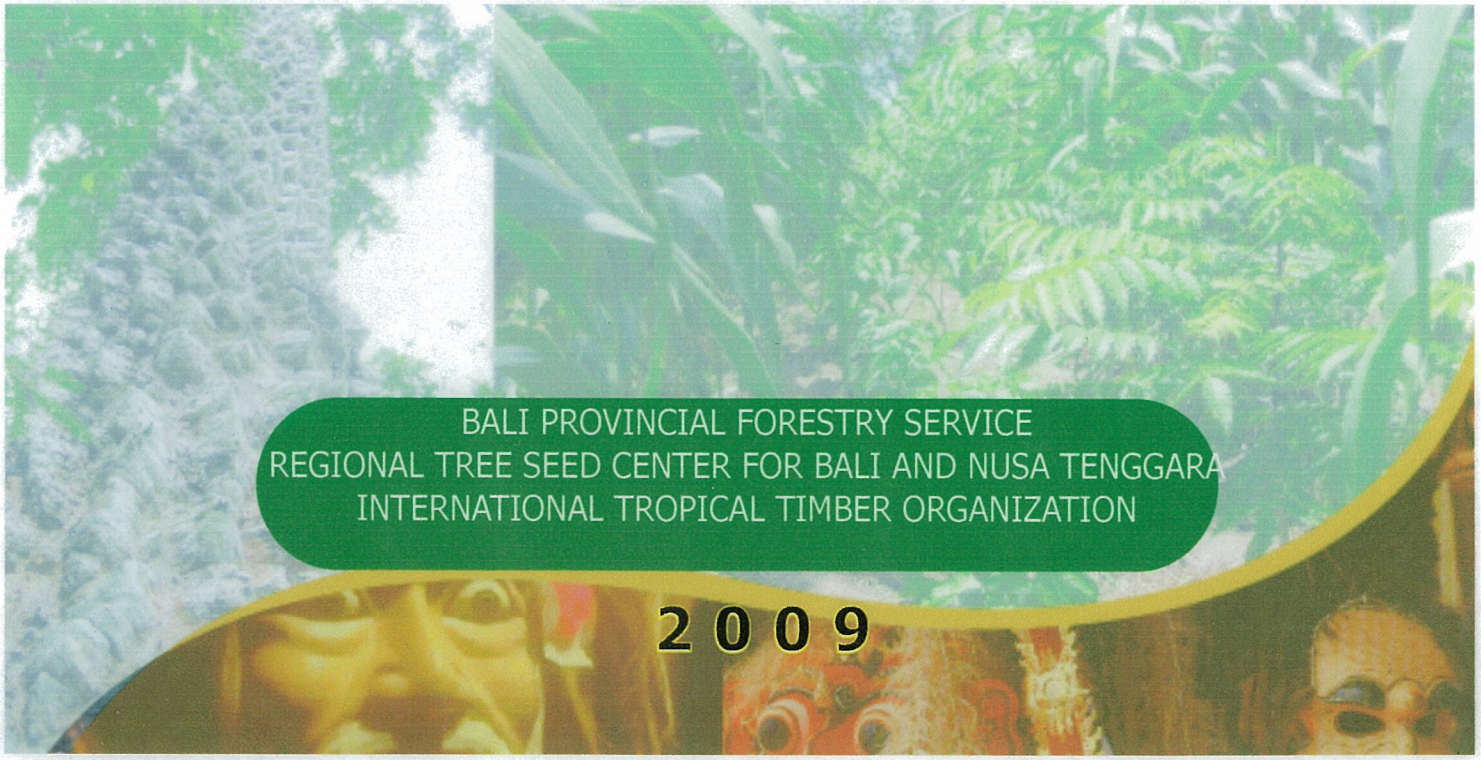
ITTO PD 386/05 Rev.1 (F)

TECHNOLOGICAL DEVELOPMENT FOR THE PRODUCTION OF PLANTING MATERIALS TO SUPPORT SUSTAINABLE PLANTATION OF BALI INDIGENOUS SPECIES THROUGH COMMUNITY PARTICIPATION

REPORTING ACTIVITY 1.4 FIELD TRIAL OF THE GENETIC MATERIALS AND SITE MANIPULATION, 6 Ha

PREPARED BY:
PROJECT EXECUTING TEAM



BALI PROVINCIAL FORESTRY SERVICE
REGIONAL TREE SEED CENTER FOR BALI AND NUSA TENGGARA
INTERNATIONAL TROPICAL TIMBER ORGANIZATION

2009

Reporting
Activity 1.4. Field trial of the genetic materials and site manipulation, 6 Ha

Project Executing Team ITTO PD 386/05 Rev.1(F)

Bali Provincial Forestry Service and
Regional Tree Seed Center for Bali and Nusa Tenggara and
International Tropical Timber Organization
2009

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SUMMARY

Field trial of the genetic materials and site manipulation has been established in Tegal Bunder, Village of Pejarakan, Sub-District of Grokgak, District of Buleleng, Province of Bali. Tested treatment consists of species and propagation techniques: seedling and cutting. Due to limitation number of cutting, total effective area for plot trial is only 4,815 hectare.
The objective of this activity is to obtain technical information and innovation to support plantation development of 6 (six) Bali indigenous species: *Fagara rhetsa, wrightia pubescens, Manilkara kauki, Planchonia valida, Dysoxylum densiflorum* and *Alstonia scholaris*.

