Genetic Improvement of *Melia volkensii*: Evaluation of Candidate Plus Trees.

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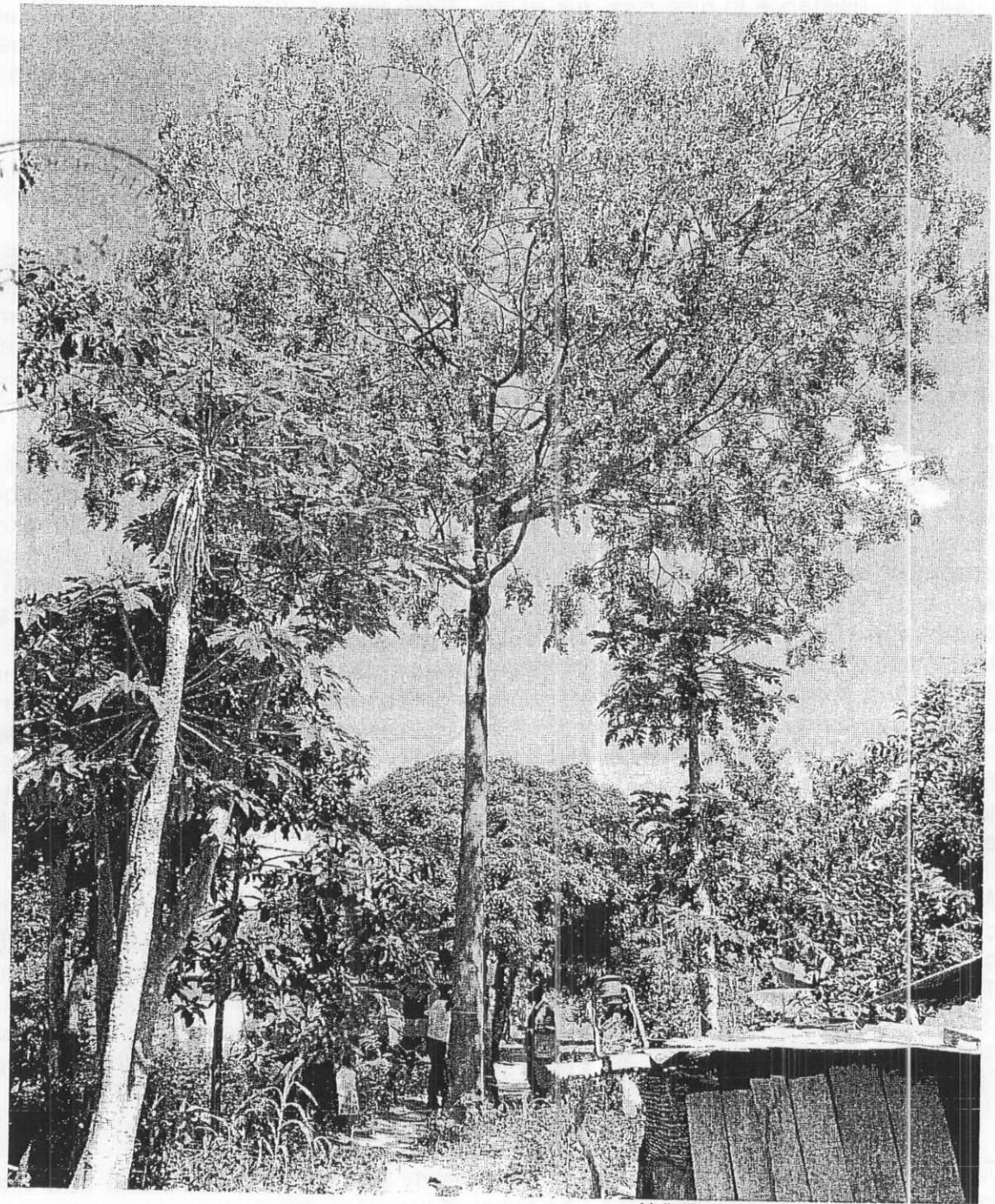


Melia Plus tree *Photo by: Mr. Ogawa*

1.0. Summary:

The field evaluation was undertaken by a group of scientist to evaluate further trees of Melia volkensii that were selected in the initial round of selections. Most selected trees were found still still This report was undertaken by: Dr. Jackson Mulatya, KEFRI Hqs; Mr. James Kimondo, Kitui Regional Research Centre; Mr. Ogawa, JICA/FD ISFP project;, Mr. Jason G. Kariuki, Muguga RRC and Mr. David Muchiri, Kibwezi. The selected trees were visited and reevaluated based on tree form, growth vigour and apparent resistance to diseases and pests. Sprouting of shoots was also assessed. A total of 40 plus trees wer selected as the base population from which initial breeding programme will commence. Additional candidate trees will also be evaluated with a view to broadening the genetic base and also for conservation.

