Republic of Kenya
Kenya Forestry Research Institute

# PROJECT ON DEVELOPMENT OF DROUGHT TOLERANT TREES FOR ADAPTATION TO CLIMATE CHANGE IN DRYLANDS OF KENYA

## Completion Report

July 2017

Japan International Cooperation Agency

Forest Tree Breeding Center
Forestry and Forest Products Research Institute

Kenya Forestry Research Institute

Japan International Cooperation Agency

# PROJECT ON DEVELOPMENT OF DROUGHT TOLERANT TREES FOR ADAPTATION TO CLIMATE CHANGE IN DRYLANDS OF KENYA

Completion Report

(2012 - 2017)

**July 2017**

**Japan International Cooperation Agency**

**Forest Tree Breeding Center**

**Forestry and Forest Products Research Institute**

# Contents

# Chapter 1 Outline of the project

## 1. Background

In Kenya, the arid and semi-arid areas (ASALs) account for 80% of the country's land area and the forest area occupies only 7% according to a KFS Report, 2010. About 70% of sources of energy consumed in Kenya are accounted for by fuel wood, placing considerable pressure on forest resources. Furthermore, in recent years, immigration of farmers from other areas into the ASALs is accelerating degradation of forest resources and soils, and affecting living of local people, who are heavily dependent on these natural resources.

Kenya is considered to be one of the countries most affected by climate change. There is a forecast that the average temperature in the East Africa region could rise by 3 ºC over the next 100 years, and if this is the case, Kenya is likely to face extreme climate events like stronger and more frequent droughts, and inevitably the ASALs would be affected likewise.

Kenya's national development program, Vision 2030, recognizes climate change as an important issue to be dealt with and proposes formulation of adaptation programs on climate change and desertification in ASALs. In this respect, the Vision recommends development of commercial tree species in ASALs.

At present, JICA gives a top priority for assistance to Kenya to environmental conservation, but JICA has collaborated with Kenya in forest conservation in the ASALs for more than 20 years. Through such collaboration, Kenya Forest Service (KFS) has strengthened its system to implement social forestry and the techniques to establish farm forests have been smoothly extended to farmers. At the same time, two species, namely, *Melia volkensii* and *Acacia tortilis*, have been more recognized as the most important trees, because both are fast-growing and of multiple uses, the former produces high quality timber and the latter provides fodder and raw material for charcoal. However, stronger and more frequent droughts would narrow suitable areas to plant these two species in the future.

KFS has developed 'Strategic Plan 2008-2012', fully taking account of Vision 2030, and clearly stipulated 'developing drought tolerant trees for adaptation to climate change' as one of the dry land forestry programs. KEFRI has already commenced their study on plus tree selection based on appearance of tree size and shape, but has not yet had enough experience to conduct evaluation of growth and other traits, among other things, drought tolerance. Thus, the major challenge KEFRI is facing is to gain necessary expertise to undertake tree breeding. In addition, it is also indispensable to grasp geographical genetic variation of plus trees so that genetic contamination with respect to the said two species can be avoided as much as possible in Kenya when genetically improved seeds available from tree breeding efforts are extended to farmers.

In view of the foregoing, the GOK has officially requested a technical cooperation on "Development of Drought Tolerant Trees for Adaptation to Climate Change in Dry lands of Kenya" to the GOJ.

In a response to the request, JICA has dispatched a mission team to design the project in detail and agreed on the framework of the cooperation with GOK in March 2012, and signed and concluded the Record of Discussions (R/D) for the project in June 2012.

This technical cooperation project is to be implemented in accordance with the above R/D, for 5 years from 2012 to 2017, in order for capacity building of tree breeding research and establishment of system for extension of improved seeds of indigenous species, with KEFRI and KFS as the counterparts (C/P).

## 2. Objective of the project

(1) Overall goal

Quality plantations of indigenous species are extended in the ASALs of Kenya.

(2) Project purpose

Research capacity and extension system necessary for promoting indigenous species plantation in the ASALs is enhanced.

(3) Outputs

(i) KEFRI's capacity for conducting research on genetic diversity of indigenous species (*Melia volkensii* and *Acacia tortilis* as pioneer trial) is strengthened.
(ii) KEFRI's capacity for implementing forest tree breeding of indigenous species (*Melia volkensii* and *Acacia tortilis* as pioneer trial) is strengthened.
(iii) Quality seed and seedling supply system for *Melia volkensii* is established.
(iv) Awareness of relevant stakeholders on the importance of quality seed and seedling is raised.

## 3. Period of the project

5 years; From July 2012 to June 2017

## 4. Implementation body and beneficiaries

(1) Implementation agencies

Kenya Forestry Research Institute (KEFRI) and Kenya Forest Service (KFS)

(2) Beneficiaries

- Staff member of KEFRI; Approximately twenty staff members
- Staff member of KFS; Approximately fifty staff members
- Inhabitants of Arid and Semi-Arid Areas (ASALs) of Kenya; Approximately one million people

## 5. Target area of the project

# Chapter 2 Basic Policy of the project implementation

## 1. Technical Policy

### (1) Genetic analysis

The purpose of this project is to develop drought tolerant native species, *Melia volkensii* in particular, to contribute to promotion of productive forestation for various uses. However, the project also provides necessary assistance of DNA analysis for capacity development of C/Ps. Recently importance of genetic diversity has been increasingly emphasized, and simultaneous pursuit of both land productivity and diversity conservation is strongly required. This means that more careful consideration to the genetic diversity is required in the tree breeding strategy. The project assists C/Ps in developing the genetic diversity conservation guideline to indicate proper distribution areas for each variety without causing genetic pollution, through the analysis of the genetic variation of indigenous tree species in Kenya, namely *Melia volkenssi* and *Acacia tortilis*. The guideline makes the C/P agency achieve both objectives of the livelihood improvement of local people and conservation of genetic diversity.

The project introduces advanced techniques of DNA analysis by using the equipment to be introduced by a grant scheme by GOJ, such as Thermal cycler and Sequencer. Full utilization of advanced equipment requires operational knowledge of the system as a whole. The project therefore organizes OJT-like training in Japan, where C/P as trainees are given assignments, and technical advice in a timely manner during a training course which takes several weeks prior to the activation of the equipment to be introduced to KEFRI.

### (2) Tree breeding system

The project aims at establishing the comprehensive tree breeding system of drought tolerant tree species. The breeding procedure mainly consists of the following activities.

A) Select candidate plus trees as breeding materials
B) Propagate clone seedling of the plus trees, and establish clonal seed orchard
C) Establish progeny test stand for identification of characteristics of each variety
D) Provide quality seeds from the seed orchard

In tree breeding, the same activities as above repeat for each generation. In order to demonstrate tangible achievements in a limited period, the project reduces the duration of one cycle of tree breeding system to only five years. KEFRI, FTBC and JICA Kenya office have already embarked on some part of the breeding cycle, and the project would take over the activities such as root stock generation for grafting propagation. Thanks to these prior activities, the project would be able to establish the clonal seed orchard in the very first year of the project. In addition, the project limits the number of target species to two, *Melia volkensii* and *Acacia tortilis*, in order to concentrate limited resources and capacity.

The project coordinates the training in Japan in order to enable trainees to obtain necessary knowledge and skills for on-site activities in suitable timing. Especially as for managerial staff, trainees study comprehensive breeding system in Japan from national policy to ground facility, which includes basic concept of tree breeding, plus tree selection, hybridization, progeny test, provenance test, quality seed production and so on. The curriculum is designed in a combination of lectures and practices for effective training.

(3) Propagation techniques

The project promotes nursery management skills of KEFRI staff in order to ensure the quality planting material provision, since the project plans many planting activities such as establishment of clonal seed orchard, progeny test field, seed stand and demonstration forest. In general, forestry nursery needs more effort than agricultural one in order to maintain the quality of propagation work since propagation works take place after a very long interval like several months or years in some cases to and tend to receive less supervising. Practical curriculum is prepared for KEFRI staff.

(4) Drought tolerant index

The project aims at analyzing drought tolerant characteristics of *Melia volkensii* and developing a method to select drought tolerant variation In order to identify the drought tolerant characteristics of each variation, various morphologic and physiologic observations are proposed, which range from simple measurement of leaf shape to photosynthesis performance by high-tech equipment. The project provides necessary measuring tools together with appropriate training in Japan including the latest analysis techniques in laboratory.

## 2. Management Policy

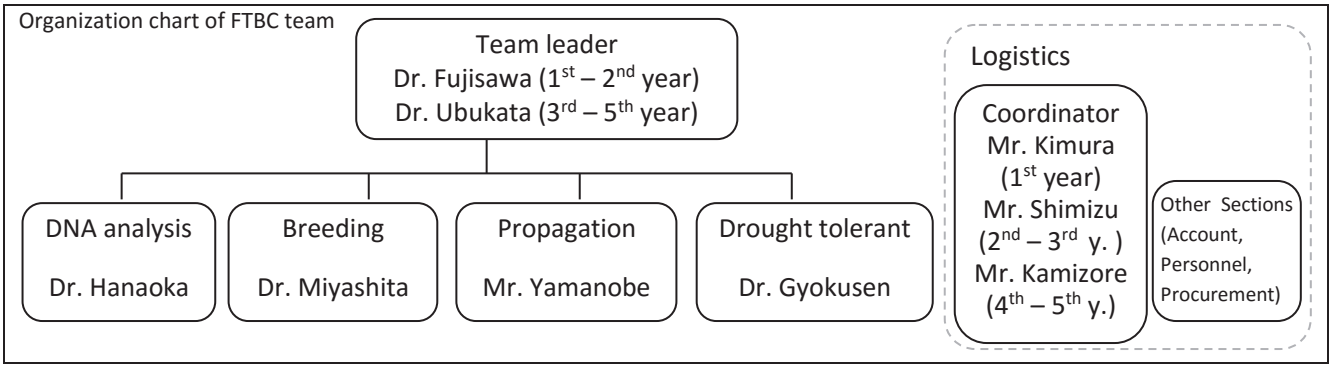
(1) Linkage between dispatching experts, Training in Japan and Equipment provision

The project intends to introduce new system which does not exist in Kenya now, such as DNA analysis of Output 1, and tree breeding system of Output 2. C/Ps, therefore, may face the difficulty of operation, if they cannot figure out appropriate work flow of newly introduced system. In order to overcome this difficulty, FTBC proposes the followings for the project management.

(a) Synchronize the project implementation and the training program in Japan
(b) Short term experts take care of the training in Japan as well as technical guidance in Kenya, in their responsible subjects
(c) KEFRI introduces the same equipment as FTBC laboratory as much as possible.

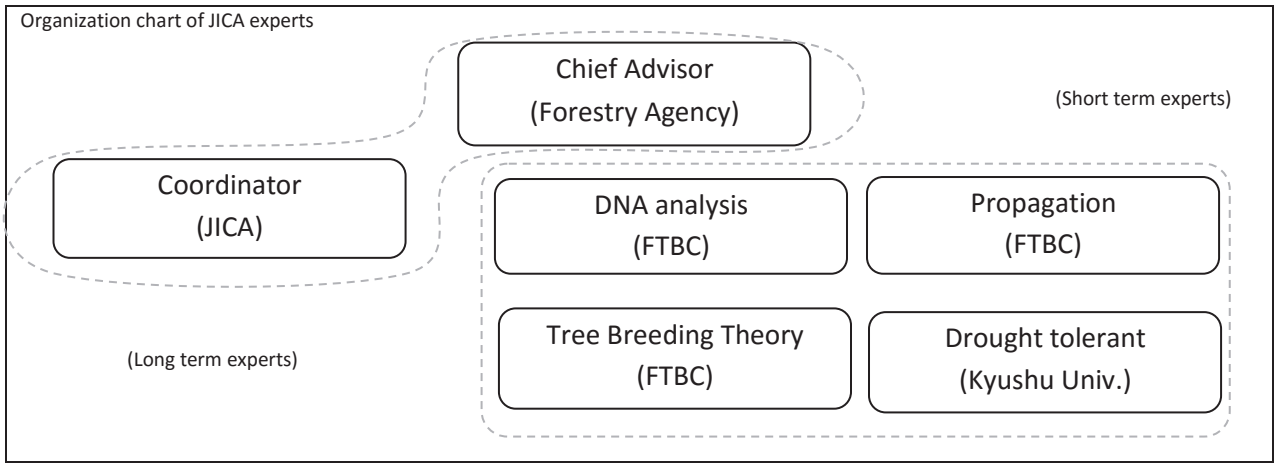
(2) Frame work of FFPRI-FTBC team

FTBC organizes the expert team as below;



(3) Framework of expert team

Long term experts and FTBC team closely cooperate and support each other under the framework of the expert team. The organization chart of the expert team looks like below;




In addition to individual TOR of each expert, general demarcation between the long term experts and short term experts is proposed as follows;

| Category | Mandate |
|---|---|
| Long term expert | • Oversee general progress of the project as a whole<br>• Implement activities of Output 3 and Output 4<br>• Procurement in Kenya and local currency accounting<br>• Liaise with KEFRI, KFS, other governmental organizations, JICA Representative Office, and other donors or NGOs. |
| Short term expert | • Implement activities of Output 1 and Output 2<br>• Technical advice on Output 3 and Output 4<br>• Organize the training in Japan<br>• Procurement in Japan (in cooperation with JICA HQs)<br>• Maintain communication and information gathering in Japan |

## 3. Assignment of experts

Experts play role of advisor and/or instructor of C/Ps in the field of their specialty.

| Title | Name of Expert | Mandate |
|---|---|---|
| Team Leader | Dr. Yoshitake Fujisawa (1st – 2nd year)<br>Dr. Masatoshi Ubukata (3rd – 5th year) | - Delegates Short term experts for coordination with Long term experts<br>- Manages the progress of short term experts' activities<br>- Supports the extension work<br>- Proposes appropriate activities for problem resolution<br>- Coordinates report writing |
| DNA Analysis | Dr. So Hanaoka<br>Dr. Michya Matsushita (3rd – 5th year) | - Gather the information of target tree species population<br>- Gather the specimens for DNA analysis<br>- Conduct DNA analysis<br>- Analyze the data<br>- Develop Genetic diversity conservation guideline |
| Tree Breeding | Dr. Hisaya Miyashita | - Select plus tree of target tree species<br>- Prepare seedling seed orchard and seed stand<br>- Develop and maintain seed orchard and progeny test stand<br>- Evaluate the candidate plus tree |
| Propagation/Extension | Mr. Taro Yamanobe | - Provide necessary planting materials<br>- Develop demonstration forest<br>- Support the extension work |
| Nursery management | Mr. Nobutaka Chiba<br>Mr. Shoki Sakamoto<br>Mr. Shutaro Yamaguchi (2nd year)<br>Mr. Yuri Fujiwara (3rd – 5th year)<br>Mr. Koji Hashimoto (3rd – 5th year) | - Instruct nursery management<br>- Support the extension work |
| Drought Tolerant | Dr. Koichiro Gyokusen<br>Dr. Kotaro Sakuda<br>Dr .Michito Tsuyama<br>Dr .Eiji Goto | - Consider evaluation method of drought tolerant<br>- Conduct morphologic and physiologic survey<br>- Select appropriate index of drought tolerant<br>- Identify drought tolerant individuals |
| Coordination/ Pregress Management | Mr. Kunio Shimizu(1st–2nd year)<br>Mr. Toshizumi Sakai(3rd-4th year)<br>Mr. Kawato (5th year)<br>Dr. Teiji Kondo (1styerar)<br>Mr. Kimura (1st year)<br>Mr. Shimizu (2nd – 3rd year)<br>Mr. Kamizore (4th – 5th year) | - Coordination at JCC level |

Remarks:Experts without year have been engaged in the project for full term.

# Chapter 3 Progress of Contract Work Implementation

## 1. Progress management

### (1) Inception Report

FFPRI-FTBC submitted and presented the draft inception report of the project to the JCC in September 2012. JCC members accept the report and discussed substantial activities based on it.

### (2) Annual Work Plan of Contract

FFPRI-FTBC submitted the annual work plan of contract to the JICA-HQ in each year.

### (3) Dispatch of short term experts, "Project Management"

- Dr. Fujisawa, the team leader of FFPRI-FTBC, attended 1st JCC meeting in 25th September 2012. He presented the contents of the draft inception report to the JCC members, and they officially kicked off the project's steering committee.
- Mr Kimura, the coordinator of FFPRI-FTBC team, attended 2nd JCC meeting in 12th February 2013. He together with the project manager and the chief advisor presented the first year progress and second year plan. JCC member confirmed the progress, and approved the plan of project activities.
- June 4th 2013, Dr. Yoshitake Fujisawa, the team leader of FFPRI-FTBC, was dispatched and explained the 2013 year plan as in Appendix4-1-1. Dr. Kondo was dispatched as in Appendix4-1-10. Dr. Kondo was also dispatched to attend 3rd JCC meeting in 12th February 2014. He together with the project manager and the chief advisor presented the second year progress and third year plan. JCC member confirmed the progress, and approved the plan of project activities as in Appendix4-1-13.
- June 8th 2014, Dr. Masatoshi Ubukata, the team leader of FFPRI-FTBC, was dispatched and explained the 2014 year plan as in Appendix4-2-3. Mr. Shimizu and Dr. Matsushita were dispatched as in Appendix4-2-8. Dr. Ubukata and Mr. Sakai were dispatched to attend 4th JCC meeting in 18th February 2015. They together with the project manager and the chief advisor presented the third year progress and forth year plan. JCC member confirmed the progress, and approved the plan of project activities as in Appendix4-2-11.
- Dr. Ubukata, Team leader of FFPRI-FTBC and Mr. Kamizore, Coordinator of FFPRI-FTBC were dispatched on Jun. 2015, and explained the 2015 year plan to the Project and JICA Kenya office.
- Mr. Sakai, Chief coordinator of FFPRI-FTBC, was dispatched to attend 4th JCC meeting on Feb. 2016.
- Dr. Ubukata, Team leader of FFPRI-FTBC and Mr. Kamizore, Coordinator of FFPRI-FTBC were dispatched on Jun. 2016, and explained the year 2016 plan to the Project and JICA Kenya office.
- Mr. Kamizore was dispatched on Oct. 2016 and discussed the project activities in 2016 to 2017 with Japanese experts and Kenyan CP.
- Dr. Ubukata, Mr. Kawato, Chief coordinator of FFPRI-FTBC, and Mr. Kamizore were dispatched to attend the International Seminar and 6th JCC meeting on Feb. 2017.
- Mr. Kawato and Mr. Kamizore were dispatched to attend the final (7th) JCC meeting on Jun. 2017.

### (4) Conduct training in Japan ("Project Management")

- The training course in Japan "Project Management" was conducted for Dr. Chikamai, Director General of KEFRI, and Dr. Muturi, Project Manegaer, in 2012 as Appendix5-1-2,3.
- The training course in Japan was conducted for Dr. Chagala, Manager of KEFRI, in 2014as Appendix5-4-1.
- The training course was conducted for Mr. Mugo, Director General of KFS, and Dr. Kigmo, Senior Dupty Director of KEFRI, in 2015as Appendix5-4-1.

(5) Coordination of Procurement

The project utilizes a couple of Japanese budget of equipment procurement, such as procurement in Japan, and local purchase. FTBC team consolidated with the project's long list of procurement such as a weather station in 2013 and dial gauge in 2014, and prepared necessary information for purchase order.

## 2. Progress of Activities 1 (DNA analysis)

1.0 Conduct training in Japan (DNA analysis)

- The training course was conducted for Mr. Machua and Mr. Fredrick in 2012 as Appendix 5-1-1.
- The training course was conducted for Mr. Omondi and Mr. Mungai in 2013 as Appendix 5-2-1.
- The training course was conducted for Mr. Omondi and Mr. Mungai in 2014 as Appendix 5-3-2.

1.1 Delineate *Melia volkensii* and *Acacia tortilis* populations based on site aridity and altitude

- In 2012, based upon a part of location data of *Melia volkensii* population, growing area was figure outed on the GIS map. This preliminary information is highly suggestive that the natural stand of *M. volkensii* may be restricted by a couple of condition.
- In 2013, the location data of 98 *M. volkensii* individuals were recorded. A total of 390 individuals was figured out on the GIS map. The project aims to gather the location data of *M. volkensii* from all over the Kenyan territory, and integrate this information into a modeling map which figures out relationship between weather condition and potential plantation area of *M. volkensii.*
- In 2014, the location data of 410 *M. volkensii* individuals were recorded. Those of *A. tortilis* were collected from the end of February 2015.
- In 2015, much location information on *Acacia tortilis* was obtained through the surveys. Technical support for statistical analysis of potential distribution area was provided to KEFRI staff.
- In 2016, the data on location information has been installed and the location map of populations was developed. GIS system for integration with the location and environmental information of *Melia volkensii* was developed.

1.2 Determine genetic diversity of *Melia volkensii* and *Acacia tortilis* population

- In 2012, during training in Japan, CPs identified 144 SSR (microsatellite) markers of *Acacia tortilis* by themselves, but no SNP markers of chloroplast genome was identified. In order to accelerate their analysis, next generation sequencing service would be applied in this fiscal year. Delivery of a sequencer was delayed due to complicated custom procedure, and it induced more problem of the machine setup which was happen by expire of certain reagents.
- In 2013, thirty samples in Kitui and 12 samples of *M. volkensii* were collected in Galana. Therefore a total of 342 samples had been collected in 12 populations in Kenya, Galana, Ishiala, Ishiolo, Kibwezi, Kitui, Marsabit, Meru, Mutha, Mwingi, Taveta, Voi, Wamba. As procurement of reagents for DNA analysis is delaying, DNA analysis is begun in the end of this fiscal year
- In 2014, *Melia volkensii* SSR genotypes were determined for 331 individuals from 11 populations. Four SSR markers were decided to identify plus tree clones. Using these markers clone identification was completed in seed orchard in Tiva. DNA isolation from the seed trees of seed orchard in Kibwezi is ongoing. In *Acacia tortilis* the developed 11 markers were began to examine. Sample collection is ongoing.
- In 2015, Appropriate and sufficient specimens of *Acacia tortilis* were collected, and DNA was extracted from them. Development of the SSR DNA markers of *Melia volkensii* and *Acacia tortilis* were completed.
- In 2016, Eleven (11) available SSR markers of *Acacia tortilis* were selected through screening and reported to a scientific journal (Conservation Genetics Resources).

It was found that the genetic diversity between 15 populations on *Acacia tortilis* was equally accepted as the result of genetic analysis, however, genetic difference among the growing areas, the north, central and south of Kenya, was accepted.

1.3 Develop guideline for conservation of genetic resources of *Melia volkensii* and *Acacia tortilis.*

- The guideline for conservation of genetic resources of *Melia volkensii* and *Acacia tortilis* was developed as following contents.

**1. Introduction**

- What is genetic diversity and how to quantify the genetic diversity?
- Why is genetic diversity important?
- Management of Genetic resources

**2. Genetic guideline for management of *Melia volkensii***

- Biology and uses of *Melia volkensii*
- Estimation of distributional area in *Melia volkensii*
- Development of SSR markers for *Melia volkensii*.
- Genetic diversity and genetic structure of *Melia volkensii* in Kenya

**3. Genetic conservation guideline for management of *Acacia tortilis***

- Biology and ecology
- Species distribution
- Importance and uses
- Genetic knowledge
- Threats to genetic diversity
- Guidelines for genetic conservation and use

## 3. Progress of Activities 2 (Tree Breeding)

2.0 Conduct training in Japan (Tree Breeding)

- The training course “Tree Breeding” was conducted for Mr. Kariuki and Mr. Muchiri in 2012 as Appendix5-1-4.The training course “Propagation Techiniques” was conducted for Ms. Mwangi and Ms. Maingi in 2012 as Appendix 5-1-5.
- The training course “Tree Breeding” was conducted for Dr. Ndufa and Ms. Muchoki in 2013 as Appendix5-2-2. The training course “Propagation Techniques” was conducted for Mr. Othuoni and Mr. Musava in 2013 as Appendix 5-2-3. The training course “Drought Torelance” was conducted for Mr. Kigwa and Mr. Muchiri in 2013 as Appendix 5-2-4.
- The training course “Tree Breeding” was conducted for Ms. Munyao and Mr. Matieka in 2014 as Appendix 5-3-3.

2.1 Select candidate plus trees of *Melia volkensii*

- In 2012 to 2014, the 100 candidate plus trees were selected as follows;
  60 trees (selected before starting the Project), 20 trees (selected in 2012), 20 trees (selected 2013 and 2014)

2.2 Establish clonal seed orchards of *Melia volkensii*

- Two colonal seed orchards of Melia were planed to established in Kitui and Kibwezi and seedling production started in 2012. The activities of 2012 were as follows;
  (a) Preparation of root stocks

Before the project opening, KEFRI intended to produce ten thousands of *Melia volkensii* root stock for grafting propagation. KEFRI produced them with technical support by FTBC researchers and the financial support by JICA Kenya office. By the end of August, approximately nine thousand root stocks are raised.

(b) Scions collection of candidate plus trees

Target numbers of grafting propagation as eighty seedlings each for sixty family has been set, thus around hundred of scion were collected.

(c) Grafting propagation for clonal seed orchards

Collected scions were packed in cooling box, and delivered immediately to Kitui Regional Research Centre. In order to provide sixty seedlings for each family, eighty grafting propagations were done. After the grafting, root stocks were kept in light intensity controlled seedling bed. Insect damages of spider mite were observed, and insecticide was applied. As the result, the nursery could not provide necessary number of seedlings, it means sixty seedlings, for around ten families. Deficit of seedlings would be compensated in next year.

(d) Site preparation of clonal seed orchard

Two clonal seed orchards would be established in Tiva and Kibwezi, and the size and number of seed orchards are described as follows;

Table Size and Number of Seed orchard (*Melia volkensii*)

| Type of design | Number of Families | Trees per Family | Number of Trees per site | Number of sites | Total number of trees |
|---|---|---|---|---|---|
| Seed Orchard | 100 | 30 | 3000 | 2 | 6000 |

Planting spacing is 6m x 6m, therefore total 10.8 ha of area is required for each seed orchard. Boundary of the orchards are rounded by concrete pole fencing with barbed wire. Water tank was set for watering for each orchard.

Planting location of each tree was allocated by computer program, and marked by plastic label.

(e) Planting seedling in the clonal orchards

All of available clone seedlings were planted in December in Tiva, and in January in Kibwezi.

・Propagation plan and method for the newly selected plus trees were proposed by the short term experts. The disease occurred in Tiva and Kibwezi seed orchards in March 2013. From the inoculation test a fungus was thought to be a source of this disease by the KEFRI tree pathologist. To avoid this disease improved grafting method was guided. Removing the infected tree and fungicide spraying were implemented.

Supplemental planting was conducted in the seed orchard. Approximately 80 % of the planting plan was completed.

・In 2014, the seedlings consisted of 20 clones were planted in December. The numbers of the trees were about 750 in Kitui and about 880 in Kibwezi. By this planting almost 100 % planting was completed. The fungicide, Topsin Paste, was effective to control disease-causing fungi, *Lasiodiplodia theobromae*. Paste containing this fungicide powder or solution was examined. Grafting was conducted in September. The numbers of the grown grafts were 1,345 in Kitui and 578 in Kibwezi. The scions for grafting were also collected in September. The number of the scions was 1,985. The rootstocks for grafting were grown. The target numbers of them were 800 in Kitui and 1,400 in Kibwezi, and more rootstocks were grown.

・In 2015, Technical guidance of stem cutting and branch pruning of trees in Tiva and Kibwezi Melia Seed Orchards was provided to 8 staffs in Kitui centre of KEFRI for 2 days on Aug. 2015. 4 blocks in each seed orchard were targeted and about 20% of all trees in the orchard were treated by KEFRI staffs following the guidance of short term experts.

Condition of treated orchard trees above mentioned was checked and some suggestions concerning influence of rot fungi to pruned part were given to KEFRI staff by the short term expert on Feb. 2016. Furthermore, cutting and seed conservation techniques were discussed among KEFRI staff with the short term expert.

## 2.3 Evaluation of plus trees of *M. volkensii* based on progeny performance

- In 2013, a total of 20 candidate progeny test sites in Kitui, Kibwezi and Embu was surveyed. One site would be selected in each region of Kitui and Kibwezi. Other sites would be selected in the different environmental condition from these two regions.
- In 2014, the progeny test trials were established in Kitui and Kibwezi. In addition to these two sites two trials were established in Marimanti and Kasigau, where environmental condition is different from Kitui and Kibwezi. The planted seedling numbers of the trials were 458 individuals of 38 families in Kitui, 390 individuals of 41 families in Kibwezi, 123 individuals of 15 families in Marimanti and 121 individuals of 18 families in Kasigau. Height and diameter were measured in late January at after planting one month. After harvesting logs in Tiva pilot forest wood quality evaluation was started.
- In 2015, new Melia progeny test sites were developed on the next to existing sites, Marimanti, Tiva, Kibwezi and Kasigau. Additionally 4 progeny test sites were developed in Voi, Marimanti (northern area), Mutomo and Wote. 12 progeny test sites have been totally established since 2014.
- Seeds from 68 candidate plus trees were collected and seedling production was implemented appropriately for the progeny test sites. Plantation Investigations of progeny test sites were taken.
- Concerning evaluation of wood property, basic researches of wood property such as vending, compression, shearing and hardness were implemented in Wood Research Center of KEFRI and the data has been analyzed in 2015. The results of the analysis were presented on the International Conference in 2017.
- Study on the progeny test sites was conducted regularly on Jan. and Jul. 2015 and Feb. 2016 and the data on 12-month tree growth was analyzed. As a result, it was found that fast growth clones had good growth in every progeny test site and the tree volume of fast growth clone, which was calculated with the height and diameter of the tree, exceeded 20% of the average on all clones. It ican be considered that the growth must exceed much more than 20% of ordinary Melia seedlings. This, however, is a result on early 12-month tree growth, therefore, a regular survey on all progeny test sites must be required so that an accurate growth pattern of each clone would be analyzed in a term. The results were presented on the International Conference.

## 2.4 Select drought tolerant from candidate *Melia volkensii* plus trees

- In 2012, In order to collect periodical growth data, dendrometers were set in Tiva station nursery. Ten melia trees were selected and apparatus was set to each trunk. Several phenologic aspects such as leaf, flower and fruit were observed in clone bank in Tiva. As a result, most of families shows variability on their phenologic timing. This result cannot explain the possibility of phenologic data for the indicator of drought tolerant characteristics, thus further observations are needed.
  Dendrometers were set on several mature melia trees in Tiva. Preliminary result of this experiment suggests the potential of scientific evaluation of melia's phenology.
  In order to observe the periodical change of physiologic characteristics, such as hydrologic potential and photosynthetic property, special test field was set in Kitui regional center. Seedlings of five species, *Melia volkensii, Melia azedarach, Eucalyptus camaldurensis, Gmelia arbore*a, and *Acasia tortalis*, would be planted nearby grafting nursery, and were designated for fixed-point observation.
  Also test seedling stand was going to be constructed which seedlings raised from the seed of three inferior and three superior clones of existing progeny test field in Tiva.
- In 2013, The growth characteristics of *M. volkensii* was compared with other four tree species, *Melia azedarach*, *Eucalyptus camaldulensis, Gmelina arborea* and *Vitex payos*. The growth of *M. volkensii* was second in height and fourth in diameter among these 5 species using one year old seedlings.
  Dendrometers were set on several mature trees in Tiva. It was clarified from the dendorometer analysis that *M. volkensii* had two growing seasons; namely from March to May and from October to December.

After measuring plus tree growth in Tiva and Kibwezi seed orchards superior and inferior trees were determined.

- In 2014, the growth characteristics of *M. volkensii* were compared with other four tree species, *Melia azedarach*, *Eucalyptus camaldulensis, Gmelina arborea* and *Vitex payos*. There was no advantageous character in *M. volkensii* concerning the drought tolerance compared with other four species.

  Dendrometers were set on several mature trees in Tiva. It was clarified from the dendorometer analysis that the thickening growth of *M. volkensii* starts at the beginning of rainy season simultaneously.
- In 2015, the maximum photosynthesis rates of fast growth clones and slow growth clones were measured in Tiva progeny test site. The rates tended to be low in slow growth clones, however not to be high in fast growth clones.

  Stem growth patterns in rainy and dry seasons were clarified by the dendrometer data in Tiva nursery.

  To reveal growth patterns of fast growth clone and slow growth clone, manual type of dendrometers were installed at Tiva and Kibwezi seed orchards in Jul. 2015. Characteristics of drought tolerant clones were analyzed based on the leaf phenology.

  Equipments for measurement of precipitation, temperature and soil water potential were installed to check the meteorological condition at Marimanti and Kasigau progeny test sites.
- In 2016, we measured leaf photosynthesis of *M. volkensii* using detached shoot. Maximum photosynthesis of detached shoot had declined within few minutes and reached the half value within 12 minutes after detaching. As a result, it was concluded that detached shoot was unavailable for photosynthesis measurement for *M.volkensii*.
- To reveal the relationship between leaf photosynthesis and tree growth of *M. volkensii*, leaf photosynthesis of three fast growth clones and a slow growth clone was compared. We made light-saturation curves of 1-month-old seedlings and compared the maximum photosynthesis of each clone. The maximum photosynthesis of the fast growth clone was higher than those of another clones, however the photosynthesis of some fast growth clones was low and similar to the slow growth clone. Then, we need more research to reveal the relation.
- We compared the drought tolerance of leaf photosynthesis among fast and slow growth clones of *M. volkensii.* Seedlings were grown under well-watering conditions for 3 months, and then subjected to drought for 3days without watering. Maximum photosynthesis of fast growth clones was higher than that of slow growth clones under soil dry conditions. This result showed that fast growth clones can maintain high photosynthetic rate even under water stress.
- To isolate *M. volkensii* clones with higher drought tolerance, the clones which remain leaves in dry season were searched by eye from100 clones of 3,000 trees (30 trees per one clone) in Kibwezi orchard. As a result, it was found that three trees, 10% (=3/30), remained leaves in each of three clones. There is a possibility that these clones had higher drought tolerance than other clones.
- We compared the stem growth of *M. volkensii* planted in both seed orchards of Tiva and Kibwezi. The growth in Tiva was larger than that of Kibwezi, and larger in 2015 compared with 2016. These differences were corresponded to rainfall in both sites and years, namely, the rainfall of 2015 and 2016 in Tiva were 596mm and 398mm, respectively, and those in Kibwezi were 441mm and 342mm, respectively.
- Stem growth phenology of fast and slow growth clones were compared in both sites of seed orchard. Stem growth rate of slow growth clone had declined quickly and the growth duration was shorter than that of fast growth clone.
- Water stress of four fast growth and three slow growth clones were compared in both sites of Tiva and Kibwezi orchards. We used the amount of shrinkage in dry season as an index of water stress. The water stress of fast growth clone was smaller than that of slow growth clones.
- The maximum photosynthesis rates of fast growth clones and slow growth clones were measured in Tiva progeny test site. The rates tended to be low in slow growth clones, however not to be high in fast growth clones.
- Stem growth patterns in rainy and dry seasons were clarified by the dendrometer data in Tiva nursery.

- To reveal growth patterns of fast growth clone and slow growth clone, manual type of dendrometers were installed at Tiva and Kibwezi seed orchards in Jul. 2015.
- Characteristics of drought tolerant clones were analyzed based on the leaf phenology.
- Equipment for measurement of precipitation, temperature and soil water potential were installed to check the meteorological condition at Marimanti and Kasigau progeny test sites.

### 2.5 Improve clonal seed orchards of *Melia volkensii*

- According to considering an appropriate measure to improve seed orchard, trees of inferior clones were treated with stem cutting and branch pruning.
- A lecture on the stem cutting and branch pruning, which can lead tree shape to having appropriate crown for seed collection, was conducted for CPs concerned. It was found that almost CPs understood the aspect and measures well through previous lectures for several times.
- Study on cutting propagation of *Melia volkensii* started in Kitui center. Scions from superior and inferior clones, which were decided by the temporary result of early growth, were provided for cutting, however, this cutting study failed unfortunately. It seems that scions of new shoots should be taken for cutting after rainy season.

### 2.6 Establish seedling seed orchard of *Acacia tortillis*

- 20 plus trees were selected and seeds were collected from 8 ones among them. Land preparation for seed orchards would be made in March 2014 in Tiva and in April 2014.
- In 2014, thirty six plus trees were selected and the seed was collected from the 14 plus trees. Seedlings of 30 families were started to grow for establishing seedling seed orchard. Land preparation for seed orchards was completed in Tiva and Kibwezi.
- In 2015, 100 plus trees of *Acacia tortilis* were selected and seeds from 63 candidates were collected and surplus seeds were stocked in cold storage. Seedling production was appropriately implemented for the progeny test sites plantation. Seedlings from 61 plus trees including new families were growing after sowing on Nov. 2015. Areas for the seed stands of *Acacia tortilis* were prepared in the next to Melia seed orchards in Kitui and Kibwezi. The seed stands containing 26 plus trees were established on Dec. 2015 and those containing 61 plus trees were estgaeblished on Apr. 2016 on each site.
- In 2016 to manage the seedling seed stands in Kitui and Kibwezi appropriately, setting of supporting poles and branch pruning were carried out through technical advice of FTBC.

## 4. Progress of Activities 3

### 3.1 Review, analyze and document the current status of seed and seedling production and distribution

- Market research was conducted from September to October in 2013 by C/P. After surveying 211 nursery companies and 213 forest products companies were taken by listning investigation and the report was published on Feb. 2014.

### 3.2 Develop a guideline for securing the quality seed and seedling production and distribution

- Short term expert explained Japanese system of the quality seed and seedling production and distribution. He also showed the philosophy concerning them. The components of draft of the guideline were framed till February. After confirming it at JCC the draft was begun to draw.
- Some technical advices concerning tree breeding concept and techniques were provided to the guideline.

3.3 Pilot distribution

Some technical advices concerning tree breeding concept and techniques were provided to the guideline.

3.4 Revice and finalize Seed Distribution Guideline

Some technical advices were provided to finalize the Seed Distribution Guideline.

## 5. Progress of Activities 4

4.0 Conduct training in Japan (Extension)

- The training course was conducted for Mr. Makee and Mr. Wekesa in 2014 as Appendix 5-3-4.
- The training course was conducted for Mr. Kamondo, Mr. Angaine, Ms. Oduor, Mr. Ongere and Dr. Mgotiareng in 2015 as Appendix 5-4-2.
- The training course was conducted for Mr. Mukolwe, Ms. Kanyororo, Mr. Njoroge, Mr. Ongere, Mr. Rukungu and Mr. Gondoi in 2016 as Appendix 5-5-1.

4.1 Establish Demonstration Forest

- Eight (8) demonstration forests were established in areas of existing progeny test sites, Tiva, Marimanthi, Kibwezi, Kasigau, Voi, Mutomo and Woto. One demonstration forest that shows the comparison of growth on improved seedling and ordinary one was established in Kitui.
- In 2016, demonstration forests that indicated the comparison between improved and ordinary seedlings were established in existing progeny test sites, Tiva and Kibwezi.
  As the result of technical advices by Japanese experts, almost appropriate technique of bud pruning was obtained for CP personnel. More accurate method for pruning could be required to achieve an absolute technique.