Assessment and measurement was done at 6 months age for all survived trees for height and diameter.
The results of data analyzed showed that treatments were highly significant on 6 months of height and diameter for all species.

1. INTRODUCTION

1.1. Back Ground

Field Trial of the Genetic Materials and Site Manipulation is a part activity 1.4. In the implementation, this project involved Bali Provincial Forestry Service and Ministry of Forestry c.q. Regional Tree Seed Centre for Bali and Nusa Tenggara. The objective of this activity is to obtain technical information and innovation to support plantation development of 6 (six) Bali indigenous species: *Fagara rhetsa, Wrightia pubescens, Manilkara kauki, Planchonia valida, Dysoxylum densiflorum* and *Alstonia scholaris*.
Technical information for plantation establishment will provide a chance to develop new innovation for increasing the success and productivity of plantation. Furthermore, intensified silvilculture technique as combining method between planting materials and its silviculture will also support the success of plantation establishment. The important aspects, therefore, will involve selecting appropriate site, uses genetically improved stock, and application appropriate silviculture technique.
The report contains scopes of: site selection, experimental design, documentation of plot trial, maintenance, assessment and data analysis.

1.2. Materials and Method

1.2.1 Materials

Plot trial is established to address the problem related to the development and establishment of plantation of 6 Bali indigenous species: *Fagara rhetsa, Wrightia pubescens, Manilkara kauki, Planchonia valida, Dysoxylum densiflorum* and *Alstonia scholaris*

1.2.2.Method

This method arranged by Dr.Arif Nirsatmanto, national expert for tree improvement. The method comprising some element as follows:

Site selection.

Some factors should be considered for site selection as accessibility, soil fertilized, topography, water supply, security, soil and climate matching.

Size area for plot trial is determined in accordance of experimental design to make compact and comprehensive plot. To ensure future uses, land status should be also considered. In order to select appropriate site, survey has been done at 2 candidate site.

Plot trial experimental design

Experimental design is generated by considering the factors: number of treatment and the availability of size area. Firstly, the design is laid-out by assuming complete number of seedling for each treatment. However, in case number of seedling is not completely available as proposed one, the design revised up to certain condition. Experimental design will contain some information, such as: site map, blocking map, treatment allocation map. In this plot trial, the tested treatment involve of species and propagation techniques.

Plot trial documentation

The documentation consists of administrative location (RPH/Sub-District/District), situation of map, size area, blocking map, treatment allocation map, and applied silviculture treatment.

1.3. Maintenance

1.3.1. Survival rates

High survival rates will become important key for field trial establishment. This is because high survival rates will determine precise and accurate field trial results through statistics tools for data analysis. To keep high survival rates of field trial, it could be achieved by protecting and preventing the plot from threatening disturbance, whether from human, climate and or pest and disease.

1.3.2. Uniformity of maintenance

It means to keep the trees to grow well without occurring a disturbance and bias to the testing treatment. Uniformity of maintenance will practiced to the aspects of excluding the testing treatments. These aspects are such as weeding, hoe before planting, watering (if necessary), spacing arrangement. Uniformity of maintenance

will play important role to avoid bias field trial results, thus it can reflect the real effect of different testing treatment.

1.3.3. Plot trial security

Plot trial security is very important aspect to ensure sustainability of field testing. It can be handled not only through preventing from disturbance such as pest and disease, but also clearance of land status. Thus, termination before finishing of field trials can be avoided. This is because the testing treatments need more long time until achieving the final results.

1.3.4. Field trial identification board

Identification board is important to provide preliminary information to who may be concern about the existing field trial. It will also important to keep the clearance of land status.

1.4. Assessment and measurement

1.4.1. Periodical assessment and measurement

Assessment and measurement should be done regularly. Regular periodical assessment and measurement will provide a chance to observe trend of treatment effect to the growth. In the beginning, periodical measurement seem to better to be practiced more frequent. During the first 2 years age, measurement can be done twice per year. Thereafter, it can be done once per year. In addition, the month of measurement should be also kept consistently. This is because different month will have varies climate circumstance

1.4.2. Consistency of field note

Filed note should be prepared systematically according to the field trial design and form-file for data entry. It will support the appropriateness of data collection in the field.

1.4.3. Consistency of measured traits among the treatment

To achieve accurate and precise results of data analysis, measured traits should be consistent among the testing treatments. Consistency is not only for the kind of traits,

but also the applied methods of measurement. Objective measurement of the traits should be paid much attention, especially for the traits that should be assessed using scoring system such as form traits. Number of scores and their each criterion should be the same among the treatments.

1.5. Data Analysis

1.5.1. Appropriateness of data entry

The appropriateness of data entry will play important role in data analysis. This is because depending on these entered data the results of testing will be analyzed. Therefore, to keep the appropriateness, form-file for data entry should be arranged according to the field note. Any mistaken during the data entry will provide incorrect results and fatal impact in case the results will be developed in large operational scale

1.5.2. Data check

As control for the appropriateness of data entry, data check should be practiced for the entered data before analyzing the data. Through this step, at a glance, can be identified the strange and outlier data. If any miss-typed data, it should be corrected by confirming the field-note.

