Appendix 4-5 Achievement of short term expert in 2016

Appendix 4-5-1 Report of short term expert(Project management)

Expertise	Name	Term
Project Management	Dr. Masatoshi Ubukata Mr. Shizuo Kamizore	28 May～5 Jun. 2016

1. Itinerary

Date	Activity
28 May	Hitachi to Haneda
29 May	Arrive at Nairobi Move to Kibwezi
30 May	Observation of Kasigau Progeny test site(PTS) and Voi sub-PTS Observation of Kibwezi Seed orchard and PTSs
31 May	Observation of Ikituki sub-PTS, Move to Kitui Observation of Kitui Seed orchard and PTSs and Makima Sub-PTS Move to Embu
1 Jun.	Observation of Marimanthi PTSs and sub- PTS Move to Kitui
2 Jun.	Meeting with Project manager and Director of KEFRI Kitui centre Move to Nairobi Report to JICA Kenya office and Embassy of Japan
3 Jun.	Making report Move to airport and depart to Dubai
4 Jun.	Dubai to Haneda
5 Jun.	Haneda to Hitachi

2. Result of major activities

- Melia Seed Orchard

  Tiva and Kibwezi seed orchards have been managed well by KEFRI staff. Melia in Tiva which was done with stem and branches cut kept good shape for producing fruits. Stem cut and branch pruning should be carried out to keep good condition for seed production in Tiva seed orchard. Some clones are observed for higher production of seed in Kibwezi seed orchard.

- Acacia Seed Stand

  Acacia seed stands have been established in Tiva and Kibwezi. They were planted on Dec.

2015 and Apr. 2016 as separating for two times. All trees are needed to be supported with poles to growth straight up.

- Progeny test sites of Melia

  We observed all Progeny test sites in this trip. It is very important to survey all test sites at one time so that all sites can be compared on the same situation.

  All PTSs are managed well and almost trees have grown satisfactory. It is found that some trees planted in 2014 in Kibwezi have less growth, which can be seen in the restricted area. Soil condition in the area could cause the situation.

  All PTSs expected in the project have been established as the plan and the base of tree breeding research has just established through much efforts of Japanese experts and C/P. It is expected to collect and analyze the data from all PTSs appropriately.

- Meeting at JICA Kenya office

  Dr. Ubukata explained that the Project has progressed steadily and got some excellent results on Melia tree breeding. It is a big result that all PTSs have been established and the survey conducted by C/P has just started. Dr. Ubukata also suggested that development of the next generation and a cutting technique of Melia for propagation should be important for a basic matter of tree breeding technology to make it sustainable.

- Courtesy call to Embassy of Japan in Kenya

  Dr. Ubukata explained that all activities of the project have progressed well. Mr. Mori, minister of the embassy, suggested that a striking “profitable” project should be established to contribute climate change, forest conservation and industry promotion in Kenya.

Location map of Seed Orchards, Seed stands and all progeny test sites

Photo

1.Kasigau Melia PTS (planted 2014)

2. Kasigau Melia PTS (planted 2015)

3. Kasigau Melia PTS

4. Voi Sub-PTS (planted 2015)

5.Kibwezi Melia Seed Orchard

6.Kibwezi Acacia Seed Stand (planted 2015)

7.Survey of Acacia Seed Stand (planed 2016)

8.Kibwezi Melia PTS (planted 2014)

9.Kibwezi Melia PTS (planted 2015)

10.Ikituki Sub-PTS (planted 2015)

11.Kitui Melia Seed Orchard

12.Stem and blanches cut tree in Kitui Seed Orchard

13.Kitui Acacia Seed Stand
(planted 2015)

14.Kitui Acacia Seed Stand
(planted 2016)

15.Kitui Acacia Seed Stand
(Left : planted 2015, Right : 2016)

16.Kitui Melia PTS (planted 2014)

17.Kitui Melia PTS (planted 2015)

18.Makima Sub-PTS (planted 2015)
Agrofortestry with beans

19.Marimanthi Melia PTS (planted 2014)

