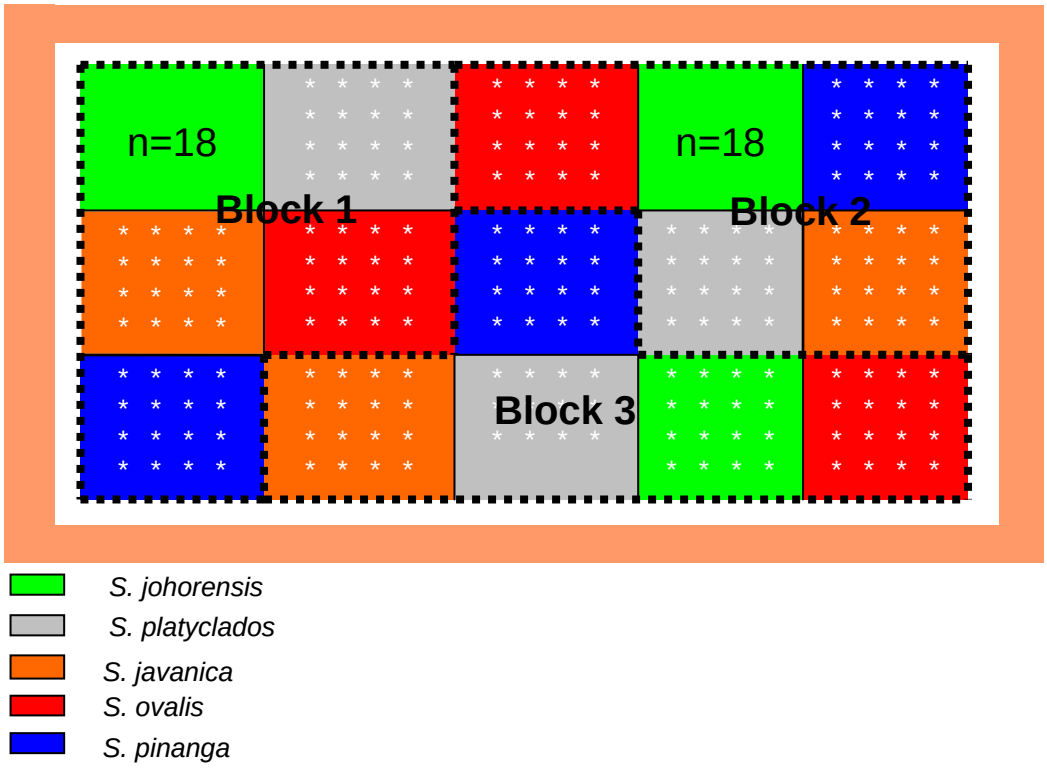

Fig. 6. Planting design of Shorea spp-Phase 2.