4.2 Produce training material

- Technical supports were implemented for preparing training materials based on the distribution guideline in 2015 and 2016.

4.3 Organize trainings and seminars for stakeholders and NGOs

- Technical supports were provided for training and seminar for stakeholders and NGOs in 2015.
- Technical advoces and supports were provided for presentations of CPs on the International Conference held on Feb. 2017.

4.4 Brochure distribution

- Necessary information was provided for the brochures preparation in 2015 and 2016.

4.5 Third country training

- Necessary technical advice on production, control and extension of improved seed and seedling was provided for the third country program.

# Chapter 4 Achievement of the project purpose

## 1. Outline of the final evaluation

Output of the project consists of 4 contents, which are described on item 2 of Chapter 1, and Strengthening KEFRI's capacity for implementing forest tree breeding is put on the output 1 and 2 of which FTBC has been in charge. Through the project activities concerned, selection of plus trees, analysis of genetic diversity, development of a guideline for conservation of genetic resources, establishment of Melia seed orchards and progeny test sites(PTSs), establishment of Acacia seed stands and survey of PTSs, these 2 outputs are achieved as planned, and candidates of superior plus trees are designated in accordance with the result. Outputs concerning extension are also achieved through the activities, development of seed distribution guideline and implementation of training courses concerned. As the result of achieving the outputs, the project purpose, which is described as "Research capacity and extension system necessary for promoting indigenous species plantation in the ASALs is enhanced" on PDM, is considered as "achieved" according to judging 4 verifiable indicators described on PDM. The achievement of each indicator is as follows;

1. At least 3 publications and these related to the project activities are published in refereed journals and results of experiments related to the project presented in at least 2 conferences.
   - Two (2) reports, "Seed pretreatment methods for improving germination of *Acacia tortillis"* and "Optimizing the size of root cutting in *Melia volkensii* Gürke for improving clonal propagation and production of quality planting stock", were published on "African Journal of Biotechnology" in 2014 and 2016. A report, "Isolation and characterization of microsatellite markers for *Acacia tortilis* (Forsk.) Hayne" was published on "Conservation Genetics Resources". Three (3) reports on the results of project activities were published totally on journals concerned.
   - A result of experiment concerned wood property study on Melia was presented on the Conference of Wood Society in Japan and also almost results of experiments in the project were presented on the International Conference on the project Feb. 2017.
2. A unit for Improved Melia seed supply is established at DERP, Kitui.
   - A Unit for Improved Melia seed supply "Improved *Melia volkensii* Seed Processing and Distribution Unit" was established at KEFRI DERP, Kitui on 30$^{th}$ November 2016.
3. Distribution of Improved Melia Seed area trained and registered and start raising and distributing seed/seedling of improved Melia following the Guideline.
   - 23 nursery owners / NGOs participated in Training for nursery owners held on August 2016 in Kitui KEFRI DERP. They registered as distributors of Improved Melia materials. 7 of them had started raising and distributing seedlings of Improved Melia by December 2016 according to the result of follow-up questionnaires.
4. A plan for breeding at least one other dryland indigenous species is developed.
   - As KEFRI staff has presented about *Melia volkensii* and *Acacia tortilis* breeding plan many times in the Project Workshops, Trainings and Conferences, KEFRI staff is considered to has had the knowledge about the structure and method to develop a breeding plan.

# Chapter 5 Recommendations for achievement of overall goal

## 1. The project overall goal

The project overall goal is described as "Promote quality plantation of indigenous species in ASALs" and the indicator is described as "Quality seed sources of indigenous species are established and produce more than 250,000 quality seeds per year" on PDM.

## 2. Recommendation for achievement of overall goal

Two (2) clonal seed orchards of *Melia volkensii* in Kitui and Kibwezi have been established as a superior result of the project activities. Seed production from the orchards has started and produced 4,900 kg of fruits totally in 2016. The amount of seeds, however, would be estimated to reduce considerably due to stem cutting and branch pruning for improvement of the seed orchards mentioned above activity 2.5. The amount of seeds, therefore, is actually insufficient to promote plantation in ASALs area of Kenya.

It can be considered that research ability of KEFRI staff has been enhanced through the project activities. However, further enhancement of the ability should be required to implement making a design and managing of a clonal seed orchard by themselves and also sufficient budget required to establish and maintain the orchard should be secured in KEFRI.

# Chapter 6 Information activities

## 1. Introduction of the Project activities in international events

- TICAD V was held at PACIFICO YOKOHAMA in Yokohama on June 1st 2013. Dr Ben Chikamai, Director of KEFRI, presented the sustainable management of arid and semi-arid African forests through the promotion of community-based approach at the ITTO-JICA Joint Side event for TICAD V. FTBC introduced the project through the display of project panel and seedlings of *Melia volkensii* and *Acacia tortilis* at the hall.
- KEFRI staff, an expert of KEFRI seed centre, presented the outline of the project at the annual meeting on forest seed, held at September 24th 2014 in Paris, hosted by OECD.

## 2. Introduction of the Project activities in the media

- The above activity in TICAD V nd training activity in Japan for KEFRI staffs were placed in a Japanese forestry journal as in Appendix 6-2-1.
- The launch of a management house of Tiva seed orchard, attended by His Excellency the Ambassador of Japan Tatsushi Terada and the Conservation Secretary Gideon Gathaara on behalf of the GOK, was held in 18th February as in Appendix 6-2-2.
- The project activities were introduced as a case of international technical cooperations in "Annual report on Forest and Forestry in Japan (FY2014)" as in Appendix 6-2-3.
- The activities of counterpart training in Japan KEFRI staffs were placed in a Japanese forestry journal as in Appendix 6-2-4.
- The activities of counterpart training in Japan KEFRI staffs were placed in a Japanese forestry journal as in Appendix 6-2-5.
- The activities of counterpart training in Japan KEFRI and KFS staffs were placed in a Japanese forestry journal and local pages of newspapers as in Appendix 6-2-6.

## 3. Introduction of the Project activities in the media

- Dr. Miyashita, a short term expert on tree breeding theory of the project, took a lecture on a open lecture in Tama forest science gardes, held at August 3rd 2014, hosted by FFPRI as in Appendix 6-3-1. Project activities were introduced to a lot of guests attended the lecture and they got interesting information on dryland forest and forestry.
- Dr. Miyashita presented this year's achievements of the project such as establishment of *Melia volkensii* clonal seed orchards at the result presentation on tree breeding, held at February 28th 2014, hosted by FTBC. A healthy exchange of ideas was generated at the presentation.
- Dr. Hanaoka, a short term expert on DNA analysis of the project, presented this year's achievements of the project such as DNA analysis and establishment of *Melia volkensii* progeny test sites at the result presentation on tree breeding, held at February 29th 2015, hosted by FTBC. A healthy exchange of ideas such as relations between a planting design and water consumption in dry land was generated at the presentation.
- Dr. Miyashita presented outlines of the project activities and results at the 14th environmental research symposium held on November 10th 2015. A lot of researches attended the symposium and took discussions concerning the research activities.
- Dr. Miyashita presented the project activities and results for 5 years at the result presentation on tree breeding, held at February 2nd 2017, hosted by FTBC. A healthy exchange of ideas was generated at the presentation.

## ○ List of Appendix

## Appendix 1 Project Design Matrix (PDM)

Project Name: Project on Development of Drought Tolerant Trees for Adaptation to Climate Change in Drylands of Kenya
Period of Cooperation: 5 years (2012.6～2017.6)
Implementing Agency: Kenya Forestry Research Institute (KEFRI)
Target Beneficiaries: Inhabitants of Arid and Semi-Arid Areas (ASALs) of Kenya

Version: June, 2012

| Narrative Summary | Objectively Verifiable Indicators | Mean of Verification | Important Assumptions |
|---|---|---|---|
| **Overall Goal**<br>Quality plantations of indigenous species are extended in the ASALs of Kenya. | 2000 ha of quality plantations of indigenous species are established in the ASALs of Kenya. | Geo-referenced maps of indigenous species plantation | 1. Sufficient budget is allocated for extension activities.<br>2. Other donor institutions or NGOs provide support in expanding extension activities. |
| **Project Purpose**<br>Research capacity and extension system necessary for promoting indigenous species plantation in the ASALs is enhanced. | 1. 400 ha of quality *Melia* plantations are established annually from the third year of the project.<br>2. A plan for breeding at least one other dryland indigenous species is developed | 1. Geo-referenced maps of *Melia volkensii* plantation<br>2. Research plan | 1. Farmers' demand for *Melia volkensii* remains unchanged.<br>2. Collaboration between KEFRI and KFS are smoothly implemented. |
| **Outputs**<br>1. KEFRI's capacity for conducting research on genetic diversity of indigenous species (*Melia volkensii* and *Acacia tortilis* as pioneer trial) is strengthened.<br>2. KEFRI's capacity for implementing forest tree breeding of indigenous species (*Melia volkensii* and *Acacia tortilis* as pioneer trial) is strengthened.<br>3. Quality seed and seedling supply system for *Melia volkensii* is established.<br>4. Awareness of relevant stakeholders on the importance of quality seed and seedling is raised. | 1-1 DNA markers of *Melia volkensii* and *Acacia tortilis* are developed.<br>1-2 Plus trees of *Melia volkensii* and *Acacia tortilis* are genotyped.<br>2-1 Plus trees of *Melia volkensii* and *Acacia tortilis* are selected.<br>2-2 Seed orchards for *Melia volkensii* and *Acacia tortilis* are established.<br>2-3 Superior clones are selected.<br>3-1 Guideline is developed.<br>3-2 Number of nurseries producing quality seedlings increase to fifteen.<br>4-1 At least two project awareness events | -Research papers<br>-Project reports<br><br>-Catalogue (that includes location, characteristics, photos etc.) of plus trees<br>-Project reports<br><br>-Guideline<br>-Nursery records<br>-Project reports<br>-Project reports | 1. Sufficient lands for orchards are allocated.<br>2. Local communities' understanding and support is obtained in target areas. |

| | | | |
|---|---|---|---|
| | (seminars, workshops, trainings) are held annually.<br>4-2 More than 80 % of participants of project awareness events are willing to use quality seedlings. | -Questionnaire | |
| **Activities**<br>1.1 Delineate *Melia volkensii* and *Acacia tortilis* populations based on site aridity and altitude.<br>1.2 Determine genetic diversity of *Melia volkensii* and *Acacia tortilis* population.<br>1.3 Develop guideline for conservation of genetic resources of *Melia volkensii* and *Acacia tortilis*.<br>2.1 Select plus tree of *Melia volkensii*and *Acacia tortilis* .<br>2.2 Establish clonal orchards of *Melia volkensii*<br>2.3 Evaluation of plus trees based on progeny performance (progeny test).<br>2.4 Select drought tolerant *Melia volkensii* from plus trees.<br>2.5 Improve the clonal orchards of *Meliavolkensii*.<br>2.6 Establish seedling seed orchards of *Acacia tortilis*.<br>3.1 Review, analyze and document the current status of seed and seedling production and distribution.<br>3.2 Develop a guideline for securing the quality seed and seedling production and distribution.<br>3.3 Pilot the guideline using improved seed sources from Output 2.<br>3.4 Improve the guideline.<br>4.1 Establish on-station and on-farm demonstrations of improved *Melia volkensii* plantation in at least three regions.<br>4.2 Produce training materials.<br>4.3 Organize trainings and seminars for stakeholders.<br>4.4 Publish and distribute brochures.<br>4.5 Share project findings with participants of the third country training program. | **Inputs**<br>(Japanese Contribution)<br>1. Dispatch of Experts<br>2. Training<br>3. Machinery and Equipment<br><br>(Kenyan Contribution)<br>1. Project Staff Allocation<br>2. Office Space for Japanese Experts<br>3. Facilities and Running Expenses | |

Appendix 1　Project Design Matrix (PDM) (Amended on 30th November 2016)

Project Name: Project on Development of Drought Tolerant Trees for Adaptation to Climate Change in Drylands of Kenya
Period of Cooperation: 5 years (2012.6～2017.6)
Implementing Agency: Kenya Forestry Research Institute (KEFRI)
Target Beneficiaries: Inhabitants of Arid and Semi-Arid Areas (ASALs) of Kenya
Version: June, 2012

| Narrative Summary | Objectively Verifiable Indicators | Mean of Verification | Important Assumptions |
|---|---|---|---|
| Overall Goal<br>Quality plantations of indigenous species are extended in the ASALs of Kenya. | 2000 ha of quality plantations of indigenous species are established in the ASALs of Kenya. | Geo-referenced maps of indigenous species plantation | Sufficient budget is allocated for extension activities.<br>Other donor institutions or NGOs provide support in expanding extension activities. |
| Project Purpose<br>Research capacity and extension system necessary for promoting indigenous species plantation in the ASALs is enhanced. | 1. At least 3 publications related to the project activities are published in refereed journals and results of experiments related to the project presented in at least 2 conferences.<br>2. A Unit for Improved Melia seed supply is established at DERP, Kitui.<br>3. Distributors of Improved Melia Seed are trained and registered and start raising and distributing seed/seedlings of improved Melia following the Guideline.<br>4. A plan for breeding at least one other indigenous species developed. | -Journal publications<br>-Project Reports<br>-Functional Melia Seed supply Unit<br>-Seed distribution evaluation feedback reports<br>-Register of Melia distributors<br>-Seed supply records<br>-Breeding research plan | Farmers' demand for Melia volkensii remains unchanged.<br>Collaboration between KEFRI and KFS are smoothly implemented. |
| Outputs<br>KEFRI's capacity for conducting research on genetic diversity of indigenous species (Melia volkensii and Acacia tortilis as pioneer trial) is strengthened.<br>KEFRI's capacity for implementing forest tree breeding of indigenous species (Melia volkensii and Acacia tortilis as pioneer trial) is strengthened.<br>Quality seed and seedling supply system for Melia volkensii is established.<br>Awareness of relevant stakeholders on the importance of quality seed and seedling is raised. | 1-1 DNA markers of Melia volkensii and Acacia tortilis are developed.<br>1-2 Plus trees of Melia volkensii and Acacia tortilis are genotyped.<br>2-1 Plus trees of Melia volkensii and Acacia tortilis are selected.<br>2-2 Seed orchards for Melia volkensii and Acacia tortilis are established.<br>2-3 Superior clones are selected.<br>3-1 Guideline is developed.<br>3-2 Number of nurseries producing quality seedlings increase to fifteen. | -Research papers<br>-Project reports<br><br><br>-Catalogue (that includes location, characteristics, photos etc.) of plus trees<br>-Project reports<br><br>-Guideline<br>-Nursery records<br>-Project reports | Sufficient lands for orchards are allocated.<br>Local communities' understanding and support is obtained in target areas. |

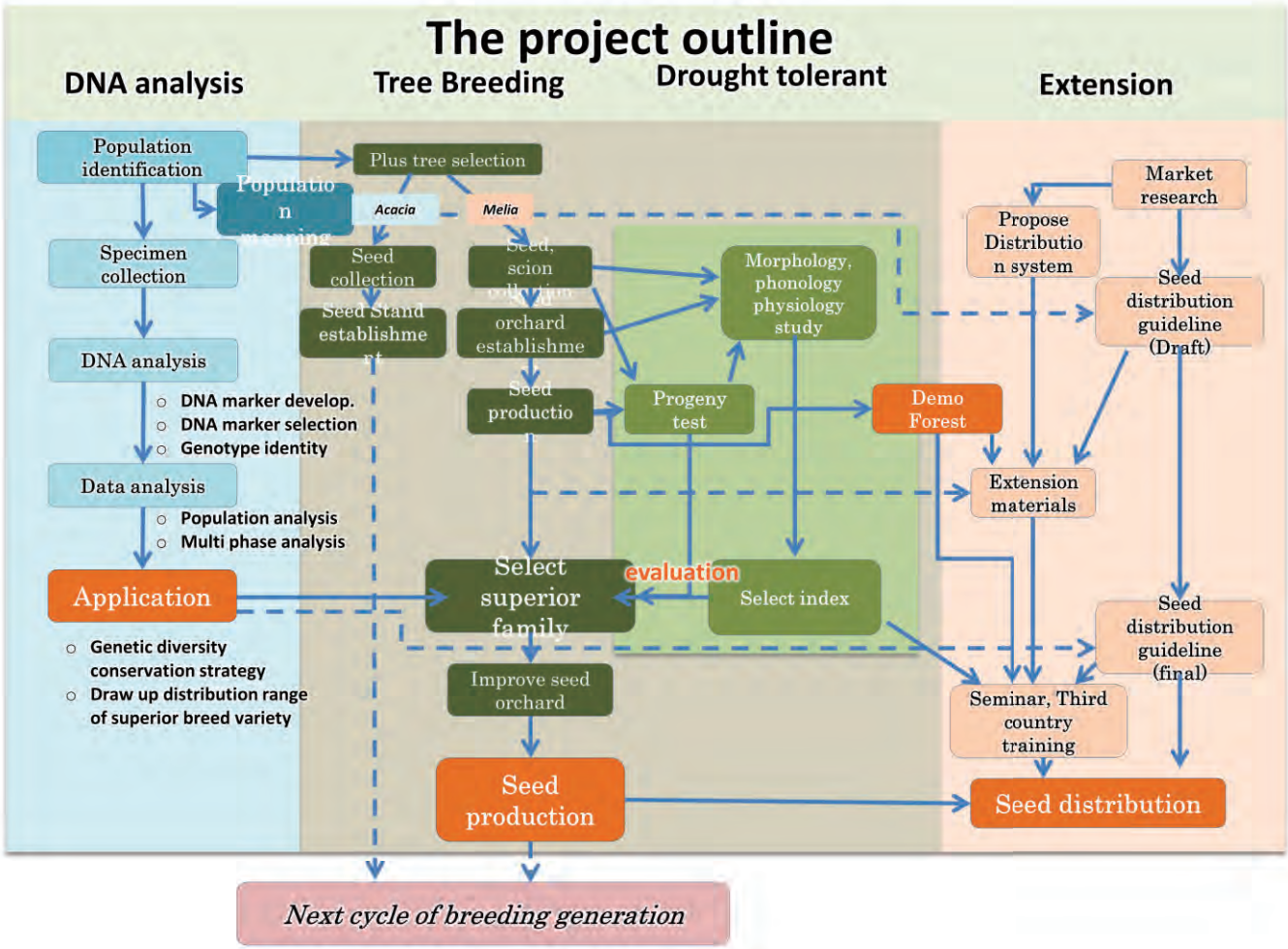
| | | | |
|---|---|---|---|
| | 4-1 At least two project awareness events (seminars, workshops, trainings) are held annually.<br>4-2 More than 80 % of participants of project awareness events are willing to use quality seedlings. | -Project reports<br>-Questionnaire | |
| Activities<br>1.1 Delineate Melia volkensii and Acacia tortilis populations based on site aridity and altitude.<br>1.2 Determine genetic diversity of Melia volkensii and Acacia tortilis population.<br>1.3 Develop guideline for conservation of genetic resources of Melia volkensii and Acacia tortilis.<br>2.1 Select plus tree of Melia volkensiiand Acacia tortilis .<br>2.2 Establish clonal orchards of Melia volkensii<br>2.3 Evaluation of plus trees based on progeny performance (progeny test).<br>2.4 Select drought tolerant Melia volkensii from plus trees.<br>2.5 Improve the clonal orchards of Meliavolkensii.<br>2.6 Establish seedling seed orchards of Acacia tortilis.<br>3.1 Review, analyze and document the current status of seed and seedling production and distribution.<br>3.2 Develop a guideline for securing the quality seed and seedling production and distribution.<br>3.3 Pilot the guideline using improved seed sources from Output 2.<br>3.4 Improve the guideline.<br>4.1 Establish on-station and on-farm demonstrations of improved Melia volkensii plantation in at least three regions.<br>4.2 Produce training materials.<br>4.3 Organize trainings and seminars for stakeholders.<br>4.4 Publish and distribute brochures.<br>4.5 Share project findings with participants of the third country training program. | Inputs<br>(Japanese Contribution)<br>Dispatch of Experts<br>Training<br>Machinery and Equipment<br><br>(Kenyan Contribution)<br>Project Staff Allocation<br>Office Space for Japanese Experts<br>Facilities and Running Expenses | | |

Appendix 1 Project Design Matrix (PDM) (Amended on 14th February 2017)
Project Name: Project on Development of Drought Tolerant Trees for Adaptation to Climate Change in Drylands of Kenya
Period of Cooperation: 5 years (2012.6～2017.6)
Implementing Agency: Kenya Forestry Research Institute (KEFRI)
Target Beneficiaries: Inhabitants of Arid and Semi-Arid Areas (ASALs) of Kenya
Version: June, 2012

| Narrative Summary | Objectively Verifiable Indicators | Mean of Verification | Important Assumptions |
|---|---|---|---|
| Overall Goal<br>Quality plantations of indigenous species are extended in the ASALs of Kenya. | Quality seed sources of indigenous species are established and produce more than 250,000 quality seeds per year. | -Geo-reference maps of indigenous species seed sources.<br>-Seed collection data<br>-20 ha of quality seed sources | Sufficient budget is allocated for extension activities.<br>Other donor institutions or NGOs provide support in expanding extension activities. |
| Project Purpose<br>Research capacity and extension system necessary for promoting indigenous species plantation in the ASALs is enhanced. | 1. At least 3 publications related to the project activities are published in refereed journals and results of experiments related to the project presented in at least 2 conferences.<br>2. A Unit for Improved Melia seed supply is established at DERP, Kitui.<br>3. Distributors of Improved Melia Seed are trained and registered and start raising and distributing seed/seedlings of improved Melia following the Guideline.<br>4. A plan for breeding at least one other indigenous species developed. | -Journal publications<br>-Project Reports<br>-Functional Melia Seed supply Unit<br>-Seed distribution evaluation feedback reports<br>-Register of Melia distributors<br>-Seed supply records<br>-Breeding research plan | Farmers' demand for Melia volkensii remains unchanged.<br>Collaboration between KEFRI and KFS are smoothly implemented. |
| Outputs<br>KEFRI's capacity for conducting research on genetic diversity of indigenous species (Melia volkensii and Acacia tortilis as pioneer trial) is strengthened.<br>KEFRI's capacity for implementing forest tree breeding of indigenous species (Melia volkensii and Acacia tortilis as pioneer trial) is strengthened.<br>Quality seed and seedling supply system for Melia volkensii is established.<br>Awareness of relevant stakeholders on the importance of quality seed and seedling is raised. | 1-1 DNA markers of Melia volkensii and Acacia tortilis are developed.<br>1-2 Plus trees of Melia volkensii and Acacia tortilis are genotyped.<br>2-1 Plus trees of Melia volkensii and Acacia tortilis are selected.<br>2-2 Seed orchards for Melia volkensii and Acacia tortilis are established.<br>2-3 Superior clones are selected.<br>3-1 Guideline is developed.<br>3-2 Number of nurseries producing quality seedlings increase to fifteen.<br>4-1 At least two project awareness events | -Research papers<br>-Project reports<br><br><br>-Catalogue (that includes location, characteristics, photos etc.) of plus trees<br>-Project reports<br><br>-Guideline<br>-Nursery records<br>-Project reports<br>-Project reports | Sufficient lands for orchards are allocated.<br>Local communities' understanding and support is obtained in target areas. |

| | | | |
|---|---|---|---|
| | (seminars, workshops, trainings) are held annually.<br>4-2 More than 80 % of participants of project awareness events are willing to use quality seedlings. | -Questionnaire | |
| Activities<br>1.1 Delineate Melia volkensii and Acacia tortilis populations based on site aridity and altitude.<br>1.2 Determine genetic diversity of Melia volkensii and Acacia tortilis population.<br>1.3 Develop guideline for conservation of genetic resources of Melia volkensii and Acacia tortilis.<br>2.1 Select plus tree of Melia volkensiiand Acacia tortilis .<br>2.2 Establish clonal orchards of Melia volkensii<br>2.3 Evaluation of plus trees based on progeny performance (progeny test).<br>2.4 Select drought tolerant Melia volkensii from plus trees.<br>2.5 Improve the clonal orchards of Meliavolkensii.<br>2.6 Establish seedling seed orchards of Acacia tortilis.<br>3.1 Review, analyze and document the current status of seed and seedling production and distribution.<br>3.2 Develop a guideline for securing the quality seed and seedling production and distribution.<br>3.3 Pilot the guideline using improved seed sources from Output 2.<br>3.4 Improve the guideline.<br>4.1 Establish on-station and on-farm demonstrations of improved Melia volkensii plantation in at least three regions.<br>4.2 Produce training materials.<br>4.3 Organize trainings and seminars for stakeholders.<br>4.4 Publish and distribute brochures.<br>4.5 Share project findings with participants of the third country training program. | Inputs<br>(Japanese Contribution)<br>Dispatch of Experts<br>Training<br>Machinery and Equipment<br><br>(Kenyan Contribution)<br>Project Staff Allocation<br>Office Space for Japanese Experts<br>Facilities and Running Expenses | | |

## Appendix 2 Flow chart of the project outline



# Appendix 3　Plan of operation

## Appendix 3-1

## Plan of operation for project activiities

| Activities | | 1st term | | | 2nd term | | | | 3rd term | | | | 4th term | | | | 5th term | | | | | Section & Program in KEFRI | Responsible Person | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2012 | | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | KEFRI | JICA |
| | | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | | | |
| 0 General issue | | | | | | | | | | | | | | | | | | | | | | | | Chief Advisor Dr Fujisawa |
| 0.1 | Inception report | ◊ | | | | | | | | | | | | | | | | | | | | | | |
| 0.2 | JCC | † | | † | | | | † | | | † | † | | | | † | | | | † | | | | |
| 0.3 | Evaluation | | | | | | | | | | ‡ | | | | | | | | | ‡ | | | | |
| 0.4 | Intrnational seminar | | | | | | | | | | | | | | | | | | | | ◊ | | | |
| 1 DNA analysis | | | | | | | | | | | | | | | | | | | | | | | | Dr. Hanaoka |
| 1.0 | Training in Japan | | | | | | | | | | | | | | | | | | | | | | | |
| 1.1 | Delineate *Melia volkensii* and *Acacia tortilis* populations based on site aridity and altitude | | | | | | | | | | | | | | | | | | | | | GIS STD | Mr. Kiama | |
| 1.2 | Determine genetic diversity of *Melia volkensii* and *Acacia tortilis* population | | | | | | | | | | | | | | | | | | | | | Biotechnology DFP | Mr. Machua | |
| 1.2.1 | Collect the specimens, leaf and seed, from *Melia volkensii* populations | | | | | | | | | | | | | | | | | | | | | | | |
| 1.2.2 | Develop the SSR DNA markers of *Melia volkensii* and *Acacia tortilis* | | | | | | | | | | | | | | | | | | | | | | | |
| 1.2.3 | Screen developed SSR markers in order to figure out genetic relationship between populations | | | | | | | | | | | | | | | | | | | | | | | |
| 1.2.4 | Determine the genotypes of collected specimens by using developed SSR markers | | | | | | | | | | | | | | | | | | | | | | | |
| 1.3 | Develop guideline for conservation of genetic resources of *Melia volkensii* and *Acacia tortilis* | | | | | | | | | | | | | | | | | | | | | | | |
| 2 Tree breeding | | | | | | | | | | | | | | | | | | | | | | Tree Breeding, DFP | Mr. Kariuki | Dr. Miyashita |
| 2.0 | Training in Japan | | | | | | | | | | | | | | | | | | | | | | | |
| 2.1 | Select candidate plus trees of *Melia volkensii* | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2 | Establish clonal seed orchards of Melia volkensii | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2.1 | Prepare root stock of *Melia volkensii* for grafting propagation | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2.2 | Collect twigs or scions of candidate plus trees | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2.3 | Conduct grafting propagation, and provide clone seedlings for clonal orchards | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2.4 | Establish of clonal seed orchard in Kitui and Kibwezi | | | | | | | | | | | | | | | | | | | | | | | |
| 2.3 | Evaluation of plus trees of *Melia volkensii* based on progeny performance | | | | | | | | | | | | | | | | | | | | | | | |
| 2.4 | Select drought tolerant from candidate *Melia volkensii* plus trees | | | | | | | | | | | | | | | | | | | | | | | |
| 2.4.1 | Prepare a drought tolerant selection procedure | | | | | | | | | | | | | | | | | | | | | | | |
| 2.4.2 | Consider the potential indicators for drought tolerant selection | | | | | | | | | | | | | | | | | | | | | | | |
| 2.4.3 | Select drought tolerant index | | | | | | | | | | | | | | | | | | | | | | | |
| 2.4.4 | Select drought tolerant *Melia volkensii* by index | | | | | | | | | | | | | | | | | | | | | | | |
| 2.5 | Improve clonal seed orchards of *Melia volkensii* | | | | | | | | | | | | | | | | | | | | | | | |
| 2.6 | Establish seedling seed stand of *Acacia tortilis* | | | | | | | | | | | | | | | | | | | | | | Mr. Machua and Mr. Omondi | |
| 2.6.1 | Collect seeds of candidate plus tree of *Acasia tortilis* | | | | | | | | | | | | | | | | | | | | | | | |
| 2.6.2 | Propagate seedling from the collected seeds | | | | | | | | | | | | | | | | | | | | | | | |
| 2.6.3 | Prepare the seedling seed stand | | | | | | | | | | | | | | | | | | | | | | | |
| 2.6.4 | Establish the seedling seed stand | | | | | | | | | | | | | | | | | | | | | | | |
| 3 Supply chain of Quality seed and seedling | | | | | | | | | | | | | | | | | | | | | | Seed Research TSP | Mr. Bernard Kamondo | Chief Advisor Dr. Fujisawa |
| 3.1 | Market research | | | | | | | | | | | | | | | | | | | | | | | |
| 3.2 | Production and distribution guideline | | | | | | | | | | | | | | | | | | | | | | | |
| 3.3 | Pilot distribution | | | | | | | | | | | | | | | | | | | | | | | |
| 3.4 | Revice and finalize seed distribution guideline | | | | | | | | | | | | | | | | | | | | | | | |
| 4 Extention of quality seed distribution system | | | | | | | | | | | | | | | | | | | | | | DFP | Mr. Giathi (Kitui) Mr. Muchiri (Kibwezi) | Chief Advisor Dr. Fujisawa |
| 4.1 | Establish Demonstration forest | | | | | | | | | | | | | | | | | | | | | | Mr. Giathi (Kitui) Mr. Muchiri (Kibwezi) | |
| 4.2 | Training material | | | | | | | | | | | | | | | | | | | | | | | |
| 4.3 | Seminer for stakeholders and NGOs | | | | | | | | | | | | | | | | | | | | | | | |
| 4.4 | Brouchure | | | | | | | | | | | | | | | | | | | | | | | |
| 4.5 | Third country training | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |

# Appendix 3-2

## Annual Plan of Operation (APO2012)

| Activities | | 2nd Q | | | 3rd Q | | | 4th Q | | | Section & Program in KEFRI | Responsible Person | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2012 | | | | | | 2013 | | | | KEFRI | JICA |
| | | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | | | |
| **0 General issue** | | | | | | | | | | | | | Chief Advisor Dr Fujisawa |
| 0.1 | Inception report | ◊ | | | | | | | | | | | |
| 0.2 | JCC | | † | | | | | | | † | | | |
| 0.3 | Evaluation | | | | | | | | | | | | |
| 0.4 | Intrnational seminar | | | | | | | | | | | | |
| **1 DNA analysis** | | | | | | | | | | | | | Dr. Hanaoka |
| 1.0.1 | Training in Japan | | | | | | | | | | | | |
| 1.0.2 | Dispatch expert | | | | | | | | | | | | |
| **1.1** | **Delineate *Melia volkensii* and *Acacia tortilis* populations based on site aridity and altitude** | | | | | | | | | | GIS STD | Mr. Kiama | |
| 1.1.1 | Make a strategy of ground survey of the populations and prepare a reporting format | | | | | | | | | | | | |
| 1.1.2 | Gather the location information of populations through the subordinate network of KEFRI, KFS and other available sources | | | | | | | | | | | | |
| 1.1.3 | Implement the ground survey, and gather the information of Melia volkensii population by using prepared reporting format together with photograph and GPS data | | | | | | | | | | | | |
| 1.1.4 | Compile the gathered information of Melia volkensii into the GIS system and develop the location map of populations | | | | | | | | | | | | |
| 1.1.5 | Consider to develop GIS system for information integration | | | | | | | | | | | | |
| **1.2** | **Determine genetic diversity of *Melia volkensii* and *Acacia tortilis* population** | | | | | | | | | | Biotechnology DFP | Mr. Machua | |
| 1.2.1 | Collect the specimens, leaf and seed, from *Melia volkensii* populations | | | | | | | | | | | | |
| 1.2.2 | Develop the SSR DNA markers of *Melia volkensii* and *Acacia tortilis* | | | | | | | | | | | | |
| 1.2.3 | Screen developed SSR markers in order to figure out genetic relationship between populations | | | | | | | | | | | | |
| 1.2.4 | Determine the genotypes of collected specimens by using developed SSR markers | | | | | | | | | | | | |
| **1.3** | **Develop guideline for conservation of genetic resources of *Melia volkensii* and *Acacia tortilis*** | | | | | | | | | | | | |
| **2 Tree breeding** | | | | | | | | | | | Tree Breeding, DFP | Mr. Kariuki | Dr. Miyashita |
| 2.0.1 | Training in Japan | | | | | | | | | | | | |
| 2.0.2 | Dispatch expert | | | | | | | | | | | | |
| **2.1** | **Select candidate plus trees of *Melia volkensii*** | | | | | | | | | | | | |
| 2.1.1 | Conduct plus tree selection work | | | | | | | | | | | | |
| 2.1.2 | Selection criteria evaluation | | | | | | | | | | | | |
| **2.2** | **Establish clonal seed orchards of Melia volkensii** | | | | | | | | | | | | |
| 2.2.1 | Prepare ten thousands root stock of *Melia volkensii* for grafting propagation | | | | | | | | | | | | |
| 2.2.2 | Collect twigs or scions of candidate plus trees | | | | | | | | | | | | |
| 2.2.3 | Conduct grafting propagation, and provide clone seedlings for clonal seed orchards | | | | | | | | | | | | |
| 2.2.4 | Embark on the establishment of clonal seed orchard in Kitui and Kibwezi | | | | | | | | | | | | |
| **2.3** | **Evaluation of plus trees of *Melia volkensii* based on progeny performance** | | | | | | | | | | | | |
| 2.3.1 | Prepare the plantation sites of *Melia volkensii* for Progeny test | | | | | | | | | | | | |
| **2.4** | **Select drought tolerant from candidate *Melia volkensii* plus trees** | | | | | | | | | | | | |
| 2.4.1 | Prepare a drought tolerant selection procedure | | | | | | | | | | | | |
| 2.4.2 | Consider the potential indicators for drought tolerant selection | | | | | | | | | | | | |
| **2.5** | **Improve clonal orchards of *Melia volkensii*** | | | | | | | | | | | | |
| **2.6** | **Establish seedling seed stand of Acacia tortilis** | | | | | | | | | | | Mr. Machua and Mr. Omondi | |
| **3 Supply chain of Quality seed and seedling** | | | | | | | | | | | Seed Research TSP | Mr. Bernard Kamondo | Chief Advisor Dr. Fujisawa |
| **3.1** | **Market research** | | | | | | | | | | | | |
| **3.2** | **Production and distribution guideline** | | | | | | | | | | | | |
| **3.3** | **Pilot distribution** | | | | | | | | | | | | |
| **3.4** | **Revice and finalize seed distribution guideline** | | | | | | | | | | | | |
| **4 Extention of quality seed distribution system** | | | | | | | | | | | DFP | Mr. Giathi (Kitui) Mr. Muchiri (Kibwezi) | Chief Advisor Dr. Fujisawa |
| **4.1** | **Establish Demonstration forest** | | | | | | | | | | | Mr. Giathi (Kitui) Mr. Muchiri (Kibwezi) | |
| **4.2** | **Prepare Training material** | | | | | | | | | | | | |
| **4.3** | **Seminer for stakeholders and NGOs** | | | | | | | | | | | | |
| **4.4** | **Prepare Brouchure** | | | | | | | | | | | | |
| **4.5** | **Third country training** | | | | | | | | | | | | |