20. Marimanthi Melia PTS (planted 2015)
Soil erosion caused by heavy rain

21.Marimanthi Melia PTS (planted 20154)

22. Marimanthi Melia PTS (planted 2016)
Soil erosion caused by heavy rain

23.Marimanthi Sub-PTS (planted 2015)

24.Marimanthi Sub-PTS (planted 2015)
Slow growing tree

25.Study on cutting of Melia
(cutting on Feb. 2016)

26.Study on cutting of Melia
Rooting seedling (same seedling to left photo)

27.Glass green house
(close to KEFRI Kitui centre nursery)

Appendix 4-5-2 Report of short term expert (Drought Tolerant)

Expertise	Name	Term
Drought Tolerant	Dr. Kotaro Sakuta Dr. Eiji Goto	22 Jul.～29 Jul. 2016

1. Schedule

22 Jul. Depart from Fukuoka
23 Jul. Arrive at Nairobi and move to Kibwezi へ移動
24 Jul. Observation of PTSs in Kibwezi
Move to Kitui
25 Jul. Maintenance of a gas exchange measure machine
26 Jul. Observation of PTS in Tiva
Measurement of samples for gas exchange
27 Jul. Measurement of samples for gas exchange
28 Jul. Move to Nairobi and depart from Nairobi airport
29 Jul. Arrive at Fukuoka

2. Activity and result

I. Visiting a progeny forest

We visited a progeny forest of *Melia volkensii* and a scion garden of A*cacia tortilis* in Kibwezi. On the progeny forest of *M. volkensii*, we discussed about a correlation between the season of falling leaves and plant biomass production among lines with local staff. On the scion garden of *A. tortilis*, we found an infection of mite and thus gave a direction of the dispersion of insecticides.

Photo 1 Observation of PTS in Kibwezi

II. Maintenance of a Li-6400

In this project, an open gas exchange measuring system (Li-6400: LI-COR, Lincoln, NE, USA) is used for photosynthetic measurement. We had taught two counterparts to use the system. However, a piece of machinery was out of order. Thus, we taught about the way of maintenance of the Li-6400.

III. Measurement of photosynthetic activity

To investigate a correlation between photosynthetic activity and tree growth on *M. volkensii*, photosynthetic activity of three superior lines (No.18, No.29 and No.59) and an inferior line (No. 39) in progeny forest were measured. First, we tried the measurement with their cuttings. But cutting was unsuitable for the measurement because photosynthetic activity of their leaves dramatically declined within few minutes. Second, we tried the measurement of light-saturation curve with seedlings. When using with 1-month-old seedlings, No.59 line showed higher photosynthetic activity than any other lines. However, it was necessary to repeat the measurement. Thus we asked counterparts to do a further analysis with same sample sets.

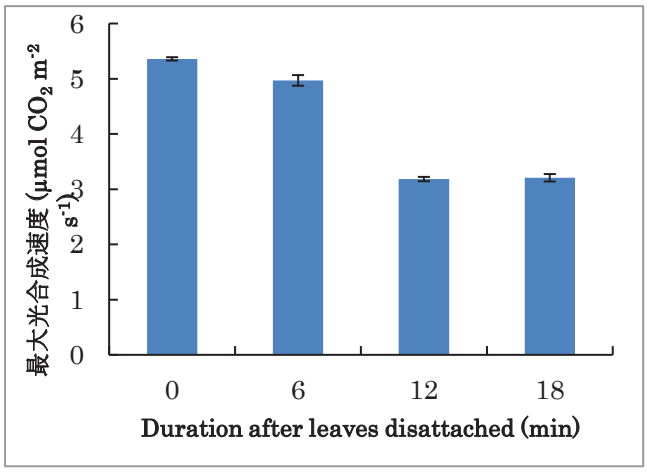


Fig.1 Photosynthesis speed on leaves irradiated with light 1200 μmol m^{-2} s^{-1}