2.0. Introduction and background:

2.1. Species description

Melia volkensii (Family: Meliaceae; common names: Melia, tree of knowledge (Eng.); mukau (Kamba), boba (Somalia) occurs naturally in the semi-arid zone of Ethiopia, Somalia, Kenya and Tanzania at altitudes between 350 and 1700 m, in areas with mean annual rainfall of 300-800 mm. The species is common in deciduous bushland in association with acacia-commiphora vegetation. It can grow on most soils; sandy, clay and shallow stony soils, but preferably sandy soils with good drainage.

M. volkensii is highly preferred in the drylands because of its high value timber and therefore it is in high demand. Its wood is durable and termite resistant. The timber is used for construction and furniture and is one of the principal species used to make log hives because the wood is easy to work and shape. Its preferred also as a fodder, coppices well and is fast growing with a rotation of 10-15 years. Twigs, leaves and fruits are used to make fodder for goats, cattle and sheep during the dry season and trees are commonly planted around homesteads for shade and firewood. In parts of Kenya it is the most commonly planted tree on cultivated and cleared lands. The trees are planted at 10-15 m spacing and pruned to avoid competition for light with the crops. Pruning is carried out during periods when other fodder sources are scarce. Because of its drought tolerance and high timber value, this species is popular and has greater potential for farmers especially in marginal areas. The species also contains compounds that are toxic to insects and aqueous extracts of the fruits are traditionally used to control fleas and ticks.

Melia volkensii is a deciduous tree, 6-20 m tall with diameter typically about 25 cm. The crown is open and the bark is grey and fairly smooth. Leaves are bright green, up to 35 cm long, compound, with 3-7 deeply lobed leaflets that are densely hairy when young. The flowers are small, white and fragrant, arranged in loose inflorescences. The fruit is a 3-4 cm long, ovoid drupe, yellow at maturity later turning pale grey due to the deposit of cork. Each fruit contains one seed that is enclosed in a very hard and thick endocarp (stone). There are about 200 stones per kg. The seeds are oval, about 2 cm long and 0.5 cm wide. At one end is an appendage called the caruncle.

The tree is deciduous, shedding its leaves early in the dry season, and new leaves emerge two to three weeks before the onset of the rains. On cultivated lands the leaves are normally shed later into the dry season. Reproductive buds develop only at the end of branches. They are generally larger than the vegetative buds. Flowering and fruiting do not follow a seasonal pattern. It can take place two or three times per year but fruits, even on the same branch, can be at very different stages of maturity. Fruits normally

ripen 12-13 months after the time of flowering. The trees have been reported to start flowering as early as 2-3 years old. It is unknown how the flowers are pollinated but bees visit the flowers indicating insect pollination. The seeds are dispersed by large mammals that feed on the fruits. When the seeds are mature the fruits change colour from green to yellowish-green and the pulp becomes soft. The endocarp becomes very hard and brittle and the colour of the seed coat turns from light brown to almost black.

The seedlings are highly susceptible to damping-off. Vegetative propagation by root cuttings is possible while there has been little success using stem cuttings as rooting is difficult.

2.2. Tree Improvement:

Tree improvement programmes aim to develop new plantations that are superior to their predecessors in one or several key economic traits. A breeding programme has to have a strategy implemented through an improvement plan. The hierarchy of populations from the base to the breeding to plantation population has to be defined. For Melia see appendix 1.

2.3. Genetic variation in *Melia volkensii*

In a study of natural and farm populations, Runo *et al* 2004, found that farmland populations differed significantly from natural or wild populations and also Those from the coast differed from the Eastern populations. Comparison of genetic diversity between Eastern and Coastal populations revealed that the Eastern populations had a higher mean value of genetic diversity (0.1146) compared to the Coastal populations with a mean of 0.0697. When genetic diversity was considered between farmland and natural populations, it was found that a high level of genetic diversity was found in farmland (0.1075) compared to natural populations. The authors showed that national park populations were less diverse. They recommend that efforts should be made to conserve the remaining stands *ex situ*. On farm conservation strategy of *M. volkensii* need to be emphasized since most of the variation is found on farmland populations. Major emphasis should therefore be placed on propagation and conservation of wildlings on-farm. In addition, fresh inclusions can be carried out from genetically diverse populations (Kibwezi and Kitui) to those with low genetic diversity (Galana, Taveta, Mwatate and Mbololo). According to Shepherd, 1989, cited in Runo *et al* 2004, the natural stands continue to decline drastically and only a few still exist in the national parks.

3.0. Summary of selected trees and classification

A detailed report on all the trees included in the initial selections carried out is given in a report "*Melia volkensii* and *Commiphorra valuensis* improvement and propagation project" by Mulatya *et al.*, 2004, attached as an appendix to this report.

4.0: Classification criteria

The selected candidate trees were classified into three distinct classes as follows: (see also appendix 1).