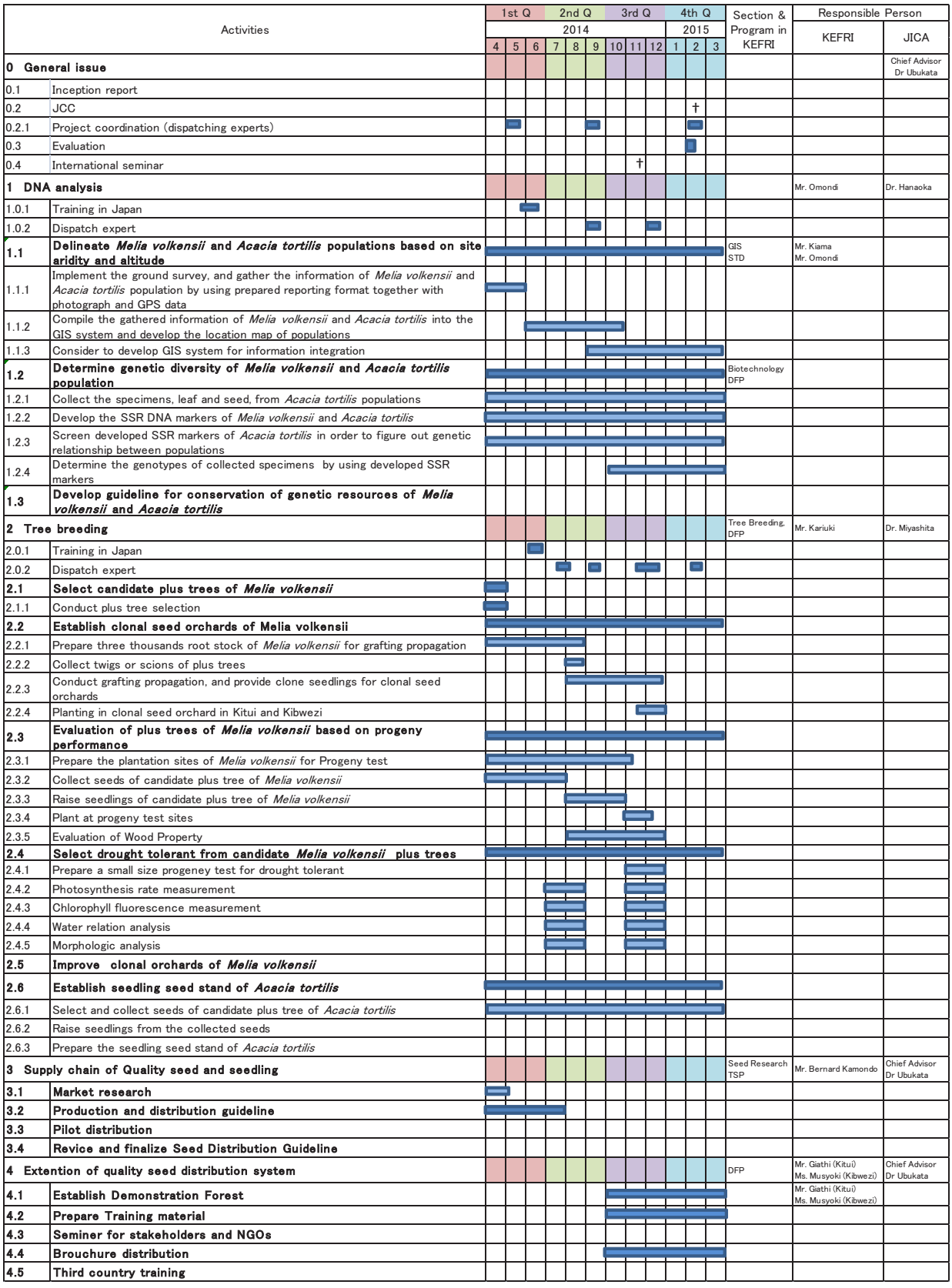
# Appendix 3-3

# Annual Plan of Operation (APO2013)

| Activities | | 1st Q | | | 2nd Q | | | 3rd Q | | | 4th Q | | | Section & Program in KEFRI | Responsible Person | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2013 | | | | | | | | | 2014 | | | | KEFRI | JICA |
| | | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | | | |
| **0 General issue** | | | | | | | | | | | | | | | | Chief Advisor Dr Fujisawa |
| 0.1 | Inception report | | | | | | | | | | | | | | | |
| 0.2 | JCC | | | | | | | | | | | † | | | | |
| 0.2.1 | Project coordination (dispatching experts) | | | | | | | | | | | | | | | |
| 0.3 | Evaluation | | | | | | | | | | | | | | | |
| 0.4 | Intrnational seminar | | | | | | | | | | | | | | | |
| **1 DNA analysis** | | | | | | | | | | | | | | | | Dr. Hanaoka |
| 1.0.1 | Training in Japan | | | | | | | | | | | | | | | |
| 1.0.2 | Dispatch expert | | | | | | | | | | | | | | | |
| **1.1** | **Delineate *Melia volkensii* and *Acacia tortilis* populations based on site aridity and altitude** | | | | | | | | | | | | | GIS STD | Mr. Kiama | |
| 1.1.1 | Implement the ground survey, and gather the information of Melia volkensii and Acacia tortilis population by using prepared reporting format together with photograph and GPS data | | | | | | | | | | | | | | | |
| 1.1.2 | Compile the gathered information of Melia volkensii and Acacia tortilis into the GIS system and develop the location map of populations | | | | | | | | | | | | | | | |
| 1.1.3 | Consider to develop GIS system for information integration | | | | | | | | | | | | | | | |
| **1.2** | **Determine genetic diversity of *Melia volkensii* and *Acacia tortilis* population** | | | | | | | | | | | | | Biotechnology DFP | Mr. Machua | |
| 1.2.1 | Collect the specimens, leaf and seed, from *Melia volkensii* populations | | | | | | | | | | | | | | | |
| 1.2.2 | Develop the SSR DNA markers of *Melia volkensii* and *Acacia tortilis* | | | | | | | | | | | | | | | |
| 1.2.3 | Screen developed SSR markers in order to figure out genetic relationship between populations | | | | | | | | | | | | | | | |
| 1.2.4 | Determine the genotypes of collected specimens by using developed SSR markers | | | | | | | | | | | | | | | |
| **1.3** | **Develop guideline for conservation of genetic resources of *Melia volkensii* and *Acacia tortilis*** | | | | | | | | | | | | | | | |
| **2 Tree breeding** | | | | | | | | | | | | | | Tree Breeding, DFP | Mr. Kariuki | Dr. Miyashita |
| 2.0.1 | Training in Japan | | | | | | | | | | | | | | | |
| 2.0.2 | Dispatch expert | | | | | | | | | | | | | | | |
| **2.1** | **Select candidate plus trees of *Melia volkensii*** | | | | | | | | | | | | | | | |
| 2.1.1 | Conduct plus tree selection | | | | | | | | | | | | | | | |
| **2.2** | **Establish clonal seed orchards of Melia volkensii** | | | | | | | | | | | | | | | |
| 2.2.1 | Prepare eight thousands root stock of *Melia volkensii* for grafting propagation | | | | | | | | | | | | | | | |
| 2.2.2 | Collect twigs or scions of candidate plus trees | | | | | | | | | | | | | | | |
| 2.2.3 | Conduct grafting propagation, and provide clone seedlings for clonal seed orchards | | | | | | | | | | | | | | | |
| 2.2.4 | Planting in clonal seed orchard in Kitui and Kibwezi | | | | | | | | | | | | | | | |
| **2.3** | **Evaluation of plus trees of *Melia volkensii* based on progeny performance** | | | | | | | | | | | | | | | |
| 2.3.1 | Prepare the plantation sites of *Melia volkensii* for Progeny test | | | | | | | | | | | | | | | |
| **2.4** | **Select drought tolerant from candidate *Melia volkensii* plus trees** | | | | | | | | | | | | | | | |
| 2.4.1 | Prepare a small size progeney test for drought tolerant | | | | | | | | | | | | | | | |
| 2.4.2 | Photosynthesis rate measurement | | | | | | | | | | | | | | | |
| 2.4.3 | Chlorophyll fluorescence measurement | | | | | | | | | | | | | | | |
| 2.4.4 | Hydropotential analysis | | | | | | | | | | | | | | | |
| 2.4.5 | Morphologic analysis | | | | | | | | | | | | | | | |
| **2.5** | **Improve clonal orchards of *Melia volkensii*** | | | | | | | | | | | | | | | |
| **2.6** | **Establish seedling seed stand of Acacia tortilis** | | | | | | | | | | | | | | | |
| 2.6.1 | Collect seeds of candidate plus tree of Acacia tortilis | | | | | | | | | | | | | | | |
| 2.6.2 | Propagate seedlings from the collected seeds | | | | | | | | | | | | | | | |
| 2.6.3 | Prepare the seedling seed stand of Acacia tortilis | | | | | | | | | | | | | | | |
| **3 Supply chain of Quality seed and seedling** | | | | | | | | | | | | | | Seed Research TSP | Mr. Bernard Kamondo | Chief Advisor Dr. Fujisawa |
| **3.1** | **Market research** | | | | | | | | | | | | | | | |
| **3.2** | **Production and distribution guideline** | | | | | | | | | | | | | | | |
| **3.3** | **Pilot distribution** | | | | | | | | | | | | | | | |
| **3.4** | **Revice and finalize Seed Distribution Guideline** | | | | | | | | | | | | | | | |
| **4 Extention of quality seed distribution system** | | | | | | | | | | | | | | DFP | Mr. Giathi (Kitui) Ms. Musyoki (Kibwezi) | Chief Advisor Dr. Fujisawa |
| **4.1** | **Establish Demonstration Forest** | | | | | | | | | | | | | | Mr. Giathi (Kitui) Ms. Musyoki (Kibwezi) | |
| **4.2** | **Prepare Training material** | | | | | | | | | | | | | | | |
| **4.3** | **Seminer for stakeholders and NGOs** | | | | | | | | | | | | | | | |
| **4.4** | **Brouchure distribution** | | | | | | | | | | | | | | | |
| **4.5** | **Third country training** | | | | | | | | | | | | | | | |

# Appendix 3-4

# Annual Plan of Operation (APO2014)



| Activities | | 1st Q | | | 2nd Q | | | 3rd Q | | | 4th Q | | | Section & Program in KEFRI | Responsible Person | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2014 | | | | | | | | | 2015 | | | | KEFRI | JICA |
| | | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | | | |
| **0 General issue** | | | | | | | | | | | | | | | | Chief Advisor Dr Ubukata |
| 0.1 | Inception report | | | | | | | | | | | | | | | |
| 0.2 | JCC | | | | | | | | | | | † | | | | |
| 0.2.1 | Project coordination (dispatching experts) | | | | | | | | | | | | | | | |
| 0.3 | Evaluation | | | | | | | | | | | | | | | |
| 0.4 | International seminar | | | | | | | | † | | | | | | | |
| **1 DNA analysis** | | | | | | | | | | | | | | | Mr. Omondi | Dr. Hanaoka |
| 1.0.1 | Training in Japan | | | | | | | | | | | | | | | |
| 1.0.2 | Dispatch expert | | | | | | | | | | | | | | | |
| **1.1** | **Delineate *Melia volkensii* and *Acacia tortilis* populations based on site aridity and altitude** | | | | | | | | | | | | | GIS STD | Mr. Kiama Mr. Omondi | |
| 1.1.1 | Implement the ground survey, and gather the information of *Melia volkensii* and *Acacia tortilis* population by using prepared reporting format together with photograph and GPS data | | | | | | | | | | | | | | | |
| 1.1.2 | Compile the gathered information of *Melia volkensii* and *Acacia tortilis* into the GIS system and develop the location map of populations | | | | | | | | | | | | | | | |
| 1.1.3 | Consider to develop GIS system for information integration | | | | | | | | | | | | | | | |
| **1.2** | **Determine genetic diversity of *Melia volkensii* and *Acacia tortilis* population** | | | | | | | | | | | | | Biotechnology DFP | | |
| 1.2.1 | Collect the specimens, leaf and seed, from *Acacia tortilis* populations | | | | | | | | | | | | | | | |
| 1.2.2 | Develop the SSR DNA markers of *Melia volkensii* and *Acacia tortilis* | | | | | | | | | | | | | | | |
| 1.2.3 | Screen developed SSR markers of *Acacia tortilis* in order to figure out genetic relationship between populations | | | | | | | | | | | | | | | |
| 1.2.4 | Determine the genotypes of collected specimens by using developed SSR markers | | | | | | | | | | | | | | | |
| **1.3** | **Develop guideline for conservation of genetic resources of *Melia volkensii* and *Acacia tortilis*** | | | | | | | | | | | | | | | |
| **2 Tree breeding** | | | | | | | | | | | | | | Tree Breeding, DFP | Mr. Kariuki | Dr. Miyashita |
| 2.0.1 | Training in Japan | | | | | | | | | | | | | | | |
| 2.0.2 | Dispatch expert | | | | | | | | | | | | | | | |
| **2.1** | **Select candidate plus trees of *Melia volkensii*** | | | | | | | | | | | | | | | |
| 2.1.1 | Conduct plus tree selection | | | | | | | | | | | | | | | |
| **2.2** | **Establish clonal seed orchards of Melia volkensii** | | | | | | | | | | | | | | | |
| 2.2.1 | Prepare three thousands root stock of *Melia volkensii* for grafting propagation | | | | | | | | | | | | | | | |
| 2.2.2 | Collect twigs or scions of plus trees | | | | | | | | | | | | | | | |
| 2.2.3 | Conduct grafting propagation, and provide clone seedlings for clonal seed orchards | | | | | | | | | | | | | | | |
| 2.2.4 | Planting in clonal seed orchard in Kitui and Kibwezi | | | | | | | | | | | | | | | |
| **2.3** | **Evaluation of plus trees of *Melia volkensii* based on progeny performance** | | | | | | | | | | | | | | | |
| 2.3.1 | Prepare the plantation sites of *Melia volkensii* for Progeny test | | | | | | | | | | | | | | | |
| 2.3.2 | Collect seeds of candidate plus tree of *Melia volkensii* | | | | | | | | | | | | | | | |
| 2.3.3 | Raise seedlings of candidate plus tree of *Melia volkensii* | | | | | | | | | | | | | | | |
| 2.3.4 | Plant at progeny test sites | | | | | | | | | | | | | | | |
| 2.3.5 | Evaluation of Wood Property | | | | | | | | | | | | | | | |
| **2.4** | **Select drought tolerant from candidate *Melia volkensii* plus trees** | | | | | | | | | | | | | | | |
| 2.4.1 | Prepare a small size progeney test for drought tolerant | | | | | | | | | | | | | | | |
| 2.4.2 | Photosynthesis rate measurement | | | | | | | | | | | | | | | |
| 2.4.3 | Chlorophyll fluorescence measurement | | | | | | | | | | | | | | | |
| 2.4.4 | Water relation analysis | | | | | | | | | | | | | | | |
| 2.4.5 | Morphologic analysis | | | | | | | | | | | | | | | |
| **2.5** | **Improve clonal orchards of *Melia volkensii*** | | | | | | | | | | | | | | | |
| **2.6** | **Establish seedling seed stand of *Acacia tortilis*** | | | | | | | | | | | | | | | |
| 2.6.1 | Select and collect seeds of candidate plus tree of *Acacia tortilis* | | | | | | | | | | | | | | | |
| 2.6.2 | Raise seedlings from the collected seeds | | | | | | | | | | | | | | | |
| 2.6.3 | Prepare the seedling seed stand of *Acacia tortilis* | | | | | | | | | | | | | | | |
| **3 Supply chain of Quality seed and seedling** | | | | | | | | | | | | | | Seed Research TSP | Mr. Bernard Kamondo | Chief Advisor Dr Ubukata |
| **3.1** | **Market research** | | | | | | | | | | | | | | | |
| **3.2** | **Production and distribution guideline** | | | | | | | | | | | | | | | |
| **3.3** | **Pilot distribution** | | | | | | | | | | | | | | | |
| **3.4** | **Revice and finalize Seed Distribution Guideline** | | | | | | | | | | | | | | | |
| **4 Extention of quality seed distribution system** | | | | | | | | | | | | | | DFP | Mr. Giathi (Kitui) Ms. Musyoki (Kibwezi) | Chief Advisor Dr Ubukata |
| **4.1** | **Establish Demonstration Forest** | | | | | | | | | | | | | | Mr. Giathi (Kitui) Ms. Musyoki (Kibwezi) | |
| **4.2** | **Prepare Training material** | | | | | | | | | | | | | | | |
| **4.3** | **Seminer for stakeholders and NGOs** | | | | | | | | | | | | | | | |
| **4.4** | **Brouchure distribution** | | | | | | | | | | | | | | | |
| **4.5** | **Third country training** | | | | | | | | | | | | | | | |

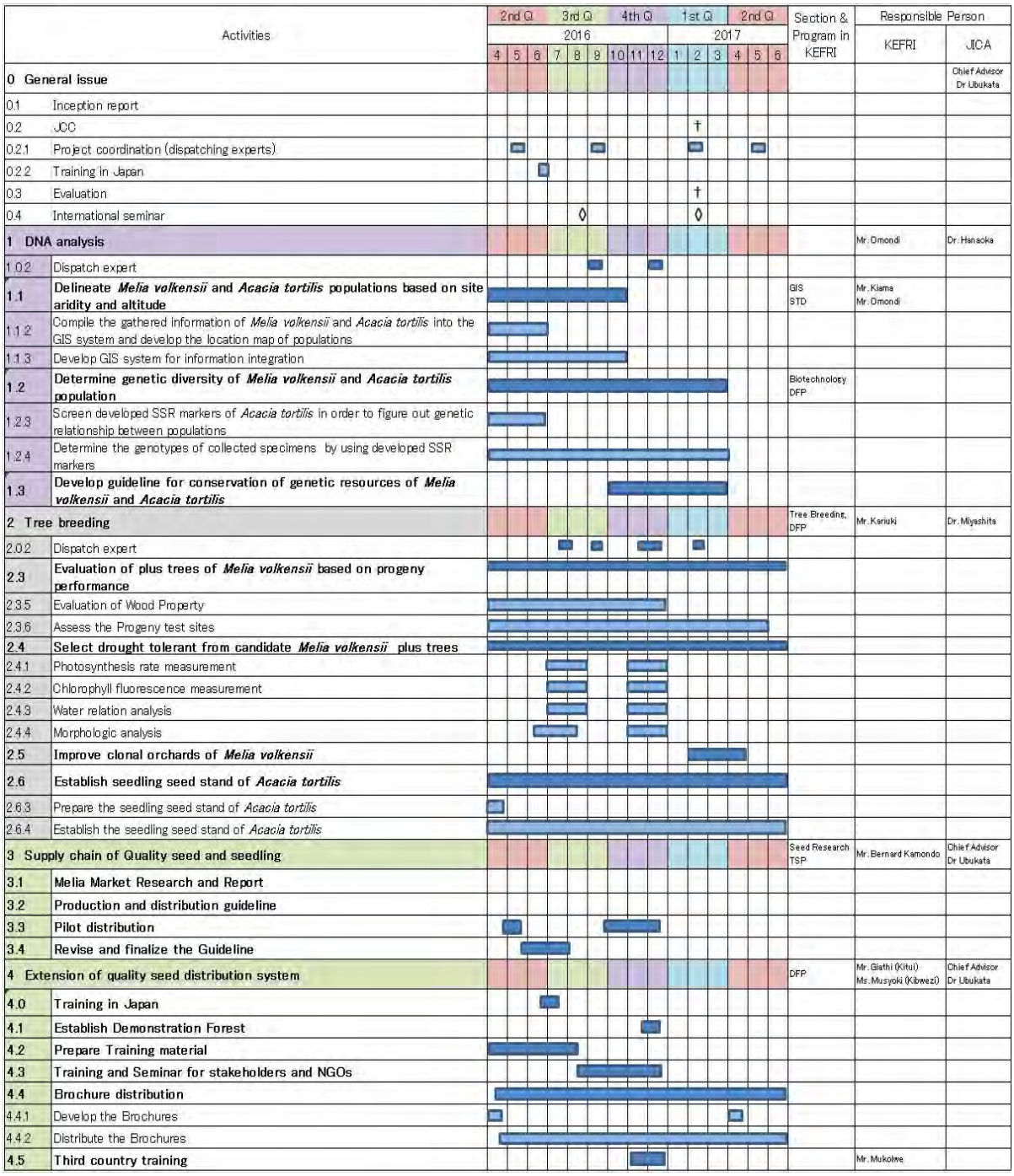
# Appendix 3-5

# Annual Plan of Operation (APO2015)

## Annual Plan of Operation 2015

| Activities | | 1st Q | | | 2nd Q | | | 3rd Q | | | 4th Q | | | Section & Program in KEFRI | Responsible Person | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2015 | | | | | | | | | 2016 | | | | KEFRI | JICA |
| | | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | | | |
| **0 General issue** | | | | | | | | | | | | | | | | Chief Advisor Dr Ubukata |
| 0.1 | Inception report | | | | | | | | | | | | | | | |
| 0.2 | JCC | | | | | | | | | | | † | | | | |
| 0.2.1 | Project coordination (dispatching experts) | | | | | | | | | | | | | | | |
| 0.2.2 | Training in Japan | | | | | | | | | | | | | | | |
| 0.3 | Evaluation | | | | | | | | | | | | | | | |
| 0.4 | International seminar | | | | | | | | | | | | | | | |
| **1 DNA analysis** | | | | | | | | | | | | | | | Mr. Omondi | Dr. Hanaoka |
| 1.0.2 | Dispatch expert | | | | | | | | | | | | | | | |
| **1.1** | **Delineate *Melia volkensii* and *Acacia tortilis* populations based on site aridity and altitude** | | | | | | | | | | | | | GIS STD | Mr. Kiama Mr. Omondi | |
| 1.1.1 | Implement the ground survey, and gather the information of *Melia volkensii* and *Acacia tortilis* population by using prepared reporting format together with photograph and GPS data | | | | | | | | | | | | | | | |
| 1.1.2 | Compile the gathered information of *Melia volkensii* and *Acacia tortilis* into the GIS system and develop the location map of populations | | | | | | | | | | | | | | | |
| 1.1.3 | Consider to develop GIS system for information integration | | | | | | | | | | | | | | | |
| **1.2** | **Determine genetic diversity of *Melia volkensii* and *Acacia tortilis* population** | | | | | | | | | | | | | Biotechnology DFP | | |
| 1.2.1 | Collect the specimens, leaf and seed, from *Acacia tortilis* populations | | | | | | | | | | | | | | | |
| 1.2.2 | Develop the SSR DNA markers of *Melia volkensii* and *Acacia tortilis* | | | | | | | | | | | | | | | |
| 1.2.3 | Screen developed SSR markers of *Acacia tortilis* in order to figure out genetic relationship between populations | | | | | | | | | | | | | | | |
| 1.2.4 | Determine the genotypes of collected specimens by using developed SSR markers | | | | | | | | | | | | | | | |
| **1.3** | **Develop guideline for conservation of genetic resources of *Melia volkensii* and *Acacia tortilis*** | | | | | | | | | | | | | | | |
| **2 Tree breeding** | | | | | | | | | | | | | | Tree Breeding, DFP | Mr. Kariuki | Dr. Miyashita |
| 2.0.2 | Dispatch expert | | | | | | | | | | | | | | | |
| **2.3** | **Evaluation of plus trees of *Melia volkensii* based on progeny performance** | | | | | | | | | | | | | | | |
| 2.3.1 | Prepare the plantation sites of *Melia volkensii* for Progeny test | | | | | | | | | | | | | | | |
| 2.3.2 | Collect seeds of candidate plus tree of *Melia volkensii* | | | | | | | | | | | | | | | |
| 2.3.3 | Raise seedlings of candidate plus tree of *Melia volkensii* | | | | | | | | | | | | | | | |
| 2.3.4 | Plant at progeny test sites | | | | | | | | | | | | | | | |
| 2.3.5 | Evaluation of Wood Property | | | | | | | | | | | | | | | |
| **2.4** | **Select drought tolerant from candidate *Melia volkensii* plus trees** | | | | | | | | | | | | | | | |
| 2.4.1 | Photosynthesis rate measurement | | | | | | | | | | | | | | | |
| 2.4.2 | Chlorophyll fluorescence measurement | | | | | | | | | | | | | | | |
| 2.4.3 | Water relation analysis | | | | | | | | | | | | | | | |
| 2.4.4 | Morphologic analysis | | | | | | | | | | | | | | | |
| **2.5** | **Improve clonal orchards of *Melia volkensii*** | | | | | | | | | | | | | | | |
| **2.6** | **Establish seedling seed stand of *Acacia tortilis*** | | | | | | | | | | | | | | | |
| 2.6.1 | Select and collect seeds of candidate plus tree of *Acacia tortilis* | | | | | | | | | | | | | | | |
| 2.6.2 | Raise seedlings from the collected seeds | | | | | | | | | | | | | | | |
| 2.6.3 | Prepare the seed stand of *Acacia tortilis* | | | | | | | | | | | | | | | |
| 2.6.4 | Establish the seedling seed stand of *Acacia tortilis* | | | | | | | | | | | | | | | |
| **3 Supply chain of Quality seed and seedling** | | | | | | | | | | | | | | Seed Research TSP | Mr. Bernard Kamondo | Chief Advisor Dr Ubukata |
| **3.2** | **Production and distribution guideline** | | | | | | | | | | | | | | | |
| **3.3** | **Pilot distribution** | | | | | | | | | | | | | | | |
| **3.4** | **Revice and finalize Seed Distribution Guideline** | | | | | | | | | | | | | | | |
| **4 Extention of quality seed distribution system** | | | | | | | | | | | | | | DFP | Mr. Giathi (Kitui) Ms. Musyoki (Kibwezi) | Chief Advisor Dr Ubukata |
| **4.0** | **Training in Japan** | | | | | | | | | | | | | | | |
| **4.1** | **Establish Demonstration Forest** | | | | | | | | | | | | | | Mr. Giathi (Kitui) Ms. Musyoki (Kibwezi) | |
| **4.2** | **Prepare Training material** | | | | | | | | | | | | | | | |
| **4.3** | **Training and Seminer for stakeholders and NGOs** | | | | | | | | | | | | | | | |
| **4.4** | **Brouchure distribution** | | | | | | | | | | | | | | | |
| **4.5** | **Third country training** | | | | | | | | | | | | | | | |

# Appendix 3-6 Annual Plan of Operation (APO2016)



| Activities | | 2nd Q | | | 3rd Q | | | 4th Q | | | 1st Q | | | 2nd Q | | | Section & Program in KEFRI | Responsible Person | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2016 | | | | | | | | | 2017 | | | | | | | KEFRI | JICA |
| | | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | | | |
| **0 General issue** | | | | | | | | | | | | | | | | | | | Chief Advisor Dr Ubukata |
| 0.1 | Inception report | | | | | | | | | | | | | | | | | | |
| 0.2 | JCC | | | | | | | | | | | † | | | | | | | |
| 0.2.1 | Project coordination (dispatching experts) | | | | | | | | | | | | | | | | | | |
| 0.2.2 | Training in Japan | | | | | | | | | | | | | | | | | | |
| 0.3 | Evaluation | | | | | | | | | | | † | | | | | | | |
| 0.4 | International seminar | | | | | ◊ | | | | | | ◊ | | | | | | | |
| **1 DNA analysis** | | | | | | | | | | | | | | | | | | Mr. Omondi | Dr. Hanaoka |
| 1.0.2 | Dispatch expert | | | | | | | | | | | | | | | | | | |
| **1.1** | **Delineate *Melia volkensii* and *Acacia tortilis* populations based on site aridity and altitude** | | | | | | | | | | | | | | | | GIS STD | Mr. Kiama Mr. Omondi | |
| 1.1.2 | Compile the gathered information of *Melia volkensii* and *Acacia tortilis* into the GIS system and develop the location map of populations | | | | | | | | | | | | | | | | | | |
| 1.1.3 | Develop GIS system for information integration | | | | | | | | | | | | | | | | | | |
| **1.2** | **Determine genetic diversity of *Melia volkensii* and *Acacia tortilis* population** | | | | | | | | | | | | | | | | Biotechnology DFP | | |
| 1.2.3 | Screen developed SSR markers of *Acacia tortilis* in order to figure out genetic relationship between populations | | | | | | | | | | | | | | | | | | |
| 1.2.4 | Determine the genotypes of collected specimens by using developed SSR markers | | | | | | | | | | | | | | | | | | |
| **1.3** | **Develop guideline for conservation of genetic resources of *Melia volkensii* and *Acacia tortilis*** | | | | | | | | | | | | | | | | | | |
| **2 Tree breeding** | | | | | | | | | | | | | | | | | Tree Breeding, DFP | Mr. Kariuki | Dr. Miyashita |
| 2.0.2 | Dispatch expert | | | | | | | | | | | | | | | | | | |
| **2.3** | **Evaluation of plus trees of *Melia volkensii* based on progeny performance** | | | | | | | | | | | | | | | | | | |
| 2.3.5 | Evaluation of Wood Property | | | | | | | | | | | | | | | | | | |
| 2.3.6 | Assess the Progeny test sites | | | | | | | | | | | | | | | | | | |
| **2.4** | **Select drought tolerant from candidate *Melia volkensii* plus trees** | | | | | | | | | | | | | | | | | | |
| 2.4.1 | Photosynthesis rate measurement | | | | | | | | | | | | | | | | | | |
| 2.4.2 | Chlorophyll fluorescence measurement | | | | | | | | | | | | | | | | | | |
| 2.4.3 | Water relation analysis | | | | | | | | | | | | | | | | | | |
| 2.4.4 | Morphologic analysis | | | | | | | | | | | | | | | | | | |
| **2.5** | **Improve clonal orchards of *Melia volkensii*** | | | | | | | | | | | | | | | | | | |
| **2.6** | **Establish seedling seed stand of *Acacia tortilis*** | | | | | | | | | | | | | | | | | | |
| 2.6.3 | Prepare the seedling seed stand of *Acacia tortilis* | | | | | | | | | | | | | | | | | | |
| 2.6.4 | Establish the seedling seed stand of *Acacia tortilis* | | | | | | | | | | | | | | | | | | |
| **3 Supply chain of Quality seed and seedling** | | | | | | | | | | | | | | | | | Seed Research TSP | Mr. Bernard Kamondo | Chief Advisor Dr Ubukata |
| 3.1 | Melia Market Research and Report | | | | | | | | | | | | | | | | | | |
| 3.2 | Production and distribution guideline | | | | | | | | | | | | | | | | | | |
| 3.3 | Pilot distribution | | | | | | | | | | | | | | | | | | |
| 3.4 | Revise and finalize the Guideline | | | | | | | | | | | | | | | | | | |
| **4 Extension of quality seed distribution system** | | | | | | | | | | | | | | | | | DFP | Mr. Githi (Kitui) Ms. Musyoki (Kibwezi) | Chief Advisor Dr Ubukata |
| 4.0 | Training in Japan | | | | | | | | | | | | | | | | | | |
| 4.1 | Establish Demonstration Forest | | | | | | | | | | | | | | | | | | |
| 4.2 | Prepare Training material | | | | | | | | | | | | | | | | | | |
| 4.3 | Training and Seminar for stakeholders and NGOs | | | | | | | | | | | | | | | | | | |
| 4.4 | Brochure distribution | | | | | | | | | | | | | | | | | | |
| 4.4.1 | Develop the Brochures | | | | | | | | | | | | | | | | | | |
| 4.4.2 | Distribute the Brochures | | | | | | | | | | | | | | | | | | |
| 4.5 | Third country training | | | | | | | | | | | | | | | | | Mr. Mukolwe | |

# Appendix 4 Summary of activities, FY2012-FY2017

FY2012

| Month | C/P Training in Japan | | | | Expert Dispatching | | | Other issues |
|---|---|---|---|---|---|---|---|---|
| April 2012 | | | | | | | | |
| May | | | | | | | | May 30, Signed on R/D |
| June | | | | | | | | June 25, Call for the tender of consultant service |
| July | July 3 - Aug 26<br>Genetic analysis course<br>Mr Machua<br>Mr Omondi | July 3 - Aug 12<br>Breeding theory couse<br>Mr Kariuki<br>Mr Muchiri | July 3 - July 29<br>Propagation course<br>Ms Mwangi<br>Ms Maingi | July 21 - Aug 12<br>Breeding project management course<br>Mr Muturi | | | | July 11, Mr Ozawa and Mr Narumi were dispatched as long term experts<br><br>July 17, Signed on the contract between JICA and FTBC |
| August | -ditto- | -ditto- | Aug 4 - Aug 12<br>Breeding project management course<br>Dr Chikamai | -ditto- | Aug 22 - Sep 5<br>Breeding<br>Dr Miyashita<br>Nursery<br>Mr Yamaguchi | Aug 25 - Sep 2<br>Draught tolerant<br>Dr Gyokusen<br>Dr Goto | | |
| September | | | | | -ditto- | -ditto- | Sep 22 - Sep 29<br>Project management<br>Dr Fujisawa | Sep 25, 1st JCC |
| October | | | | | | | | |
| November | | | | | Nov 24 - Dec 9<br>Breeding<br>Dr Miyashita<br>Propagation<br>Mr Yamanobe<br>Nursery<br>Mr Chiba | Nov 24 - Dec 9<br>DNA analysis<br>Dr Hanaoka | | |
| December | | | | | -ditto- | -ditto- | Dec 11 - 23<br>Draught tolerant<br>Dr Sakuta | |
| January 2013 | | | | | Jan 23 - Fe 13<br>Breeding<br>Dr Miyashita<br>Nursery<br>Mr Sakamoto | Jan 25 - Feb 4<br>Draught tolerant<br>Dr Gyokusen | | |
| February | | | | | -ditto- | -ditto- | Feb 5 - 14<br>Project management<br>Mr Kimura | Feb 12, 2nd JCC |
| March | | | | | | | | |

FY2013

| Month | C/P Training Japan | | | | Expert Dispatching | | | | Other issues |
|---|---|---|---|---|---|---|---|---|---|
| April 2013 | | | | | | | | | Apr.22, Signed on the contract between JICA and FTBC |
| May | | | | | | | | | |
| June | Jun.9 - Jul.13<br>“Genetic analysis”<br>Mr Mungai<br>Mr Omondi | Jun.9 - Jun.29<br>“Breeding theory”<br>Dr Ndufa<br>Ms Musyoki | Jun.23 - Jul.13<br>“Propagation”<br>Mr Othuoni<br>Mr Musava | Jun.23 - Jul.20<br>“Drought tolerant”<br>Mr Kigwa<br>Mr Muchiri | Jun.4 - Jun.13<br>“Project Management”<br>Dr Fujisawa | | | | Jun.1- Jun.3,<br>TICAD V, Yokohama |
| July | -ditto- | | -ditto- | -ditto- | Jul.22 - Aug.11<br>“Drought tolerant”<br>Dr Gyokusen | Jul.22 - Jul.28<br>“Drought tolerant”<br>Dr Sakuta | Jul.22 - Jul.31<br>“Drought tolerant”<br>Dr Goto | | |
| August | | | | | -ditto- | | | | |
| | | | | | Aug.22 - Sep.2<br>“DNA analysis”<br>Dr Hanaoka | Aug.22 - Sep.2<br>“Forest disease”<br>Dr Sahashi | Aug.22 - Sep.2<br>“Nursery”<br>Mr Chiba<br>Mr Yamaguchi | Aug.22 - Sep.6<br>“Breeding”<br>Dr Miyashita | |
| September | | | | | -ditto- | -ditto- | -ditto- | -ditto- | |
| October | | | | | | | | | |
| November | | | | | Nov.18 - Nov.27<br>“Project management ”<br>Dr Kondo | Nov.18 - Nov.27<br>“Drought tolerant”<br>Dr Gyokusen<br>Dr Tsuyama | | | |
| December | | | | | | | | | |
| January 2014 | | | | | Jan. 25 - Feb.2<br>“Propagation”<br>Mr Yamanobe | Jan. 25 - Feb.3<br>“Nursery”<br>Mr Sakamoto | | | |
| February | | | | | -ditto- | -ditto- | | | |
| | | | | | Feb.1 - Feb.8<br>“Breeding”<br>Dr Miyashita | Feb.7 - Fe.16<br>“Project management ”<br>Dr Kondo | | | Feb. 12nd<br>3rd JCC, Kitui |
| March | | | | | | | | | |

FY2014

| Month | C/P Training Japan | | | | Expert Dispatching | | | | Other issues |
|---|---|---|---|---|---|---|---|---|---|
| April 2014 | | | | | Apr.6 - Apr.15<br>“DNA analysis”<br>Dr Hanaoka | | | | |
| May | | May.18 - Jun.14<br>“DNA analysis”<br>Mr Omondi<br>Mr Mungai | May.18 - Jun.14<br>“Breeding theory”<br>Ms Munyao<br>Mr Matieka | | | | | | |
| June | Jun.1 - Jun.14<br>“Project management”<br>Dr Adhaya | -ditto- | -ditto- | Jun.1 - Jun.28<br>“Extension”<br>Mr Makee<br>Mr Wekesa | Jun.1 - Jun.15<br>“Breeding”<br>Dr Miyashita | Jun.8 - Jun.15<br>“Project management”<br>Dr Ubukata | | | |
| July | | | | | Jul.13 - Jul.27<br>“Drought tolerant”<br>Dr Gyokusen | Jul.13 - Jul.27<br>“Drought tolerant”<br>Dr Tsuyama | | | |
| August | | | | | Aug.20 - Aug.29<br>“Nursery”<br>Mr Hashimoto | Aug.20 - Aug.29<br>“Breeding”<br>Dr Miyashita | | | |
| September | | | | | | | | | |
| October | | | | | | | | | |
| November | | | | | Nov.2 - Nov.12<br>“Drought tolerant”<br>Dr Tsuyama | Nov.23 - Nov.30<br>“Project management ”<br>Mr Shimizu<br>Dr Matsushita | | | |
| December | | | | | | | | | |
| January 2015 | | | | | | | | | |
| February | | | | | Feb.7 - Feb.15<br>“Drought tolerant”<br>Dr Gyokusen | Feb.9 - Feb.16<br>“Nursery”<br>Mr.Sakamato<br>Mr Chiba | Feb. 9 - Feb.22<br>“Breeding”<br>Dr Miyashita | Feb.14 - Feb.22<br>“DNA analysis”<br>Dr Hanaoka | Feb. 18th<br>4th JCC, Kitui |
| | | | | | Feb 14 - Feb 22<br>“Project management”<br>Dr Ubukata<br>Mr Sakai | | | | |
| March | | | | | | | | | |

FY2015

| Month | C/P Training Japan | | | | Expert Dispatching | | | | Other issues |
|---|---|---|---|---|---|---|---|---|---|
| April 2015 | | | | | | | | | |
| May | May.24 - Jun.20<br>“Extension course”<br>Mr Kamondo | May.24 - Jun.20<br>“Extension course”<br>Mr Angaine | May.24 - Jun.20<br>“Extension course”<br>Ms Oduor | May.24 - Jun.20<br>“Extension course”<br>Dr Ngoriareng | | | | | |
| June | | | | | Jun.28 - Jul.5<br>“Project management”<br>Dr Ubukata | Jun.28 - Jul.5<br>“Project management”<br>Mr Kamizore | | | |
| July | Jul.6 - Jul.13<br>“Project management course”<br>Mr Mugo | Jul.6 - Jul.13<br>“Project management course”<br>Dr Ngure | | | Jul.13 - Aug.2<br>“Drought tolerant”<br>Dr Gyokusen | Jul.13 - Jul.27<br>“Drought tolerant”<br>Dr Tsuyama | Jul.21 - Aug.2<br>“Drought tolerant”<br>Dr Goto | Jul.13 - July.27<br>“Drought tolerant”<br>Dr Sakuta | |
| August | | | | | | | Aug.21 - Aug.29<br>“Nursery”<br>Mr Sakamoto | Aug.21 - Aug.29<br>“Breeding”<br>Dr Miyashita | |
| September | | | | | | | | | |
| October | | | | | | | | | |
| November | | | | | Nov.24 - Dec.4<br>“DNA analysis”<br>Dr Hanaoka | Nov.24 - Dec.4<br>“DNA analysis”<br>Dr Matsushita | | | |
| December | | | | | | | | | |
| January 2016 | | | | | | | | | |
| February | | | | | Feb.1 - Feb.11<br>“Drought tolerant”<br>Dr Gyokusen | Feb.8 - Feb.17<br>“Project management”<br>Mr Sakai | Feb. 8 - Feb.17<br>“Nursery Management“<br>Mr Chiba | | |
| March | | | | | | | | | |

FY2016-2017

| Month | C/P Training Japan | | | Expert Dispatching | | | | Other issues |
|---|---|---|---|---|---|---|---|---|
| April 2016 | | | | | | | | |
| May | | | | May.28 - Jun.5<br>“Project management”<br>Dr Ubukata | May.28 - Jun.5<br>“Project management”<br>Mr Kamizore | | | |
| June | Jun.20 - Jul.14<br>“Extension course”<br>Mr Mukolwe | Jun.20 - Jul.14<br>“Extension course”<br>Ms Kanyororo | Jun.20 - Jul.14<br>“Extension course”<br>Mr Njoroge | | | | | |
| | Jun.20 - Jul.14<br>“Extension course”<br>Mr Ongere | Jun.20 - Jul.14<br>“Extension course”<br>Mr Rukungu | Jun.20 - Jul.14<br>“Extension course”<br>Mr Gondo | | | | | |
| July | | | | Jul.22 - Jul.29<br>“Drought tolerant”<br>Dr Goto | Jul.22 - Jul.29<br>“Drought tolerant”<br>Dr Sakuta | | | |
| August | | | | | | Aug.30 – Sep.11<br>“Drought tolerant”<br>Dr Gyokusen | Aug.30 – Sep.11<br>“Drought tolerant”<br>Dr Tsuyama | |
| September | | | | | | | | |
| October | | | | Oct.24 – Nov.3<br>“Project management”<br>Mr Kamizore | Oct.24 – Nov.3<br>“Nursery”<br>Mr Hashimoto | Oct.24 – Nov.3<br>“Nursery”<br>Mr Chiba | | 5th JCC |
| November | | | | | | | | |
| December | | | | | | | | |
| January 2017 | | | | | | | | |
| February | | | | Feb.1 - Feb.11<br>“Drought tolerant”<br>Dr Gyokusen | Feb.11 - Feb.18<br>“Project management”<br>Dr Ubukata | Feb.11 - Feb.18<br>“Project management”<br>Mr Kawato | Feb.11 - Feb.18<br>“Project management”<br>Mr Kamizore | International Conference<br>6th JCC |
| | | | | Feb.11 – Feb.18<br>“Tree Breeding”<br>Dr Miyashira | Feb.1 – Feb.11<br>“Genetic Analysis”<br>Dr Matsushita | Feb.1 – Feb.11<br>“Genetic Analysis”<br>Dr Hanaoka | | |
| March | | | | | | | | |
| April | | | | | | | | |
| May | | | | | | | | |
| June | | | | Jun.9 - Jun.17<br>“Project management”<br>Mr Kawato | Jun.9 - Jun.17<br>“Project management”<br>Mr. Kamizore | | | 7th JCC |

# Appendix 4-1 Achievement of short term expert in 2012

## Appendix 4-1-1 Report of short term expert (Breeding and propagation)

| Expertise | Name | Term |
|---|---|---|
| Breeding theory | Dr. Hisaya Miyashita | 22.8.2012~5.9.2012 |
| Nursery | Mr. Hidetaro Yamaguchi | 22.8.2012~5.9.2012 |

Itinerary

| Date | Activities |
|---|---|
| Aug 23 | Arrive to Nairobi |
| Aug 24 | Courtesy call to JICA Kenya Office, KEFRI Director<br>Meeting in KEFRI |
| Aug 25 | Meeting with JICA experts |
| Aug 26 | Move to Kitui |
| Aug 27 | Kitui Regional centre, nursery |
| Aug 28 | Tiva pilot forest station, nursery, seed orchard |
| Aug 29 | Kitui, scion collection |
| Aug 30 | Kitui Regional centre, grafting exercise |
| Aug 31 | move to Kibwezi, seed orchard |
| Sep 1 | move to Nairobi |
| Sep 2 | Documentation |
| Sep 3 | Meeting in KEFRI, depart Nairobi |

Activities

- Site preparation of seed orchard in Tiva
  - The selected site was confirmed, and ground design was discussed

- Scion collection
  - Experts instructed the scion collection nearby Kitui regional center

- Grafting
  - Experts instructed grafting techniques at the Kitui nursery

- Site selection of seed orchard in Kibwezi
  - Potential site was confirmed, and KEFRI CP started land rental negotiation.