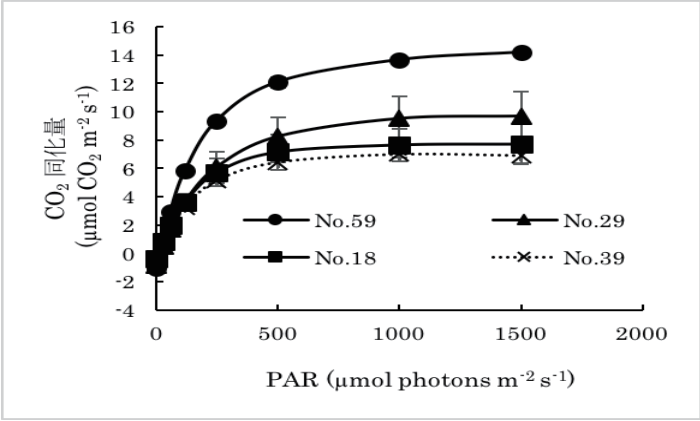


Fig. 2 Photosynthesis speed of seedlings

Appendix 4-5-3 Report of short term expert (Drought Tolerant)

Expertise	Name	Term
Drought Tolerant	Dr. Koichiro Gyokusen	30 Aug.～11 Sep. 2016

1. Schedule

	AM	PM	Accommodation
08.30 (Tue.)		20:00 JAL330 Fukuoka-Haneda 21:40	
08.31 (Wed.)	00:30 EK313 Departure (TOKYO/HANEDA)	14:45 EK719 Arrival (NAIROBI)	Kitui
09.01 (Thr.)	move to Kibwezi	Download of the weather data in Kibwezi	kibwezi
09.02 (Fri.)	Chlorophyll measurement in Kibwezi	Download of weather data in Kasigau and voi	Voi
09.03 (Sat.)	Download of weather data in Ikutuki	Download ofweather data in Makima	Embu
09.04 (Sun.)	Download of weather data in Marimanti	Download of weather data in Gaciongo	Kitui
09.05(Mon.)	Download of the weather data in Tiva	Download of automatic camera data	Kitui
09.06 (Tue.)	Meassurement of stem chlorophyll inTiva	Maintenance of autokamera and installation of them	Kitui
09.07 (Wed.)	Meassurement of chlorophyll in Tiva	Data analysisi	Kitui
09.08 (Thr.)	Data analysis	Meassurement of water potentioa in Kitui center	Kitui
09.09 (Fri.)	Data analysis	Wrap-up meeting with Dr. Muturi, Dr.Ndufa, Mr. Muchiri and Mrs. Mushoki	Kitui
09.10(Sat.)	Travel to Nairobi (3hours)	16:40 EK720 Nairobi-Dubai 22:40	
09.11 (Sun.)	3:00 EK316 Dubai-Osaka 17:10	19:35 NH1709 Osaka-Fukuoka 20:45	

2. Activities and results

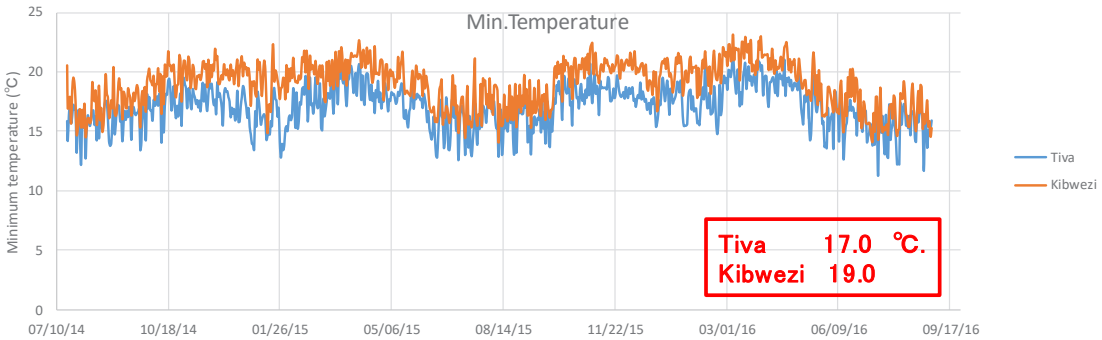
2.1. Weather conditions at Tiva and Kibwezi seed orchard

[Activities]

Weather data collection in Tuva and Kibwezi seed orchards.