- Class "A" trees: All trees with straight, clear boles, light but vigorous crowns, no diseases or infestations.
- Class "B" trees: Good trees but with a minor defect
- Class "C" trees: These were marginal trees, having only one good feature, but otherwise several bad features
- Class "D" trees – These were though to be selected initially based solely on size or hugeness regardless of the tree form. These trees were rejected outright and may not be used for breeding programme. However they may be used for genetic conservation of the species.

3.1. KITUI DISTRICT:

Two transects were covered in Kitui District. One transect was located in the farmlands whereas the other was in natural/wild populations. These were Kitui-katulani – Kavisuni transects and the Mutha – Inyali transects respectively.

3.1.1 Kitui – Katulani – Kavisuni transect:

A total of 8 plus on-farm trees were evaluated on this transect. Trees No. 1, 2, 3 and 7 were found to be sprouting. A classification was done based on 4 classes (A, B, C, and D) and the classification of the various trees shown in Table 1. All class D trees will be discarded in this transect. Trees graded C are marginal and could be included depending on attainment of the required number of trees.

Table 1: Plus trees in Kitui-Katulani –Kavisuni transect.

Tree	Class	Spout	Comments	Action
1	B	Yes	Good form	Include (P4282575)
2	A	Yes	Good form	Include (P4282547)
3	D	No	Fair, canker	Discard Photo P4282543, replace with P4282544
4	C	No	Good	Include, given the poor form of most trees here
5	C	No	Fair form, fruiting	Include
6	D	No	Poorly formed tree	Discard, replace with nearby tree P4282583
7	D	Yes	Poor form	Discard
8	D	No	Diebark	Discard replace with nearby tree Photo P4282528

A=1 tree, B=1 tree C=2 trees

In summary, most tree in this transect were generally of poor stem form and it is possible that most good trees may have been selectively removed. Four trees should be discarded i.e. trees No. 3, 6, 7 and 8. To be included are trees No. 2, 1, 4 and 5 in a ranking order, starting with the best. Trees 3, 6 and 8 should be replaced as shown in Table 1. Total numbers of trees including replacements are 7.

3.1.2 *Mutha – Tulima – Inyali transect.*

Some trees in the Mutha –Tulima - Inyali transect are found occurring in the rangelands and therefore considered wild. Some of the trees were found to have distinct characteristics such as thick bark, smaller and more serrated leaves, but also good stem form despite lack of management. Suggested to be included in this transect are trees No. 9, 6, 5, and 7. A total of 5 trees had sprouted out of 8. Number of trees selected in this transect=4

Table 2: Classification of *Melia volkensii* trees in the Mutha-Tulima transect

Tree	Class	Spout	Comments	Action
1	C	No	Sweeps, fair form	
2			Not seen	
3	D	No	Poor form, fissures	Discard (see Photo P 4272642) replace P4272466
4	----	Yes	Cut, but coppicing	
5	A	Yes	Good form	Include (P4272472)
6	A	Yes	Good form	
7	C	No	Heavy branching	(P4272482)
8	D	Yes	Poor form	
9	A	Yes	Excellent form	Include (P4272510)

A=3 trees; B=0 trees, C=1 tree; D=2 trees

3.1.3. *Voi- Taveta transect*

All the trees in the Voi-Taveta transect are found on farms and therefore subjected to some form of management. Trees number 4, 5, 6 and 7 were found to be of acceptable class and may be included in the selections. Six out of the eight trees in this transect were found to be sprouting (see Table 3) and one tree was missed. In general, most trees in this transect were found to be of good form, some due to some form of management. Number of trees selected in this transect = 5

Table 3: Classification of *Melia volkensii* trees in the Voi-Taveta transect

Tree	Class	Spout	Comments	Action
1		---------	Tree not seen	See photo in Mulatya *et al* 2004 DOs Office
2	C	Yes		Photo P4262416
3	D	No	Scarred,	
4	A	Yes	Very good tree	
5	B	Yes	Good clear bole	P4262434
6	B	Yes	Good bole	P4262443
7	B	Yes	Fruiting	P4262445-7
8	D	Yes	Deformed	Discard (see P4262451)

3.1.4. *Embu – Ishiara transect*

The transects in this region were located at somewhat higher altitudes. It was apparent from observations that most good trees had not been interfered with as opposed to the Kitui and Voi-Taveta regions. All trees were located on farmland, where also planting of *Grevillea robusta* was pronounced. The availability of other tree species and ample food crops and other economic activities may have assisted in conserving Melia trees on farm.

Trees were generally oif average quality, very large but many had slightly deformed stems. At least three trees had sprouted, and one had been cut and had not coppiced.

Total trees to be included in this transect = 3 plus one replacement ie trees 1, 2, 6, and replace tree number 4 (see Table 4).