## Appendix 4-1-2 Report of short term expert (Drought tolerant)

| Expertise | Name | Term |
|---|---|---|
| Drought tolerant | A-Prof.Dr Koichiro Gyokusen | 25.8.2012~2.9.2012 |
| Drought tolerant | Dr Eiji Goto | 25.8.2012~2.9.2012 |

Itinerary

| Date | Activities |
|---|---|
| Aug 26 | Arrive to Nairobi |
| Aug 27 | Courtesy call to KEFRI, meeting w/ CP, move to Kitui |
| Aug 28 | Tiva pilot forest station |
| Aug 29 | Tiva pilot forest station, dendrometer setting |
| Aug 30 | Tiva pilot forest station, dendrometer setting, phenology survey |
| Aug 31 | Tiva pilot forest station, dendrometer setting,Kitui nursery. |
| Sep 1 | move to Nairobi, depart Nairobi |

Activities

8.26 (Sun.)

**Meeting with Mr. Muturi at hotel Prideinn**

- We talked with Mr. Muturi about equipments scheduled for purchase and our C/P .
- Mr. Muturi was eager to exchange the photosynthesis equipment from ADC to Li-cor.
- He introduced two researches (Mr.Kigwa and Ms. Balla) to us as C/Ps.

8.27 (Mon.)

**Courtesy call to KEFRI HQs**

- We visited Kefri HQs for courtesy call.
- Deputy director explained about the organization and work contents of Kefri.
- After the call, we inspected its laboratories and nursery.
- No equipments related with plant physiological study were found in Kefri HQs.

**Move from Nairobi to Kitui**

・We moved from Nairobi to Kitui, where was located about 180 km east of Nairobi city.

・We stayed at the guest house of Kitui regional research center for four days.

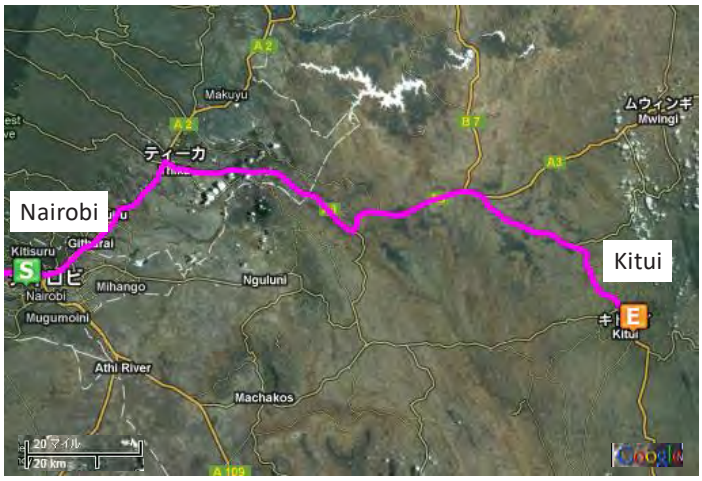



Fig.1 Location of Nairobi and Kitui city.

8.28 (Tue.)

**Field survey in Tiva station (together with the breeding team)**

・To find sample trees for the dendrometoric study of *Melia*, we surveyed around Tiva station.

・Although there were a lots of *Melia* trees growing in the field, it seemed to be difficult for us to use these trees because of the problem of security for dendrometer equipments.


Fig.2 Location of Kitui city and Tiva station. Tiva station is located about 20km west of Kitui city.

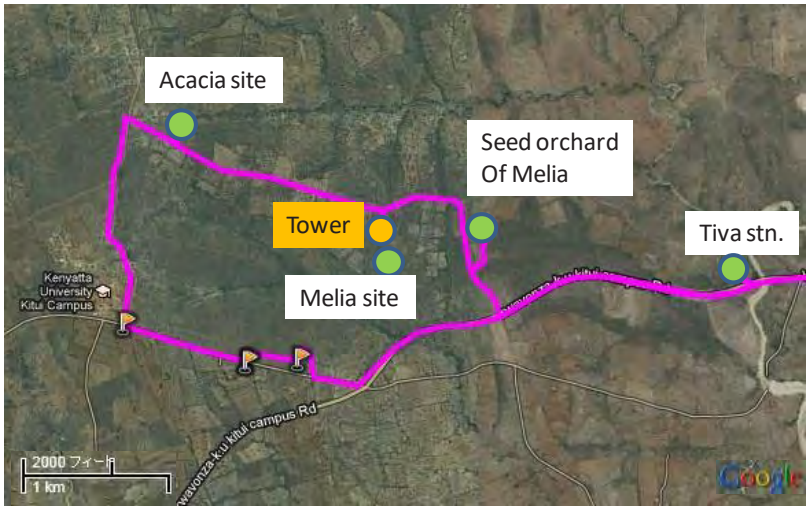



Fig.3 Distribution of pilot-forest in Tiva station

8.29 (Wed.), 30 (Thu.), 31 (Fri.)

**Dendrometer installation**

・We decided to use *Melia* trees growing inside Tiva station (nursery area) for dendrometoric measurement. The security of this area was thought to be a little higher than that of other areas.

・Ten individual trees were selected as sample trees, and ten manual type dendrometers were installed at 1.2m height in each stem, respectively (fig.4). Additionally, a multi-channel automatic dendrometer was installed in four trees growing at a nearby site, and the logger of the dendrometer was locked up in a repaired steel box (fig.4). The distribution of sample tree was shown in fig.5.

・A sheet which we asked to C/P (Ms.Balla) filling out the blanks is shown in table1.

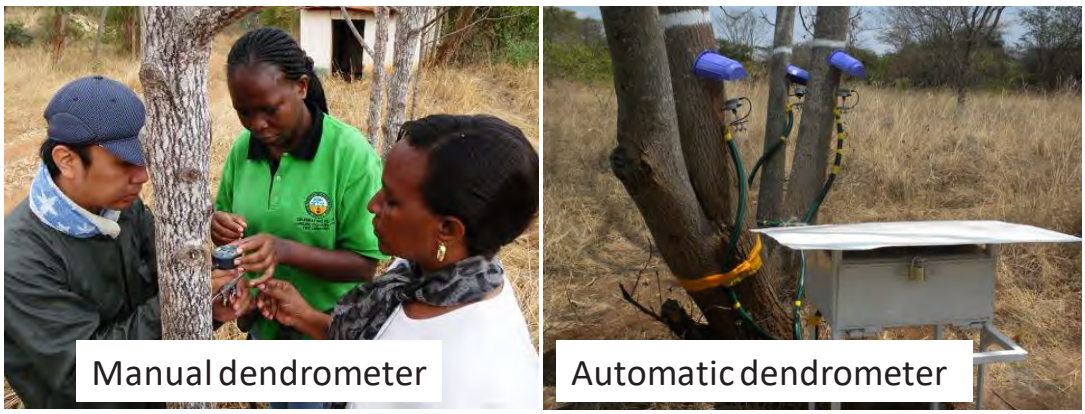



Fig.4 Installation of two types of dendrometer

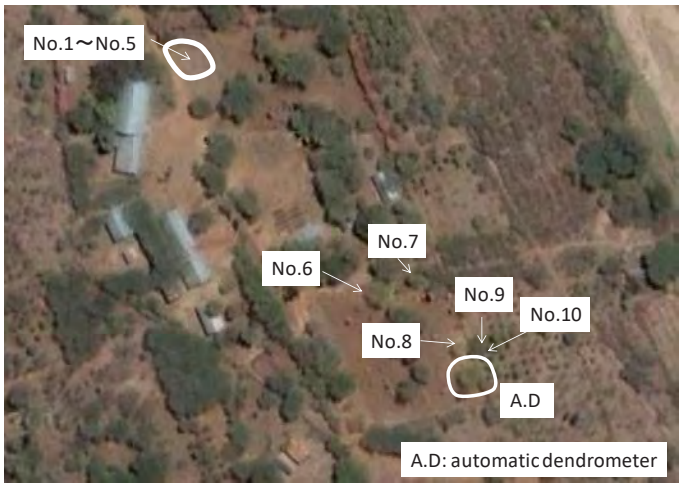



Fig.5 Distribution of sample trees installed the dendrometer

| | | 2012.'8.31 | 9.15 | 9.30 | 10.15 | 10.31 | 11.15 | 11.30 | 12.15 | 12.31 |
|---|---|---|---|---|---|---|---|---|---|---|
| No.1 | D1 | 10.3 | | | | | | | | |
| | D2 | 10.2 | | | | | | | | |
| | H | 7.07 | | | | | | | | |
| Dendrometer | | 1.28 | | | | | | | | |
| No.2 | D1 | 11.7 | | | | | | | | |
| | D2 | 11.5 | | | | | | | | |
| | H | 7.16 | | | | | | | | |
| Dendrometer | | 0.43 | | | | | | | | |
| No.3 | D1 | 9.5 | | | | | | | | |
| | D2 | 9.2 | | | | | | | | |
| | H | 7.2 | | | | | | | | |
| Dendrometer | | 0.63 | | | | | | | | |
| No.4 | D1 | 7.5 | | | | | | | | |
| | D2 | 7.7 | | | | | | | | |
| | H | 5.68 | | | | | | | | |
| Dendrometer | | 0.39 | | | | | | | | |
| No.5 | D1 | 9.2 | | | | | | | | |
| | D2 | 9.4 | | | | | | | | |
| | H | 5.96 | | | | | | | | |
| Dendrometer | | 0.69 | | | | | | | | |
| No.6 | D1 | 32.2 | | | | | | | | |
| | D2 | 31.2 | | | | | | | | |
| Dendrometer | | 0.57 | | | | | | | | |
| (14.0m) | | | | | | | | | | |
| No.7 | D1 | 30.8 | | | | | | | | |
| | D2 | 33.8 | | | | | | | | |
| Dendrometer | | 0.72 | | | | | | | | |
| (14.5m) | | | | | | | | | | |
| No.8 | D1 | 22.9 | | | | | | | | |
| | D2 | 24.7 | | | | | | | | |
| Dendrometer | | 0.61 | | | | | | | | |
| (12.0m) | | | | | | | | | | |
| No.9 | D1 | 18.1 | | | | | | | | |
| | D2 | 17.5 | | | | | | | | |
| Dendrometer | | 0.62 | | | | | | | | |
| (9.5m) | | | | | | | | | | |
| No.10 | D1 | 12.4 | | | | | | | | |
| | D2 | 12.1 | | | | | | | | |
| Dendrometer | | 1 | | | | | | | | |
| (8.0m) | | | | | | | | | | |

Table 1 A sheet to fill out the data of annual tree growth. (D:cm, H:m)

8.30 (Thu.)

**The pre-survey on phonological variations in Melia clones**

・One of our purposes of this trip was to compare the leaf characteristics (eg. leaf size, chlorophyll content, SLA) of *Melia* clones planted in seed orchard. However, almost all leaves were already defoliated, we changed our purpose to compare the phonological extent of defoliation, flower, and fruit in the field.

・Leaf, flower, and fruit conditions were divided into three categories, respectively. Category 0 means that there was no element, category 1 means that small element remains, and category 3 means that there were a lots of element on the crown.

・Location and alignment of seed orchard at Tiva station is shown in fig.6, and the result of this survey is shown in Table 2.

・Almost all of the clones showed the mixture of different extends of each elements, and a few clones showed same extend in each element

・We expected that each individual tree of the same clone showed same extends of each element, if there were clonal variations in the phenology for these elements.

・From the result of this survey, we could not show the apparent evidence of clonal variations in the phenology of three elements, but could show the possibility of the existence of variations.

・We need to continue like this survey in seasonally and yearly for the comprehension of clonal variations.

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ISH2 | KAT2 | ISH9 | MWAT2 | MTH10 | D7 | GAT11 | ISH9 | TSE6 | MTH15 | SK9 | TSE6 | MWAT5 | GAT11 | MTH12A | TSE4 | MWAT1 | GAT11 |
| KAT1 | TSE9 | D2 | TSE4 | MWAT7 | GAL1 | MWAT2 | GAL2 | MTH9 | MAR5. | KAT1 | MWAT7 | MTH11 | GAL1 | MWAT6 | MTH11 | MWAT5 | TSE6 |
| MAR4A | GAL2 | MWAT7 | MTH15 | ISH1 | MWAT4 | TSE2 | SK6 | MAR4A | NUU1 | TSE4 | GAT11 | MTH12A | TSE4 | MWAT1 | D2 | TSE4 | MWS | KAT1 |
| MWAT2 | MTH15 | SK9 | MAR5. | KAT2 | ISH9 | MAR4A | TSE5 | MWAT4 | ISH1 | MWAT6 | ISH1 | TSE4 | MWAT1 | TSE4 | KAT2 | ISH2 | GAL1 | MTH12 |
| GAL1 | MTH11 | MWAT2A | TSE6 | MTH14 | D2 | MTH11 | MTH15 | TSE4 | TSE1 | GAL2 | KAT1 | MWAT6 | TSE4 | MWAT1 | TSE2 | MTH15 | MWAT4 |
| KAT1 | NUU1 | MWS | MWAT4 | ISH2 | KAT4 | MWAT4 | MAR4A | MTH14A | ISH9 | MTH12 | GAT11 | MTH15 | SK6 | MTH14 | NUU1 | SK6 | MTH15 |
| MTH9 | MWAT6 | TSE4 | MTH9 | GAT11 | ISH1 | MWAT1 | SK9 | MTH15 | ISH2 | GAL2 | TSE2 | KAT2 | MAR4A | MTH10 | MWAT2A | TSE6 | TSE4 |
| MWAT1 | TSE2 | ISH9 | MWAT1 | SK6 | MAR4A | MWAT1 | MAR5. | MTH9 | MWS | MTH12A | D2 | KAT4 | MWAT6 | ISH1 | TSE9 | D7 | NUU1 |
| ISH2 | GAT11 | MTH10 | ISH2 | D7 | TSE4 | ISH1 | MTH15 | KAT1 | MWAT5 | MWAT2 | TSE3 | MAR5. | SK9 | MWAT2 | MTH15 | ISH2 | MWAT2 | ISH1 |
| MTH9 | KAT2 | TSE6 | KAT1 | GAL1 | MTH11 | KAT1 | ISH2 | GAT11 | GAL2 | TSE2 | KAT2 | MTH15 | ISH2 | MWAT2A | TSE6 | GAT11 | TSE2 |
| MWAT7 | MAR4A | MWAT6 | MWAT2 | TSE1 | MTH4 | ISH9 | TSE6 | GAL1 | SK6 | GAT11 | MTH9 | GAL2 | MWAT1 | TSE2 | GAL1 | TSE6 | MWAT7 |
| MTH11 | SK9 | GAL1 | KAT4 | TSE4 | ISH2 | TSE4 | MWAT6 | MAR4A | TSE4 | MWAT5 | TSE1 | ISH1 | KAT1 | MTH10 | SK6 | MWAT6 | MAR5. |
| ISH2 | MTH10 | MTH9 | MWAT2A | GAT11 | MTH9 | SK9 | TSE5 | GAL2 | MTH10 | MWAT5 | ISH9 | TSE9 | MWAT4 | MAR4A | GAL2 | KAT4 | |
| TSE3 | TSE2 | D2 | MWS | KAT2 | KAT1 | MTH15 | MWAT6 | KAT2 | GAT11 | TSE2 | MWAT7 | MTH9 | D7 | NUU1 | MTH10 | MWS | MTH14 |
| MWAT1 | KAT2 | MTH15 | ISH9 | KAT4 | ISH1 | MAR4A | TSE2 | TSE4 | MWAT4 | MTH15 | MWAT6 | MTH11 | TSE3 | TSE4 | ISH2 | MTH15 | MWAT1 |
| GAT11 | TSE4 | SK6 | ISH2 | D7 | MWAT2 | MTH15 | D2 | MWAT4 | ISH2 | MAR5. | SK9 | MWAT2 | MAR4A | GAL1 | SK6 | KAT2 | MAR5. |




Fig.6 Location of seed orchard at TIVA station

Table 2 Leaf, flower, and fruit conditions of selected plus clones of *Melia volkensii*

| 2012.8.30 | | | |
|---|---|---|---|
| clone | Leaf | Flower | Fruit |
| D2 | 0 | 0 | 0 |
| D2 | 1 | 0 | 0 |
| D2 | 1 | 0 | 0 |
| D2 | 1 | 0 | 0 |
| D2 | 2 | 0 | 0 |
| D2 | 2 | 0 | 0 |
| D2 | 2 | 0 | 0 |
| D7 | 1 | 0 | 0 |
| D7 | 2 | 1 | 0 |
| D7 | 2 | 1 | 1 |
| D7 | 2 | 2 | 1 |
| D7 | x | x | x |
| GAL1 | 0 | 0 | 0 |
| GAL1 | 0 | 0 | 0 |
| GAL1 | 0 | 0 | 0 |
| GAL1 | 0 | 0 | 0 |
| GAL1 | 1 | 0 | 0 |
| GAL1 | 1 | 1 | 0 |
| GAL1 | 2 | 1 | 0 |
| GAL1 | x | x | x |
| GAL1 | x | x | x |
| GAL2 | 1 | 0 | 0 |
| GAL2 | 2 | 0 | 0 |
| GAL2 | 2 | 1 | 0 |
| GAL2 | 2 | 1 | 1 |
| GAL2 | 2 | 2 | 1 |
| GAL2 | x | x | x |
| GAL2 | x | x | x |
| GAT11 | 1 | 0 | 0 |
| GAT11 | 1 | 0 | 0 |
| GAT11 | 1 | 1 | 0 |
| GAT11 | 1 | 1 | 0 |
| GAT11 | 1 | 1 | 0 |
| GAT11 | 2 | 1 | 0 |
| GAT11 | 2 | 1 | 0 |
| GAT11 | 2 | 2 | 0 |
| GAT11 | 2 | 2 | 1 |
| GAT11 | 2 | 2 | 1 |
| GAT11 | 2 | 2 | 1 |
| GAT11 | x | x | x |
| GAT11 | x | x | x |

| clone | Leaf | Flower | Fruit |
|---|---|---|---|
| ISH1 | 1 | 0 | 1 |
| ISH1 | 2 | 1 | 1 |
| ISH1 | 2 | 2 | 1 |
| ISH1 | 2 | 2 | 1 |
| ISH1 | x | x | x |
| ISH1 | x | x | x |
| ISH1 | x | x | x |
| ISH1 | x | x | x |
| ISH1 | x | x | x |
| ISH2 | 0 | 0 | 0 |
| ISH2 | 1 | 0 | 0 |
| ISH2 | 2 | 0 | 0 |
| ISH2 | 2 | 1 | 0 |
| ISH2 | 2 | 1 | 0 |
| ISH2 | 1 | 2 | 1 |
| ISH2 | 2 | 2 | 0 |
| ISH2 | 2 | 2 | 0 |
| ISH2 | 2 | 2 | 1 |
| ISH2 | 2 | 2 | 1 |
| ISH2 | x | x | x |
| ISH2 | x | x | x |
| ISH2 | x | x | x |
| ISH9 | 0 | 0 | 0 |
| ISH9 | 1 | 1 | 0 |
| ISH9 | 1 | 2 | 2 |
| ISH9 | 2 | 2 | 1 |
| ISH9 | 2 | 2 | 1 |
| ISH9 | 2 | 2 | 2 |
| ISH9 | 2 | 2 | 2 |
| ISH9 | 2 | 2 | 2 |
| ISH9 | x | x | x |
| KAT1 | 0 | 0 | 0 |
| KAT1 | 1 | 0 | 0 |
| KAT1 | 2 | 1 | 0 |
| KAT1 | 2 | 2 | 0 |
| KAT1 | 2 | 2 | 0 |
| KAT1 | 2 | 2 | 1 |
| KAT1 | 2 | 2 | 2 |
| KAT1 | x | x | x |
| KAT1 | x | x | x |
| KAT1 | x | x | x |

Continued

| clone | Leaf | Flower | Fruit |
|---|---|---|---|
| KAT2 | 0 | 0 | 1 |
| KAT2 | 1 | 0 | 0 |
| KAT2 | 2 | 0 | 1 |
| KAT2 | 1 | 1 | 1 |
| KAT2 | 2 | 1 | 1 |
| KAT2 | 2 | 2 | 1 |
| KAT2 | 2 | 2 | 1 |
| KAT2 | x | x | x |
| KAT2 | x | x | x |
| KAT4 | 1 | 0 | 0 |
| KAT4 | 2 | 0 | 0 |
| KAT4 | 2 | 0 | 0 |
| KAT4 | 1 | 1 | 1 |
| KAT4 | 2 | 1 | 0 |
| KAT4 | 2 | 1 | 0 |
| KAT4 | 2 | 2 | 1 |
| MAR4A | 0 | 0 | 0 |
| MAR4A | 1 | 0 | 0 |
| MAR4A | 1 | 0 | 0 |
| MAR4A | 1 | 0 | 0 |
| MAR4A | 1 | 1 | 0 |
| MAR4A | 1 | 1 | 1 |
| MAR4A | 2 | 1 | 0 |
| MAR4A | 2 | 1 | 1 |
| MAR4A | 2 | 1 | 1 |
| MAR4A | 2 | 1 | 1 |
| MAR4A | x | x | x |
| MAR4A | x | x | x |
| MAR5. | 0 | 0 | 0 |
| MAR5. | 1 | 1 | 1 |
| MAR5. | 2 | 1 | 0 |
| MAR5. | 2 | 2 | 1 |
| MAR5. | 2 | 2 | 1 |
| MAR5. | x | x | x |
| MAR5. | x | x | x |
| MTH10 | 1 | 1 | 0 |
| MTH10 | 1 | 2 | 1 |
| MTH10 | 2 | 2 | 1 |
| MTH10 | 2 | 2 | 1 |
| MTH10 | 2 | 2 | 2 |
| MTH10 | x | x | x |
| MTH10 | x | x | x |

| clone | Leaf | Flower | Fruit |
|---|---|---|---|
| MTH11 | 0 | 0 | 0 |
| MTH11 | 0 | 0 | 0 |
| MTH11 | 1 | 0 | 0 |
| MTH11 | 1 | 0 | 1 |
| MTH11 | 1 | 0 | 1 |
| MTH11 | 2 | 0 | 0 |
| MTH11 | 1 | 1 | 1 |
| MTH11 | 2 | 2 | 1 |
| MTH12 | 2 | 2 | 1 |
| MTH12 | x | x | x |
| MTH14 | 2 | 1 | 0 |
| MTH14 | x | x | x |
| MTH14 | x | x | x |
| MTH14A | 2 | 1 | 0 |
| MTH14A | 2 | 1 | 1 |
| MTH14A | 2 | 2 | 1 |
| MTH14A | x | x | x |
| MTH15 | 0 | 0 | 0 |
| MTH15 | 1 | 0 | 0 |
| MTH15 | 1 | 0 | 0 |
| MTH15 | 1 | 0 | 0 |
| MTH15 | 1 | 0 | 0 |
| MTH15 | 2 | 0 | 0 |
| MTH15 | 2 | 0 | 0 |
| MTH15 | 2 | 1 | 0 |
| MTH15 | 2 | 1 | 0 |
| MTH15 | 2 | 1 | 1 |
| MTH15 | 2 | 2 | 1 |
| MTH15 | 2 | 2 | 1 |
| MTH15 | 2 | 2 | 2 |
| MTH15 | x | x | x |
| MTH15 | x | x | x |
| MTH4 | 1 | 0 | 0 |
| MTH9 | 0 | 0 | 1 |
| MTH9 | 2 | 0 | 0 |
| MTH9 | 1 | 1 | 1 |
| MTH9 | 0 | 2 | 1 |
| MTH9 | 2 | 2 | 1 |
| MTH9 | 2 | 2 | 1 |
| MTH9 | 2 | 2 | 1 |
| MTH9 | 2 | 2 | 2 |
| MTH9 | x | x | x |

Continued

| clone | Leaf | Flower | Fruit |
|---|---|---|---|
| MWAT7 | 0 | 0 | 0 |
| MWAT7 | 2 | 1 | 2 |
| MWAT7 | 2 | 2 | 1 |
| MWAT7 | 2 | 2 | 1 |
| MWAT7 | 2 | 2 | 2 |
| MWAT7 | 2 | 2 | 2 |
| MWs | 2 | 1 | 1 |
| MWs | 2 | 2 | 0 |
| MWs | 2 | 2 | 1 |
| MWs | x | x | x |
| MWs | x | x | x |
| NUU1 | 2 | 0 | 0 |
| NUU1 | 2 | 1 | 0 |
| NUU1 | 2 | 1 | 0 |
| NUU1 | 2 | 1 | 0 |
| NUU1 | 2 | 2 | 0 |
| NUU1 | x | x | x |
| SK6 | 1 | 0 | 0 |
| SK6 | 1 | 0 | 0 |
| SK6 | 1 | 0 | 0 |
| SK6 | 2 | 0 | 0 |
| SK6 | 2 | 0 | 0 |
| SK6 | 2 | 1 | 0 |
| SK6 | 2 | 1 | 1 |
| SK6 | x | x | x |
| SK9 | 2 | 1 | 0 |
| SK9 | 2 | 1 | 1 |
| SK9 | 2 | 2 | 1 |
| SK9 | x | x | x |
| SK9 | x | x | x |
| SK9 | x | x | x |
| SK9 | x | x | x |
| TSE1 | 2 | 0 | 0 |
| TSE1 | x | x | x |
| TSE1 | x | x | x |
| TSE2 | 1 | 0 | 0 |
| TSE2 | 1 | 0 | 0 |
| TSE2 | 1 | 0 | 0 |
| TSE2 | 1 | 0 | 0 |
| TSE2 | 2 | 1 | 0 |
| TSE2 | x | x | x |
| TSE2 | x | x | x |
| TSE2 | x | x | x |
| TSE2 | x | x | x |

| clone | Leaf | Flower | Fruit |
|---|---|---|---|
| TSE3 | 0 | 0 | 0 |
| TSE3 | 0 | 0 | 0 |
| TSE3 | 2 | 2 | 1 |
| TSE4 | 1 | 0 | 0 |
| TSE4 | 1 | 0 | 0 |
| TSE4 | 1 | 0 | 0 |
| TSE4 | 1 | 0 | 0 |
| TSE4 | 1 | 0 | 0 |
| TSE4 | 1 | 0 | 0 |
| TSE4 | 2 | 0 | 0 |
| TSE4 | 2 | 0 | 0 |
| TSE4 | 2 | 0 | 0 |
| TSE4 | 2 | 0 | 0 |
| TSE4 | 2 | 0 | 0 |
| TSE4 | 2 | 0 | 0 |
| TSE4 | 2 | 1 | 0 |
| TSE4 | 2 | 2 | 1 |
| TSE4 | x | x | x |
| TSE4 | x | x | x |
| TSE5 | x | x | x |
| TSE5 | x | x | x |
| TSE5 | x | x | x |
| TSE6 | 0 | 0 | 0 |
| TSE6 | 1 | 0 | 0 |
| TSE6 | 1 | 1 | 1 |
| TSE6 | 2 | 1 | 1 |
| TSE6 | 2 | 2 | 0 |
| TSE6 | 2 | 2 | 1 |
| TSE6 | 2 | 2 | 1 |
| TSE6 | x | x | x |
| TSE6 | x | x | x |
| TSE9 | 1 | 1 | 0 |
| TSE9 | 2 | 1 | 1 |
| TSE9 | 2 | 2 | 2 |

8.31(Fri.)

**Preparation of seedlings for drought tolerance research**

・A few young *Melia* tree are necessary for us in Kitui regional center for measurements of annual changes of water relation, photosynthesis, and other many characteristics.

・Additionally, some other useful tree species in semi-arid zone growing in center are necessary to compare *Melia* tree with other species.

・However, it revealed that *Melia* tree was not growing in Kitui regional center except one individual tree which was being used for sap flow measurement in another project.

・We tried to collect seedlings of *Melia volkensii, Melia azedarach, Eucalyptus camaldurensis, Gmelia arbore*a, and *Acasia tortalis*, the last three species were recommended by Dr. Ndufa (Director of Kitui regional center) as useful species in semi-arid zone.

・Seedlings of Acacia tortalis could not collect during our stay, but Kitui center promised to collect it after our departure.

・We also got a permission from Dr. Ndufa for planting these seedlings in the nursery. He appointed the corner of nursery (fig.7) as the area not to disturb grafting procedure.

・We asked to our C/P to plant them as soon as possible after all species were collected.

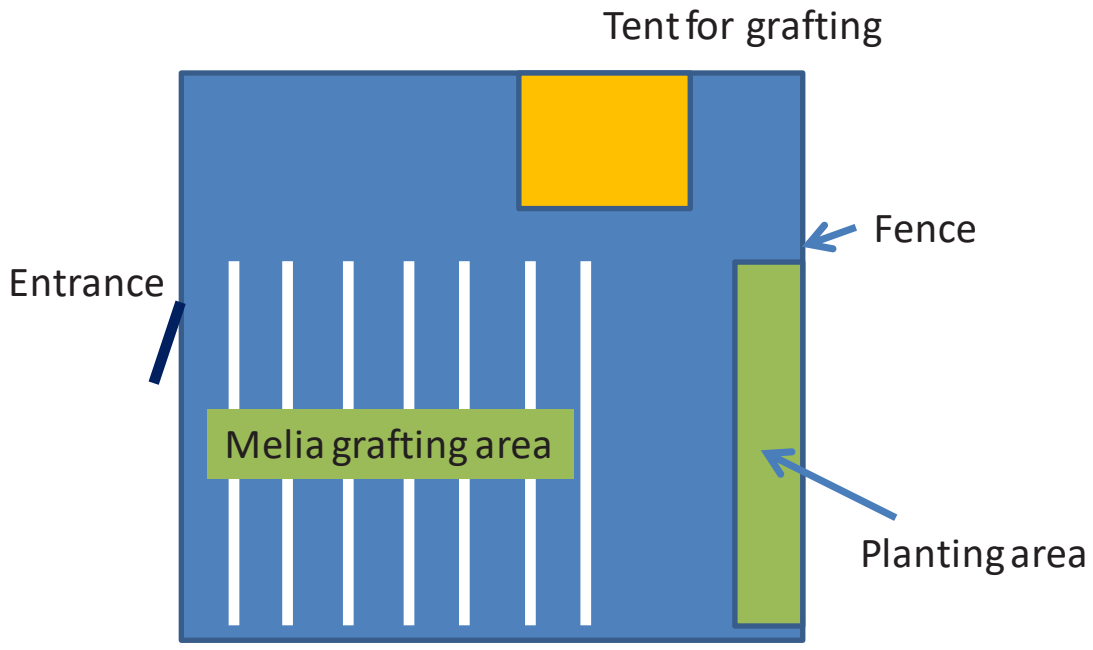



Fig.7 Planting area for five semi-arid tree species

**Checking of laboratory and equipments available for physiological research in Kitui**

**Laboratory**

・A particular laboratory was not prepared for our project. There were a lot of laboratory in Kitui center, but almost all of them were already occupied and unavailable.

・We asked to Mr. Narumi to get permission from Kitui center for the use of the short-term expert's research room as our project laboratory.

・We thought this room was the most convenient room for our research activities in the Kitui center under existing conditions.

**Dark room**

・Although a dark room available for photosynthesis study could not be found, a part of the short-term expert's research room seemed to be possible to change for that purpose.

**Equipments**

・**Pressure chamber**

Three sets of pressure chamber (Daiki Rika Kogyo) were existed, and only one of them was available.

There was a set of air-bomb, too. We can substitute this air-bomb set for the newly scheduled pressure chamber.

・**Porometer**

A steady-state porometer (Li-1600, Licor) was existed, but did not work well, even it had been repaired by Japanese another project lately.

・**Portable photosynthesis system**

No equipments related with photosynthesis were existed.

・**Leaf area meter**

Leaf area meter (Licor) was existed, but was broken.

・**Dry oven**

Two dry oven were existed and available.

・**Electric balance**

Three resolution type (0.1g, 0.01g. 0.001g) were existed and available.

## Appendix 4-1-3 Report of short term expert (Project Management)

| Expertise | Name | Term |
|---|---|---|
| Team leader | Dr Yoshitake Fujisawa | 22.9.2012~29.9.2012 |

Itinerary

| Date | Activities |
|---|---|
| Sep 23 | Arrive to Nairobi, meeting w/ JICA experts |
| Sep 24 | Courtesy call to JICA Kenya office, meeting in JICA Kenya office |
| | Courtesy call to KEFRI Director, meeting w/ CP |
| Sep 25 | JCC, move to Kitui |
| Sep 26 | Kitui regional center, move to Kibwezi |
| Sep 27 | Kibwezi station, UoN site, move to Nairobi |
| Sep 28 | Report to KEFRI, depart Nairobi |

Major Activities

- Attendance to 1st JCC

  1st JCC was held on 25th Sep 2012, and the project inception report was proposed by FTBC.

- Seedling preparation for seed orchard

  The expert studied progress of grafting propagation, and instructed necessary measures for seedling preparation.

- Site preparation of seed orchard

  KEFRI counterparts and the expert discussed availability space for seed orchard at Kibwezi, which owned by University of Nairobi.

- Others

  The expert confirmed working environment of short term expert in Kitui and Kibwezi.

## Appendix 4-1-4 Report of short term expert (DNA analysis)

| Expertise | Name | Term |
|---|---|---|
| DNA analysis | Dr So Hanaoka | 25.11.2012 ~ 8.12.2012 |

Itinerary

| Date | Activities |
|---|---|
| Nov 25 | Arrive to Nairobi, meeting w/ JICA experts |
| Nov 26 | Courtesy call to JICA Kenya office |
| | Courtesy call to Project manager, meeting w/ CPs |
| Nov 27 ~ Dec 6 | Technical advice about DNA analysis |
| Dec 7 | Courtesy call to Project Director, meeting w/ CPs |
| Dec 8 | Depart Nairobi |

Result of major activities

- Upgrading DNA extracting techniques
  In order to extract pure DNA from viscosity organs of woody plant, modified CTAB method was introduced, and CPs obtained necessary techniques of this procedure.

DNA is not extracted clearly

⇒

High purity DNA extraction by CTAB method

- Multiplex PCR procedure
  In order to amplify multiple loci in single thermal cycling procedure, a special recipe of reagents and equipment manipulation were instructed.

- Direct sequencing
  In order to reduce the cost of PCR procedure, polyethylene glycol – NaCl solution is applied for purification.

- GIS

In order to integrate the population information of Melia and Acacia, a GIS development was proposed by KEFRI staff

- Remained tasks

  Delivery of the sequencing machine which is procured by Japanese Grant Aid delayed, and the practical exercise could not be implemented. Therefore following tasks will be conducted by Kenyan CPs by themselves.

  - Alternative training for sequencer operation will be programmed after the delivery.
  - 17 SSR markers were selected by the screening out of 144 SSR markers which were developed during the last CP training in Japan. These markers will be tested by 90 samples of 3 populations.
  - 60 plus tree candidates of Melia will be identified by developed SSR makers.

## Appendix 4-1-5 Report of short term expert (Propagation and planting)

| Expertise | Name | Term |
|---|---|---|
| Breeding | Dr Hisaya Miyashita | 25.11.2012 ~ 8.12.2012 |
| Propagation | Mr Taro Yamanobe | 25.11.2012 ~ 8.12.2012 |
| Propagation | Mr Nobutaka Chiba | 25.11.2012 ~ 8.12.2012 |

Itinerary

| Date | Activities |
|---|---|
| Nov 25 | Arrive to Nairobi |
| Nov 26 | Courtesy call to JICA Kenya office, Courtesy call to KEFRI Assistant Director, Move to Kitui |
| Nov 27 | Meeting at Kitui regional center, Instruction at nursery |
| Nov 28 ~ Dec 1 | Instruction at Tiva seed orchard |
| Dec 2 | Preparation of sampling collection |
| Dec 3 | Instruction at Tiva seed orchard |
| Dec 4 | Leaf sampling collection from all of planted seedling at the seed orchard |
| Dec 5 | Move to Kibwezi, vegetation survey at seed orchard |
| Dec 6 | Move to Nairobi |
| Dec 7 | Courtesy call to KEFRI Director, meeting w/ CPs |
| Dec 8 | Depart Nairobi |

Result of major activities

- Instruction at the seed orchard in Kitui
  - Seedlings were planted as following procedures;
    - Planting locations were marked by sticks with ID number label
    - Planting holes were dug, and watered
    - Seedlings were also marked by ID number label, and planted at the hole of same ID number
    - Plastic bottle water filling system is applied, water is filled adequately
    - Cattle is prevented by fencing and guard man

- Leaf sampling
  - Leaf specimens were collected from all of planted seedlings in order to identify the clone by DNA analysis.

- Instruction at the seed orchard in Kibwezi
  - Land clearing work was observed, and necessary data for planting design was collected.