[Results]

- Weather data from Jul. 14, 2014 to Sep. 1, 2016 in Tiva and Kibwezi seed orchard were compared. The average minimum temperature over all period in Tiva and Kibwezi were 17.0℃ and 19.0℃, and the maximum temperature were 29.8℃ and 31.9℃, and average temperature were 22.4℃ and 24.7℃, respectively (fig.1). The fluctuation of temperature in 2016 was larger than that of 2015, and the minimum humidity was always lower in Kibwezi compared with Tiva (fig.2). The precipitation over all period in Tiva and KIbwezi were 1117mm and 719mm, respectively. The precipitation of Kibwezi was 64% of that of Tiva, and precipitation of 2016 was lower than that of 2016.
- Seasonal changes of soil water potential at Tiva and Kibwezi from 2014 to 2016 were shown in fig. 3, 4. The soil water potential has synchronized to the pattern of precipitation. The soil water potential of 100cm depth had decreased from 2014 to 2017 in Tiva, and that of Kibwezi had decreased, too. This result shows that the drying of soil has been in progress for these three years.
- The changes of stem growth and precipitation were shown in fig.5. Each data of stem growth was expressed as an average of twenty individual trees. The stem growth started at the beginning of rain season, and stopped during the dry season. Two times of growth period were observed at Tiva, and one time of growth period was observed at Kibwezi. The cause of growth difference between the two sites seems to be the pattern of precipitation. There were little precipitation in Kibwezi during the rain season from March to April of 2016. The stem growth duration in Tiva was longer than that of Kibwezi because of the moderate water condition in Tiva.



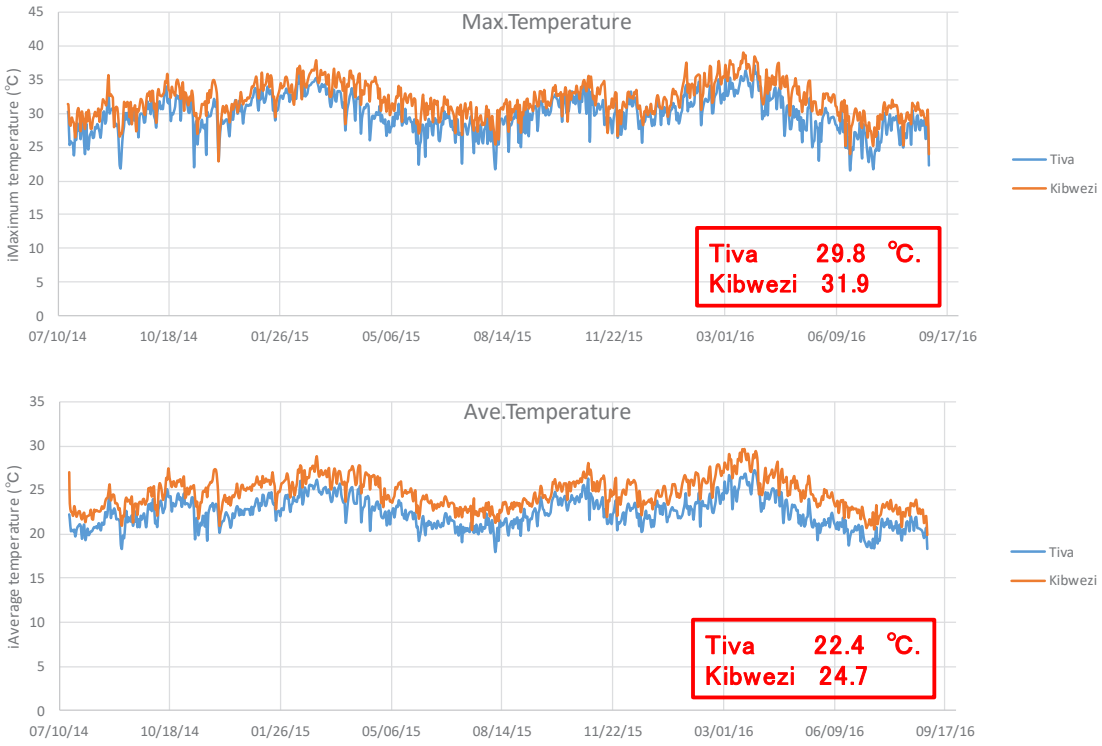


Fig.1 The changes of average, maximum, and minimum temperature in Tiva and Kibwezi for three year from 2014 to 2016.