1.5.3. Interpretation of the results of data analysis

Interpretation should be done to describe the results of data analysis into the conclusion field testing results.

2. MAIN TEXT

Establishment field trial of the genetic materials and site manipulation, 6 ha

2.1.1. Site selection

Considering requirements in order to make compact design, site for plot trial establishment as follows:

- Tegal Bunder
- RTK : 19
- RPH : Sumber Kelampok
- Village : Pajarakan
- Sub-District : Gerokgak
- District : Buleleng
- Province : Bali

Site is located near to Taman Nasional Bali Barat (West Bali National Park), with the demarcation of seed orchard of putat (*Planchonia valida*) and Gerhan plantation (Site location in detail as presented in Appendix 01.)

Beside good accessibility, other considerations to select this location are good soil fertility (as shown by the growth of trees in demonstration plot), available size area, acceptable topography (flat) and compactness. Condition of site is presented in Figure 01.

Figure 01. Condition of site for plot trial establishment

Based on the availability number of seedling for each species and propagation technique (Appendix 02), experimental design is arranged in detail as presented in Table 01. Total area is about 6 hectares consisting of:

- 4,815 hectares as plot trial, and
- 1,20 hectares as border.

Tree species planted in border area should be the same as those planted in respective plot.

Table 01. Recapitulation of experimental design for plot trial of Field trials of genetic materials and site manipulation

No.	Species	Propagation technique	number seedling	spacing (m)	design	Area (ha)
1.	*P.valida*	Seed	600	3 x 3	RCBD *)	0,675
		Cutting	150			
2.	*A.scholaris*	Seed	600	3 x 3	RCBD	1,800
		Cutting	300			
3.	*F.rhetsa*	Seed	600	3 x 3	RCBD	0,540
		Cutting	90			
4.	*W.pubescens*	Seed	600	3 x 3	RCBD	0,360
		Cutting	60			
5.	*M.kauki*	Seed	600	3 x 3	RCBD	0,360
		Cutting	60			
6.	*D.densiflorum*	Seed	600	3 x 3	RCBD	1,080
		Cutting	180			

Note : *) *randomized complete block design*

Experimental design in detail is presented in Appendix 02.

Problems related to the composing experimental design was the limitation number of available materials from cutting. Moreover, cutting varied among species in growth and size. In this case, design is generated separately for each species using only available number of cutting. Whereas the number of seedling is complete where each species contains the same number. That is 600 seedlings for each and completely distributed into 3 replications.

Material condition for plot trial establishment as shown in Figure 02.

Figure 02. Condition of materials for plot trial establishment in nursery

2.1.3. Plot trial documentation

In order to be easier monitoring and evaluation of plot trial, database of plot trial has been composed. The database contains some data and information related to the plot trial establishment, such as:

- administrative location (RPH/BKPH/kecamatan/kabupaten),
- geographic location (LS-LU,BT-BB, elevation),
- indicative and situation map,
- area and spacing applied,
- name of target species and year of planting,

- type and kind of tested treatment,
- silviculture treatment,

2.2. Maintenance

Maintenance of *Field Trial of the Genetic Materials and Site Manipulation* covering of six species has been done as scheduled. However, due to the limitation of planting seasons, the mortality rate is high with the most suffered plot in *D. densiflorum*. In future, maintenance of the plots should be much paid attention to avoid increasing the mortality.

2.3. Assessment and measurement

Plot of *Field Trial of the Genetic Materials and Site Manipulation* was laid out as Randomized Complete Block Design (RCBD) with 3 replications and spacing 3 x 3 meter. Assessment and measurement were done at 6 months age for all survived trees inside the plot.

Measured traits consisted of:

- Height, measured form the base up to the top crown using metric scale (cm),
- Diameter, measured at the stem of 5 cm above the ground using metric scale (mm).

List of treatments tested for each species are presented in Table 02.

Table 02. List of treatments tested in *Field Trial of the Genetic Materials and Site Manipulation* for 6 species in Bali

No.	Treatment	Species					
		BT	MJ	SK	PB	PL	PT
1	Seedling-polytube	V	V	V	V	V	-
2	Seedling-polybag	V	V	V	V	V	V
3	Seedling-polybag + acrosoft 3 gr	V	V	V	V	V	V
4	Seedling-polybag + acrosoft 3 gr + nutrition 0.5 cc	V	V	V	V	V	V
5	Cutting-polytube	V	V	V	V	V	-
6	Cutting-polybag	-		V			-
7	Tissue culture	V		-			-
8	Shoot cutting	-					V
9	Stem cutting	-					V
TOTAL		**6**	**5**	**6**	**5**	**5**	**5**

Note : (V) tested treatments
BT : Bentawas
MJ : Majegau
SK : Sawo kecik
PB : Panggal buaya
PL : Pulai
PT : Putat

2.4. Data Analysis

Due to vary of treatments and limitation number of materials, data analysis was done separately for each species. Data analysis was run using analysis covariance (ANCOVA) due to vary in initial size and number of materials for each treatment.

The results of data analysis of Field *Trial of the Genetic Materials and Site Manipulation* covering 6 species are presented in bellow.