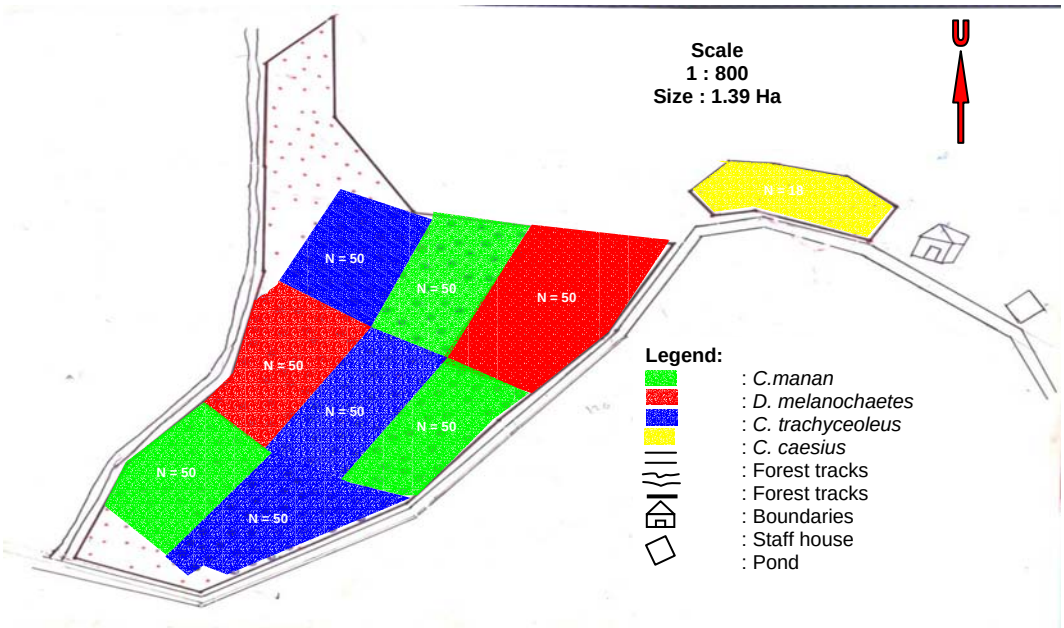

Fig. 7. Planting design of Rattan-Phase 2.

3.2. Seedling survival and growth

Th latest monitoring of plant performances in the field in order to find out their survival rates and growth was conducted in October 2005.

3.2.1. Meranti (*Shorea* spp.)

In Shorea demplot, results of inventory showed that survival rate and growth performance varied according to species. In demplot 1, *S. mecistopteryx* showed the fastest growth in comparison to other Shorea species (Table 3), while in demplot 2, the growth of *S. platyclados* was the best (Table 4). In demplot 1, the highest height increment after 1.5 year was 83.0 cm recorded for *S. mecistopteryx* and the lowest was only 29.3 cm for *S. stenoptera.* In demplot 2, the fastest growth after 7 months was recorded for *S. johorensis* (17.2 cm) and the slowest growth was observed for *S. javanica* (0.4 cm only).

Overall performance of Shorea spp. in both demplots are illustrated in Figure 8.

Table 3. Survival rate and height of Shorea spp in demplot of Phase 1.

Species	Survival (%)	Height (m)		Growth (cm)
		Mar'04	Oct'05	
1. *Shorea palembanica*	91,3	50.4	104.4	54.0
2. *Shorea mecistopteryx*	100	55.1	138.1	83.0
3. *Shorea stenoptera*	76,3	46.1	75.4	29.3
4. *Shorea pinanga*	93,8	38.8	81.6	42.8
5. *Shorea leprosula*	86,3	40.5	107.6	67.1

Fig. 8. Performance of Shorea spp. in demplot of Phase 1 (first row in March 2004 and second row in October 2005)

Table 4. Survival rate and average height of Shorea spp. in demplot of Phase 2.

Species	Survival (%)	Height (cm)		Growth (cm)
		Mar'05	Oct'05	
1. *Shorea johorensis*	97.7	49.7	66.9	17.2
2. *Shorea platyclados*	73.3	38.9	51.7	12.8
3. *Shorea pinanga*	93.3	57.8	66.8	9.0
4. *Shorea javanica*	91.1	37.3	37.7	0.4
5. *Shorea ovalis*	93.3	39.2	46.1	6.9

3.2.2. Rattan

Observation of rattan performance in demplots was usually conducted based on average survival rate only (Table 5 and 6). General conditions of rattan in the demplots are presented in Figure 9. In demplot 1, after the last replanting, the survival rate for both *C. manan* and *D. melanochaetes* per october 2005 were almost similar, i.e. 90.5% and 92.5%, respectively. On the other hand, the survival rates for *C. manan*, *C. trachycoleus*, *C. caesius* and *D. melanochaetes* varied ranging from, 44.4% to 69.3%. *C. manan* showed highest survival than others suggetsing its better adaptability than other species in this environment. The results of this evaluation still showed low survival rates of rattan and replanting activities is recommended to be carried out soon.

Table 5. Survival rate of Rattan in demplot of Phase 1 (per October 2005).

Species	Survival (%)
1. *Calamus manan*	90.5
2. *Daemonorops melanochaetes*	92.5

Table 6. Survival rate of Rattan in demplot of Phase 2 (per October 2005).