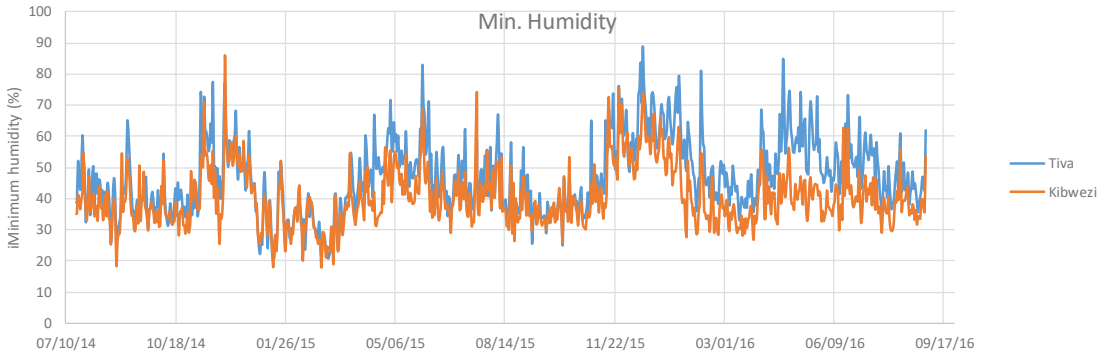


Fig.2 The change of minimum humidity for three years from 2014 to 2016.

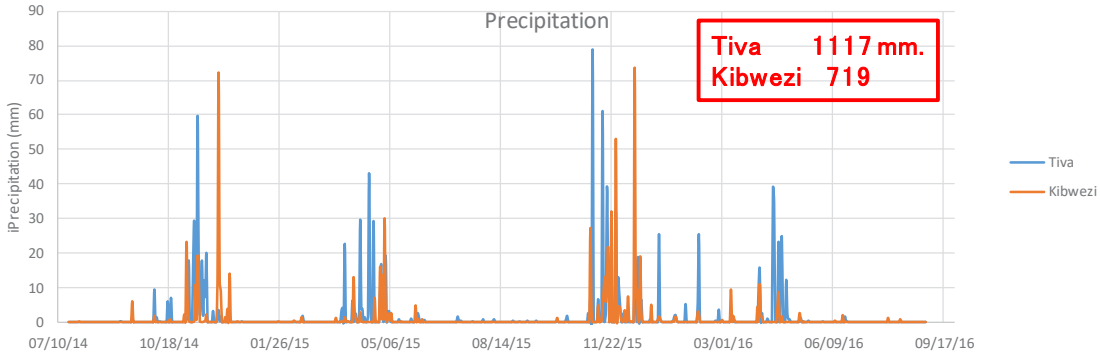


Fig.3 The change of precipitation in Tiva and Kibwezi for three years from 2014 to 2015.

Fig.4 The changes of precipitation and soil water potential in Tiva and Kibwezi (Upper figures were shown in Tiva and lower figures were in Kibwezi).