- Next year plan
  - Drafting work will be prepared for 20 clones.
  - Total 5000 stock will be prepared for grafting work.

## Appendix 4-1-6 Report of short term expert (Drought tolerant)

| Expertise | Name | Term |
|---|---|---|
| Drought Tolerant | Dr Kotaro Sakuta | 12.12.2012 ~ 22.12.2012 |

Itinerary

| Date | Activities |
|---|---|
| Dec 12 | Arrive to Nairobi, |
| Dec 13 | Meeting w/ JICA experts, Project Manager at KEFRI, Move to Kitui |
| Dec 14 | Survey at Tiva nursery and seed orchard |
| Dec 15 | Move to Kibwezi, survey at seed orchard |
| Dec 16 | Vegetation survey in Kibwezi, |
| Dec 17 | Vegetation survey at the candidate nursery in UoN, move to Kitui |
| Dec 18 | Research in Kitui regional center |
| Dec 19 ~ Dec 20 | Leaf shape survey (57 clone) in Kitui regional center |
| Dec 21 | Instruction of the planting in Tiva seed orchard |
| Dec 22 | Move to Nairobi, Depart Nairobi |

Result of major activities

- Instruction of seedling planting in Kitui seed orchard
  Planting and nursing procedures are instructed at Kitui seed orchard, especially for preventing insect attack and drought damage.

- Instruction of seed orchard preparation in Kibwezi
  Previous vegetation was surveyed and watering measures are advised.

- Instruction of morphological survey
  - Sump method was introduced for morphological analysis of candidate plus tree clones.
  - Size and density of stoma were surveyed by a handy microscope camera. It is recommended that the digital camera scanning system will be introduced for precise microscope.
  - Area and dry weight of young leaves were surveyed. Same study of mature leaf will be done when the seedlings grown.

Collected leaf specimens


Slides developed by sump method

## Appendix 4-1-7 Report of short term expert (Propagation and planting)

| Expertise | Name | Term |
|---|---|---|
| Breeding | Dr Hisaya Miyashhita | 24.1.2013 ~ 13.2.2013 |
| Propagation | Mr Shoki Sakamoto | 24.1 2013 ~ 3.2.2013 |

Itinerary

| Date | Activities |
|---|---|
| Jan 24 | Arrive to Nairobi, Courtesy call to JICA Kenya office |
| Jan 25 | Courtesy call to KEFRI Director, meeting w/ CP |
| | Move to Kitui |
| Jan 26 | Instruction at Tiva seed orchard, Kitui regional center |
| Jan 27 | Move to Kibwezi, survey at the seed orchard |
| Jan 28 ~ 30 | Instruction at the Seed orchard |
| Jan 31 | Move to Kitui |
| | Survey at Kitui Regional Center |
| Feb 1 | Meeting among Japanese experts |
| | Move to Nairobi |
| Feb 2 | Documentation |
| Feb 3 | Documentation (Mr Sakamoto Depart Nairobi) |
| Feb 4 | Survey at Forest Products Research Center (Karura) |
| | Meeting w/ Chief advisor |
| Feb 5 | Meeting w/ Project Manager |
| Feb 6 | Meeting w/ Project Manager |
| Feb 7 ~ 9 | Documentation |
| Feb 10 | Meeting w/ Project Manager |
| Feb 11 | Meeting at JICA Kenya office |
| Feb 12 | 2nd JCC in MFWL Nairobi |
| Feb 13 | Depart Nairobi |

Result of major activities

- Instruction of the seed orchard development in Kibwezi
  Following activities were instructed.
  - Label identification of hole location and seedling
  - Hole digging and watering
  - Planting
  - Nursing

- Instruction of the seed orchard maintenance in Tiva
  Following maintenance activities were instructed.
  - Spline support against the lean by strong wind
  - Lateral buds removing and pruning, inducing good shape of tree crown
  - Drip watering by using plastic bottle
  - Surveying and Recording

- Operation plan 2013
  - Candidate plus tree selection - 20 clones (2012), 20 clones (2013)
  - Preparation of progeny test fields and supplemental test fields
  - Seed seedling stand of A. tortilis
  - Nursery allocation for Melia grafting in Kibwezi sub center
  - Seedling stand for clonal comparison and drought tolerant experiment in Kitui regional center
  - Dark room for chlorophyll fluorescence measurement
  - Additional grafting propagation 2013 - Total 4,000 root stock will be prepared for grafting works

- Information gathering in KEFRI Forest Products Research Center -Karura
  Information of forest products were gathered as follows;
  - Wood demand in Kenya
  - Major wood products in Kenya
  - Possibility of timber production by using dryland forest resources
  - Wood test laboratory

- CP training in Japan 2013
  Trainee appointment and contents were discussed between senior staff of KEFRI and Japanese experts

- Japanese expert dispatchment 2013
  Details of Japanese experts' mandate were discussed among CPs and Japanese experts.

## Appendix 4-1-8 Report of short term expert (Drought tolerant)

| Expertise | Name | Term |
|---|---|---|
| Drought tolerant | Ass Prof Dr Koichiro Gyokusen | 26.1.2013 ~ 3.2.2013 |

## 1. Schedule

Jan. 2013 （Short -term Expert)

2 Drought Tolerance

Duration； 2013.1.26-2013.2.03
Member； Dr Koichiro Gyokusen

| | AM | PM | |
|---|---|---|---|
| 1.26(Sat.) | | 22:00<br>Departure (Tokyo) | |
| 1.27 (Sun.) | Dubai 0345<br>Dubai 1045 | 14:45<br>Arrival (NAIROBI) | Nairobi |
| 1.28(Mon.) | Courtesy call to JICA office | Movement from Nairobi to Kitui | Kitui |
| 1.29 (Tue.) | Field survey in Tiva pilotforest | Field survey in Tiva pilotforest | Kitui |
| 1.30 (Wed.) | Field survey in Kitui nursery | Data analysis | Kitui |
| 1.31 (Thu.) | Field survey in Tiva pilotforest | Data analysis | Kitui |
| 2.1 (Fri.) | Field survey in Kitui nursery | Data analysis | Kitui |
| 2.2(Sat.) | Kitui to Nairobi | 16:40<br>Departure (NAIROBI) | |
| 2.3 (Sun.) | | 17:35<br>Arrival (TOKYO/NARITA) | |

## 2. Avtivities

### 01.28 (Mon.)

[In the morning]

・Courtesy call to JICA office in Nairobi

・We met Mrs. Fukae and obtained a lots of information about JICA projects in Kenya.

[In the afternoon]

・Meeting with Dr NDUFA, the director of Kitui center, concerning about our research activities and purposes of this visit.

・He accepted our two requests, one is about the new nursery and the other is about the meteorology box. He has already selected the candidate site as the new nursery in the Kitui center, and promised to weed around the site just before my departure. He accepted also to set a box in nursery for measurement of air temperature and soil water contents.

・Seedlings from the old orchard was now preparing. Seeds from two superior clones were already collected and now waiting for the ripening of other clones. They will saw them after finishing the collection of all clones, and may be able to provide some seedlings by my next visit.

Photo1. The candidate site for the new  nursery. Grass was cut from Jan.28 to Jan.30.

Photo 2. A box made of wood to store the water content meter and thermometer.

**01.29 (Tue.)**

[In the morning]

・Visited the Tiva pilot forest together with Dr. Muturi.

・Checked dedrometer equipments set last visit.

・Visited the new and old seed orchards.

[In the afternoon]

・Downloaded the tree growth data logged by automatic dendrometers.

・Analyzed tree growth data.

**[Results]**

Stem growth of No.1 tree, air temperature, and precipitation from 2012.9.1 to 2013.1.31 were shown in fig.1. There was no growth from 0 day to 80 days, conversely a little shrink was monitored. Growth had started around 80 days and finished around 120 days. The beginning of stem growth was corresponded with the beginning of rainy season.

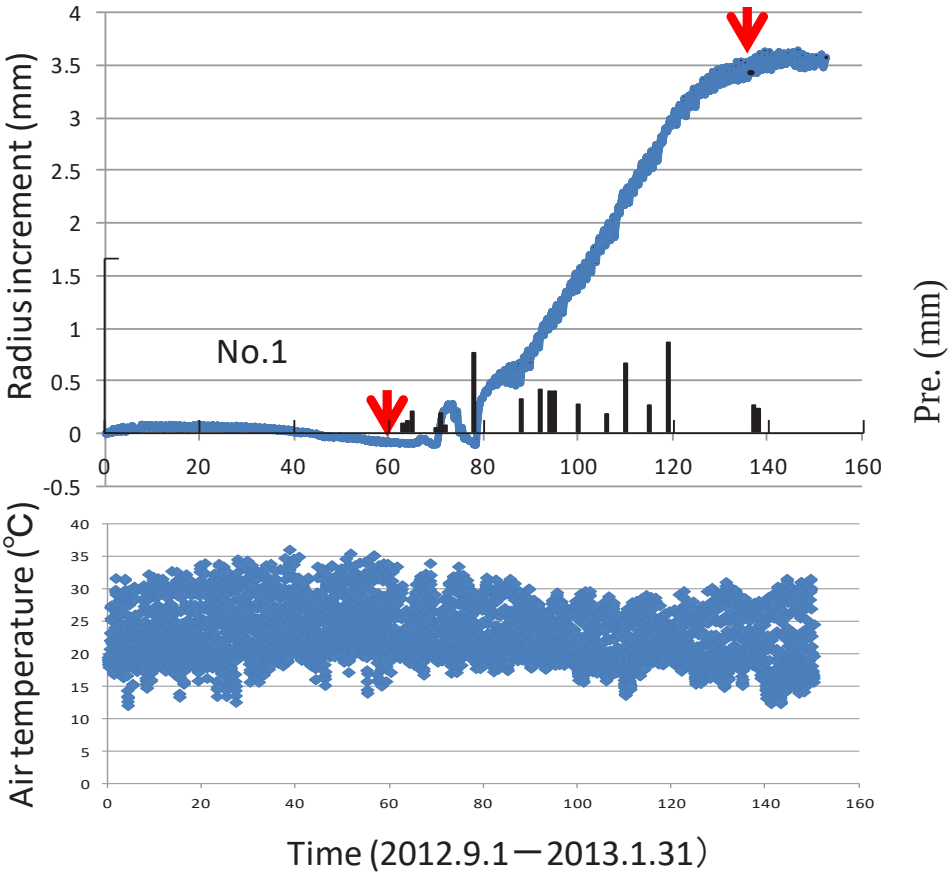



Fig.1 Seasonal changes of stem radius increment and air temperature

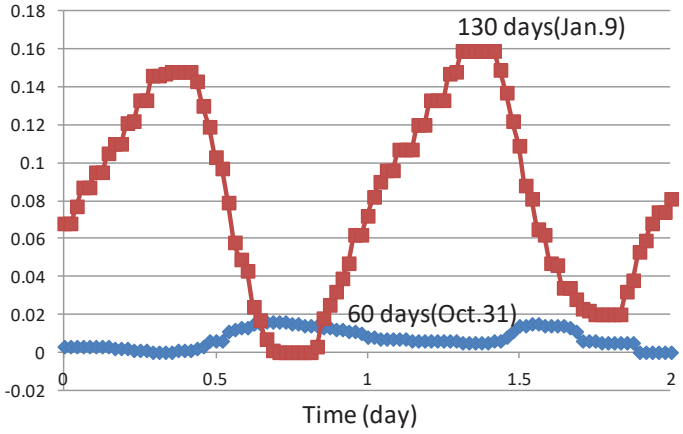



Fig.2 Diurnal changes of stem radius of Melia volkensii

Diurnal fluctuations of stem radius were shown in fig.2. Two types of diurnal changes were shown in fig.2, namely, one was the rainy season (Jan.9-10) and the other was dry season (Oct.31-Nov.1). A large fluctuation was observed in wet season and a small change was observed in dry season. The fluctuation patter was differed with two seasons. The shrink of wet season occurred in the afternoon but that of dry season occurred in the early morning. The reason of the difference is not known in this instance.

01.30 (Wed.)
[In the morning]
・Setting an equipment to measure water contents in Kitui center.
I dug a hole about 1 m depth at the nursery planted five tree species and set four sensors in different depths, namely, 0.2m, 0.4m, 0.6m, 0.8m, respectively.
[In the afternoon]
Discussed about the difference between the tree growth data collected with automatic dendrometer and those of collected with manual dendrometer.

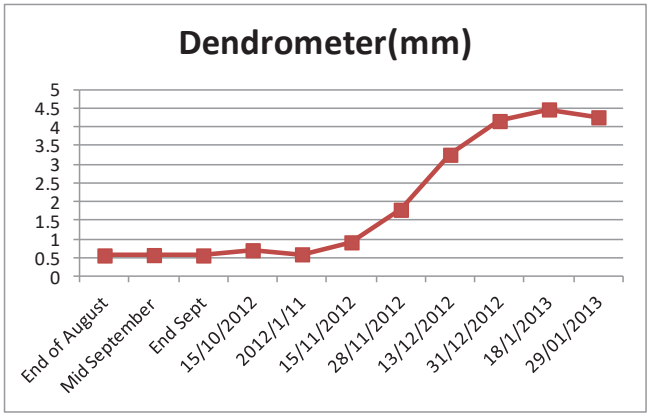


Fig.3 Diameter growth of No.6 obtained by digital dendrometer.

[**Results** ]
Similar growth patterns were obtained with both of automatic dendrometer and manual dendrometer. I can say that Manual dendorometer introduced here is useful for measuring diameter growth of Melia volkensii, and can be applied for the comparison of growth difference in superior and inferior clones. However there is a security problem to set them in the field, we have to think more to set them in the field (e.g.: old or new seed orchard).

01.31 (Thr.)
[In the morning]
Visited to Tiva pilot forest to repair and reset the dendrometer.
Collected leaves from superior or inferior clones at old seed orchard
[In the afternoon]
Checked the water content meter and thermometer and set them in a wooden box put in the nursery.

02.01 (Fri)
[In the morning]
Measured the size of five tree species planted in Kitui center.
[**Results** ]
Five tree species were planted in nursery of Kitui center. These five species were Melia volkensii, Melia azedarach, Eucalyptus camaldulensisi, Gmeina arborea, and Vitex payos. Although one more species (Acaccia tortolis) was planted nearby lately, they are too small to measure the size.

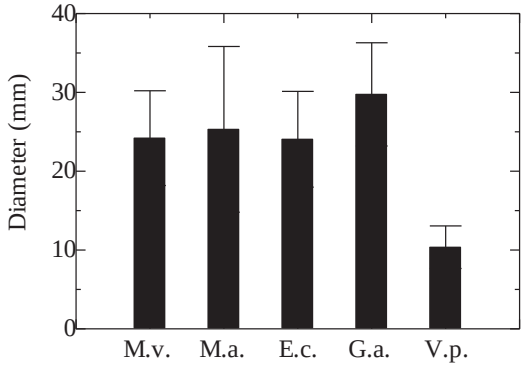
Photo 3. A scenery of the nursery planted of five tree species.

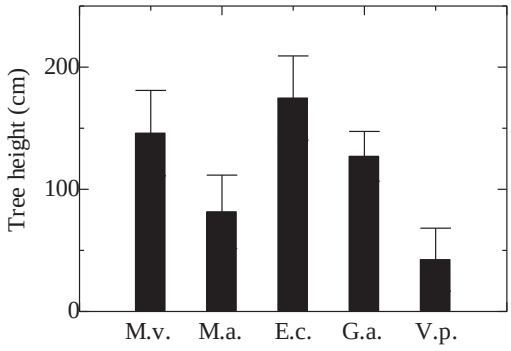
Photo 4. Tree shapes and growth conditions of each tree.

Melia volkensii Melia azedarach Eucalyptus camaldulensis Gmenia arborea Vitex payos

[Results]

Tree height, diameter at 10cm height from ground level, and H/D ratio were shown in fig. 4,5,6, respectively. The order of tree height was E.c.>M.v.>G.a>M.a.>V.p. and the order of diameter was G.a.>M.a.>M.v.>=G.a>V.p.. Tree height and diameter were not corresponded, then the H/D ratio was E.c.>=M.v.>G.a.>V.p.>=M.a. From these results, we can conclude that E.c. and M.v. seem to have a strong apical dominant characteristics compared with other three species.



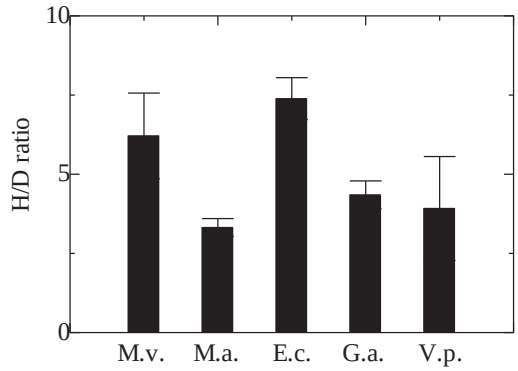



Fig. 7,8,9 Tree height, diameter, and H/D ratio of five tree species used as common planting tree.

[In the afternoon]
Measurement of leaf and leaflet size collected from old orchard.
[**Results**]
The representative leaf copy of each clone was shown in photo 4. I could not pick up any differences between superior and inferior clones, but found a large variation in leaflet size among clones, especially TSE4 had very small leaflets. We should continue more research regarding the relationship between leaf structure and its physiology.

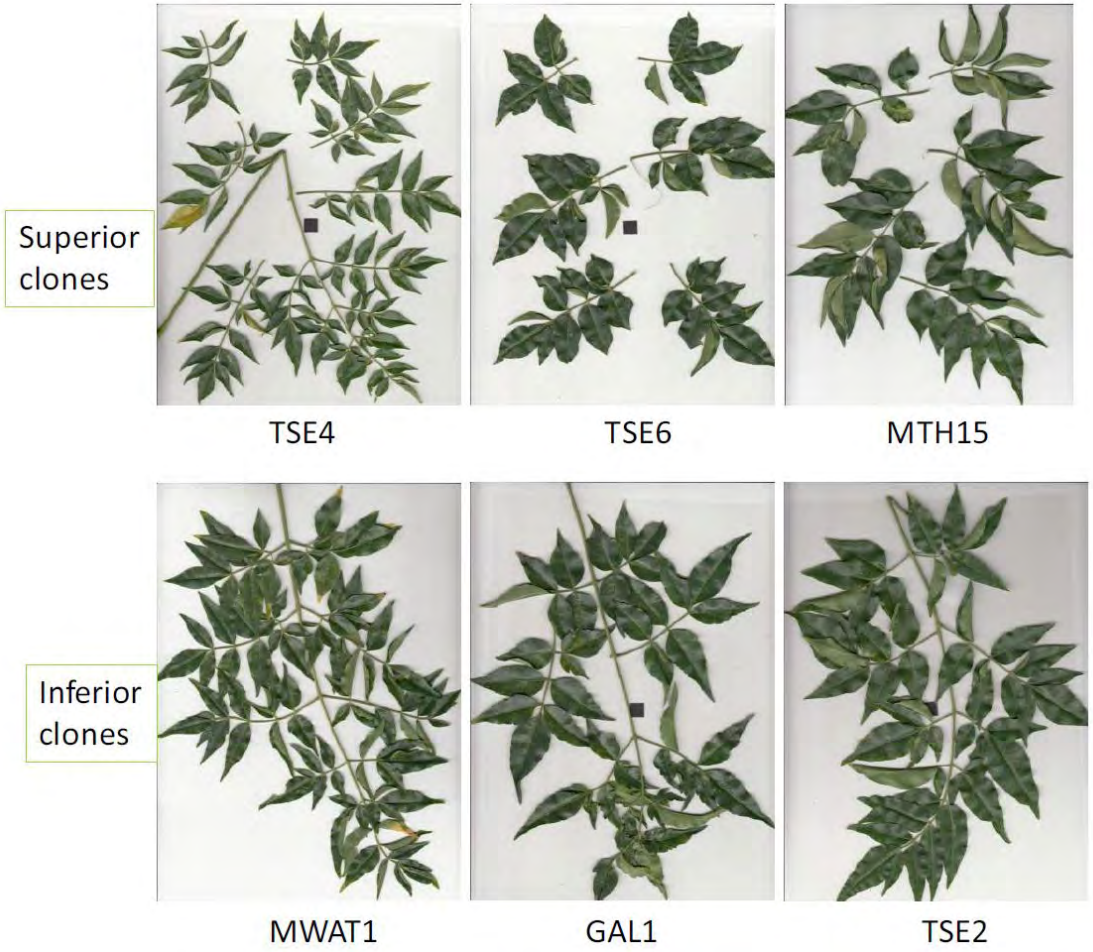



Photo 5. Leaf copy of 6 clones.

The growth of upper 3 clones (SE4, TSE6, MTH15) were better than these of lower three clones (MWAT1, GAL1, TSE2).

02.02.-02.03 (Sat. and Sun.)
Movement from Kitui (Kenya) to Narita (Japan)

## Appendix 4-1-9 Report of short term expert (Project management)

| Expertise | Name | Term |
|---|---|---|
| Coordinator | Mr Yuzuru Kimura | 6.2.2013 ~ 13.2.2013 |

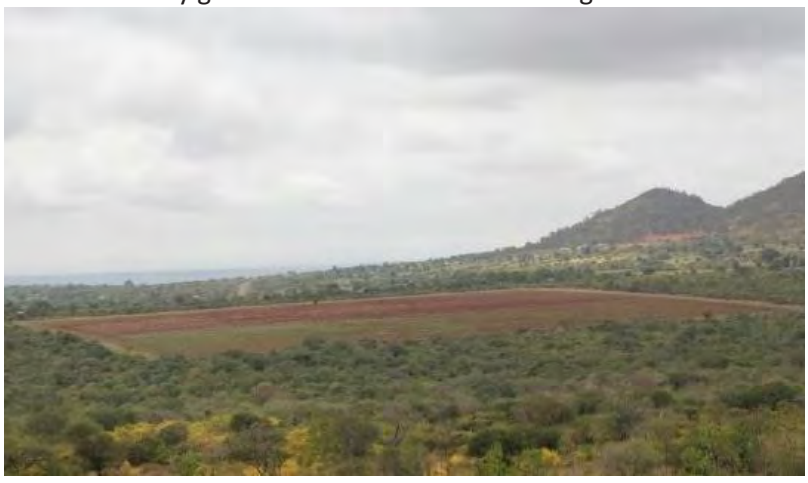
Itinerary

| Date | Activities |
|---|---|
| Feb 6 | Arrive to Nairobi, meeting w/ JICA experts, Project Manager |
| Feb 7 | Move to Kitui, visit Tiva seed orchard, Kitui regional center, |
| Feb 8 | Move to Kibwezi Kibwezi station, UoN site |
| Feb 9 | Move to Nairobi |
| Feb 10 | Meeting w/ Project manager, chief advisor |
| Feb 11 | Courtesy call to JICA Kenya office<br>Courtesy call to KEFRI Director, meeting w/ CP |
| Feb 12 | 2nd JCC in MFWL Nairobi |
| Feb 13 | Depart Nairobi |

Result of major activities

- Field survey
  - Tiva seed orchard

    Ten hectors of seed orchard was established in Tiva research station area, and melia clone seedlings were planted in last December. The seedlings are maintained very well and some of them have already grown more than one meter height.



  - Tiva research station

    In Tiva area, many useful research materials and facilities are provided by KEFRI and former JICA project, such as progeny test field, provenance test plantation, lookout tower, and nursery. Dr gyokusen utilizes those materials for dendrometer survey and seedling stand for physiological

survey.

- Kitui Research Center
  Well maintained facilities equipped such as nursery, laboratory, green house, meeting room, and dormitory. Small scale seedling stand and darkroom will be prepared by the project in next year.

- Kibwezi seed orchard
  The other ten hectors of seed orchard was established nearby Kibwezi town, and melia seedlings were planted in January. KEFRI staff has eagerly maintained the seedlings though harassed condition of tick weed and drought.


- Kibwezi Research Sub Center
  Some nursery space is vacant which is good enough for melia grafting for seed orchard in Kibwezi.

- Melia plantation by farmer
  Since 2006, a leading farmer established meila plantation by the technical support of KEFRI. Total ten thousand of seedlings were planted nearby his dwelling and have been well maintained.

- Melia plantation in elementary school
  In 2009, KEFRI promoted school forest in Nguumo elementary school. The planted trees have been well maintained by stakeholders. This is the potential style of progeny test field by our project.


- Training program 2013
  The training program in 2013 was discussed among Japanese expert and KEFRI staff, and tentatively

agreed as follows;

- DNA analysis course: 2 participants, 5 weeks
- Breeding theory course: 2 participants, 3 weeks
- Propagation techniques course: 2 participants, 3 weeks
- Drought tolerant course: 2 participants, 4 weeks

All of course will be implemented in June and July 2013.

- Expert dispatchment 2013
  The dispatchment schedule of Japanese experts was discussed among both side, and tentatively agreed as follows;

  - Project management: May, October, and February
  - DNA analysis: November (possibly in July also)
  - Propagation: August and December
  - Breeding theory: August and December
  - Drought tolerant: June, August, September, November and December

  Total eighteen experts will be dispatched.

- Procurement of tools
  FTBS support the procurement if necessary, and utilize training budget for the tools procurement in Japan and deliver by the experts.

- Activities 3 and 4
  Market research might be conducted under the contract with local consultant or NGO. The consultant TOR should be proposed by the consultant and considered by Japanese expert and KEFRI staff.
  Training materials will be divided into several parts and subsequently be prepared year by year.

- 2nd JCC
  2nd JCC was held on 12th February 2013 in MFWL in Nairobi city, and discussed the project progress and next year plan. FTBC proposed the training program in Japan and the expert dispatchment.

# Appendix 4-2 Achievement of short term expert in 2013

## Appendix 4-2-1. Report of short term expert (Project management)

| Expertise | Name | Term |
|---|---|---|
| Team leader | Dr. Yoshitake Fujisawa | 1.6.2013 – 12.6.2013 |

1.Itinerary

| Date | Activity |
|---|---|
| 5–Jun | Arrive to Nairobi, move to Kitui, visit seed orchard |
| 6–Jun | Meeting with JICA expert, Project manager, Kitui Director |
| | Visit Tiva nursery, test plantation candidate site |
| 7–Jun | Move to Kibwezi station, nursery, seed orchard |
| 8–Jun | Move to Nairobi |
| 9–Jun | Meeting with JICA experts, documentation |
| 10–Jun | Courtesy call to KEFRI Director, meeting withJICA experts |
| 11–Jun | Courtesy call to JICA Kenya office, Japanese Embassy |
| | Meeting with Project manager |
| 12–Jun | Depart Nairobi |

2.Result of major activities

● Seed orchard establishment

Tiva seed orchard

Sixty clones were planted in this orchard. Most trees grow to around two meter high in a half year after planting. The survival rate was also very high, around 95 %. Although the trees grew very well, some trees were suffered with a disease. Therefore it is necessary to cope with this disease by dispatching a short term expert of this field.

Kibwezi seed orchard

Sixty clones were also planted in this orchard. As the rainfall in Kibwezi is less than in Tiva, it is said that Kibwezi is more suitable for Melia. The tree growth in Kibwezi is similar to that in Tiva.

● Nursery establishment

Nursery establishment plan in Kibwezi station is discussing.

● Utilization of equipment

The DNA sequencer, most expensive equipment has been already set and used.

● Meeting with C/P

Twenty *Melia* plus trees have been selected as planned. Candidate sites for test plantation were nominated. Some of the C/P have gone abroad to study. Therefore replenishment of the C/P was requested.

Photo 1. Meeting in Kitui Regional Research Centre

Photo 2. Ms Bara was explaining the outline of drought tolerance research

Photo 3. Candidate site of progeny test in Tiva


Photo 4. A distant view of Tiva seed orchard

## Appendix 4-2-2. Report of short term expert (Drought tolerant)

| Expertise | Name | Term |
|---|---|---|
| Drought tolerant | A-Prof. Dr. Koichiro Gyokusen | 22.7.2013 – 11.8.2013 |

1.Itinerary

| Date | Activity |
|---|---|
| 23-Jul | Arrive to Nairobi, move to Kitui, visit Melia seed orchard |
| 24-Jul | Tiva pilot forest station, dendrometer setting, data collection, analysis |
| 25-Jul | Discussion on the treatment for infected tree in the seed orchard |
| | Repairment of the dendrometer |
| 26-Jul | Chemical treatment for the infected tree in the seed orchard |
| | Instruction of the dendrometer to C/P |
| 27-Jul | Visit Kibwezi seed orchard |
| 28-Jul | Documentation |
| 29-31-Jul | Measurement of tree size in the Tiva seed orchard |
| 1-Aug | Move to Kibwezi |
| 2-3-Aug | Measurement of tree size in the Kibwezi seed orchard |
| 4-Aug | Input tree size data |
| 5-Aug | Measurement of tree size in the Kibwezi seed orchard |
| 6-Aug | Move to Kitui |
| 7-Aug | Input tree size data |
| 8-Aug | Data collection, input data |
| 9-Aug | Instruction of the equipment |
| 10-Aug | Depart Nairobi |

**2. Activities and results**

**2.1. Stem growth phenology of Melia volkensii**

**[Activities]**

To reveal the stem growth phenology of M.volkensii, we attached nine manual and four automatic dendorometers to the stem of individual tree growing in Tiva pilot forest at 31. August, 2012. The data of manual dendrometer were being collected in every two weeks by CP. (Miss Bala), and the data of automatic dendrometer were collected at the time of my visit. The maintenance of dendrometer, i.e., battery, rubber, and rain cover exchange were also conducted during my stay in Kitui.

[**Results**]

Seasonal changes of air temperature in Tiva pilot forest was shown in fig.1. Temperatures were higher around March and Oct. and lower around Feb. and Jul.. Stem growth patterns of nine trees from 2012.9.1 to 2013.7.13 collected by the manual dendrometer were shown in fig.2. There were two growing seasons during these two years. The one is from the beginning of Nov. to the middle of Jan., and the other is from the end of March to the middle of May. In other seasons, there were no growth, but looked like to be shrunk (minus growth) in diameter.

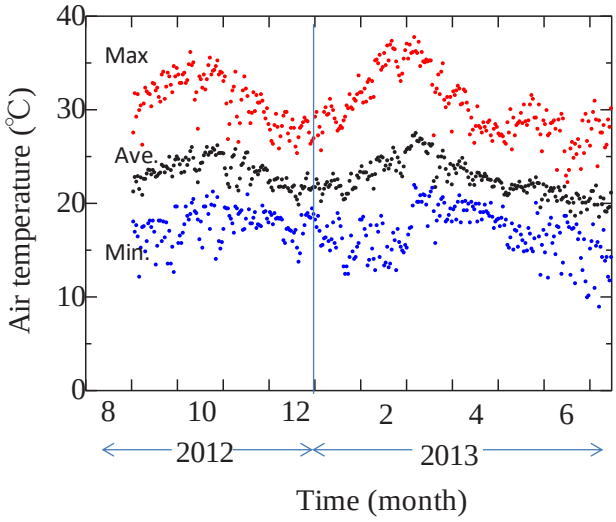



Fig. 1. Seasonal changes of air temperature in Tiva.

The stem growth patterns collected by automatic dendorometer were shown in fig3. Two of four dendrometers were not available by battery drain. The growth pattern of these trees was corresponded to those of fig.2. Two growing seasons and two dormancy seasons are obvious. In Fig.3, the amplitude of fluctuation means the extent of water stress. Large amplitudes were observed at the end of growing seasons.

A conceptual diagram of seasonal stem growth pattern was drawn by using these two data (fig.4). The length of two growing season was 2.5 month in each, and that of dormancy season was 1.5 month and 5.5month, respectively.

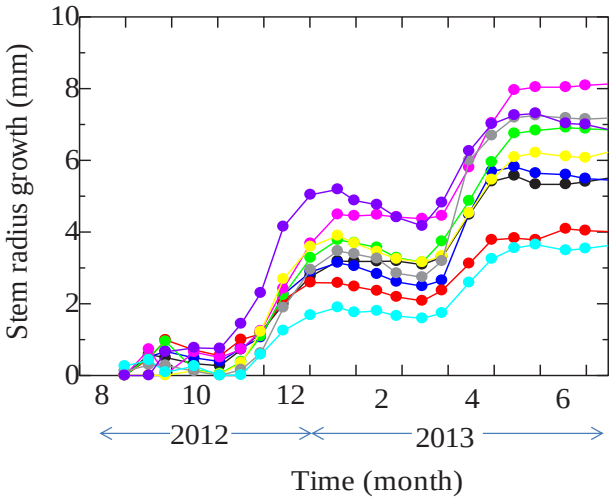



Fig. 2. Stem growth pattern of Melia volkensii measured by manual dendrometer.

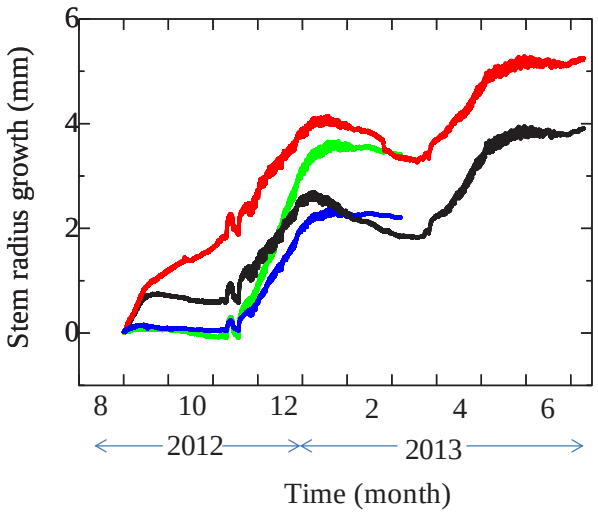



Fig. 3. Stem growth pattern of Melia volkensii measured by automatic dendrometer.

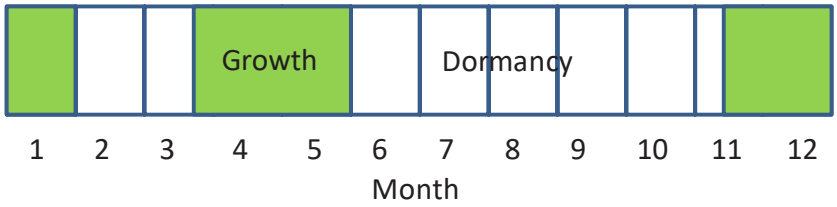



Fig.4. Conceptual diagram of seasonal stem growth pattern in Tiva.

**2.2. Growth data of 60 plus trees planted in seed orchard**

**[Activities]**

To reveal the growth characteristics of selected plus trees, we conducted field survey to measure the tree size. Stem diameter at 0.5m height and tree height of all planted trees in Tiva and Kibwezi seed orchard were measured.

[**Results**]

The outline of tree size was shown in table.1, 2. Averaged diameter, tree height, and D2H(parameter used as tree weight) are shown as growth characteristics. In addition to these data, the tree number infected by fungi was shown.

The maximum clone in size was ID49 (diameter), ID40 (tree height), and ID49 (D2H) in Tiva seed orchard. The maximum clone in Kibwezi seed orchard was ID49 (diameter), ID40 (tree height), and ID40 (D2H). Two clones (ID40, ID49) showed high growth rates in both seed orchards.