Table 4: Classification of *Melia volkensii* trees in the Embu_Ishiara transect

Tree	Class	Spout	Comments	Action
1	B		Good tree, but sweep	Include (P5162746)
2	B	No	Large tree, clear bole	Include (P5162773)
3	C	??	Large tree, knot	Include P5162723
4	C	Yes	Large tree, deformed	P 5162724 Replace with nearby tree (P5162728)
5	C	Yes	Heavy branching, deformed	
6	B	Yes	Light branching, rocky site	Include (P5162757)
7	----	No	Tree has been cut	P5162763
8	C	No	Many knots, sweeps	P 5162778

3.1.5. Shiakago Gacoka

Another higher altitude zone. One tree had been found to be cut, whereas 3 trees were suggested to be excluded with one replacement (see Table 5, tree 5). Total trees selected =4, ie trees number 4, 2, 3, and 7. Trees number 1 and 5 are to be discared whereas tree number 8 had been cut but can be salvaged through collection of sprouted material.

Table 5: Classification of *Melia volkensii* trees in the Shiakago-Gacoka transect

Tree	Class	Spout	Comments	Action
1	D	No	Many sweeps	Discard (P5172860)
2	B	Yes	Well formed	Include P5172853
3	B	No	Clear bole, seeding lightly	Include P5172782
4	A	Yes	Clear bole straight, excellent tree	Include (5172801)
5	D	No	Fairly crooked	Exclude P 5172793 and replace /797
6	C	No	Fair	Replace with tree next to it
7	C	No	V heavy branches	Marginal
8	----	Yes	Tree cut	To salvage using coppices

3.1.6. Mwingi – Nuu transect

Most trees in this transect have the unique characteristic of very large crowns and short but clear boles, identical with crop ideotypes which may yield very little timber but large amounts of fodder. Most trees were therefore found in class D, ie trees number 2, 3, 4, and 8 and these should be discarded. However tree number 2 may be replaced (see Table 6). Of the eight trees in this transect, only one had sprouted. Total trees to be include 3 including replacement of tree number 3. Tree number 5 was not found.

Table 6: Classification of *Melia volkensii* trees in the Mwingi - Nuu transect

Tree	Class	Spout	Comments	Action
1	B	Yes	Good bole, light branches	Include
2	D	No	Poor form, stem sweeps	
3	*D*	*No*	*Huge crown small bole*	P5192998 Replace with P5193000
4	D	No	Poor form, heavy branches	
5			Missed.	

6	C	No	V. Heavy branches	??? (P5192993)
7	C	No	*Large taper, short clear bole, fruiting*	Marginal Include??(P5192989)
8	D	No	Not fruiting, heavy branches	Exclude

3.1.7. Mwingi – Kyuso – Tseikuru transect

Most of the trees in this transect were generally of poor quality. According to the local people, most good trees have been selectively felled for sale to timber merchants. Three out of eight trees had produced sprouts. To be include 4 trees, ie tree numbers 7, 8, 4, and 5. Tree number 2 may be replaced with another tree (see Table 7).

Table 7: Classification of Melia volkensii trees in the Mwingi - Kyuso transect

Tree	Class	Spout	Comments	Action
1	D	Yes	Poor form, heavy branching	To discard (P5182929)Replace with P5182930)
2	D	No	Poor form, scarred	Discard (P P5182907 (Replace with P5182910
3	C	Yes	Large sweeps, heavy branching	Marginal (P5182953
4	C	No	Double leader, but v. vigorous, large seeds, leaves	Include but observe P5182938/43
5	C	No	Heavy fruiting	P5182969 OK
6	C	No	Large crown, short bole	P5182879
7	B	Yes	Heavy fruiting, clear bole	Include (P5182883)
8	C	No	Clear bole, slight sweep, Hives	Include (P5182872)

4.1. Summary of ranking of candidate trees per transect

Kitui – Katulani – Kavisuni transect:	Class	Rank	Tree No	Photo ref. No
	A	1	2	
	B	2	1	
	C	3	4	
	C	4	5	
	C	5	3	
	D	6	7	
	D	7	6	
	D	8	8	
Subtotal trees selected:		4		

Mutha – Tulima – Inyali transect	Class	Rank	Tree No	Photo ref. No
	A	1	9	
	A	2	6	
	B	3	5	
	C	4	1	
	C	5	7	
	C	6	8	
	D	7	3	
	D	8	4	
Sub-total trees selected		4		

Voi- Taveta transect	Class	Rank	Tree No	Photo ref. No
		1	4	
		2	5	
		3	6	
		4	7	
		5	2	
		6	3	
		7	4	
		8	8	
Sub-total trees selected		5		