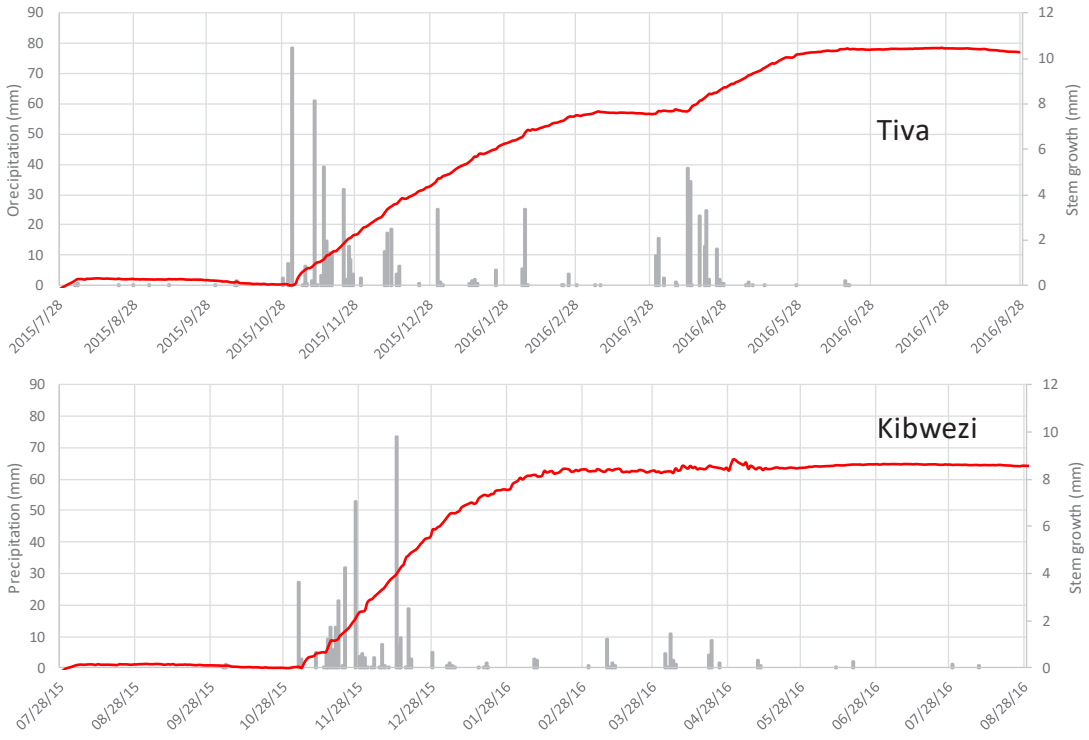


Fig.5 The changes of precipitation and stem growth in Tiva and Kibwezi.

2.2. Weather conditions in progeny sites

[Activities]

The weather data of two progeny sites in Kasigau and Marimanti, and four sites of subsite in Voi, Yikutuki, Makima, Gatiogo were collected and analyzed.

[Results]

The weather conditions in Kasigau and Marimanti were shown in fig.6-1 and fig.6-2. The average air temperature and precipitation in Kasigau were 25.9℃ and 455mm, and those of in Marimanti were 27.9℃ and 1198mm, respectively. Both of air temperature and precipitation were higher in Marimanti, and differences between the two sites were 2℃ in air temperature and 2.6times in precipitation. The water potential in Marimanti was higher than that of Kasigau. The result shows that the water condition of Marimanti was better than that of Kasigau. The leaf conditions in both sites were shown in fig.7. There were a lot of leaves on the crown in Marimanti but no leaves in Kasigau. The differences of leaf condition seem to be depended on the soil water conditions.

The air temperature and humidity data of progeny sites and subsites were shown in fig.8-1 と fig.8-2. The average air temperatures of Kasigau, Voi, Ikutuki, Makima, Marimanti, and Gatiogo were 25.5℃, 25.1℃, 23.8℃, 23.0℃, 27.9, and 26.9℃, respectively.