Table1. Sizes of Melia volkensii clone planted in Tiva orchard planted in 2012 Oct-Nov.

| D | n | D2H (cm3) | std | D (cm) | std | H (cm) | std | Dis.(Di) | Di/n |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 28 | 3755.1 | 3015.9 | 3.5 | 0.9 | 268.0 | 45.7 | 2 | 7.1 |
| 2 | 29 | 4922.0 | 1837.6 | 4.4 | 0.7 | 243.4 | 17.4 | 1 | 3.4 |
| 3 | 24 | 6088.2 | 2794.4 | 4.5 | 0.9 | 277.3 | 43.4 | 6 | 25.0 |
| 4 | 27 | 5931.4 | 2518.5 | 4.5 | 0.8 | 271.7 | 33.5 | 3 | 11.1 |
| 5 | 28 | 5771.1 | 2885.4 | 4.4 | 1.0 | 278.2 | 33.2 | 2 | 7.1 |
| 6 | 26 | 7939.5 | 3714.6 | 4.9 | 0.9 | 316.0 | 69.5 | 4 | 15.4 |
| 7 | 25 | 6088.9 | 2888.1 | 4.4 | 0.9 | 291.0 | 51.0 | 5 | 20.0 |
| 8 | 25 | 8087.2 | 4123.2 | 5.1 | 1.2 | 283.1 | 46.5 | 5 | 20.0 |
| 9 | 22 | 6242.1 | 3584.6 | 4.5 | 1.2 | 267.1 | 47.1 | 8 | 36.4 |
| 10 | 27 | 6760.9 | 2102.6 | 5.0 | 0.7 | 259.4 | 25.9 | 3 | 11.1 |
| 11 | 27 | 6960.4 | 2420.1 | 4.8 | 0.8 | 291.5 | 29.0 | 3 | 11.1 |
| 12 | 27 | 8380.4 | 3898.2 | 4.9 | 1.1 | 313.0 | 61.3 | 3 | 11.1 |
| 13 | 25 | 6211.9 | 2389.2 | 4.4 | 0.8 | 304.2 | 37.5 | 5 | 20.0 |
| 14 | 27 | 7229.7 | 2870.4 | 4.9 | 0.8 | 292.0 | 29.5 | 3 | 11.1 |
| 15 | 29 | 5994.6 | 2442.6 | 4.2 | 0.7 | 322.1 | 35.6 | 1 | 3.4 |
| 16 | 22 | 6270.1 | 3200.3 | 4.7 | 0.9 | 266.8 | 41.7 | 8 | 36.4 |
| 17 | 24 | 6654.5 | 2676.2 | 4.6 | 0.8 | 302.4 | 37.2 | 6 | 25.0 |
| 18 | 30 | 8926.6 | 3561.8 | 5.1 | 0.9 | 322.4 | 35.0 | 0 | 0.0 |
| 19 | 29 | 4433.3 | 1975.2 | 4.0 | 0.7 | 266.3 | 35.6 | 1 | 3.4 |
| 20 | 28 | 6195.9 | 1915.5 | 4.9 | 0.6 | 251.8 | 21.9 | 2 | 7.1 |
| 21 | 24 | 5529.2 | 2476.5 | 4.4 | 0.9 | 268.6 | 25.9 | 6 | 25.0 |
| 22 | 30 | 7735.4 | 3499.5 | 4.9 | 1.0 | 304.1 | 34.0 | 0 | 0.0 |
| 23 | 28 | 4402.6 | 2085.2 | 4.2 | 0.8 | 240.2 | 52.1 | 2 | 7.1 |
| 24 | 28 | 5599.2 | 2579.9 | 4.4 | 1.1 | 269.3 | 32.3 | 2 | 7.1 |
| 25 | 27 | 5794.9 | 2778.9 | 4.4 | 0.8 | 276.6 | 28.2 | 3 | 11.1 |
| 26 | 29 | 5850.7 | 2286.8 | 4.7 | 0.8 | 257.3 | 21.3 | 1 | 3.4 |
| 27 | 28 | 8761.6 | 3477.2 | 5.0 | 0.9 | 330.4 | 39.2 | 2 | 7.1 |
| 28 | 29 | 7502.4 | 3617.5 | 4.6 | 1.2 | 307.6 | 58.5 | 1 | 3.4 |
| 29 | 25 | 10209.5 | 3933.4 | 5.3 | 0.9 | 350.9 | 30.8 | 5 | 20.0 |
| 30 | 23 | 5752.5 | 2829.7 | 4.2 | 0.9 | 299.3 | 44.4 | 7 | 30.4 |
| 31 | 28 | 3622.2 | 1227.9 | 3.7 | 0.5 | 249.5 | 20.2 | 2 | 7.1 |
| 32 | 27 | 5930.4 | 2519.2 | 4.5 | 0.9 | 269.2 | 39.5 | 3 | 11.1 |
| 33 | 29 | 5200.2 | 1981.7 | 4.3 | 0.7 | 268.4 | 30.2 | 1 | 3.4 |
| 34 | 29 | 7264.5 | 2708.4 | 5.0 | 0.8 | 274.2 | 26.5 | 1 | 3.4 |
| 35 | 28 | 6822.2 | 2666.6 | 4.3 | 0.9 | 335.1 | 60.4 | 2 | 7.1 |
| 36 | 27 | 5450.6 | 2235.9 | 4.3 | 0.8 | 282.1 | 33.6 | 3 | 11.1 |
| 37 | 26 | 6575.1 | 2558.7 | 4.5 | 0.8 | 312.6 | 66.2 | 4 | 15.4 |
| 38 | 25 | 5978.7 | 2142.5 | 4.6 | 0.8 | 273.1 | 25.6 | 5 | 20.0 |
| 39 | 29 | 5120.6 | 1545.5 | 4.3 | 0.6 | 263.5 | 27.0 | 1 | 3.4 |
| 40 | 27 | 9076.5 | 2649.4 | 4.9 | 0.6 | 363.3 | 35.3 | 3 | 11.1 |
| 41 | 28 | 5821.3 | 2379.3 | 4.3 | 0.8 | 293.4 | 42.5 | 2 | 7.1 |
| 42 | 28 | 5503.1 | 2153.9 | 4.3 | 0.8 | 277.7 | 29.2 | 2 | 7.1 |
| 43 | 28 | 7165.6 | 3121.6 | 4.7 | 0.9 | 297.0 | 43.1 | 2 | 7.1 |
| 44 | 27 | 8691.7 | 4091.2 | 5.1 | 1.1 | 316.7 | 76.9 | 3 | 11.1 |
| 45 | 29 | 7637.5 | 2784.2 | 4.8 | 0.8 | 322.9 | 29.7 | 1 | 3.4 |
| 46 | 27 | 5610.7 | 2138.3 | 4.2 | 0.7 | 301.0 | 26.6 | 3 | 11.1 |
| 47 | 29 | 7616.9 | 3691.4 | 4.8 | 1.0 | 308.1 | 41.2 | 1 | 3.4 |
| 48 | 28 | 6930.6 | 3218.5 | 4.7 | 1.0 | 282.9 | 49.8 | 2 | 7.1 |
| 49 | 29 | 10908.2 | 3918.0 | 5.7 | 0.9 | 323.1 | 25.7 | 1 | 3.4 |
| 50 | 28 | 5864.7 | 2207.2 | 4.3 | 0.7 | 305.2 | 32.3 | 2 | 7.1 |
| 51 | 22 | 6841.2 | 2764.5 | 4.6 | 0.7 | 309.2 | 54.8 | 8 | 36.4 |
| 52 | 26 | 8723.6 | 3485.8 | 5.1 | 0.8 | 314.1 | 40.1 | 4 | 15.4 |
| 53 | 27 | 8583.6 | 3844.9 | 4.8 | 1.0 | 351.1 | 62.5 | 3 | 11.1 |
| 54 | 30 | 4492.3 | 1993.6 | 4.2 | 0.7 | 243.8 | 35.0 | 0 | 0.0 |
| 55 | 28 | 5457.1 | 2339.5 | 4.3 | 0.8 | 283.6 | 31.1 | 2 | 7.1 |
| 56 | 28 | 5067.9 | 1736.8 | 4.2 | 0.6 | 273.0 | 32.5 | 2 | 7.1 |
| 57 | 24 | 5128.1 | 2087.7 | 4.1 | 0.8 | 291.1 | 43.2 | 6 | 25.0 |
| 58 | 27 | 8105.3 | 2939.0 | 4.8 | 0.8 | 335.6 | 36.6 | 3 | 11.1 |
| 59 | 27 | 7173.5 | 2442.1 | 4.7 | 0.8 | 314.1 | 34.0 | 3 | 11.1 |
| 60 | 24 | 6370.6 | 3729.7 | 4.3 | 0.9 | 307.2 | 65.9 | 6 | 25.0 |
| totalorAve. | 1619 | 6578.6 | | 4.6 | | 292.2 | | 181 | 11.9 |

D2H max
D max
H max

D D number
n survived tree number of each D clone
std standard deviation
Dis. Disease tree infected with fungii
Di/n Disease rate

Table2. Sizes of Melia volkensii clone planted in Tiva orchard planted in 2013 Jan.-Feb.

| D | n | D2H (cm3) | std | D (cm) | std | H (cm) | std | Dis.(Di) | Di/n |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 30 | 2598.5 | 1268.1 | 3.3 | 0.6 | 225.9 | 37.4 | 2 | 6.7 |
| 2 | 5 | 4184.7 | 1743.7 | 4.2 | 0.7 | 230.4 | 26.4 | 0 | 0.0 |
| 3 | - | | | | | | | | |
| 4 | 11 | 2637.1 | 931.7 | 3.4 | 0.4 | 224.0 | 33.8 | 0 | 0.0 |
| 5 | 30 | 3442.5 | 1689.8 | 3.7 | 0.8 | 230.5 | 34.7 | 1 | 3.3 |
| 6 | 28 | 4546.6 | 2119.9 | 4.0 | 0.7 | 266.1 | 42.2 | 4 | 13.3 |
| 7 | 2 | 5595.8 | - | 4.5 | - | 271.0 | - | 0 | 0.0 |
| 8 | 28 | 3977.8 | 2006.3 | 4.0 | 0.8 | 229.1 | 35.2 | 3 | 10.0 |
| 9 | 5 | 3221.3 | 1479.0 | 3.6 | 0.7 | 229.6 | 27.9 | 3 | 10.0 |
| 10 | 19 | 3002.0 | 1364.3 | 3.8 | 0.6 | 199.3 | 23.0 | 2 | 6.7 |
| 11 | 13 | 2943.4 | 1554.0 | 3.4 | 0.8 | 230.5 | 49.0 | 1 | 3.3 |
| 12 | 14 | 4169.9 | 2340.6 | 3.8 | 0.9 | 251.0 | 60.7 | 4 | 13.3 |
| 13 | 27 | 3706.7 | 1641.4 | 3.7 | 0.7 | 256.3 | 44.9 | 3 | 10.0 |
| 14 | 28 | 3473.2 | 1663.4 | 3.7 | 0.7 | 227.2 | 44.0 | 4 | 13.3 |
| 15 | 21 | 3304.4 | 1594.1 | 3.6 | 0.7 | 238.7 | 45.6 | 0 | 0.0 |
| 16 | 29 | 2957.4 | 1469.5 | 3.6 | 0.7 | 212.5 | 39.4 | 4 | 13.3 |
| 17 | 9 | 2219.2 | 871.2 | 3.1 | 0.5 | 215.2 | 30.2 | 2 | 6.7 |
| 18 | 30 | 4649.5 | 1909.0 | 4.0 | 0.7 | 270.0 | 34.8 | 2 | 6.7 |
| 19 | 30 | 3195.2 | 2000.3 | 3.6 | 0.9 | 219.1 | 48.4 | 4 | 13.3 |
| 20 | 29 | 3496.4 | 1523.1 | 3.9 | 0.7 | 214.2 | 29.0 | 0 | 0.0 |
| 21 | 6 | 4229.1 | 892.8 | 4.1 | 0.4 | 249.8 | 12.2 | 0 | 0.0 |
| 22 | 18 | 3996.4 | 1876.2 | 3.8 | 0.7 | 251.7 | 41.3 | 1 | 3.3 |
| 23 | 17 | 3107.3 | 1179.4 | 3.7 | 0.5 | 210.6 | 32.5 | 3 | 10.0 |
| 24 | 14 | 3269.5 | 1327.8 | 3.8 | 0.6 | 209.1 | 31.2 | 0 | 0.0 |
| 25 | 15 | 3836.1 | 2178.5 | 3.8 | 0.9 | 237.1 | 47.0 | 1 | 3.3 |
| 26 | 29 | 3153.6 | 1938.2 | 3.6 | 0.9 | 206.2 | 42.7 | 2 | 6.7 |
| 27 | 30 | 4619.5 | 1776.3 | 4.2 | 0.6 | 254.2 | 36.0 | 0 | 0.0 |
| 28 | 28 | 2784.6 | 1335.6 | 3.2 | 0.7 | 243.0 | 43.0 | 5 | 16.7 |
| 29 | 27 | 4204.3 | 1654.4 | 3.8 | 0.7 | 269.9 | 35.8 | 2 | 6.7 |
| 30 | 12 | 3664.4 | 1964.3 | 3.6 | 0.7 | 254.1 | 37.0 | 5 | 16.7 |
| 31 | 29 | 2453.2 | 1392.8 | 3.3 | 0.8 | 204.9 | 37.7 | 3 | 10.0 |
| 32 | 24 | 3088.0 | 1571.5 | 3.5 | 0.8 | 219.6 | 47.2 | 1 | 3.3 |
| 33 | 17 | 2839.7 | 1159.2 | 3.5 | 0.6 | 216.8 | 28.4 | 1 | 3.3 |
| 34 | 29 | 3780.7 | 1462.1 | 3.9 | 0.6 | 230.7 | 35.8 | 3 | 10.0 |
| 35 | 23 | 2755.5 | 1325.8 | 3.2 | 0.7 | 246.5 | 51.7 | 0 | 0.0 |
| 36 | 8 | 1814.2 | 715.6 | 3.0 | 0.5 | 190.3 | 31.7 | 0 | 0.0 |
| 37 | 30 | 3858.3 | 2019.5 | 3.7 | 0.8 | 251.8 | 48.3 | 1 | 3.3 |
| 38 | 28 | 3220.3 | 1248.8 | 3.7 | 0.6 | 224.0 | 31.7 | 3 | 10.0 |
| 39 | 30 | 2679.2 | 1040.9 | 3.5 | 0.4 | 207.8 | 37.4 | 5 | 16.7 |
| 40 | 29 | 5270.3 | 1952.2 | 4.1 | 0.7 | 300.2 | 31.2 | 0 | 0.0 |
| 41 | 18 | 3214.0 | 1974.6 | 3.5 | 0.8 | 232.8 | 54.4 | 1 | 3.3 |
| 42 | 21 | 2536.2 | 1169.9 | 3.3 | 0.6 | 213.3 | 30.8 | 0 | 0.0 |
| 43 | 21 | 3395.5 | 1947.3 | 3.6 | 0.7 | 236.4 | 41.4 | 1 | 3.3 |
| 44 | 29 | 4962.5 | 2547.2 | 4.0 | 0.8 | 277.2 | 45.9 | 3 | 10.0 |
| 45 | 12 | 4054.3 | 2274.9 | 3.7 | 0.9 | 254.4 | 64.5 | 2 | 6.7 |
| 46 | 13 | 3295.8 | 1314.6 | 3.6 | 0.5 | 247.4 | 32.0 | 1 | 3.3 |
| 47 | 28 | 3648.4 | 1832.2 | 3.7 | 0.7 | 245.9 | 39.3 | 3 | 10.0 |
| 48 | 26 | 4395.4 | 1871.7 | 4.0 | 0.7 | 257.7 | 42.5 | 5 | 16.7 |
| 49 | 29 | 4929.7 | 2613.8 | 4.2 | 0.8 | 260.0 | 45.1 | 0 | 0.0 |
| 50 | 27 | 3172.4 | 1453.2 | 3.5 | 0.7 | 239.7 | 47.6 | 2 | 6.7 |
| 51 | 14 | 4226.2 | 1992.7 | 3.9 | 0.7 | 259.2 | 48.8 | 2 | 6.7 |
| 52 | 24 | 3209.3 | 2201.8 | 3.5 | 1.0 | 215.5 | 51.1 | 3 | 10.0 |
| 53 | 16 | 3788.4 | 2043.8 | 3.6 | 0.7 | 266.9 | 52.8 | 1 | 3.3 |
| 54 | 29 | 2358.0 | 1248.2 | 3.3 | 0.7 | 190.1 | 43.0 | 1 | 3.3 |
| 55 | 9 | 2575.4 | 1593.2 | 3.2 | 0.8 | 220.2 | 48.4 | 0 | 0.0 |
| 56 | 8 | 3160.4 | 1562.5 | 3.7 | 0.6 | 218.5 | 36.3 | 1 | 3.3 |
| 57 | 24 | 2941.8 | 1751.6 | 3.4 | 0.7 | 224.6 | 40.4 | 1 | 3.3 |
| 58 | 7 | 3773.1 | 2824.8 | 3.6 | 1.0 | 254.9 | 58.0 | 0 | 0.0 |
| 59 | 19 | 4754.7 | 1910.1 | 4.1 | 0.6 | 270.3 | 34.4 | 0 | 0.0 |
| 60 | 20 | 4956.3 | 2655.5 | 4.1 | 0.8 | 271.2 | 50.2 | 5 | 16.7 |
| total or Ave. | 1225 | 3547.3 | | 3.7 | | 236.9 | | 107 | 6.0 |

D2H max
D max
H max

| | |
|---|---|
| D | D number |
| n | survived tree number of each D clone |
| std | standard deviation |
| Dis. | Disease tree infected with fungii |
| Di/n | Disease rate |

The seed orchard was designed to have six replications, i.e. each clone was planted in six sites with 5 individuals. To select the superior clones (which have high growth rate) and inferior clones (which have low growth rate), we compared the growth of each clone in six replications. The D2H was used as an index in this analysis. The ranking of each clone in each replication was calculated and averaged (table 3). It is likely that the high ranking clones had high ranking in all sites, and low ranking clones had low ranking in all sites (fig.5).

We used the average of all tree (Ave.), average of the 3 largest tree (Top3), and the largest tree (Top1) to rank them, and selected the maximum and minimum 8 clones as superior and inferior clones (table 4). Clones which were selected as 8 clones in each category were listed in table 4.

Clones which ranking was within 8 in both of three categories and two seed orchards were selected as candidate for superior and inferior clones.

As a result, ID18, 27, 40, 44, 49 were selected as superior clone, and ID1, 31, 39, 54 were selected as inferior clone.

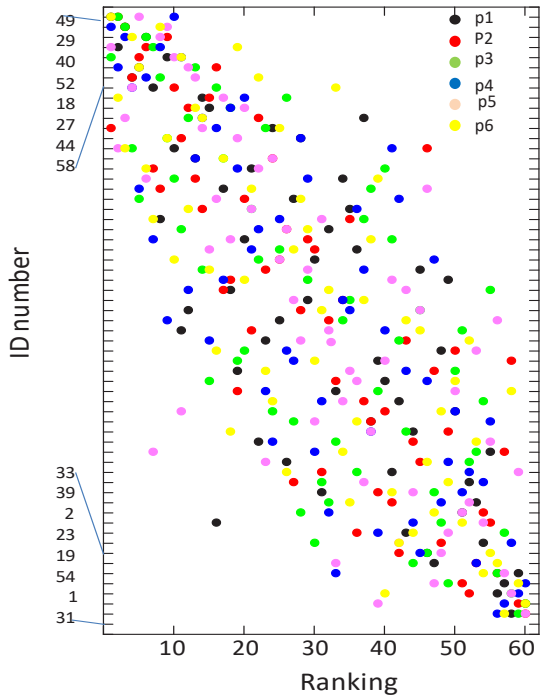



Fig. 5. Ranking of each clone in six replication site. Ranking of Ave. in Tiva seed orchard is used for this figure.

Table 3. Ranking in 6 replications and averaged ranking (averaged D2H was used).

| ID | p1 | p2 | p3 | p4 | p5 | p6 | averaged ranking |
|---|---|---|---|---|---|---|---|
| 49 | 1 | 2 | 2 | 10 | 5 | 1 | 4 |
| 29 | 3 | 3 | 3 | 1 | 9 | 8 | 5 |
| 40 | 6 | 9 | 6 | 3 | 8 | 4 | 6 |
| 52 | 2 | 6 | 7 | 8 | 1 | 19 | 7 |
| 18 | 9 | 5 | 1 | 11 | 10 | 11 | 8 |
| 27 | 5 | 16 | 13 | 2 | 12 | 5 | 9 |
| 44 | 4 | 4 | 8 | 6 | 13 | 22 | 10 |
| 58 | 7 | 10 | 16 | 4 | 4 | 33 | 12 |
| 53 | 14 | 15 | 26 | 20 | 17 | 2 | 16 |
| 45 | 15 | 12 | 18 | 18 | 20 | 13 | 16 |
| 8 | 37 | 22 | 12 | 14 | 3 | 14 | 17 |
| 6 | 24 | 1 | 23 | 16 | 14 | 25 | 17 |
| 22 | 28 | 11 | 9 | 28 | 19 | 9 | 17 |
| 12 | 10 | 46 | 4 | 41 | 2 | 3 | 18 |
| 34 | 13 | 24 | 17 | 13 | 24 | 17 | 18 |
| 47 | 21 | 7 | 40 | 19 | 22 | 6 | 19 |
| 28 | 34 | 13 | 10 | 29 | 6 | 39 | 22 |
| 43 | 17 | 8 | 38 | 5 | 46 | 21 | 23 |
| 14 | 27 | 20 | 5 | 42 | 16 | 28 | 23 |
| 59 | 35 | 14 | 21 | 36 | 21 | 12 | 23 |
| 48 | 8 | 35 | 37 | 25 | 31 | 7 | 24 |
| 51 | 32 | 26 | 11 | 22 | 26 | 29 | 24 |
| 10 | 20 | 29 | 41 | 7 | 18 | 38 | 26 |
| 17 | 36 | 30 | 25 | 21 | 15 | 27 | 26 |
| 11 | 30 | 25 | 22 | 47 | 25 | 10 | 27 |
| 35 | 45 | 23 | 14 | 37 | 29 | 15 | 27 |
| 37 | 49 | 18 | 29 | 17 | 41 | 20 | 29 |
| 16 | 18 | 17 | 55 | 12 | 43 | 32 | 30 |
| 13 | 29 | 34 | 35 | 34 | 27 | 37 | 33 |
| 20 | 12 | 28 | 45 | 35 | 45 | 31 | 33 |
| 7 | 25 | 32 | 34 | 9 | 56 | 43 | 33 |
| 3 | 11 | 21 | 51 | 40 | 32 | 45 | 33 |
| 38 | 23 | 43 | 42 | 15 | 28 | 52 | 34 |
| 15 | 48 | 50 | 20 | 26 | 53 | 16 | 36 |
| 26 | 39 | 58 | 19 | 27 | 40 | 30 | 36 |
| 50 | 19 | 47 | 50 | 43 | 35 | 23 | 36 |
| 32 | 40 | 33 | 15 | 46 | 36 | 50 | 37 |
| 5 | 33 | 19 | 39 | 23 | 50 | 58 | 37 |
| 41 | 42 | 37 | 54 | 31 | 34 | 24 | 37 |
| 9 | 50 | 40 | 24 | 50 | 11 | 48 | 37 |
| 4 | 38 | 38 | 27 | 55 | 30 | 36 | 37 |
| 25 | 44 | 49 | 43 | 38 | 38 | 18 | 38 |
| 24 | 22 | 44 | 33 | 24 | 55 | 53 | 39 |
| 60 | 55 | 57 | 53 | 30 | 7 | 34 | 39 |
| 46 | 26 | 45 | 52 | 49 | 23 | 46 | 40 |
| 30 | 41 | 31 | 36 | 52 | 59 | 26 | 41 |
| 21 | 52 | 27 | 31 | 54 | 37 | 49 | 42 |
| 42 | 31 | 39 | 47 | 51 | 44 | 41 | 42 |
| 36 | 53 | 41 | 32 | 48 | 52 | 35 | 44 |
| 55 | 51 | 54 | 28 | 32 | 51 | 47 | 44 |
| 56 | 16 | 55 | 48 | 44 | 54 | 51 | 45 |
| 57 | 43 | 36 | 57 | 39 | 49 | 44 | 45 |
| 33 | 54 | 48 | 30 | 58 | 42 | 42 | 46 |
| 39 | 46 | 42 | 46 | 45 | 48 | 55 | 47 |
| 2 | 47 | 53 | 44 | 53 | 33 | 56 | 48 |
| 23 | 59 | 56 | 56 | 33 | 57 | 54 | 53 |
| 19 | 57 | 51 | 49 | 60 | 47 | 59 | 54 |
| 54 | 56 | 52 | 58 | 59 | 58 | 40 | 54 |
| 1 | 60 | 59 | 60 | 57 | 39 | 60 | 56 |
| 31 | 58 | 60 | 59 | 56 | 60 | 57 | 58 |

superior 8 clones

inferior 8 clones

Table 4. List of superior and inferior candidate clones

| | | | | Superior | | | | | | Inferior | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Tiva | | | Kibwezi | | | Tiva | | | Kibwezi | | |
| ID | Code | Transect | Altitude (m) | Ave. | Top3 | Top1 | Ave. | Top3 | Top1 | Ave. | Top3 | Top1 | Ave. | Top3 | Top1 |
| 01001 | VM-4 | Voi-Mwatate | 733 | | | | | | | 2 | 3 | 5 | 3 | 7 | 7 |
| 01002 | VM-5 | Voi-Mwatate | 732 | | | | | | | 6 | 6 | | | | |
| 01003 | VM-6 | Voi-Mwatate | 731 | | | | | | | | | | | | |
| 01004 | VM-9 | Voi-Mwatate | 757 | | | | | | | | | | | | |
| 01005 | VM-7 | Voi-Mwatate | 709 | | | | | | | | | | | | |
| 01006 | VM-8 | Voi-Mwatate | 746 | | | | 7 | 6 | | | | | | | |
| 01007 | VM-1 | Voi-Mwatate | 902 | | | | | | | | | | | | |
| 01008 | VM-3 | Voi-Mwatate | 904 | | | | | | | | | | | | |
| 01009 | VM-10 | Voi-Mwatate | 878 | | | | | | | | | | | | |
| 01010 | VM-2A | Voi-Mwatate | 852 | | | | | | | | | | | | |
| 01011 | KT-2 | Katulani-Kavisuni | 1043 | | | | | | | | | | | | |
| 01012 | KT-1 | Katulani-Kavisuni | 1024 | | 8 | | | | | | | | | 8 | |
| 01013 | KT-3 | Katulani-Kavisuni | 976 | | | | | | | | | | | | |
| 01014 | KT-4 | Katulani-Kavisuni | 969 | | | | | | | | | | | | |
| 01015 | KT-5 | Katulani-Kavisuni | 1044 | | | | | | | | | | | | |
| 01016 | KT-6 | Katulani-Kavisuni | 906 | | | | | | | | | | 8 | | 8 |
| 01017 | KT-7 | Katulani-Kavisuni | 930 | | | | | | | | | | | | |
| 01018 | KT-8 | Katulani-Kavisuni | 1042 | 5 | 6 | 6 | 3 | 3 | 3 | | | | | | |
| 01019 | MTA-10 | Mutha-Inyali | 643 | | | | | | | 4 | 4 | 3 | | | |
| 01020 | MTA-7 | Mutha-Inyali | 628 | | | | | | | | | | | | |
| 01021 | MTA-15 | Mutha-Inyali | 557 | | | | | | | | | 7 | | | |
| 01022 | MTA-9 | Mutha-Inyali | 557 | | | | | | | | | | | | |
| 01023 | MTA-6 | Mutha-Inyali | 649 | | | | | | | 5 | 5 | 6 | | | |
| 01024 | MTA-8 | Mutha-Inyali | 527 | | | | | | | | | | 5 | | |
| 01025 | MTA-12 | Mutha-Inyali | 537 | | | | | | | | | | | | |
| 01026 | MWA-2S | Mwea Special | 1097 | | | | | | | | | | | | |
| 01027 | EMBD-2 | Embu-Dams | 1096 | 6 | 3 | 4 | 6 | 5 | 4 | | | | | | |
| 01028 | MWA-1S | Mwea Special | 1099 | | | 8 | | | | | | | 7 | 6 | 5 |
| 01029 | TSK-2 | Mwingi-Tseikuru | | 2 | 2 | 2 | 8 | | 7 | | | | | | |
| 01030 | TSK-4 | Mwingi-Tseikuru | 934 | | | | | | | | | | | | |
| 01031 | TSK-1 | Mwingi-Tseikuru | | | | | | | | 1 | 1 | 1 | 2 | 5 | 6 |
| 01032 | TSK-3 | Mwingi-Tseikuru | 646 | | | | | | | | | | | | |
| 01033 | TSK-6 | Mwingi-Tseikuru | 960 | | | | | | | 8 | 7 | 8 | | | |
| 01034 | TSK-5 | Mwingi-Tseikuru | 983 | | | | | | | | | | | | |
| 01035 | EmbD-7 | Embu-Dams | 1195 | | | | | | | | | | | 3 | 4 |
| 01036 | EmbD-8 | Embu-Dams | 1186 | | | | | | | | | | | | |
| 01037 | EmbD-6 | Embu-Dams | 1183 | | | | | 8 | 6 | | | | | | |
| 01038 | EmbD-3 | Embu-Dams | 1138 | | | | | | | | | | | | |
| 01039 | KT-10 | Katulani-Kavisuni | 1152 | | | | | | | 7 | 8 | 4 | 4 | 4 | 3 |
| 01040 | KT-9 | Katulani-Kavisuni | 1128 | 3 | 4 | 7 | 1 | 1 | 1 | | | | | | |
| 01041 | NUU-5 | Mwingi-Nuu | 672 | | | | | | | | | | | | |
| 01042 | NUU-6 | Mwingi-Nuu | 664 | | | | | | | | | | 6 | 2 | 1 |
| 01043 | NUU-2 | Mwingi-Nuu | 656 | | | | | | | | | | | | |
| 01044 | NUU-1 | Mwingi-Nuu | 641 | 7 | 5 | 5 | 2 | 2 | 5 | | | | | | |
| 01045 | TSK-8 | Mwingi-Tseikuru | 992 | | | | | | | | | | | | |
| 01046 | TSK-7 | Mwingi-Tseikuru | 991 | | | | | | | | | | | | |
| 01047 | MTA-5 | Mutha-Inyali | 521 | | | | | | | | | | | | |
| 01048 | MTA-4 | Mutha-Inyali | 542 | | | | 5 | 7 | 8 | | | | | | |
| 01049 | MTA-11 | Mutha-Inyali | 510 | 1 | 1 | 1 | 4 | 4 | 2 | | | | | | |
| 01050 | EmbIG-11 | Embu-Ishiara-Gatunga | | 3 | | | | | | | | | | | |
| 01051 | EmbIG-6 | Embu-Ishiara-Gatunga | 850 | | | | | | | | | | | | |
| 01052 | EmbIG-13 | Embu-Ishiara-Gatunga | 600 | 4 | 7 | 3 | | | | | | | | | |
| 01053 | EmbIG-7 | Embu-Ishiara-Gatunga | 792 | | | | | | | | | | | | |
| 01054 | EmbIG-12 | Embu-Ishiara-Gatunga | 660 | | | | | | | 3 | 2 | 2 | 1 | 1 | 2 |
| 01055 | EmbIG-5 | Embu-Ishiara-Gatunga | 789 | | | | | | | | | | | | |
| 01056 | EmbD-5 | Embu-Dams | 1154 | | | | | | | | | | | | |
| 01057 | EmbIG-10 | Embu-Ishiara-Gatunga | 708 | | | | | | | | | | | | |
| 01058 | EmbIG-4N | Embu-Ishiara-Gatunga | 704 | 8 | | | | | | | | | | | |
| 01059 | EmbD-4 | Embu-Dams | 1131 | | | | | | | | | | | | |
| 01060 | EmbIG-3 | Embu-Ishiara-Gatunga | 698 | | | | | | | | | | | | |

Candidate for superior clone

Cndidate for inferior clone

## 3. Dispersal of disease tree

## [Activities]

A lots of trees planted in seed orchard were infected by some kind of disease. The color of stem skin near the ground turned brown and produced gum-like latex on its surface (photo1). To reveal the number of infected tree and distribution of infected tree in seed orchard, we conducted field survey. Additionally, we treated the infected trees by fungicide (photo 2). 'Toppujin M peisuto (Japanese name)'was used as a fungicide.

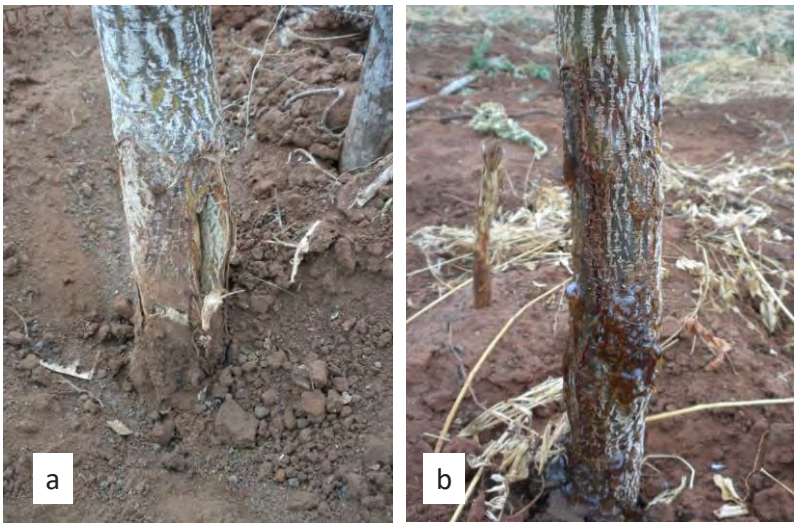



Photo 1. Appearance of the infected tree.
a: skin color turned to brown, b:gum production

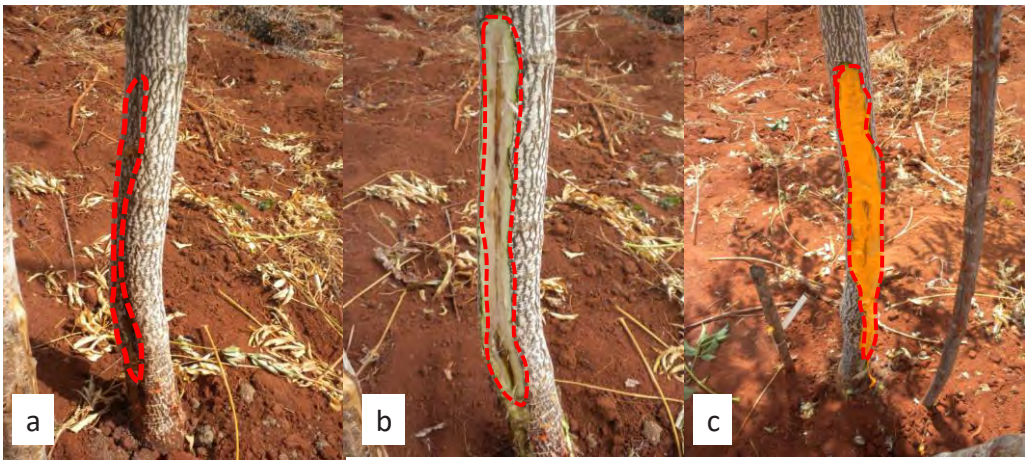



Photo2. Treatment of infected tree by fungicide
a: infected part, b: removal of the infected part, c: application of fungicide

[**Results**]

・Infected ratio

The infected ratios in Tiva and Kibwezi were 11.9% and 6.0%, respectively. The fluctuation ranges of infected ratio among clones were 36.4%-0.0%, 16.7%-0.0% in Tiva and Kibwezi, respectively. Clones of high

infected ratio in Tiva did not necessarily correspond to those in Kibwezi. Clones of high infected ratio did not necessarily show a high ratio in all replication site (data were not shown).

. ・Distribution

The infected trees were not randomly distributed. They were concentrated in some part of the seed orchard. The infected tree distributed on the upper part of Fig.6 in Tiva, and on the left and upper part of fig.7 in Kibwezi. These distribution patterns indicate that the fungi, which seemed to be the cause of this disease came not from the seedling (nursery) but from the planted site.

Fig.6. Distribution map of infected and dead tree in Tiva seed orcharad

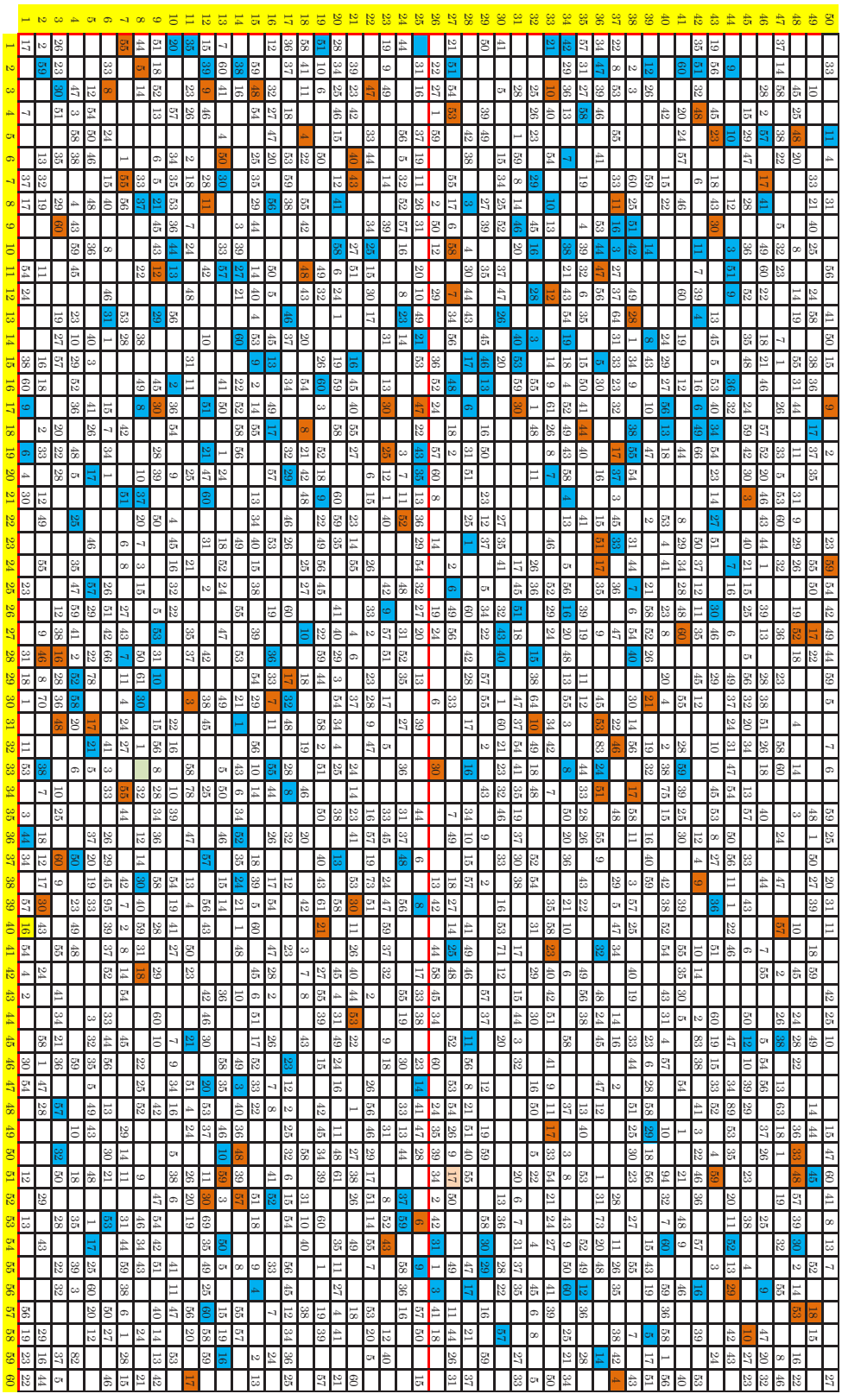
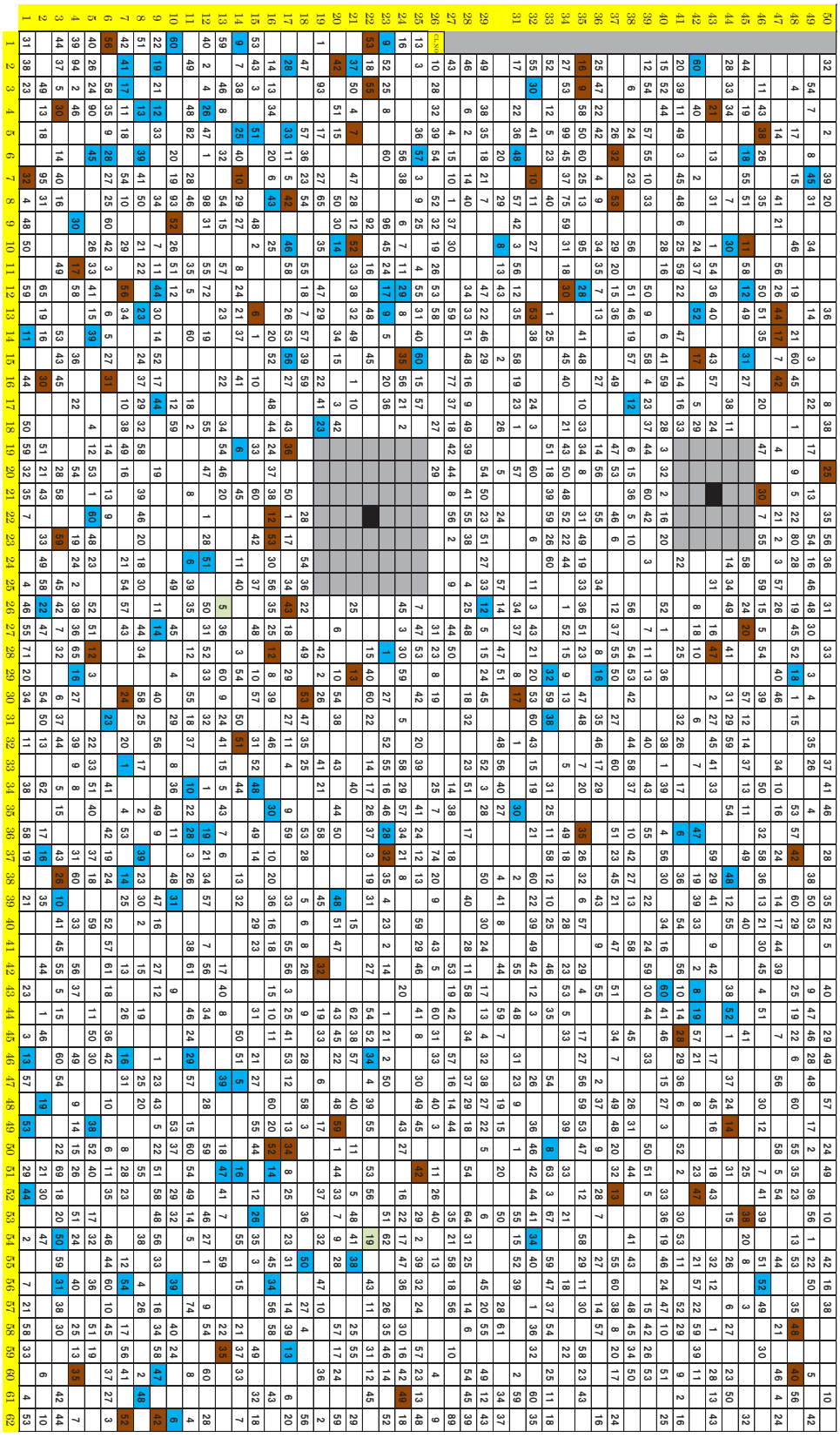



Fig7. Distribution map of infected and dead tree in Kibwezi seed orcharad




## 4. Growth characteristics of Melia volkensii

### [Activities]

To compare the growth characteristics of Melia volkensii with other useful tree species, we planted the seedlings of 5 tree species (i.e. *Melia volkensii, Melia azedarach, Eucalyptus camaldulensisi, Gmeina*

*arborea, and Vitex payos*) in Kitui center at Oct. 2012. Tree size (stem diameter and tree height) and the weight of litter fall had been collected in every two weeks.