Species	Survival (%)
1. *Calamus manan*	69.3
2. *Calamus trachycoleus*	44.4
3. *Calamus caesius*	57.3
4. *Daemonorops melanochaetes*	45.0

Fig. 9. General performance of rattans in demplot of Phase 1 & 2. (Note: a=*C. manan*, b= *D. melanochaetes*, c= *C. trachycoleus* and d= *C. caesius*)

3.3. Procurement of new additional seedlings

During the evaluation, it was recognized that there are great interests to expand the planting of Shorea spp and rattans outside the demplots. In addition, the activity must not only restricted to the species of Shorea but also to other dipterocarps. Therefore, future planting activities will also be conducted outside the demplots in order to enrich the species diveristy in GWEF. Rencently, 1300 seedlings of Shorea and Hopea as well as 440 seedlings of rattans of three species were purchased and now maintained in the nursery of Faculty of Forestry IPB (Figure 10). After they reach acceptable heights for outplanting, the seedlings will be sent out to GWEF for enrichment planting outside the demplots. The management of GWEF and Faculty of Forestry IPB however will continue the planting activities despite termination of support from AUNP.

Fig. 10. Examples of newly purchased seedlings of Shorea and rattan maintained in nursery of Faculty of Forestry IPB for further expansion and enrichment planting in GWEF.

3.4. Genetype of multiple seedlings

The results of genetic investigation showed that multiple seedlings germinated from the same fruit of *Shorea mecistopteryx* originated from a plantation have different genotypes (Figure 10). This is in line with the investigation in *Hopea odorata* (Wickneswari and Norwati,1994), raising the possibility that multiple seedlings may nor necessarily involve apomixis.

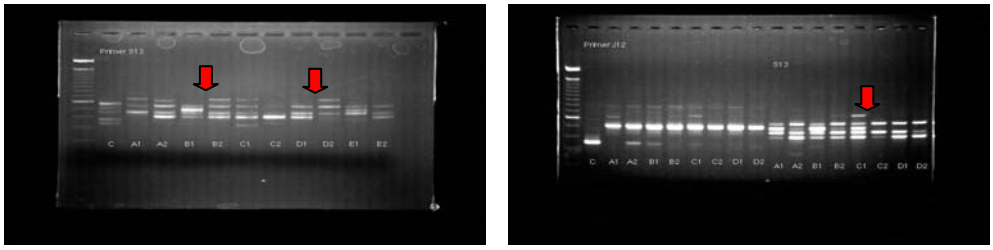

Fig. 11. Examples of DNA banding patterns as revealed by RAPD using primer S13 (left) and J12 (right). Red arrows shows genotypically different seedlings originated from one single fruit (B1≠B2; D1≠D2 and C1≠C2).

3.5. Others

It is realised that the presence of ex situ demplots of Shorea and rattans have been benificial objects for student academic activities as well as other stakeholders. The demplots have been used by students to examine among others silvicultural aspects of Shorea and rattans. A number of activity such as stand maintenance as well as growth measurement has been done with student involvement. In 2005, around 35 students of silviculture diploma programme visited demplots and carry out practical work on silvicultural aspects of Shorea and rattan. In addition, four final year students of silviculture diploma program have completed their final projects using demplots as their study objects. Apart from students, 29 journalists of Indonesian newspaper and magazines have visited the demplots to get the first hand experinece on tree species which are conserved in GWEF, i.e. Shorea and rattans. Since their establishment, demplots have become objects of interest in GWEF. Now, management of GWEF promotes the exposition of demplots to the visitors of various backgrounds including farmers from surrounding villages.

IV. CONCLUSION

In general, the establishment of ex situ conservation demplots in GWEF has provided lessons learned, which can be concluded as as follows:

1. Intensive care to the demplots is always necessary and enrichment planting of other rattan species need to be done soon. Addition of several species of dipterocarps not restricted to Shorea will be carried out after termination of AUNP project.
2. Demplots of Shorea & rattan have become one of points of interest offered in GWEF. Students can use demplots of Shorea and rattan for practical works on silvicultural techniques as well as observation of their survival and growth. Apart from students, other visitors of different backgrounds can be exposed to the demplots.
3. There is a lot of possibility for students to carry out experiments on rattan and Shorea spp. in the near future. Some important topics were clearly identified such as fertilizer application, shade intensity effects, pest and disease, etc.

V. REFERENCES

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