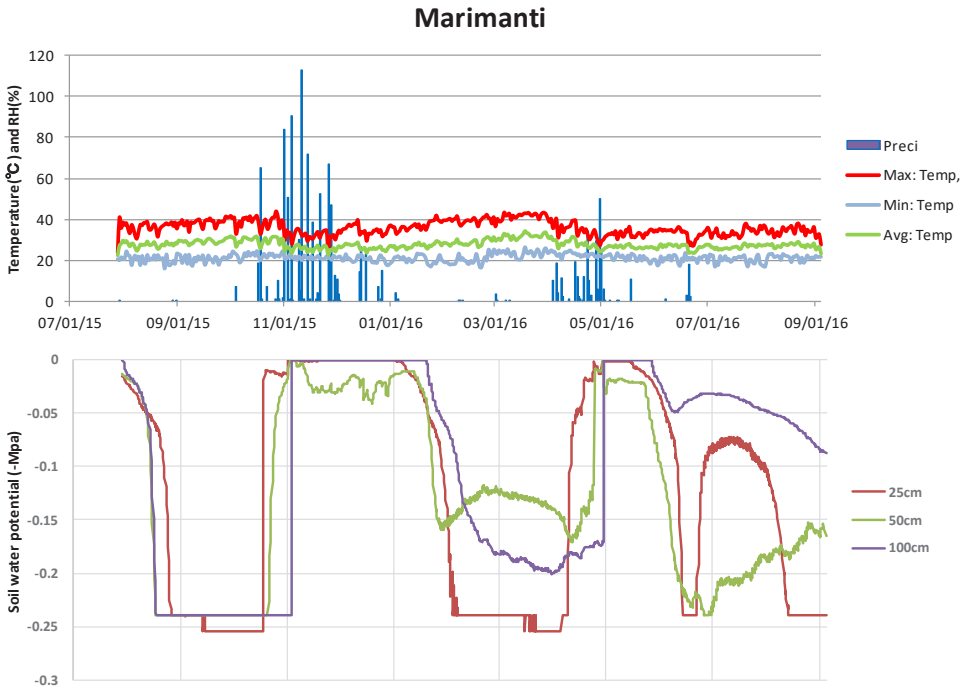


Fig.6-1 The weather data in Marimanti.

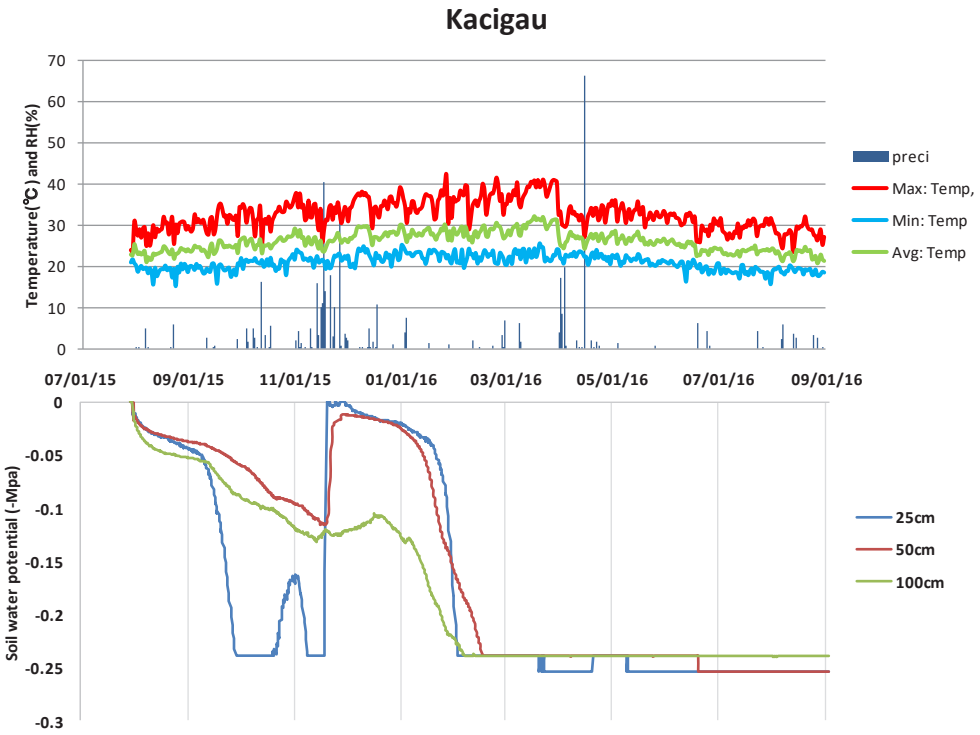


Fig.6-2 The weather data in Kacigau.