[**Results**]

Tree height, diameter at 10cm height from ground level, and H/D ratio were shown in fig. 8, 9, 10, respectively. The ranking of tree height was E.c.>M.v=G.a>M.a.>V.p. and the ranking of diameter was G.a.>E.c.>M.a.>M.v.>V.p.. Tree height and diameter were not corresponded, then the H/D ratio was E.c.>=M.v.>G.a.>V.p.>=M.a.. About the litter fall (fig.11), there was not apparent difference among species so far.

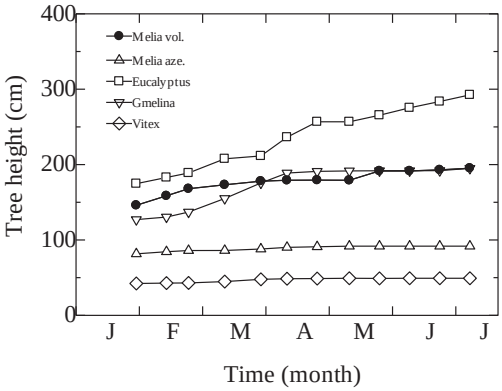



Fig.8. Tree height changes of five useful tree species Planted in the Kitui center

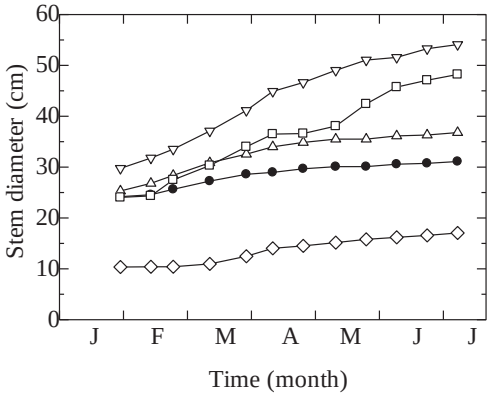



Fig.9. Stem diameter changes of five useful tree species Planted in the Kitui center

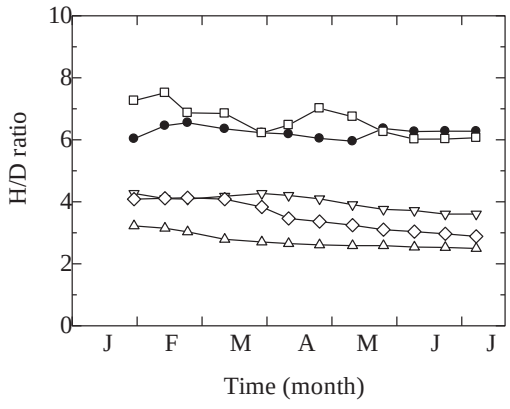



Fig.10. H/D ratio changes of five useful tree species planted in the Kitui center

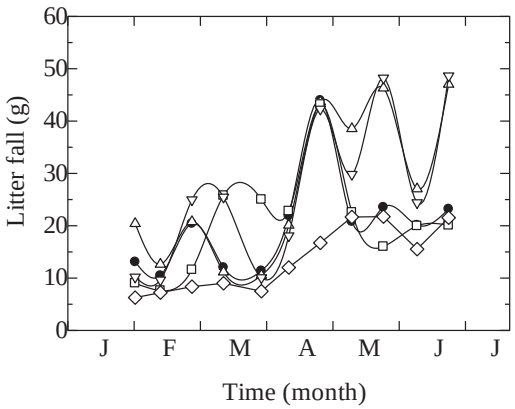



Fig.11. Litter fall changes of five useful tree species planted in the Kitui center

**5. Set up of pressure chamber**

**[Activities]**

A newly equipped pressure chamber was set up. We tried to connect the new chamber to the old air bomb, which was already equipped in Kitui center.

[**Results**]

Air bombs and compressor were already equipped in Kitui center (photo 3). The newly equipped pressure chamber could connect with the air bomb without problem (photo 4). However, the compressor was needed to be cleaned with the oil, I requested to the center to change oil and clean the oil room.

Mr. Kigwa (C.P.) tried to use it (photo 5), and finally comfirmed there was no problem to use the new pressure chamber in Kitui center.

Photo 3. Air bomb and compressor already equipped in Kitui center

Photo 4. Air bomb and pressure chamber connection

Photo 5 Measurement of xylem water potential using the newly introduced pressure chamber.

## Appendix 4-2-3. Report of short term expert (Drought tolerant)

| Expertise | Name | Term |
|---|---|---|
| Drought tolerant | Dr. Kotaro Sakuta | 22.7.2013 – 28.7.2013 |

1.Itinerary

| Date | Activity |
|---|---|
| 23–Jul | Arrive to Nairobi, move to Kitui, visit Melia seed orchard |
| 24–Jul | Preparation of the laboratory |
| 25–Jul | Setting the equipment in the laboratory |
| 26–Jul | Chemical treatment for the infected tree in the seed orchard |
| | Instruction of the dendrometer to C/P |
| 27–Jul | Move to Nairobi, Depart Nairobi |

2.Result of major activities

● Preparation of the laboratory

Preparation of the laboratory was done for the experiment. The equipment for drought tolerant experiment was checked.

● Instruction of the equipment

Instruction of polometer which is used to measure water condition of the leaves was done to the C/P.

● Surgical treatment of the tree

Some trees of the seed orchard were dead because of the decay at the grafting point. Therefore after removing the decayed parts from the tree fungicide was adopted.

## Appendix 4-2-4. Report of short term expert (Drought tolerant)

| Expertise | Name | Term |
|---|---|---|
| Drought tolerant | Dr. Eiji Goto | 22.7.2013 – 31.7.2013 |

1.Itinerary

| Date | Activity |
|---|---|
| 23–Jul | Arrive to Nairobi |
| 24–Aug | Move to Kitui |
| 25–Aug | Check and setting the equipment for photosynthesis condition |
| 26–Aug | Tiva seed orchard |
| 27–Aug | Move to Kibwezi |
| 28–Aug | Survey in Kibwezi, move to Kitui |
| 29–Aug | Measurement of tree growth in Tiva seed orchard |
| 30–Aug | Move to Nairobi, Depart Nairobi |

2.Result of major activities

● Preparation of the laboratory

Preparation of the laboratory was done for the experiment. The equipment for photosynthesis measurement was checked.

● Instruction of the equipment

Instruction of the equipment used to measure photosynthesis of the leaves was done to the C/P.

● Surgical treatment of the tree

Some trees of the seed orchard are dead because of the decay at the grafting point. Therefore after removing the decayed parts from the tree fungicide was adopted.

## Appendix 4-2-5. Report of short term expert (DNA analysis)

| Expertise | Name | Term |
|---|---|---|
| DNA analysis | Dr. So Hanaoka | 210.8.2013 – 2.9.2013 |

1.Itinerary

| Date | Activity |
|---|---|
| 22–Aug | Arrive to Nairobi |
| 23–Aug | Courtesy call to KEFRI, move to Kitui |
| 24–Aug | Collection in Kitui |
| 25–Aug | Collection in Galana |
| 26–Aug | Survey in Ukunda |
| 27–Aug | Survey in Kwale |
| 28–Aug | Survey in Kibwezi, move to Nairobi |
| 29–30–Aug | Instruction in laboratory |
| 31–Aug | Documentation |
| 1–Sep | Documentation |
| 2–Sep | Depart Nairobi |

2.Result of major activities

● Collection of the materials

The leaves of 30 *Melia volkensii* individuals in Kitui and 12 ones in Galana were collected. Supplemental collection will be done in Galana. As in these three years the leaves of 342 individuals from 12 populations were collected in total, the number of the material was thought to be almost enough.

● Experiment in the laboratory

DNAs have been already isolated from 60 *M. volkensii* individuals by C/Ps. They have already mastered the SSR analysis, the most important method in this project. DNA genotyping in *M. volkensii* and Development of DNA markers in *A. tortilis* will be done.

**Recommendation of Short-Term Experts "DNA Analysis" as follows;**

1. Sampling

- Sampling of Acacia tortilis has not finished yet. It should be achieved within this fiscal year (March 2014). In addition, if possible, sampling of Melia volkensii in Galana should be carried out.

2. Experiments

- Primer screening of Acacia tortilis and SSR genotyping of Melia plus trees are high-priority task. They will be the most important output of this fiscal year. If those tasks complete, the next comes clone identification of grafted trees.

3. Others

- We have to compile the list of reagents and consumables which will be used within this fiscal year. We have to order them within next quarter (December 2013). Regarding to the training of Genemapper, we reached the consensus of the necessity of training.

It is recommendable to start gene flow studies in TIva and Kibwezi, firstly starting observation of flowering phenology.

## Appendix 4-2-6. Report of short term expert (Breeding theory)

| Expertise | Name | Term |
|---|---|---|
| Breeding | Dr. Hisaya Miyashita | 21.8.2013 –6.9.2013 |

1.Itinerary

| Date | Activity |
|---|---|
| 22–Aug | Arrive to Nairobi, Courtesy call to Embassy |
| 23–Aug | Courtesy call to KEFRI |
| 25–Aug | Move to Kitui |
| 26–Aug | Survey progeny test candidate site in Kitui |
| 27–Aug | Survey progeny test candidate site in Kitui |
| 28–Aug | Move to Kibwezi |
| 29–Aug | Survey progeny test candidate site in Kibwezi |
| 30–Aug | Survey progeny test candidate site in Voi |
| 31–Aug | Survey progeny test candidate site in Galana |
| 1–Sep | Move to Nairobi |
| 2–Sep | Survey progeny test candidate site in Embu |
| 3–Sep | Survey progeny test candidate site in Marimanti |
| 4–Sep | Survey progeny test candidate site in Tseikuru |
| 5–Sep | Visit Karura Regional Research Centre |
| 6–Sep | KEFRI, Depart Nairobi |

2.Result of major activities

● Candidate site for progeny test in *Melia volukensii*

The number of the progeny test sites were planned 3 sites from each region, Kitui, Kibwezi and Embu. As the candidate sites were surveyed in this time, the sites will be determined in February 2014.

● Wood property study

After visiting Karura Regional Research Centre cooperation of the wood property study of *Melia* was requested to the Director and it was accepted.

**Recommendation of Short-Term Experts "Progeny Test" as follows;**

1. Compilation of Information/Data

- Information and data should be compiled in a table so that we compare the candidate sites at a glance. It should contain the following items.

Ownership (name of owner and contact person, acreage, etc. )

Location (GPS data on altitude, latitude and longitude, County, District, etc. )

Access (distance from the nearest town, road condition, etc.)

Environmental condition (soil, precipitation, slope, etc. )

Demonstration effects (interests of nearby farmers, etc. )

Other remarks (exploitation, etc. )

2. Schedule

- As the final decision would be made by February next year, information/data collection should complete by that time.

- In Tiva and Kibwezi, preliminary preparation work should start in advance so as to get the picture of site establishing work.

## Appendix 4-2-7. Report of short term expert (Disease control, Nursery management)

| Expertise | Name | Term |
|---|---|---|
| Tree disease | Dr. Norio Sahashi | 21.8.2013 – 2.9.2013 |
| Nursery management | Mr. Nobutaka Chiba | 21.8.2013 – 2.9.2013 |
| Nursery management | Mr. Shutaro Yamaguchi | 21.8.2013 – 2.9.2013 |

1.Itinerary

| Date | Activity |
|---|---|
| 22-Aug | Arrive to Nairobi, Courtesy call to Embassy |
| 23-Aug | Courtesy call to KEFRI, move to Kitui |
| 24-Aug | Documentation |
| 25-Aug | Move to Kitui, Tiva seed orchard |
| 26-Aug | Kitui Centre, Disease survey in Tiva seed orchard |
| 27-Aug | Instruction of improved grafting method in Kitui Centre nursery |
| 28-Aug | Move to Kibwezi |
| 29-Aug | Disease survey in Kibwezi seed orchard, pruning seed trees |
| 30-Aug | Instruction of scion collection and improved grafting method |
| | Move to Voi |
| 31-Aug | Move to Kibwezi |
| 1-Sep | Move to Nairobi |
| 2-Sep | Depart Nairobi |

2.Result of major activities

● Propagation plan and method of Melia plus tree

Total 2250 grafts are necessary for Tiva and Kibwezi seed orchards.

Improved grafting method was developed and instructed

Cutting was tried.

● Topping and pruning of Melia seed tree

Topping and pruning were adopted to some trees in the seed orchard.

**Recommendation of Short-Term Experts as follows;**

## "Disease control"

1 Inoculation Experiment

- Inoculation experiment should be done immediately to confirm the pathogenicity of the candidate pathogen (*Lasiodiplodia theobromae*) which was isolated from diseased parts of the affected trees, so that we could take appropriate measures efficiently.
  Thanks to Dr. Njuguna and the Centre Director Kitui, the experiment can be conducted in Melia planting site in Tiva, under Dr. Njuguna's guidance. The consensus was made on the experiment method that Dr. Sahashi proposed.

2 Treatment (Sterilization, etc)

- Because pycnidia (spore) are formed in rainy seasons, uprooting of the dead trees should be done immediately, followed by sterilization.
- As for uprooting, all of the stems and branches of dead trees should be removed from the orchards and burnt. The fine roots and soil are not necessarily removed.
- Based upon the precondition of candidate pathogen (*Lasiodiplodia)*, we should proceed with sterilization. Fungicides should be applied to the orchards. At the meeting in Kitui, specific fungicides were proposed as BENLATE, RIDOMIL and BAVISTIN. When we use these fungicides, side effects (or toxicity) of fungicides should be checked in a small number of actual trees before the application, even though the application methods comply with the manual. The sterilization should complete before the rainy season. The use of spreading agent in the fungicides is recommendable so as to extend the duration of its effect.
- The method that Prof. Gyokusen carried out on the infected trees seems worth doing, while the effects might be limited because of difficulties of complete elimination of infected tissue. The treatment can be recommendable if there would be enough labour, time and material (Topsin paste).

## "Propagation"

1 Plus Tree Propagation

- First priority should be placed to plus tree propagation. 20 plus tree, which were additionally selected last/this year, should be grafted in September. The newly introduced method (rubber-band and wax method) is recommendable.
  (Number: 20 plus trees x (@30+10 )x 2 sites =1600 )
- The second priority is the supplemental planting for Kibwezi (about 500) and the dead trees (about 200). The scions for Tiva and Kibwezi should be collected from each orchard respectively. If there is not sufficient number of scions in an orchard, scions from another orchard can be used.

- The selection method of scion differs between being collected from seed orchard trees and collected from plus trees. The shoot in the former case is green, while the latter is dormant and relatively thick. Specifically, in the seed orchard, where most of the trees do not shed leaves at this season, the scion should rather be selected from those in the thin green branch if they are hard enough. In this case, the scions should be grafted as soon as possible after the collection, most hopefully on the very day of collection or at least the day after, because these scions cannot hold long –haul storage.
- Because we instructed the method from seed orchard trees in Kibwezi, but not in Kitui, it is recommendable to send Kibwezi staff, who know this method like Pius, to Tiva so that the staff would forward it there.
- Grafting would be done in both Kitui and Kibwezi. We should prepare the necessary facilities, material and equipment such as iron frame, refrigerator, temporary seedling bed, shading net. To minimize the risk of infection, rubber-band and wax method is recommendable. The nursery staff in Kitui and Kibwezi seemed to be well accustomed with the method.
- The planting in Kibwezi was conducted in January 2013 after relatively long period of hardening and the survival was good. We may consider that planting might be done at this timing. Further discussion is needed.
- The third priority is the preparation for the supplemental planting of infected trees, which would be done next year. One option is to use cutting. The preliminary trial of cutting was done in Kitui and Kibwezi and the results would be assessed and discussed in November by next short term expert (most likely Mr. Yamanobe). If the cutting would perform satisfactorily, it could be applied. As the survival ratio of cutting is expected as around 50% or less, the other option should be prepared in the meantime. We should start growing the root stocks so as to get the proper size root stocks early enough. If we collect and sow seeds in September, the root stock would be ready in April next year and we could advance the process of propagation.

2 Seed Orchard Management (Pruning, etc)

- The planted trees in seed orchards need pruning and pollarding for the easy maintenance work, as well as the maximum seed production. Trial pruning and pollarding should be done in Tiva, as it was done in Kibwezi. Specifically, we select three (3) well grown, sound and non-infected trees then measure the height and take photographs first. The stem of these trees are cut at the height of 3 meter. The side branch of one of these trees should be pruned at the 50cm length from the stem. After completing, photographs should be taken.
  The effects of the work would be assessed by next short term experts in November.
- The elongated branches in lower part of the tree seem not to contribute to the growth. It is recommendable to prune these branches and to apply topsin paste at the cut before rainy season.

## Appendix 4-2-8. Report of short term expert (Drought tolerant)

| Expertise | Name | Term |
|---|---|---|
| Drought tolerant | Ass Prof Dr Koichiro Gyokusen | 18.11.2013 ~ 27.11.2013 |

1.Itinerary

November 2013 (Short-term experts)
2 Drought torerance

Duration 2013.11.18-2013.11.27
Member: Dr. Koichiro Gyokusen

| | AM | PM |
|---|---|---|
| 11.18 (Mon.) | | Departute (Fukuoka) |
| 11.19 (Tue.) | Arrival (Nairobi)<br>Movem went from Nairobi to Kitui | Visit to Tiva seed orchard and pilot forsst |
| 11.20 (Wed.) | Selection of superior and inferior clones at Tiva seed orchard | Data collection of automatic dendrometer at Tiva pilot forest |
| 11.21 (Thu.) | Maintenance of automatic dendrometer | Collection of stem discs of Melia volkensii for growth analysis |
| 11.22 (Fri.) | Selection of target tree for automatic camera setting | Meeting with Dr.Muturi and Mr.Muchiri about the scheme of physiological approach |
| 11.23 (Sat.) | Inspection to the progeny site of Embu and Mwingi | Inspection to the progeny site of Embu and Mwingi |
| 11.24 (Sun.) | Setting of manual dendrometer to superior and inferior clones at Tiva seed orchard | Setting of manual dendrometer to superior and inferior clones at Tiva seed orchard |
| 11.25 (Mon.) | Setting of automatic camera to superior and inferior clones at Tiva seed orchard | Setting of automatic camera to superior and inferior clones at Tiva seed orchard |
| 11.26 (Tue.) | Deparature (Nairobi) | |
| 11.27 (Wed.) | Arrival (Fukuoka) | |

| KEFRI staff |
|---|
| Mr. Kigwa |
| Mr. Muchiri |
| Dr. Muturi |
| Dr. Ndufa |

**2.Result of major activities**

**2.1. Stem growth phenology of Melia volkensii in Tiva pilot forest**

**[Activities]**

To reveal the stem growth phenology of Melia.volkensii, we attached ten manual and four automatic dendorometers to stem of Melia trees growing in Tiva pilot forest at 31th. August, 2012. We continued collecting data and could get one year dataset (from Aug. 2012 to Nov. 2013) of tree growth. I detached five manual dendrometers and moved them to the newly established seed orchard in this time to start a new measurement, but four manual dendrometers and four automatic dendrometers were remained there to continue the measurement. About the automatic dendrometers, two individual trees of four attached trees fell down in the cause of a heavy rain in Nov. I detached all dendrometers and reset them to another three trees.

[**Results**]

Seasonal changes of stem growth and leaf phenology were shown in fig.1. The stem growth of tree No.1 of automatic dendrometer was shown as a representative data.

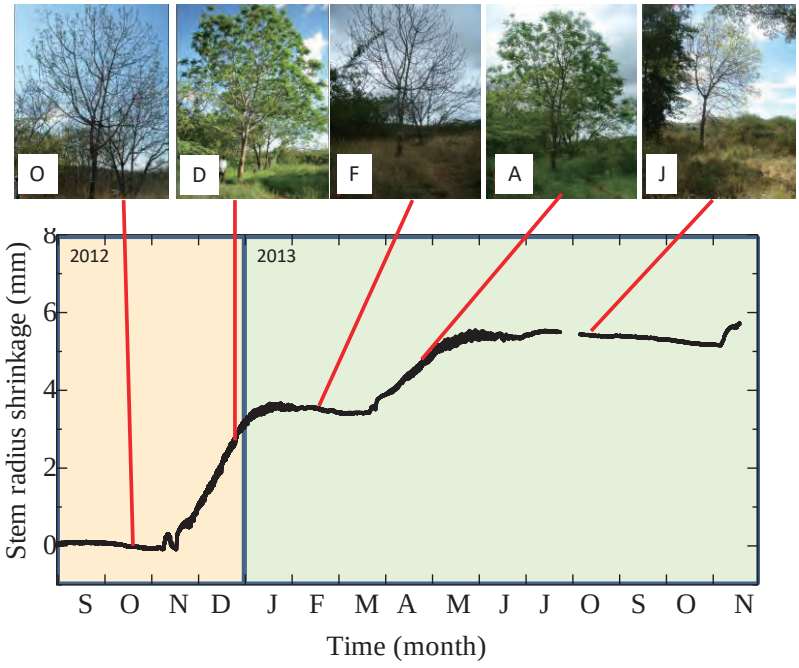



Fig1. Leaf and stem growth phenology of *Melia volkensii* growing in Tiva forest station

The line thickness means the extent of fluctuation of stem shrinkage.

There were two times of leaf fall and leaf flushing seasons in one year. The leaf fall took place during Jan.- Mar. and Jul.- Oct., and leaf flushing took place during Apr.-Jul. and Nov. - Jan.. There were also two times of stem growth seasons in one year, and they were corresponded to leaf phenology. Stem continued to grow during the leaf flushing seasons and stopped it's growth during leaf fall seasons. The fluctuation magnitude of stem shrinkage which assumed to be an index of water stress became large in Jan. and May. It is recommended that these two months are available for drought tolerant research activity.

## 2.2. Physiological characteristic of superior and inferior clones

**[Activities]**

To reveal the physiological characteristics of superior and inferior clones, we started to measure the leaf phenology and stem growth phenology of several clones planted in Tiva seeed orchard. Six sets of automatic camera and manual dendrometer were attached to target clones, and data loggers for soil water and air temperature measurement were equipped (fig.2).

[**Results**]

We chose the target clones from Block2 and 3 of Seed orchard in Tiva (fig.3) because of the convenience of electricity and security. ID18, 27, 40, 44, 49 and ID1, 31, 39, 54 were

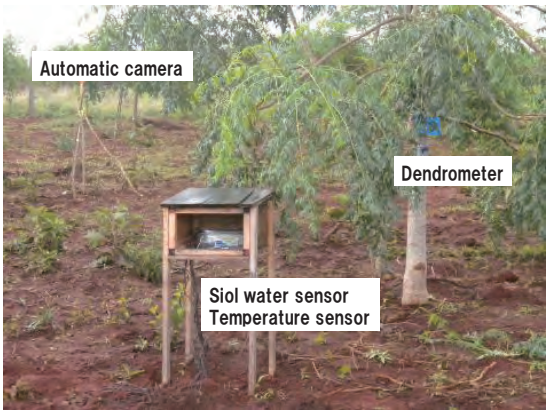



Fig.2 Set up of some equipments in Tiva

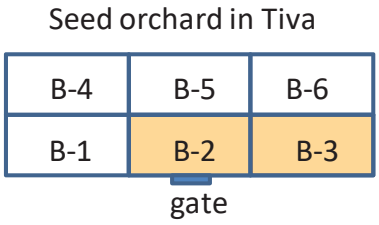



Fig.3 Location of selected blocks

already selected as superior and inferior clones, respectively, from the previous survey. ID40, 44, 49 and ID31, 39, 54 were chosen newly in this survey in view of the distribution pattern. We tried to find the target clones which were planted as neighbors and easy to set up the equipments. Tree size distribution of chosen clones in Block2, 3 was shown in fig.4.

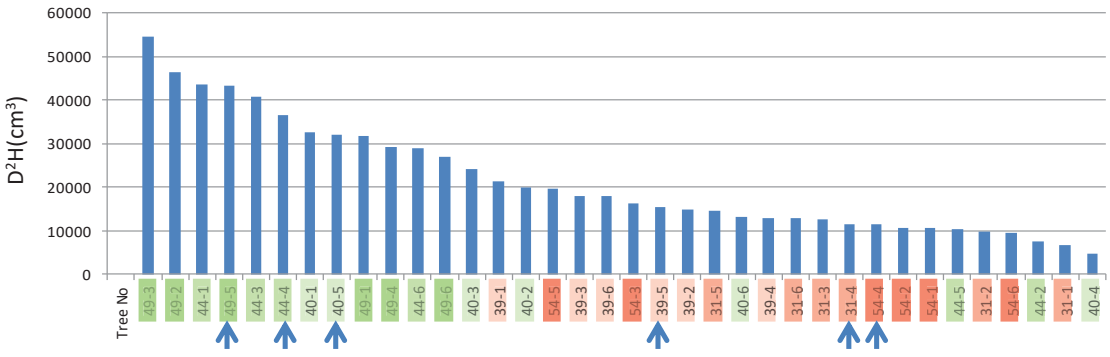



Fig.4 Size distribution of chosen clones. Arrows show the target trees.

## Appendix 4-2-9. Report of short term expert (Drought tolerant)

| Expertise | Name | Term |
|---|---|---|
| Drought tolerant | Dr. Michito Tsuyama | 18.11.2013 ~ 27.11.2013 |

1.Itinerary

| Date | Activities |
|---|---|
| Nov 18 | Depart Fukuoka |
| Nov 19 | Arrive to Nairobi, move to Kitui |
| Nov 20 | Tiva seed orchard |
| Nov 21 | Tiva seed orchard |
| Nov 22 | Tiva seed orchrad |
| Nov 23 | Embu and Mwingi |
| Nov 24 | Tiva seed orchard |
| Nov 25 | Tiva seed orchard |
| Nov 26 | Depart Nairobi |
| Nov 27 | Arrive to Fukuoka |

2.Result of major activities

2.6. Set up of PAM chlorophyll fluorometer

[Activities]

A newly equipped chlorophyll fluoromer (PAM fluorometer) was set up. The control software (Wincontrol) was installed to PC and connection between PAM and PC was established.

[Results]

LED light sources, fiber optics, cables, leaf clip, etc. were all checked. Measurements of chlorophyll fluorescence can be conducted successfully.

2.7. Measurements of chlorophyll fluorescence

[Activities]

The chlorophyll fluorescence parameter Fv/Fm was measured and compared between leaves from superior and inferior clones. The parameter indicates the potential quantum yield of photosystem II, which reflects so called ‘the degree of soundness’ of photosynthesis of a leaf. The Fv/Fm value in a healthy leaf is normally from 0.8 to 0.85.

[Results]

The values of Fv/Fm parameter were 0.82-0.85 in all the clones selected (Table 1) and there was no difference in the values between the superior and inferior clones (three clones each). We are planning to continue this comparison for the coming year including dry seasons.

Table 1. Values of the Fv/Fm parameter in superior and inferior clones of *Melia volkensii*

| Category | Line (address) | Fv/Fm | | | ave. | s.d. |
|---|---|---|---|---|---|---|
| Superior | 40 (23-15) | 0.832 | 0.822 | 0.839 | 0.831 | 0.008 |
| | 49 (23-14) | 0.825 | 0.834 | 0.831 | 0.830 | 0.005 |
| | 18 (23-13) | 0.831 | 0.826 | 0.825 | 0.827 | 0.003 |
| Inferior | 31 (23-12) | 0.822 | 0.818 | 0.827 | 0.822 | 0.005 |
| | 54 (29-15) | 0.827 | 0.836 | 0.825 | 0.829 | 0.006 |
| | 39 (38-15) | 0.844 | 0.845 | 0.849 | 0.846 | 0.003 |

## Appendix 4-2-10. Report of short term expert (Project management)

| Expertise | Name | Term |
|---|---|---|
| Project management | Dr. Teiji Kondo | 18.11.2013 – 27.11.2013 |

Itinerary

| Date | Activity |
|---|---|
| 19–Nov | Arrive to Nairobi, move to Kitui, Tiva seed orchard |
| 20–Nov | Kitui Centre, Disease survey in Tiva seed orchard |
| 21–Nov | Tiva, move to Kibwezi |
| 22–Nov | Kibwezi Centre, seed orchard, farmer |
| 23–Nov | Documentation |
| 24–Nov | Move to Nairobi |
| 25–Nov | KEFRI, JICA |
| 26–Nov | Depart Nairobi |

Result of major activities

● General issues

Most project activities were going well.

● Nursery

Grafts were very well raising in both Kitui and Kibwezi nursery (Photo 1, 2). The grafting method was very improved to avoid disease infection. Cutting was tried but rooting was poor (Photo 3–5).

● Seed orchard

From the inoculation study it is clarified that the disease in seed orchard was caused by a fungus by Dr. Njuguma, KEFRI tree pathologist (Photo 7-11). Fungicide spray will be done soon. In seed orchard some infected trees recovered (Photo 12-16). The trees of the seed orchard was growing well and show various tree shapes (Photo 18-23). Pruning was adopted some trees in seed orchard (Photo 24-26). There were a lot of fruit setting in the 3 years old seed orchard (Photo 27-30). Management house of seed orchard was on construction (Photo 31, 32).

● Candidate site for progeny test

Three candidate sites for progeny test was surveyed. All of them were suitable land and access condition (Photo 33-40).

● Farmer growing *Melia volkensii*

Two farmers who were growing *M. volkensii* were surveyed. One farmer are growing around 10,000 trees in his land (Photo 41-45). He was also growing seedlings in his nursery and produced seeds. Another farmer was less scale but very interested to grow *M. volkensii* (Photo 46-51).

Photo 1-2. Well growing grafts in the nursery

Photo 3-5. Cutting experiment

Photo 6. Candidate site for nursery expansion


Photo 7-11 Inoculation study by Dr. Njuguma laboratory


Photo 12-16. Recovery of infected trees in the seed orchard

Photo 17. Damage by mite





Photo 18-23. Various tree shapes in the seed orchard



Photo 24-26. Pruning experiment in the seed orchard


Photo 27-30. A lot of fruit setting in the 3 years old seed orchard

Photo 31-32 Management house of seed orchard

Photo 33. Kitui campus of Kenyatta University

Photo 34. Candidate site for progeny test beside the Kitui campus


Photo 35. KARI

Photo 36. Candidate site beyond the experimental field of KARI

Photo 37. Arid vegetation in the candidate site in KARI

Photo 38. Good access from the main road

Photo 39. Candidate site of private land

Photo 40. Fertile soil in the site

Photo 41. The farmer (third person from the right)

Photo 42-44. Growing *Melia volkensii*

Photo 45. Big tree of  estimated around 15,000 s.




Photo 46-51.The Musawas.

## Appendix 4-2-11. Report of short term expert (Propagation, Nursery management)

| Expertise | Name | Term |
|---|---|---|
| Propagation | Mr. Taro Yamanobe | 25.1.2014 – 2.2.2014 |
| Nursery management | Mr. Syousei Sakamoto | 25.1.2014 – 3.2.2014 |

1.Itinerary

| Date | Activity |
|---|---|
| 26-Jan | Arrive to Nairobi, move to Kibwezi |
| 27-Jan | Kibwezi seed orchard |
| 28-Jan | Kibwezi seed orchard, move to Kitui |
| 29-Jan | Tiva seed orchard |
| 30-Jan | Tiva seed orchard |
| 31-Jan | Tiva seed orchard, move to Nairobi |
| 1-Feb | Depart Nairobi |

2.Result of major activities

● Selection of *Melia volkensii* plus tree

The improved grafting method was very successful. There was no damage on the grafts. Grafting using green shoots was also successful.

● Planting in *Melia volkensii* seed orchard

The newly selected plus tree grafts were planted in both Tiva and Kibwezi seed orchards. In each seed orchard the grafts were kept in the shade until planting. Ten litters of water were provided for each graft.

● Disease in the seed orchard

The disease was not expanding in the seed orchard. Burning treatment of severe damaged tree and fungicide spraying are thought to be necessary to cope with the disease.

● Seed orchard management

Pruning experiment was conducted in the 3 years old seed orchard. Two methods, strong and medium pruning treatments were adopted.

## Appendix 4-2-12. Report of short term expert (Breeding theory)

| Expertise | Name | Term |
|---|---|---|
| Breeding | Dr. Hisaya Miyashita | 1.2.2014 – 8.2.2014 |

1.Itinerary

| Date | Activity |
|---|---|
| 1–Feb | Arrive to Nairobi, move to kibwezi |
| 2–Feb | Move to Kitui, Tiva seed orchard |
| 3–Feb | Kitui Regional Research Centre, move to Nairobi |
| 4–Feb | KEFRI |
| 5–Feb | KEFRI |
| 6–Feb | Move to Karura |
| 7–Feb | Survey progeny test candidate site in Kibwezi |
| 8–Feb | Depart Nairobi |

2.Result of major activities

● Progeny test sites in *Melia volkensii*

The test sites were determined to establish in Kitui and Kibwezi. Another site will be established under the different climate condition. Seed procurement and seedling raising plans for the progeny test sites were discussed.

● Plus tree selection of *Acacia*

The seeds from 8 plus trees are stored in KARI GENE Bank.

● Wood property study of *M.volkensii*

Samples for wood property study were decided. Wood property of plus trees will be surveyed using old seed orchard in Tiva.

## Appendix 4-2-13. Report of short term expert (Project management)

| Expertise | Name | Term |
|---|---|---|
| Project management | Dr. Teiji Kondo | 7.2.2014 – 16.2.2014 |

1.Itinerary

| Date | Activity |
|---|---|
| 8-Feb | Arrive to Nairobi |
| 9-Feb | Meeting |
| 10-Feb | KEFRI, JICA |
| 11-Feb | Move to Kitui |
| 12-Feb | JCC |
| 13-Feb | Move to Kibwezi |
| 14-Feb | Move to Nairobi |
| 15-Feb | Depart Nairobi |

2.Result of major activities

● Joint Coordinating Committee

In the morning the members visited seed orchard at first, and then the meeting was held in the afternoon. The minutes of the previous meeting was confirmed. The project activities were presented by Dr. Muturi, Mr. Ozawa and Dr. Kondo. Demonstration of the superior seed and seedling was discussed.

Participants

- Mr. Gideon Gathaara (Chairperson)
  Conservation Secretary, Ministry of Environment, Water and Natural Resources

- Mr. Ephraim Muchiri
  Deputy Director, Forest Conservation, MoEWNR

- Mr. Robert Gitonga Economist, Treasury, Ministry of Finance
- Dr. Gabriel Muturi Project Manager, KEFRI Muguga
- Mr. Jason Kariuki Assistant Project Manager, KEFRI Muguga
- Dr. James Ndufa Field Manager, KEFRI Kitui
- Ms. Josephine Msyoki Assistant Field Manager, KEFRI Kibwezi
- Mr. Kazuhiro Goseki JICA HQs
- Mr. Jun Watanabe JICA HQs
- Ms. Meri Fukai Project FormulationAdviser, JICA Kenya Office

- Mr. Makoto Ozawa Chief Adviser, JICA
- Mr. Masaki Narumi Coordinator, JICA
- Dr. Teiji Kondo FTBC

● Seed orchard

Trees were growing very well in both Tiva and Kibwezi seed orchards. In Kibwezi seed orchard yellow spots on the leaves were found in many trees. Same leaves were taken to show the tree pathologist in KEFRI.

● Farmer Field School (FFS)

KFS held FFS as one of the extension activities. We visited one village and they have compared Mango varieties. Two tree species, *Grevillea robusta* and *Melia volkensii* have been also compared in their growth. It is thought to be useful to demonstrate superior *Melia* seedlings in FFS.

# Project on Development of Drought Tolerant Trees for Adaptation to Climate Change in Drylands of Kenya

The Third Joint Coordinating Committee Meeting
12th February 2014, Kitui, KENYA

PROJECT DURATION
2012 - 2017

FTBC Forest Tree Breeding Center

JICA

## Presenters: KEFRI, FTBC & JICA

1 Project Outline

2 Results of FY2013 (The Second Term) and Plan of FY2014 (The Third Term)

a) DNA Analysis
b) Tree Breeding
c) Extension
d) Training in Japan

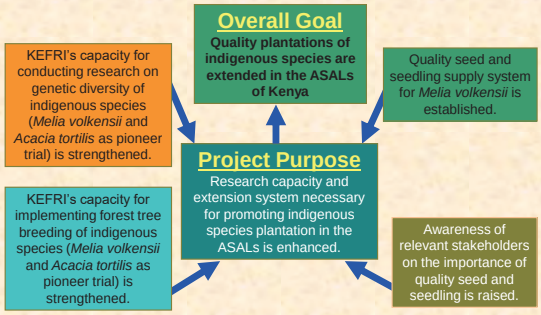
3 PO and APO

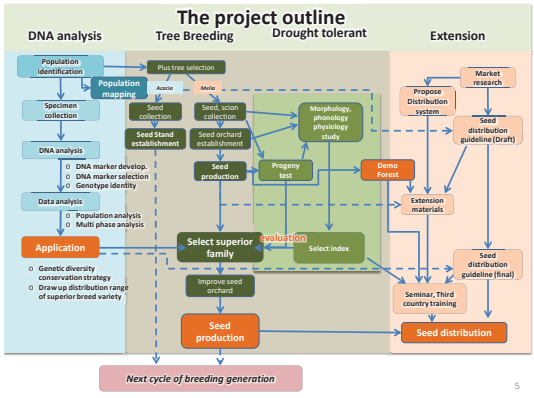
2

## Project Duration, Implementers, Beneficiaries & Target Area

| | |
|---|---|
| **Project Period** | 5 years; From July 2012 to June 2017 |
| **Project Implementers** | KEFRI, FTBC and KFS |
| **Beneficiaries** | Staff members of KEFRI and KFS, inhabitants of ASALs of Kenya |
| **Project target Areas** | Muguga (KEFRI HQs), Kitui, Makueni, Garissa, Embu |

## PROJECT DESIGN



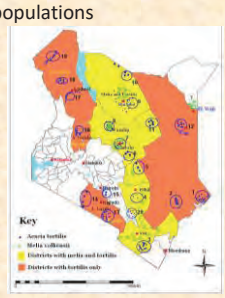




5

## 2 Results of FY 2013 / Plan of FY 2014

A: DNA Analysis

1. Delineate *Melia volkensii* and *Acacia tortilis* populations




A total of 310 Melia and 390 Acacia have been mapped and sampled.