Wrightia pubescens

The results of ANCOVA showed that treatments were highly significant on height and diameter. Duncan test of the differences among the mean of treatment are presented in Table 02.

Table 03. Duncan test of the differences among the mean of treatment for height and diameter in *Field Trial of the Genetic Materials and Site Manipulation* of Bentawas at 6 months age

Rank	Height			Diameter		
	Mean	Treatment		Mean	Treatment	
1	58.14	4	a	1.42	1	a
2	54.19	2	a	1.21	7	a
3	48.39	3	b	0.96	2	b
4	34.69	5	c	0.94	3	b
5	30.35	1	d	0.67	5	c
6	22.83	7	e	0.66	4	c

Test of the differences showed that the highest mean of height was found at treatment no. 4 (Seedling-polybag + acrosoft 3 gr + nutrition 0.5 cc), and the lowest was found at treatment no. 7 (tissue culture). Whereas for diameter, highest mean was found at treatment no. 1 (Seedling-polytube) and the lowest was found at treatment no. 4 (Seedling-polybag + acrosoft 3 gr + nutrition 0.5 cc).

Dysoxylum densiflorum.

In case of *D. densiflorum*, almost all of tree is died and there is no data available for analyzing.

Manilkara kauki

The results of ANCOVA showed that treatments were highly significant on height and diameter. Duncan test of the differences among the mean of treatment are presented in Table 03.

Table 04. Duncan test of the differences among the mean of treatment for height and diameter in *Field Trial of the Genetic Materials and Site Manipulation* of Sawo kecik at 6 months age

Rank	Height			Diameter		
	Mean	Treatment		Mean	Treatment	
1	22.32	5	a	1.37	6	a
2	19.80	4	a	1.24	5	a
3	19.31	2	b	0.86	2	b
4	18.25	1	b	0.80	4	b
5	18.23	3	b	0.78	3	b
6	17.39	6	b	0.75	1	b

Test of the differences showed that the highest mean of height was found at treatment no. 5 (Cutting-polytube), and the lowest was found at treatment no. 6 (Cutting-polybag). Whereas for diameter, highest mean was found at treatment no. 6 (Cutting-polybag) and the lowest was found at treatment no. 1 (Seedling-polytube).

Fagara rhetsa

The results of ANCOVA showed that treatments were highly significant on height and diameter. Duncan test of the differences among the mean of treatment are presented in Table 04

Table 05. Duncan test of the differences among the mean of treatment for height and diameter in *Field Trial of the Genetic Materials and Site Manipulation* of Panggal buaya at 6 months

Rank	Height			Diameter		
	Mean	Treatment		Mean	Treatment	
1	42.39	4	a	1.39	1	a
2	41.46	3	a	1.15	4	b
3	37.17	2	b	1.13	5	b
4	28.98	5	c	1.10	3	b
5	18.22	1	d	1.03	2	b

Test of the differences showed that the highest mean of height was found at treatment no. 4 (Seedling-polybag + acrosoft 3 gr + nutrition 0.5 cc), and the lowest was found at treatment no. 1 (Seedling-polytube). Whereas for diameter, highest mean was found at treatment no. 1 (Seedling-polytube) and the lowest was found at treatment no. 2 (Seedling-polybag).

Alstonia scholaris

The results of ANCOVA showed that treatments were highly significant on height and diameter. Duncan test of the differences among the mean of treatment are presented in Table 05

Table 06. Duncan test of the differences among the mean of treatment for height and diameter in *Field Trial of the Genetic Materials and Site Manipulation* of Pulai at 6 months

Rank	Height			Diameter		
	Mean	Treatment		Mean	Treatment	
1	54.80	2	a	1.61	5	a
2	46.42	3	b	1.61	3	a
3	42.33	1	c	1.52	4	a
4	38.22	5	d	1.52	2	a
5	34.05	4	e	1.01	1	b

Test of the differences showed that the highest mean of height was found at treatment no. 2 (Seedling-polybag), and the lowest was found at treatment no. 4 (Seedling-polybag + acrosoft 3 gr + nutrition 0.5 cc). Whereas for diameter, highest mean was found at treatment no. 5 (Cutting-polytube) and the lowest was found at treatment no. 1 (Seedling-polytube).

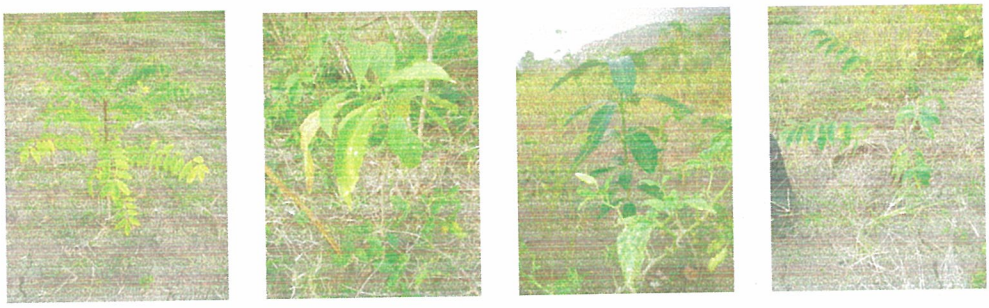
Planchonia valida

The results of ANCOVA showed that treatments were highly significant on height and diameter. Duncan test of the differences among the mean of treatment are presented in Table 06