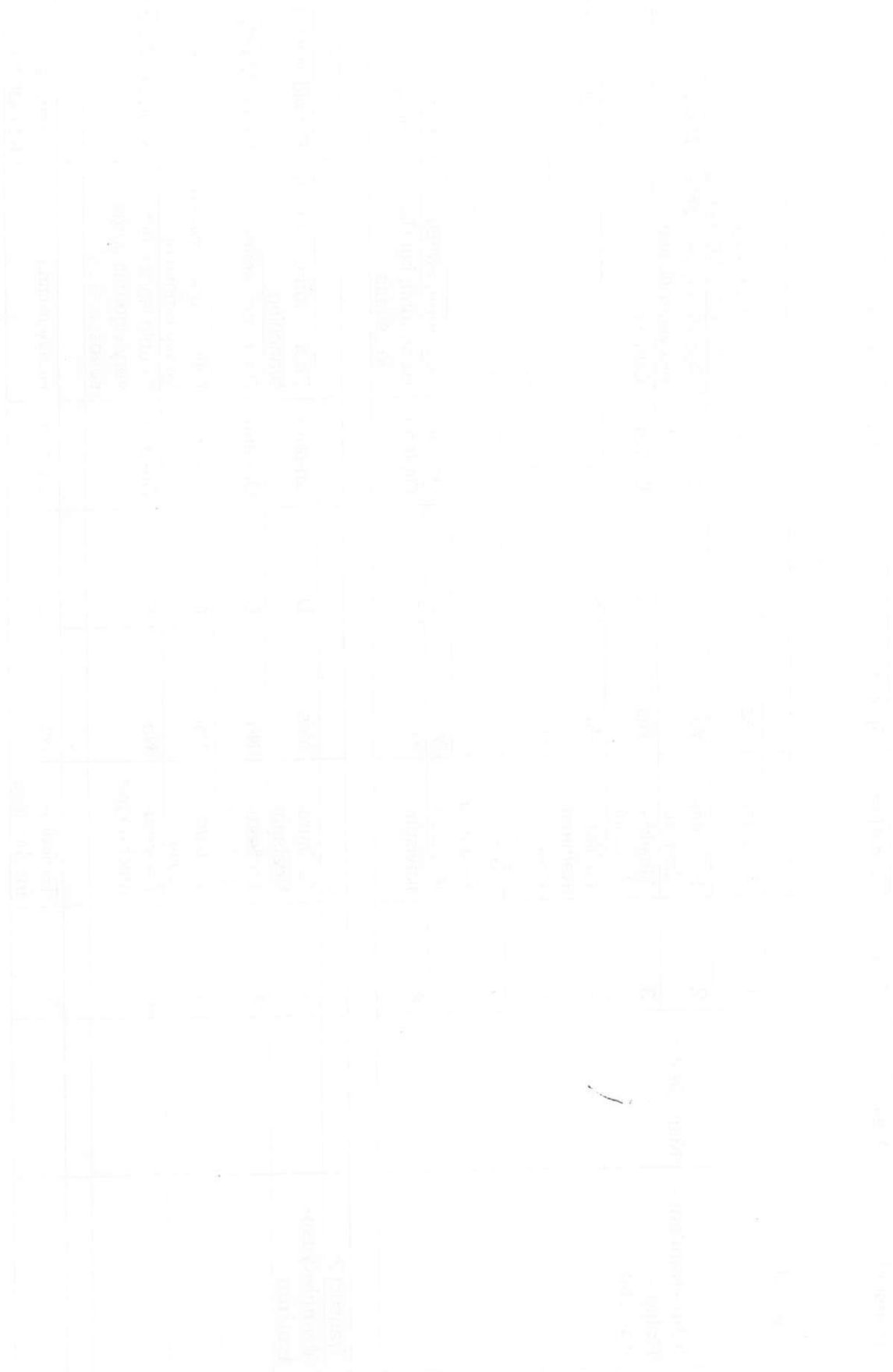
Shiakago Gacoka transect	Class	Rank	Tree No	Photo ref. No
	A	1	4	P5172882
	B	2	2	P5172853
	B	3	3	P5172782
	C	4	6	
	C	5	7	P5172793
	D	6	5	
	D	7	1	P5172860
	Cut	8	8	
Sub-total trees selected		4		

Mwingi – Nuu transect	Class	Rank	Tree No	Photo ref. No
	B	1	1	
	C	2	6	
	C	3	7	
	D	4	2	
	D	5	3	
	D	6	4	
	D	7	8	
	Missed	8	5	
Sub-total trees selected		3		

Mwingi – Kyuso – Tseikuru transect	Class	Rank	Tree No	Photo ref. No
		1	4	
		2	5	
		3	6	
		4	7	
		5	2	
		6	3	
		7	4	
		8	8	
Sub-total trees selected		4		

Embu – Ishiara transect	*Class*	*Rank*	*Tree No*	*Photo ref. No*
		1	1	
		2		
		3		
		4		
		5		
		6		
		7		
		8		
Sub-total trees selected		***4***		