6

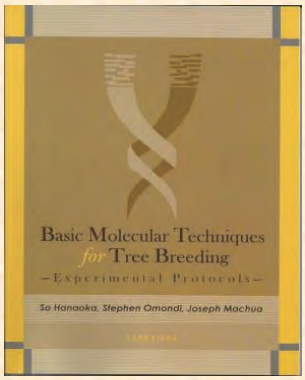
2: Determine genetic diversity of *Melia volkensii* and *Acacia tortilis* populations

- DNA research protocol was compiled and issued.
- A total of 192 microsatellite markers were developed in Acacia and 18 selected for further screening.
- Analysis on genotypes of collected samples is on going

7

Basic Molecular Techniques

To be used in 3rd Country training



## Plan of FY 2014 (The Third Term)

- To collect specimen and geographical information (continued)
  (target; 2 *Melia* and 3 *Acacia* populations )
- To compile the gathered information on the distribution of both species
- To screen markers of *Acacia tortilis* (continued)
- To analyze genotypes of *Melia* by using developed markers

## 2 b) Tree Breeding

### - Overview of FY 2013

- Raising of *Melia* rootstock at Kitui Centre
- Scion collection from 20 newly selected Plus Trees in 4 transects, as well as from existing trees, in October and November 2013
- Grafting of 72 scions for each of the 20 PTs. For supplementary planting of existing PTs, grafting conducted additionally
- Planting of a total of 800 grafted seedlings (from 20 plus trees X 30 grafts each and supplementary planting) at Kitui Seed Orchard in January 2014
- Planting of a total of 1200 grafted seedlings at Kibwezi Seed Orchard in January 2014
- 21 *Acacia* PTs were selected

## Status and projection of *Melia* scions collection


## Grafting of Melia

- Grafting was done simultaneously with scion collection from the end of October to November 2013
- A total of 2800 grafts were done at Kitui RRC and Kibwezi Station

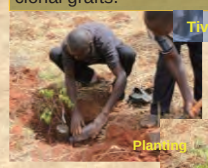
Nursery at Kibwezi Station

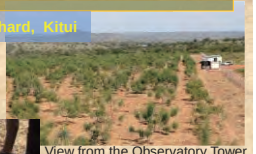

Nursery at Kitui RRC


## Planting of Melia Orchards

Planting was carried out in Kibwezi from 25th -27th January 2014. 1200 clonal grafts were additionally planted in a design that will maximize crossing rather than self pollination among clones.

In Kitui, planting was done from 29th -30th January, with 800 clonal grafts.




View from the Observatory Tower

## Plan of FY 2014 (The Third Term)

### Tree breeding operation in *Melia volkensii*

**Additional planting in seed orchard in 2014**

| Location | Number of Families to plant | Trees per Family | Number of Trees to plant | Remark |
|---|---|---|---|---|
| Kitui | 20 | 30 | 600 | Supplementary planting for dead trees |
| Kibwezi | 20 | 30 | 600 | Supplementary planting for dead trees |

## Operationalization of Progeny Tests

**OBJECTIVES**

To evaluate the performance of Plus Trees in the different ecological zones

**DESIGN**

- Approx. 60 available clones of PT be used
- Schedule
  Seed collection : April~July
  Raising seedlings: August ~ November
  Planting: November ~ December
- One progeny test site each in Kitui and Kibwezi
- Based on relevant factors (#), additional test sites to be established

(#: e.g. land availability, demonstration impact, ease of management, etc.)

## Project Target Areas

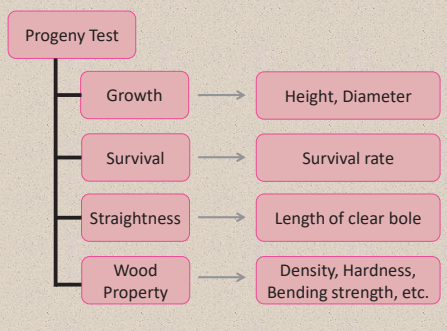
**Record of Discussion (May 2012)**

Appendix 1 Project Description
Ⅱ OUTLINE OF THE PROJECT
3 Project Sites and Beneficiaries
Project Sites: Muguga (KEFRI HQs), Kitui, Makueni, Garissa, Embu
Beneficiaries: Inhabitants of ASALS of Kenya

Candidate Place for Progeny Test sites (County-wise):

Kitui, Makueni, Embu, **Tharaka-Nithi, Taita Taveta, Kilifi**

## Evaluation of Melia Plus Trees




## Evaluation of Wood Properties




18

## Tree breeding operation in *Acacia tortilis*

Number of plus tree selection (*Acacia tortilis*)

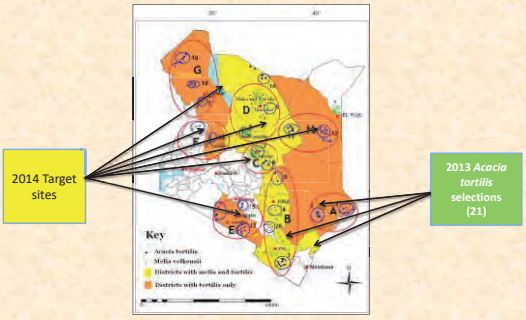
| Year | Number | Note |
|---|---|---|
| 2013 | 21 | Selected |
| 2014 | 79 | To be selected by October |

Establishment of *Acacia tortilis* Seed Stand

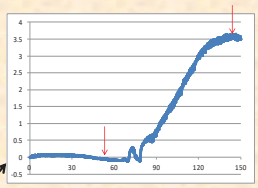
- Seed Stand: Tiva field station and Kibwezi sub Research Station
- After the completion of seed collection, raising the seedlings for Seed Stand starts.

19

## Status and projection of *Acacia tortilis* Plus Trees selection



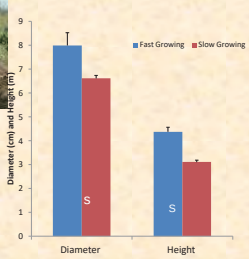

## Development of criteria for evaluating variation of drought tolerance in *Melia*




- Growth monitored with dendrometer
- Growth resumed shortly after onset of rains
- Dormancy sets in at onset of dry season

21

## Clonal variation in growth

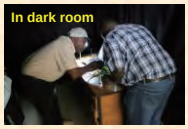




22

## Chlorophyll fluorescence measurement

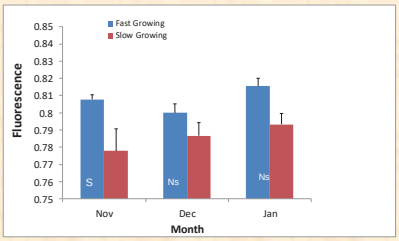
Data collection on the characteristics of photosynthesis in fast growing and slow growing clones

- Young leaves determined, cut and dipped in cold water
- Transported to lab for analysis and stored in dark room for 2hrs
- Chlorophyll fluorescence measured at specified light intensity


23

## Variation in chlorophyll fluorescence between fast and slow growing clones




- Fluorescence of fast growing clones generally higher than that of slow growing clones
- Note differences during dry and wet seasons

24

## 2 c) Extension

### 1 Market research

OBJECTIVES

To review, analyze and document the current status of seed and seedling production and distribution of *Melia*, as well as utilization of timber

IMPLEMENTATION

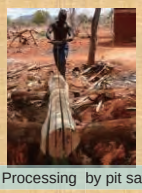
- Pre-test in Tharaka-Nithi (Jul. 2013)
- Main Survey in Taita Taveta, Makueni, Kitui and Embu (Sep. 2013 – Oct.2013)

-A total of 211 Seed/Seedling enterprise and 213 Timber enterprise were interviewed.

*Interview to a seed collector / a nursery owner*

25

- Melia producers, as well as distributers, have keen interests on the species in general.
- Melia volkensii enterprises have a great potential to improve the livelihoods of the dry land communities.
- The report is underway for finalization.

Processing by pit saw

### 2 Production and distribution of guideline

The Guideline for supplying the quality seed and seedling would be done, based upon the results of research.

26

## Plan of FY 2014 (The Third Term)

***Activity 3 (Supply chain of quality seed and seedling)***

1 Market research

- Analysis and compilation of results of market research

2 Developing production/distribution guideline

- Developing of tentative guideline, based upon the market needs grasped

***Activity 4 (Extension of quality seed distribution system)***

1 Preparing training materials

2 Brochure Distribution

- Discussion on the structure and contents
- Production of materials

27

## 2 d)Training in Japan

| Course | Participant | 2012 | 2013 | 2014 |
|---|---|---|---|---|
| Project management | PD | 9 | | 15 |
| | PM | 23 | | 15 |
| DNA analysis | | 55 | 39 | 30 |
| | | 55 | 39 | 30 |
| Breeding theory | | 41 | 23 | 30 |
| | | 41 | 23 | 30 |
| Breeding tech | | 27 | 23 | |
| | | 27 | 23 | |
| Drought tolerant | | | 30 | |
| | | | 30 | |
| Dissemination | | | | 30 |
| | | | | 30 |
| Total | Persons | 8 | 8 | 8 |
| | Days | 278 | 226 | 210 |

28

地方のトピックニュース

◆ケニアから8名の研修生が来日、最新の育種技術学ぶ

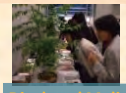
*'A Total of 8 Trainees From KENYA Trained on Cutting-edge Tree Breeding Technology in FTBC and Kyushu University'*

RINSEI NEWS <7th Aug. 2013>
(Forestry Journal in Japan)

## Side Event in TICAD V
(1st Jun. 2013, Japan)

**Director's Presentation**

**Presentation on The Sustainable Management of Arid and Semi-arid African Forests Through the Promotion of Community-based Approach**



**Displayed Melia**

## Side Event in UNCCD
(26th Sep. 2013, Namibia)


## *Thank you*

**Planting Team in Tiva, Kitui 30/01/2014**

31

Annual Plan of Operation 2014 (proposed)

| Activities | | 1st Q | | | 2nd Q | | | 3rd Q | | | 4th Q | | | Section & Program in KEFRI | Responsible Person | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2014 | | | | | | | | | 2015 | | | | KEFRI | JICA |
| | | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | | | |
| **0 General issue** | | | | | | | | | | | | | | | | Chief Advisor OIC (FTBC) |
| 0.1 | Inception report | | | | | | | | | | | | | | | |
| 0.2 | JCC | | | | | | | | | | | † | | | | |
| 0.2.1 | Project coordination (dispatching experts) | | | | | | | | | | | | | | | |
| 0.3 | Evaluation | | | | | | | | | | | | | | | |
| 0.4 | International seminar | | | | | | | | † | | | | | | | |
| **1 DNA analysis** | | | | | | | | | | | | | | | Mr. Omondi | Dr. Hanaoka |
| 1.0.1 | Training in Japan | | | | | | | | | | | | | | | |
| 1.0.2 | Dispatch expert | | | | | | | | | | | | | | | |
| **1.1** | **Delineate *Melia volkensii* and *Acacia tortilis* populations based on site aridity and altitude** | | | | | | | | | | | | | GIS STD | Mr. Kiama Mr. Omondi | |
| 1.1.1 | Implement the ground survey, and gather the information of *Melia volkensii* and *Acacia tortilis* population by using prepared reporting format together with photograph and GPS data | | | | | | | | | | | | | | | |
| 1.1.2 | Compile the gathered information of *Melia volkensii* and *Acacia tortilis* into the GIS system and develop the location map of populations | | | | | | | | | | | | | | | |
| 1.1.3 | Consider to develop GIS system for information integration | | | | | | | | | | | | | | | |
| **1.2** | **Determine genetic diversity of *Melia volkensii* and *Acacia tortilis* population** | | | | | | | | | | | | | Biotechnology DFP | | |
| 1.2.1 | Collect the specimens, leaf and seed, from *Acacia tortilis* populations | | | | | | | | | | | | | | | |
| 1.2.2 | Develop the SSR DNA markers of *Melia volkensii* and *Acacia tortilis* | | | | | | | | | | | | | | | |
| 1.2.3 | Screen developed SSR markers of *Acacia tortilis* in order to figure out genetic relationship between populations | | | | | | | | | | | | | | | |
| 1.2.4 | Determine the genotypes of collected specimens by using developed SSR markers | | | | | | | | | | | | | | | |
| **1.3** | **Develop guideline for conservation of genetic resources of *Melia volkensii* and *Acacia tortilis*** | | | | | | | | | | | | | | | |
| **2 Tree breeding** | | | | | | | | | | | | | | Tree Breeding, DFP | Mr. Kariuki | Dr. Miyashita |
| 2.0.1 | Training in Japan | | | | | | | | | | | | | | | |
| 2.0.2 | Dispatch expert | | | | | | | | | | | | | | | |
| **2.1** | **Select candidate plus trees of *Melia volkensii*** | | | | | | | | | | | | | | | |
| 2.1.1 | Conduct plus tree selection | | | | | | | | | | | | | | | |
| **2.2** | **Establish clonal seed orchards of Melia volkensii** | | | | | | | | | | | | | | | |
| 2.2.1 | Prepare three thousands root stock of *Melia volkensii* for grafting propagation | | | | | | | | | | | | | | | |
| 2.2.2 | Collect twigs or scions of plus trees | | | | | | | | | | | | | | | |
| 2.2.3 | Conduct grafting propagation, and provide clone seedlings for clonal seed orchards | | | | | | | | | | | | | | | |
| 2.2.4 | Planting in clonal seed orchard in Kitui and Kibwezi | | | | | | | | | | | | | | | |
| **2.3** | **Evaluation of plus trees of *Melia volkensii* based on progeny performance** | | | | | | | | | | | | | | | |
| 2.3.1 | Prepare the plantation sites of *Melia volkensii* for Progeny test | | | | | | | | | | | | | | | |
| 2.3.2 | Collect seeds of candidate plus tree of *Melia volkensii* | | | | | | | | | | | | | | | |
| 2.3.3 | Raise seedlings of candidate plus tree of *Melia volkensii* | | | | | | | | | | | | | | | |
| 2.3.4 | Plant at progeny test sites | | | | | | | | | | | | | | | |
| 2.3.5 | Evaluation of Wood Property | | | | | | | | | | | | | | | |
| **2.4** | **Select drought tolerant from candidate *Melia volkensii* plus trees** | | | | | | | | | | | | | | | |
| 2.4.1 | Prepare a small size progeney test for drought tolerant | | | | | | | | | | | | | | | |
| 2.4.2 | Photosynthesis rate measurement | | | | | | | | | | | | | | | |
| 2.4.3 | Chlorophyll fluorescence measurement | | | | | | | | | | | | | | | |
| 2.4.4 | Water relation analysis | | | | | | | | | | | | | | | |
| 2.4.5 | Morphologic analysis | | | | | | | | | | | | | | | |
| **2.5** | **Improve clonal orchards of *Melia volkensii*** | | | | | | | | | | | | | | | |
| **2.6** | **Establish seedling seed stand of *Acacia tortilis*** | | | | | | | | | | | | | | | |
| 2.6.1 | Select and collect seeds of candidate plus tree of *Acacia tortilis* | | | | | | | | | | | | | | | |
| 2.6.2 | Raise seedlings from the collected seeds | | | | | | | | | | | | | | | |
| 2.6.3 | Prepare the seedling seed stand of *Acacia tortilis* | | | | | | | | | | | | | | | |
| **3 Supply chain of Quality seed and seedling** | | | | | | | | | | | | | | Seed Research TSP | Mr. Bernard Kamondo | Chief Advisor OIC (FTBC) |
| **3.1** | **Market research** | | | | | | | | | | | | | | | |
| **3.2** | **Production and distribution guideline** | | | | | | | | | | | | | | | |
| **3.3** | **Pilot distribution** | | | | | | | | | | | | | | | |
| **3.4** | **Revice and finalize Seed Distribution Guideline** | | | | | | | | | | | | | | | |
| **4 Extention of quality seed distribution system** | | | | | | | | | | | | | | DFP | Mr. Giathi (Kitui) Ms. Musyoki (Kibwezi) | Chief Advisor OIC(FTBC) |
| **4.1** | **Establish Demonstration Forest** | | | | | | | | | | | | | | Mr. Giathi (Kitui) Ms. Musyoki (Kibwezi) | |
| **4.2** | **Prepare Training material** | | | | | | | | | | | | | | | |
| **4.3** | **Seminer for stakeholders and NGOs** | | | | | | | | | | | | | | | |
| **4.4** | **Brouchure distribution** | | | | | | | | | | | | | | | |
| **4.5** | **Third country training** | | | | | | | | | | | | | | | |

# Plan of Operation

| Activities | | 1st term | | | 2nd term | | | | 3rd term | | | | 4th term | | | | 5th term | | | | | Section & Program in KEFRI | Responsible Person | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2012 | | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | | | 2017 | | KEFRI | JICA |
| | | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | | | |
| 0 General issue | | | | | | | | | | | | | | | | | | | | | | | | Chief Advisor |
| 0.1 | Inception report | ◊ | | | | | | | | | | | | | | | | | | | | | | |
| 0.2 | JCC | † | | | † | | | | † | | | | † | | | | † | | | | † | | | |
| 0.3 | Evaluation | | | | | | | | | | | | ‡ | | | | | | | | ‡ | | | |
| 0.4 | Intrnational seminar | | | | | | | | | | | | | | | | | ◊ | | | | | | |
| 1 DNA analysis | | | | | | | | | | | | | | | | | | | | | | | | Dr. Hanaoka |
| 1.0 | Training in Japan | | | | | | | | | | | | | | | | | | | | | | | |
| 1.1 | Delineate *Melia volkensii* and *Acacia tortilis* populations based on site aridity and altitude | | | | | | | | | | | | | | | | | | | | | GIS STD | Mr. Kiama | |
| 1.2 | Determine genetic diversity of *Melia volkensii* and *Acacia tortilis* population | | | | | | | | | | | | | | | | | | | | | Biotechnology DFP | Mr. Machua | |
| 1.2.1 | Collect the specimens, leaf and seed, from *Melia volkensii* populations | | | | | | | | | | | | | | | | | | | | | | | |
| 1.2.2 | Develop the SSR DNA markers of *Melia volkensii* and *Acacia tortilis* | | | | | | | | | | | | | | | | | | | | | | | |
| 1.2.3 | Screen developed SSR markers in order to figure out genetic relationship between populations | | | | | | | | | | | | | | | | | | | | | | | |
| 1.2.4 | Determine the genotypes of collected specimens by using developed SSR markers | | | | | | | | | | | | | | | | | | | | | | | |
| 1.3 | Develop guideline for conservation of genetic resources of *Melia volkensii* and *Acacia tortilis* | | | | | | | | | | | | | | | | | | | | | | | |
| 2 Tree breeding | | | | | | | | | | | | | | | | | | | | | | Tree Breeding, DFP | Mr. Kariuki | Dr. Miyashita |
| 2.0 | Training in Japan | | | | | | | | | | | | | | | | | | | | | | | |
| 2.1 | Select candidate plus trees of *Melia volkensii* | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2 | Establish clonal seed orchards of Melia volkensii | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2.1 | Prepare root stock of *Melia volkensii* for grafting propagation | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2.2 | Collect twigs or scions of candidate plus trees | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2.3 | Conduct grafting propagation, and provide clone seedlings for clonal orchards | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2.4 | Establish of clonal seed orchard in Kitui and Kibwezi | | | | | | | | | | | | | | | | | | | | | | | |
| 2.3 | Evaluation of plus trees of *Melia volkensii* based on progeny performance | | | | | | | | | | | | | | | | | | | | | | | |
| 2.4 | Select drought tolerant from candidate *Melia volkensii* plus trees | | | | | | | | | | | | | | | | | | | | | | | |
| 2.4.1 | Prepare a drought tolerant selection procedure | | | | | | | | | | | | | | | | | | | | | | | |
| 2.4.2 | Consider the potential indicators for drought tolerant selection | | | | | | | | | | | | | | | | | | | | | | | |
| 2.4.3 | Select drought tolerant index | | | | | | | | | | | | | | | | | | | | | | | |
| 2.4.4 | Select drought tolerant *Melia volkensii* by index | | | | | | | | | | | | | | | | | | | | | | | |
| 2.5 | Improve clonal seed orchards of *Melia volkensii* | | | | | | | | | | | | | | | | | | | | | | | |
| 2.6 | Establish seedling seed stand of *Acacia tortilis* | | | | | | | | | | | | | | | | | | | | | | Mr. Machua and Mr. Omondi | |
| 2.6.1 | Collect seeds of candidate plus tree of *Acasia tortilis* | | | | | | | | | | | | | | | | | | | | | | | |
| 2.6.2 | Propagate seedling from the collected seeds | | | | | | | | | | | | | | | | | | | | | | | |
| 2.6.3 | Prepare the seedling seed stand | | | | | | | | | | | | | | | | | | | | | | | |
| 2.6.4 | Establish the seedling seed stand | | | | | | | | | | | | | | | | | | | | | | | |
| 3 Supply chain of Quality seed and seedling | | | | | | | | | | | | | | | | | | | | | | Seed Research TSP | Mr. Bernard Kamondo | Chief Advisor |
| 3.1 | Market research | | | | | | | | | | | | | | | | | | | | | | | |
| 3.2 | Production and distribution guideline | | | | | | | | | | | | | | | | | | | | | | | |
| 3.3 | Pilot distribution | | | | | | | | | | | | | | | | | | | | | | | |
| 3.4 | Revice and finalize seed distribution guideline | | | | | | | | | | | | | | | | | | | | | | | |
| 4 Extention of quality seed distribution system | | | | | | | | | | | | | | | | | | | | | | DFP | Mr. Giathi (Kitui) Mr. Muchiri (Kibwezi) | Chief Advisor |
| 4.1 | Establish Demonstration forest | | | | | | | | | | | | | | | | | | | | | | Mr. Giathi (Kitui) Mr. Muchiri (Kibwezi) | |
| 4.2 | Training material | | | | | | | | | | | | | | | | | | | | | | | |
| 4.3 | Seminer for stakeholders and NGOs | | | | | | | | | | | | | | | | | | | | | | | |
| 4.4 | Brouchure | | | | | | | | | | | | | | | | | | | | | | | |
| 4.5 | Third country training | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |

**MINISTRY OF ENVIRONMENT, WATER AND NATURAL RESOURCES**
**State Department of Environment and Natural Resources**


**Telegrams:** **"NATURE", Nairobi**
**Telephone:** **254-20- 2730808**
**Fax:** **254-20- 2734722**
**Email:** **psoffice@environment.go.ke**

**N.H.I.F BUILDING**
**RAGATI ROAD**
**P.O.BOX 30126-00100**
**NAIROBI**


Ref: DENR/EMC/35

5th February, 2014

**Mr. Yuzuru Kimura**
Director of International Cooperation
Forest Tree Breeding Centre
**NAIROBI**

Dear Kimura,

**RE: INVITATION TO THE THIRD JOINT CO-ORDINATING COMMITTEE(JCC) MEETING FOR KEFRI/JICA PROJECT ON DEVELOPMENT OF DROUGHT TOLERANT TREES FOR ADAPTATION TO CLIMATE CHANGE IN DRYLANDS OF KENYA ON 12TH FEBRUARY, 9.00 A.M AT KITUI REGIONAL RESEARCH CENTRE**

The 3rd meeting of the Joint Co-ordinating Committee (JCC) for KEFRI.JICA Project on development of Drought tolerant trees for adaptation to Climate Change in Dry lands of Kenya will take place on 12th February, 2014 at 9 a.m at Kitui Regional Research Centre.

The Agenda will be:

1. Opening remarks by the Principal Secretary of Environment, Water & Natural Resources and Director KEFRI,
2. Brief from Mr. Hideo Eguchi, Chief Representative JICA Kenya Office,
3. Presentation by Dr. Muturi, Dr. Kondo and Mr. Ozawa,
4. Questions and answers,
5. Any other Business.

The purpose of this letter is to invite you in the meeting. Please observe punctuality.

Yours faithfully,

**RICHARD L. LESIYAMPE, (PhD), MBS**
**PRINCIPAL SECRETARY**

Ministry of Environment, Water and Natural Resources | Kenya Forestry Research Institute | Japan International Cooperation Agency

**MINISTRY OF WATER, ENVIRONMENT AND NATURAL RESOURCES (MWENR)**

**KENYA FORESTRY RESEARCH INSTITUTE (KEFRI)**

**AND**

**JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)**

MINUTES OF MEETING

OF

2ND JOINT COORDINATING COMMITTEE (2ND JCC)

ON

THE PROJECT ON DEVELOPMENT OF DROUGHT TOLERANT TREES

FOR

ADAPTATION TO CLIMATE CHANGE IN THE DRYLANDS

OF KENYA

HELD ON TUESDAY, 12TH FEBRUARY, 2013

AT

THE MINISTRY OF **WATER, ENVIRONMENT AND NATURAL RESOURCES**

TELEPOSTA TOWERS - NAIROBI

Signed: JANUARY 2014

**MINISTRY OF WATER, ENVIRONMENT AND NATURAL RESOURCES (MWENR)**

**KENYA FORESTRY RESEARCH INSTITUTE (KEFRI)**

**AND**

**JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)**

MINUTES OF MEETING (M/M)

OF

2ND JOINT COORDINATING COMMITTEE (2ND JCC)

THESE MINUTES OF MEETING OF 2ND JOINT COORDINATING COMMITTEE (2ND JCC) ON THE PROJECT ON DEVELOPMENT OF DROUGHT TOLERANT TREES FOR ADAPTATION TO CLIMATE CHANGE IN THE DRYLANDS OF KENYA ("Project") is made on the 12th day of February two thousand and thirteen. The Ministry of Water, Environment and Natural Resources (MWENR), and the Kenya Forestry Research Institute (KEFRI) which expression shall, where the contents so admits include its successors and assignees on one hand and the Japan International Cooperation Agency (JICA) on the other hand which expression so admits include its successors and assignees.

**WHEREAS,**

The conclusion and the direction of the project for the coming four years are summarized in four themes as below.

First in order to strengthen KEFRI's capacity for conducting research on genetic diversity of indigenous tree species (*Melia volkensii* and *Acacia tortilis* as pioneer trials) the following actions shall be taken:

- Capacity training for KEFRI staff in diversity studies of indigenous tree species

- Development of DNA markers for *Melia volkensii* and *Acacia tortilis*
- Genotyping of *Melia volkensii* and *Acacia tortilis* Plus trees
- Conducting research on genetic diversity of *Melia volkensii* and *Acacia tortilis*.

Secondly in order to strengthen KEFRI's capacity for implementing forest tree breeding of indigenous species (*Melia volkensii* and *Acacia tortilis* as pioneer trials) the following actions shall be taken concurrently with the first actions:

- Selection of of *Melia volkensii* and *Acacia tortilis* Plus trees;
- Establishment of *Melia volkensii* and *Acacia tortilis* seed orchards
- Selection of superior clones.

Thirdly in order to establish quality seed and seedling supply system for *Melia vokensii* the following actions shall be taken;

- Development of guideline for securing quality seed and seedling production, and distribution.
- Piloting the production and distribution guideline
- Revising and finalizing the seed production and distribution guideline

Lastly in order to create and raise awareness of relevant stakeholders on the importance of using quality seed and seedlings the following actions shall be taken;

- At least two project awareness events (seminars, workshops, trainings) shall be held annually.

M of F &W, KEFRI and JICA recognizing the conclusion and direction of the above project now come to the understanding on collaboration arrangement for support through this Minutes of Meeting

SIGNED AT NAIROBI BY THE DULY AUTHORIZED REPRESENTATIVES OF THE PARTIES ON THE DAY AND YEAR AS WRITTEN ABOVE

| | |
|---|---|
| **Dr Richard L. Lesiyampe, MBS** | **Mr. Hideo EGUCHI** |
| Principal Secretary | Chief Representative |
| State Department of Environment and Natural Resources | JICA Kenya Office |
| **Dr Ben Chikamai** | **Mr. Makoto OZAWA** |
| Director | Chief Advisor |
| Kenya Forestry Research Institute | JICA project Team |

# THE ATTACHED DOCUMENT ON 2ND JCC MEETING

AGENDA

1. Opening remarks by the Permanent Secretary Ministry of Forestry and Wildlife and Director KEFRI
2. Brief from Chief Representative of JICA Kenya Office
3. Presentation by Dr. Muturi, Mr. Kimura and Mr. Ozawa
4. Questions and answers
5. AOB

**MIN 1: Opening remarks by the Permanent Secretary (PS) Representative Mr Gideon Gathaara and remarks by the Director, KEFRI**

The meeting started with self-introduction of those in attendance. Minutes of the last meeting were reviewed and adopted

Mr Gathaara welcomed the participants on behalf of the PS and gave a commitment of the Government of Kenya in support of the Project. He also appraised members on new developments in the Ministry

The Director, KEFRI observed that he had visited the two project sites in Kitui and Kibwezi and was impressed by the progress and also appreciated the inputs from JICA, KEFRI and the Ministry in implementing the project. The Director observed that since the project started after commencement of the financial year, it had not been factored sufficient funds in the budget. However, KEFRI sourced funds internally to support the project in addition to commitments made by JICA to support the project to the end of financial year. The Director assured the meeting that the project would fully factor required funds in the 2013/2014 KEFRI budget.

**MIN 2: Brief from Chief JICA Representative in Kenya**

Ms Meri Fukai, on behalf of JICA apologized for the absence of Mr. Eguchi and gave the following comments on his behalf.

- 5 years is short in terms of forestry and there is therefore need to strictly follow the project plan.

- Materials and equipment acquired from the Grant Aid for the Forest Conservation Programme has already arrived and should be used to support the project.

- Long-term sustainability of the project is important after end of the project period. Hence, the training of personnel in Japan aims for long term sustainability as it builds institutional capacity to help sustain the project. By the same token, a sufficient number of staff should be allocated for the project work.

- ASALs have been neglected for a long time but this has changed with the recent launch of ASAL policy by the government thereby recognizing their importance in economic development. The current project therefore can contribute to ASALs development and there is need to use the project outputs for the benefit of farmers through involvement of the Ministry of Agriculture and KFS extension service as well as other relevant stakeholders.

She thanked KEFRI and other stakeholders for their commitment to the project.

Comments

- Mr Gathaara concurred with the above comments agreeing that extension services should be fully involved.

- The Director KEFRI gave assurance that KEFRI will make good use of the Grant Aid equipment in the project. He also gave KEFRI's approach of attracting and retaining staff through provision of better working conditions which will help retain knowledge gained in the project.

**MIN 3: Project presentation (KEFRI, JICA and FTBC) by Dr Muturi, Mr Ozawa and Mr Kimura)**

The presentation was a joint effort by Kenyan and Japanese project teams working in the project. The team highlighted the project achievements as follows:

**(a) Determine genetic diversity of *Melia volkensii* and *Acacia tortilis* populations (Molecular work):**

- Good progress had been reported by the molecular work team and it was reported that this involved sampling of leaves and developing markers that would identify specific clones.
- 15 microsatellite markers were developed and screened in *Melia*.
- 154 microsatellite markers were developed in *Acacia*.
- Analysis on genotypes of collected samples was still in progress

- A sequencer had been received by KEFRI and training for the use of the machine arranged
- On delineation of *Melia volkensii* and *Acacia tortilis* populations, 240 *Melia* and 120 *Acacia* populations were mapped
-

**(b) On tree breeding:**

- There has been good progress reported in establishment of *Melia* clonal seed orchards where 1800 grafted seedlings were planted in Tiva and 1300 in Kibwezi orchard. About 500 seedlings were not planted Kibwezi due to shortfall of grafts but this would be done in 2013/14 financial year.
- The main challenge in the nursery was outbreak of nematodes but this was solved through fumigation. Spider mites were constant challenge but this was solved through use of pesticides.
- Selection of plus trees has been done and selection of remaining trees scheduled for 2013/14 targeting the drier areas.
- Full site preparation was done for planting of the orchards in order to increase survival rate. Establishment is about 90% while anything above 75% is considered as exceptionally successful for drylands.

**(c) On Development of physiological criteria:**

This component is crucial for development of criteria for drought tolerance indices. Drought tolerance is being evaluated through study of deciduousness, leaf characteristics such as stomatal conductance, osmotic pressure and growth responses of clones.

- A dendrometer is being used for automatic data collection on growth
- Leaves sampled from inferior and superior clones to determine variation in leaf area
- Seeds were collected from superior and inferior clones to test drought tolerance variation in ½ sib seedlings

**(d) On extension component**

There has been no activity in this component as research is still ongoing. According to the project document, there will be a market research/survey on seedlings and products in the next few months. Only preliminary discussions have been done so far to establish a basis for the studies which would also involve the Kenya Forest Service.

**PLAN FOR YEAR 2:**

**DNA Analysis:**

- To continue collection of specimen and geographical information targeting 3 *Melia* and 8 Acacia sub-groups and compile the gathered information on the distribution of both species
- To continue developing screen markers of *Melia* and *Acacia*
- To develop markers which will be used for screening of clones.
  *Action: Molecular (DNA) work team*

**Tree breeding**

The plan for the second term is as follows:

- Selection of 20 additional plus trees of *Melia*
- Collect *Melia* scions, graft and plant additional 600 seedlings in Tiva and 1100 seedlings in Kibwezi orchards
- Selection of progeny test sites in 3 regions (Kitui, Kibwezi, Embu), 3 sites per region
- Selection of supplementary Progeny Test site in 3 regions (Tseikuru, Mutha, Mwatate)
- Selection of *Acacia* plus trees and preparation for seedling seed stands
  *Action: Tree breeding team*

**Development of drought tolerance indices**

- Preliminary study to assess variation of water stress response in 5 species through leaf fall and growth was initiated at Kitui Nursery.
- Upon procurement of equipment through Grant Aid, e.g. LiCOr physiological studies focusing on stomatal variables will commence
- Upon procurement of requisite plant physiology equipment, plant-soil water relations studies will be undertaken.

*Action: Physiology team*

**Extension** - Activity 3 (Supply chain of quality seed and seedling)

- A Market research survey will be conducted in 2013 through interviews/questionnaire to understand market needs. Analysis of collected data/information will be done.
- Developing production/distribution guidelines will commence through compilation of a tentative guideline

**Extension** - Activity 4 (Extension of quality seed distribution system)

- Preparation of training materials and discussion on the structure and contents

*Action: Extension team*

**Director of International Cooperation, FTBC – Mr Y. Kimura**

- Expressed gratitude for the hard work so far done in the project
- Reported that capacity building in Japan has been arranged for 2012/13 and training will be in June and July 2013 targeting a total of 8 KEFRI staff (2 for DNA; 2 for tree breeding theory and 2 for drought tolerance and 2 for propagation) with a cumulative total of 230 days.
- Experts dispatch: A total of 14 experts were dispatched in 2012 and 18 will be dispatched to Kenya in 2013.
  *Action: CA/JICA and PM*

**MIN 4: Questions and answers**

Q: Director KEFRI: Raised an issue on closeness of clones and whether there is a good foundation of the orchard for future planting

A: The PM responded that there is adequate diversity of clones being used in the project and the 30 trees per clone were as per the recommended standards for a seed orchards' establishment.

Q: Ministry of Forestry representative hoped that the project will contribute to realization of 10% forest cover in the country. He also asked if it is possible for members of JCC to go to the project sites to see the progress achieved so far. He also suggested also that carbon trading could be introduced in the intended planting regions in future as part of the project

A: The Chief Advisor and Project Manager concurred and agreed with the proposal to have the next meeting in the project sites. Therefore the next JCC would be held in Kitui so that members can visit Tiva Orchard.

During this session, the PS arrived for the meeting and after introductions, made his remarks as follows:

- Noted that the research being done on drought tolerance is very important and was long overdue
- On behalf of the Ministry of Forestry and Wildlife, he thanked JICA for the crucial inputs in the project while noting that there is a high level of destruction of forests because of high demand for tree products and other benefits. There is, therefore, a need for new fast growing tree varieties to meet the demand and also for investments
- Focus should be on planting of trees rather than use of natural forest resources

**MIN 5: AOB**

- MEMR representative (L. Kamande) commented that the project is timely especially in view of climate change and that there should be mainstreaming through the ministry of planning
- Mr Machua (KEFRI) was concerned that there were huddles in terms of clearance of the project equipment (duty exemption issues)
    - The PS agreed and said that documentation needs to be done early in order to avoid any future delays. He promised quick intervention whenever Ministerial contribution was required
- Ms Fukai applauded the collaboration that has led to success of the project
- Mr Kimura, informed the meeting that there is an existing Memorandum of Agreement between KEFRI and FFPRI-Japan that was signed in 2009 and is impressed by the achievements
- Ozawa: Appreciated project outputs and asked for more support from members

The meeting ended at 1.30 PM

***LIST OF PARTICIPANTS ON ON 1ST JCC MEETING***

| No | Name | Designation/Institution | Station | Email |
|---|---|---|---|---|
| 1 | Mr. Gideon Gathaara | Conservation Secretary MoF&W | Teleposta | gideongathara@yahoo.com |
| 2 | Mr. Ephraim Muchiri | Deputy Director, Forest Conservation MoF&W | Teleposta | |
| 3 | Dr. Ben Chikamai | Director KEFRI | KEFRI Muguga | director@kefri.org |
| 4 | Dr. Gabriel Muturi | Project manager KEFRI | KEFRI Muguga | gabrielmukuria2012@gmail.com |
| 5 | Mr. Jason Kariuki | Assistant project manager | KEFRI Muguga | kariukijason@yahoo.com |
| 6 | Mr. Joseph | Assistant Project | KEFRI | machuaj@yahoo.com |

| | | | | |
|---|---|---|---|---|
| | Machua | Manager | Muguga | |
| 7 | Dr. James Ndufa | Field Manager | KEFRI Kitui | jkndufa@yahoo.com |
| 8 | Mr. Makoto Ozawa | Chief Advisor, JICA | KEFRI Muguga | kj-forestry1@hotmail.co.jp |
| 9 | Mr. Masaki Narumi | Project Coordinator, JICA | KEFRI Muguga | kj-forestry2@hotmail.co.jp |
| 10 | Ms Meri Fukai | Project Formulation Advisor | JICA Kenya | Fukai.Meri@jica.go.jp |
| 11 | Ms Emma Wairegi | Administrative Assistant | JICA Kenya | WairegiEmma.KY@jica.go.jp |
| 12 | Mr. Yuzuru Kimura | Director of International Cooperation -FTBC | FFPRI | -- |
| 13 | Dr. Hisaya Miyashita | Senior Researcher - FTBC | FFPRI | hmiyasi@affrc.go.jp |
| 14 | Mr. Robert Gatonga | Economist, MoF Kenya | Treasury | rwgatonga@gmail.com |
| 15 | Eng. Wafula Mutoro | Ministry of Agriculture | MOA, Kenya | wafulamutoro@ymail.com |
| 16 | Ms Lucy Kamande | P.N.R.S | MENR/CCS | lkmumbi@ymai.com |
| 17 | Mr. Hyslop P. Ipu | Permanent Secretary, MoF&W | MoF&W | |