Table 07. Duncan test of the differences among the mean of treatment for height and diameter in *Field Trial of the Genetic Materials and Site Manipulation* of Putat at 6 months

Rank	Height			Diameter		
	Mean	Treatment		Mean	Treatment	
1	33.75	4	a	1.43	3	a
2	24.89	3	b	1.31	1	a
3	22.82	5	b	1.26	5	a
4	20.82	1	c	1.11	2	ab
5	20.36	2	c	0.89	4	b

Test of the differences showed that the highest mean of height was found at treatment no. 4 (Seedling-polybag + acrosoft 3 gr + nutrition 0.5 cc), and the lowest was found at treatment no. 2 (Seedling-polybag). Whereas for diameter, highest mean was found at treatment no. 3 (Seedling-polybag + acrosoft 3 gr) and the lowest was found at treatment no. 4 (Seedling-polybag + acrosoft 3 gr + nutrition 0.5 cc).



(a) (b) (c) (d)

Figure 03. Trees at 6 months age in the plot trial (a) *Fagara rhetsa*; (b) *Planchonia valida*; (c) *Alstonia scholaris*; (d) *Wrightia pubescens*

3. CLOSING

Selected site for plot trial of Field Trial of the Genetic Materials and Site Manipulation is located at Tegal Bunder, RTK 19, RPH Sumber Kelampok, Village of Pajarakan, District of Buleleng, Province of Bali.

Tested treatment consists of species and propagation techniques: seedling and cutting.

Due to limitation number of cutting, total effective area for plot trial is only 4,815 hectare.

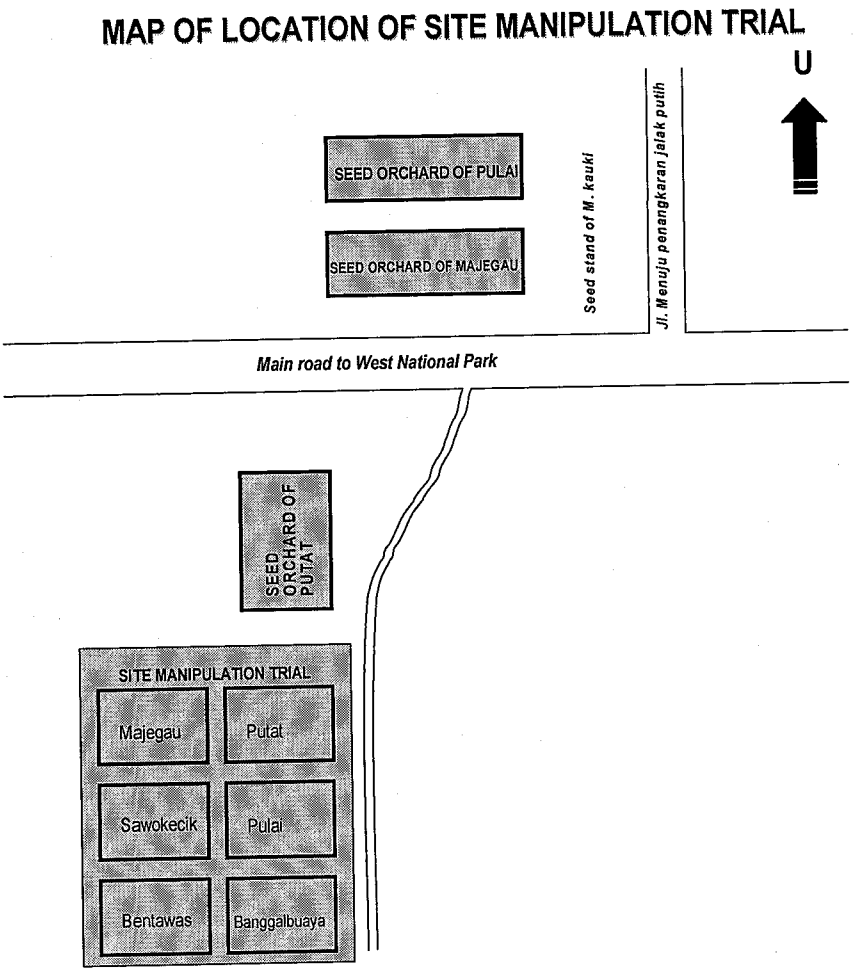
Maintenance was done as scheduled, however due to the limitation planting seasons, some of trees are died, mostly in *Dysoxylum densiflorum*.

Assessment and measurement was done at 6 months age for all survived trees for height and diameter.

The results of data analyzed showed that treatments were highly significant on 6 months of height and diameter for all species.