TOTAL TREES = 28



Transect	Area	Tree No	Location	Sprouts	Class (A-V. Good) B-Good C-Fair D-Poor)	Status	Remarks	Farmer
Transect 1:								
Kitui - Katulani – Maliku – Kavisuni	Kitui Central	1	Kavisuni	Yes	B	On-fam	Heavy fruiting, good bole, heavy branching	Mwanza Musui
		2	Kavisuni-Nzukini	Yes	A	On-farm	Good form, clear bole, heavy branching	Musyoka Manzu
		3	Maluku-Kasungi	Yes	D	On-farm	Canker	
		4	Maliku-Kathungi	No	C	On-farm		Kithuka wa Muswi
		5	Kavisuni-maliku	No	C	On-farm	Fruiting	Kyalo mbuvi
		6	Katulani-Kwa muli	No	D	On-farm	V. heavy branching	Mwanza Mutisya
		7	Kavisuni	Yes	D	On-farm	Poor form, sweep	Kiveva
		8	Kavisuni	No	D	On-farm	Good form, but Die-bark, stress	George Kikuu
Transect 2:								
Mwingi-Kyuso-tseikuru		1	Tseikuru-Ngalangi	Yes	D	On-farm	Poor form, heavy branching	Ronald Musyimi
		2	Tseikuru-Ngalangi	No	D	On-farm	Poor form, scarred	Muthui Mulalya
		3	Tseikuru-Nziitu	Yes	C	On-farm	Has large sweeps, heavy branching	David Musila
		4	Tseikuru-machungwa	No	C	On-farm	Double leader, but very vigorous, large seeds, leaves	Kimwele Manze
		5	Tseikuru-machungwa	No	C	On-farm	Heavy fruiting	Mwanzia Kiumanzia

		6	Kyuso - Kiimu	No	C	On-farm	Large crown, short bole	Kasembi Kirugi
		7	Kyuso-kimu	Yes?	B	On-farm	Heavy fruiting, clear bole	Muvea Kirusi
		8	Kyuso - Kamwongo	No	C	On-farm	Clear bole, slight sweep, Hives	Mutie maluki

Transect 4								
Mwingi – Nuu		1	Nguni-Mathiakani	Yes	B	On-farm	Good bole, light branches	Mutembi Kisombe
		2	Nguni-Mathiakani	No	D	On-farm	Poor form, stem sweeps	Katungu Kimwele
		3	Nguni-Mathiakani	No	B	On-farm	New tree selected	Mwendwa Ngotho
		4	Nuu-Ngieni	No	D	On-farm	Poor form , heavy branches	Munywoki Mwanzia
		5					Missed.	
		6	Nyaani-Kavuti	No	C	On-farm	V. heavy branches	Danel Musyoka
		7	Kavuti	No	C	On-farm	Large taper, short clear bole, fruiting	Mulalya Ngondu
		8	Nguni	No	C	On-farm	Not fruiting, heavy branches	Miriam Mwendwa

Tree N

Transect 3:		1	Mutha-Ngaani	No	C	On-farm	Good bole, but sweeps	Simon muthusi
Mutha – Tulima - Inyali		2	Mutha-Inyali junction				Not seen	
		3	Mutha-ikutha	No	D	Wild/natural	Poor shape, deeply fissured	----------
		4	Mutha-Ngaani	Yes	-----	Wlid/natural	Tree has been cut	----------

		5	Mutha - Tulima	Yes	A	wild tree	Excellent form, light crown	
		6	Mutha-Ngaani	Yes	A	Wild/Natural	Very good tree	Nzuku kamuta
		7	Mutha	Yes	D	On-farm	Old tree, highly branched, poor form	Nzuku Kamuta
		8	Mutha - ngaani	Yes	D	On-farm	Old tree, large crown	Simon Muthusi
		9	Mutha-Ngaani	Yes	A	Natural/ Wild	Best wild tree, exc. form	Simon Muthusi

Transect	Area	Tree No	Location	Sprouts	Class (A-V. Good) B-Good C-Fair D-Poor)	Status	Remarks	Farmer
Transect								
Voi-Mwatate		1	Mwatate	--------	---------	----------	Tree not seen	
		2	Mwatate	Yes	C	On-farm	Tree standing, fruiting	Jared Singila
		3	NMwatunge-Mbogo	No	C		Scared, moderate deformity	
		4	Mwakiki Centre	Yes	A	On-farm	Very good candidate, seeding	Mrs Ngeti
		5	Mwakiki Centre	Yes	B	On-farm		Livingstone Mwabamba
		6	Tausa-Mraru	Yes	C	On-farm	Interfered with, die-bark, fruiting	Hezron Mwabara
		7	Tausa-Ndome	Yes	B	On-farm	Fruiting	James Msinga
		8		Yes	D	On -farm	Poor form	John Kibuyi

3.0. Genetic improvement of M. volkensii: Suggested way forward

3.1. Problem statement

Melia volkensii is one of the highly valued timber trees in arid and semi arid areas of Kenya. Its growth rate shows that timber can be obtained from the tree at least after 8 years. However, felling of trees with good stem form for timber production may have led to dysgenic selection (leaving only phenotypically poor trees, leading to progressive loss of variation and poor form of the remaining trees and their offspring. This aspect is evident in some areas like Kitui where specific characteristics of the tree associated with poor form are evident. In Mbeere, Melia trees on farms are generally of good form and vigour, and this could be attributed to presence of alternative species like Grevillea, eucalypts and also due to other sources of income available to the farmers, leading to lower levels of exploitation of the species on-farm.