APPENDIXES

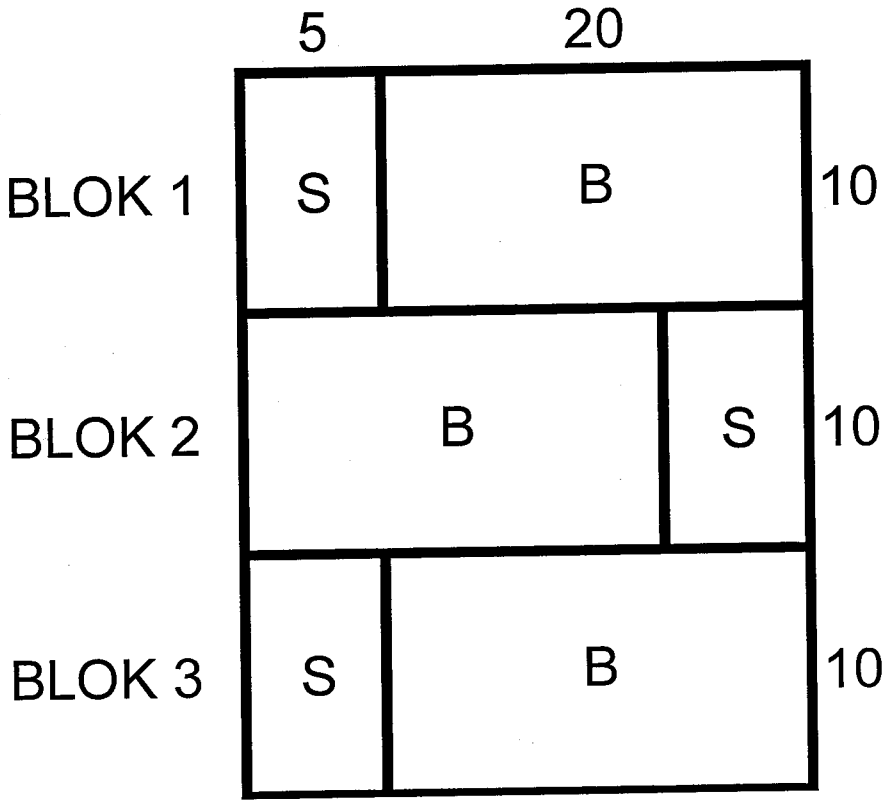
Appendix 01. Site map for establishing plot trial of Field Trial of the Genetic Materials and Site Manipulation Field Trial of the Genetic Materials and Site Manipulation



Appendix 02. Experimental design for field trial of genetic materials and site manipulation

DESIGN I

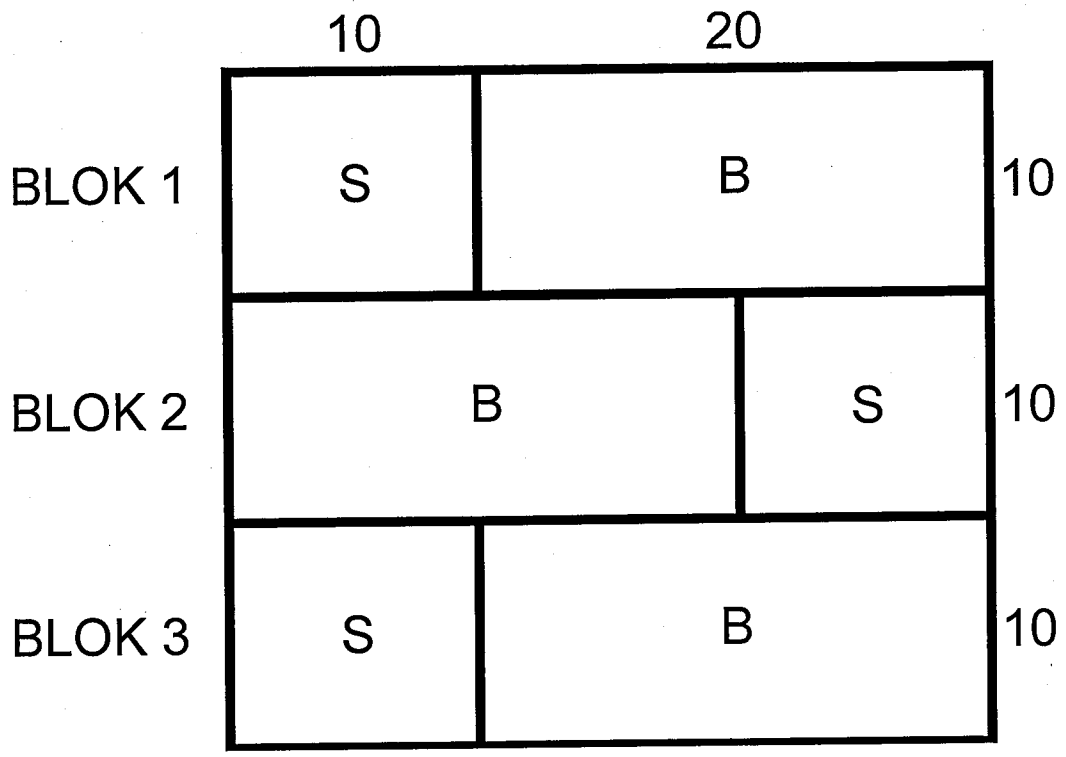
SPECIES	: PUTAT
TREATMENT	: 1) SEED (B)
	2) CUTTING (S)
BLOCK	: 3
NUMBER TREE PLOT	: 1) SEED = 200 SEEDLING / BLOCK (10 x 20)
	2) CUTTING = 50 SEEDLING / BLOCK (10 x 5)
SPACING	: 3 X 3 METERS
EFECTIVE AREA	: 0,675 HECTARES



Note : B : seed
S : cutting

DESIGN II

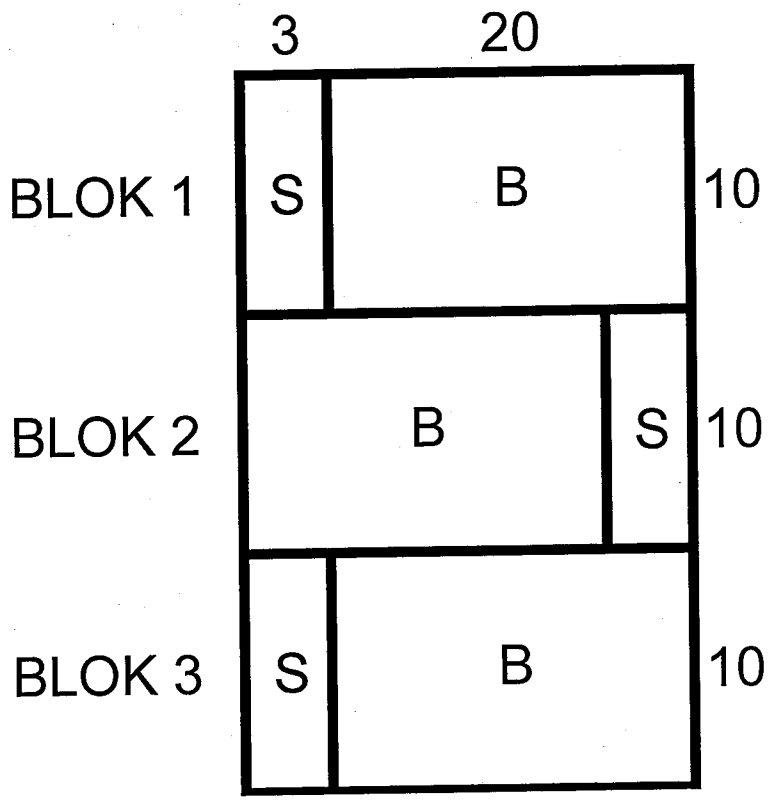
SPECIES	: PULAI
TREATMENT	: 1) SEED (B) 2) CUTTING (S)
BLOCK	: 3
NUMBER OF TREE PLOT	: 1) SEED = 200 SEEDLING / BLOCK (10 x 20) 2) CUTTING = 100 SEEDLING/ BLOCK (10 x 10)
SPACING	: 3 X 3 METERS
EFECTIVE AREA	: 1,800 HECTARES



Note : B : seed
S : cutting

DESIGN III

SPECIES	: PANGGAL BUAYA
TREATMENT	: 1) SEED (B)
	2) CUTTING (S)
BLOCK	: 3
NUMBER OF TREE PLOT	: 1) SEED = 200 SEEDLING / BLOCK (10 x 20)
	2) CUTTING = 30 SEEDLING / BLOCK (10 x 3)
SPACING	: 3 X 3 METERS
EFECTIVE AREA	: 0,54 HECTARES



Note : B : seed
S : cutting

DESIGN IV

SPECIES : BENTAWAS

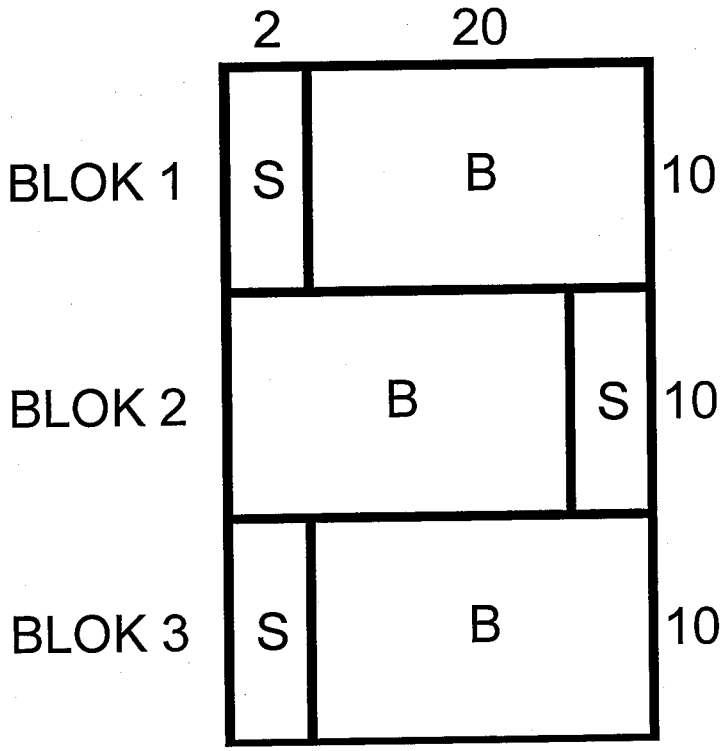
TREATMENT : 1) SEED (B)
2) CUTTING (S)

BLOCK : 3

NUMBER OF TREE PLOT : 1) SEED = 200 SEEDLING / BLOCK (10 x 20)
2) CUTTING = 20 SEEDLING / BLOCK (10 x 2)