On the other hand, natural populations in Mutha-mutomo areas have good plus trees which are comparable to if not better than on-farm trees, even without management. The pls trees on-farms were also subjected to differing levels of management, thereby interfereing with the phenotype. Some trees have attained good form even without management and represent good gene pools for the species. However, felling of the trees for timber still continues with the danger that these valuable populations will be lost over time. As is practiced on-farm, those felling these trees also go for the best formed trees and the likelihood of dysgenic selection also taking place in the wild populations. Population genetic theory predicts that the decrease in the genetic diversity limits a species ability to keep pace with the changing selection pressure

From the foregoing, it can be hypothesized that the genetic resources of *Melia volkensii* are being depleted at an alarming rate although this has been of late been balanced by the increasing interest of the farmers to plant the species. This depletion may not be in physical terms but through reduction of genetic quality of the planted or propagated material. There is therefore need to complement this interest by developing and introducing good genotypes that will lead to higher productivity and adaptability of the species in the target planting zones. Previous studies by Runo *et al* indicate that the species has several distinct populations that are differentiated at the genetic level.

Already 56 candidate trees have been selected in Taita, Kitui, Mwingi, Tharaka and Mbeere areas. Some of the candidate trees show obvious variation in leaf size and serration, stem form and bark type. It is hypothesized that due to selection of trees on farm for timber, most of the best genetic material has already been lost. However, some outstanding trees in the wild populations may still contain more variability.

3.2. Project goal:

Livelihoods of people in arid and semi-arid areas improved through enhanced production and productivity of (Melia volkensii) forest products

3.3. Project purpose:

The tree improvement purpose is to maximize the value of logs produced by farmers in arid and semi-arid areas.

3.2. Main Objective: Genetic improvement of Melia volkensii through selection, breeding and propagation and conservation of genetic resources for future breeding and use.

3.2.1. Specific Objectives:

- Select more plus trees especially in the wild populations (10)??
- To evaluate the selected superior trees to confirm their genetic superiority.
- Develop a breeding strategy for *Melia volkensii*
- Conserve populations (selected trees of Melia volkensii) in a conservation stand (clonal)
- Carry out progeny tests for the selected plus trees
- Establish clonal seed orchards using selected plus trees
- To compare propagation techniques of *Melia volkensii* for use in deployment of plus trees in clonal seed orchards.
- Assess performance of the grafted clones for further selection.

4.0. Activities:

4.1. Objective 1: Further selection of plus trees:

Selection criteria:
In the first cycle of selection and breeding, the following traits were used for as grounds for phenotypic selection of plus trees. The criteria will also be used in the second cycle to select 10 more trees (??).

- Stem form
- Growth and vigour
- Disease resistance
- Spiral grain tendency

The selected tree will be assessed and compared with the nearest five trees for stem form, growth and vigour, spiral grain prevalence and disease resistance. Comparison of growth traits such as height and diameter will be made but may not be used as a criterion due to possible differences in ages.

Outputs:

- 10 additional plus trees of Melia selected and documented
- Trees secured from the farmers –if on-farm for further use

Activities:

- Survey to identify potential areas
- Selection of candidate trees
- Comparative assessment of selected trees

- Selection and documentation

Objective 2: Develop a breeding strategy for Melia based on information on the species

Output:

- Short and long-term breeding strategy developed and approved

Activity:
- Collection of information on the species
- Consultations
- Develop breeding strategy

Objective 3: Conserve populations of Melia volkensii

Outputs:

- Sampling of M. volkensii populations for conservation of diversity
- Collection of genetic material for conservation
- Clonal banks of the selected trees established
- Source information and data of the material documented

Activities:
- Rising of rootstock for grafting
- Collection of scion material from plus trees, collection of root cuttings
- Grafting and raining of root cuttings
- Establishment assessment and monitoring

Objective 4: Carry out progeny tests of selected plus trees:

Output
- Progeny tests on 2 sites established

Activities:
- Collection of seed of the plus trees
- Nursery prepared and seeds sown
- Site preparation, design and layout of progeny trial carried out
- Planting initial assessment and monitoring