SPACING : 3 X 3 METERS

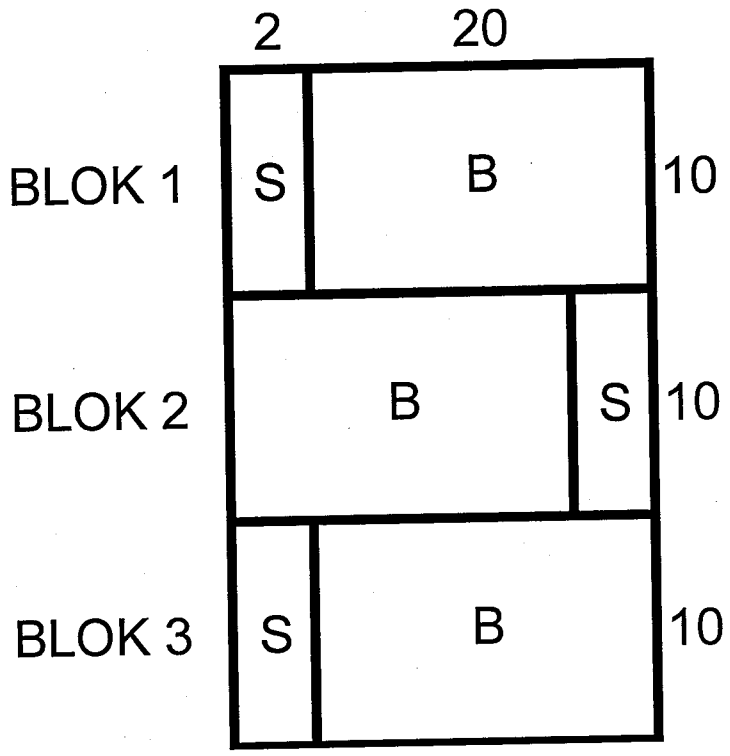
EFECTIVE AREA : 0,36 HECTARES



Note : B : seed
S : cutting

DESIGN V

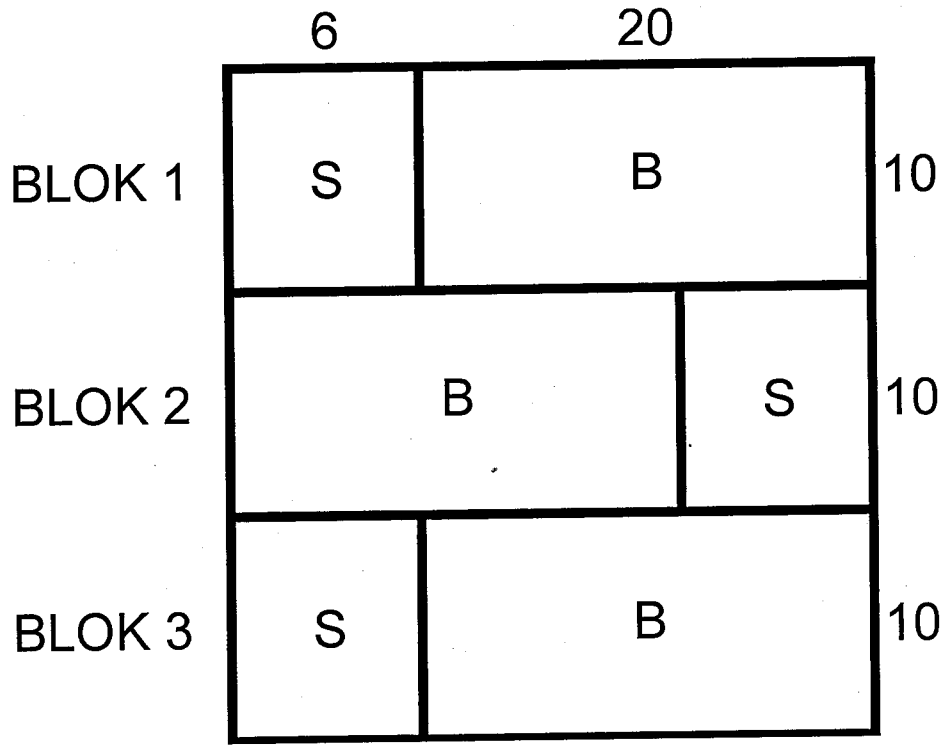
SPECIES	: SAWO KECIK
TREATMENT	: 1) SEED (B)
	2) CUTTING (S)
BLOCK	: 3
NUMBER OF TREE PLOT	: 1) SEED = 200 SEEDLING / BLOCK (10 x 20)
	2) STEK = 20 SEEDLING / BLOCK (10 x 2)
SPACING	: 3 X 3 METERS
EFECTIVE AREA	: 0,36 HECTARES



Note : B : seed
S : cutting

DESIGN VI

SPECIES	: MAJEGAU
TREATMENT	: 1) SEED (B)
	2) CUTTING (S)
BLOCK	: 3
NUMBER OF TREE PLOT	: 1) SEED = 200 SEEDLING / BLOCK (10 x 20)
	2) CUTTING = 60 SEEDLING / BLOCK (10 x 6)
SPACING	: 3 X 3 METERS
EFECTIVE AREA	: 1,08 HECTARES



Note : B : seed
S : cutting