Objective 5: Establish seeds orchards using selected plus trees

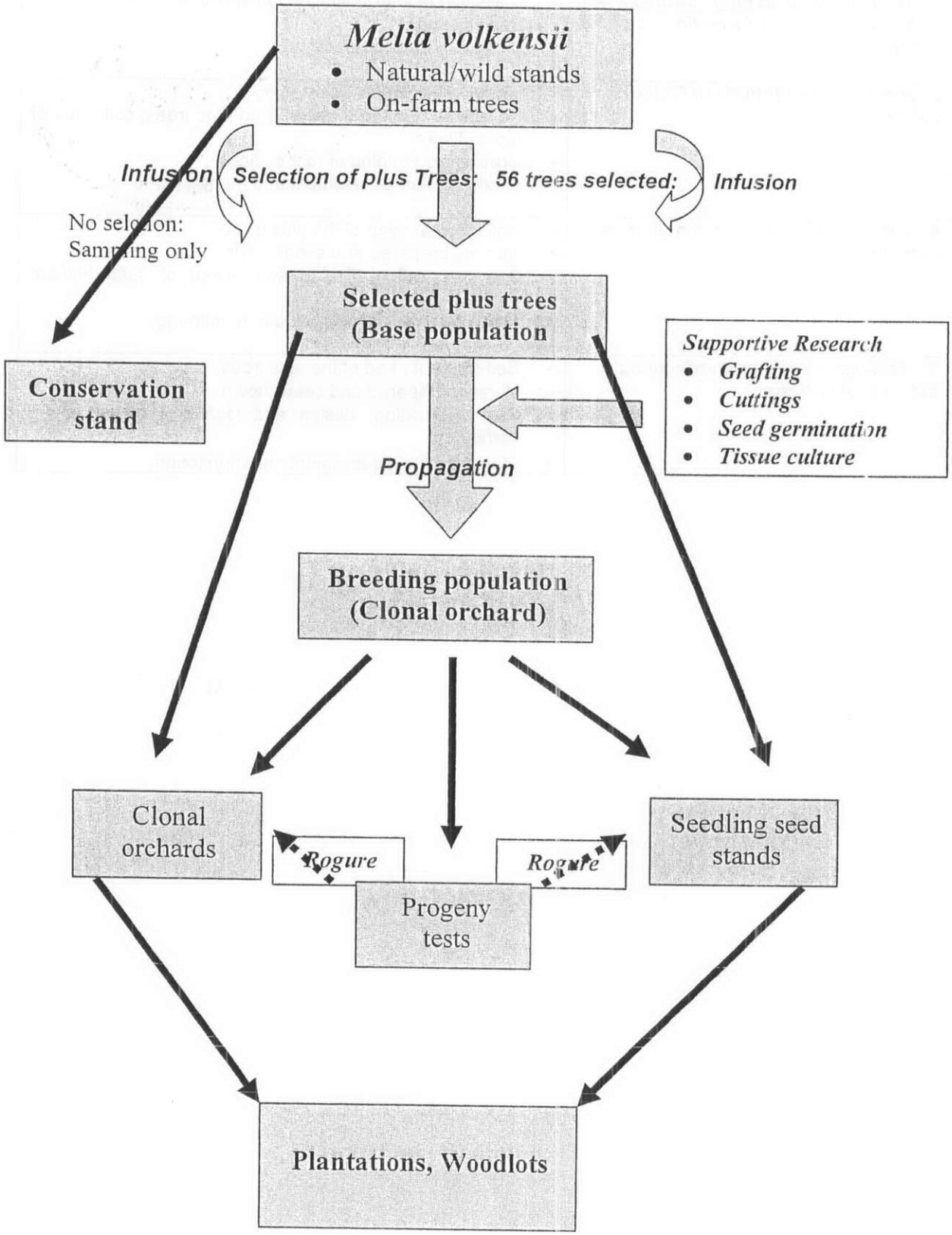
Outputs:
- Seeds orchards established
- Documentation of source material and information

Activities:
- Collection of seed of the plus trees

- Nursery prepared and seeds sown
- Site preparation, design and layout of seed orchard carried out
- Planting initial assessment and monitoring

APPENDIX 1: Model improvement strategy for *Melia volkensii*

GENETIC IMPROVEMENT OF *MELIA VOLKENSII*



OBJECTIVE	ACTIVITY
1: *Further selection of plus trees*	• Survey to identify potential areas • Selection of candidate trees • Comparative assessment of selected trees • Selection and documentation
2: Develop a breeding strategy for Melia based on information on the species	• Collection of information on the species • Consultations • Develop breeding strategy
3: Conserve populations of Melia volkensii	• Raising of rootstock for grafting • Collection of scion material from plus trees, collection of root cuttings • Grafting and raining of root cuttings • Establishment assessment and monitoring
4: *Carry out progeny tests of selected plus trees*	• Collection of seed of the plus trees • Nursery prepared and seeds sown • Site preparation, design and layout of seed orchard carried out • Planting initial assessment and monitoring
5: Establish seeds orchards using selected plus trees	• Collection of seed of the plus trees • Nursery prepared and seeds sown • Site preparation, design and layout of seed orchard carried out • Planting initial assessment and monitoring