Fig.7 Photos of Kasigau and Marimanti after two years of planting.

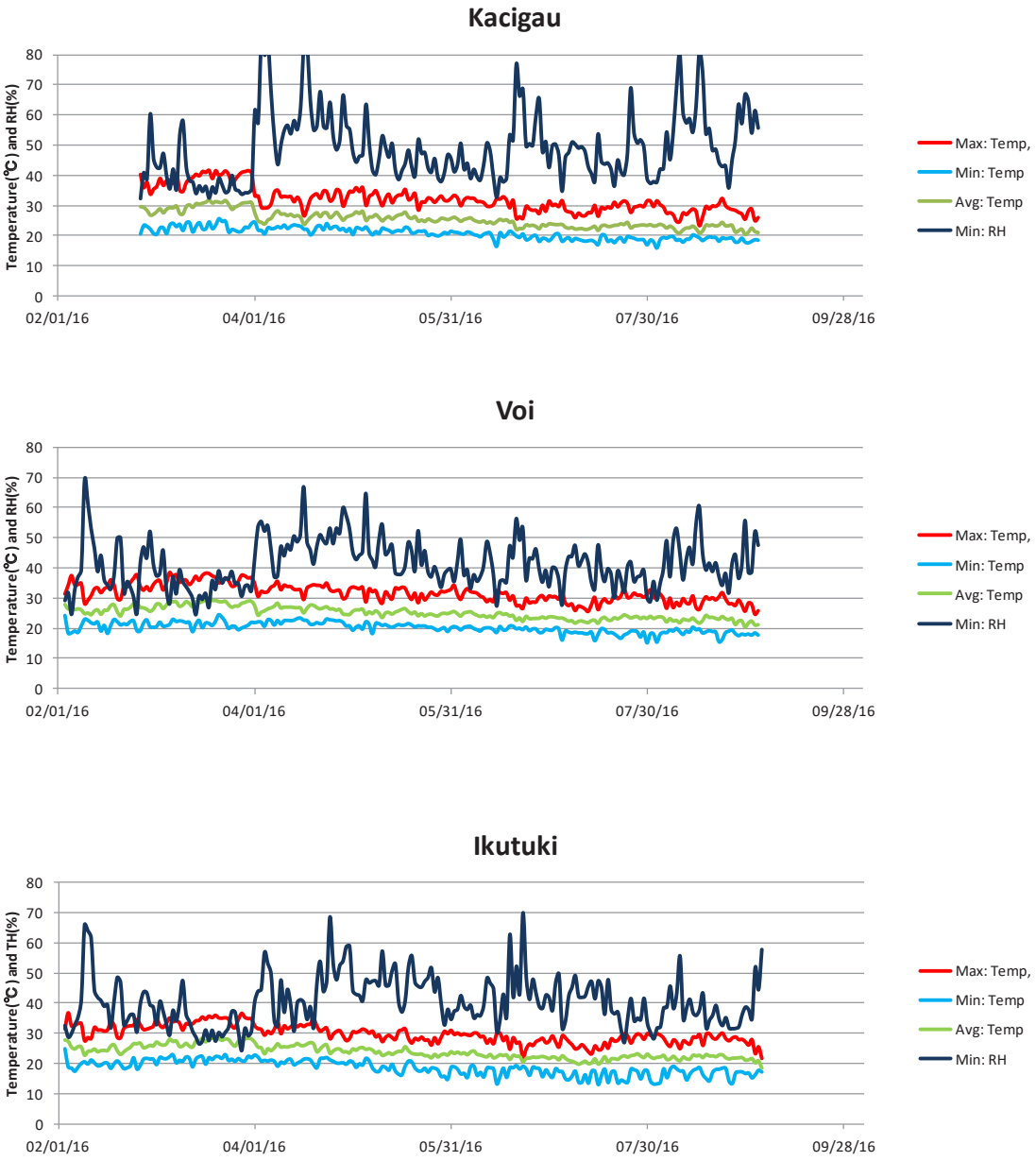


Fig.8-1 Changes of temperature and humidity.

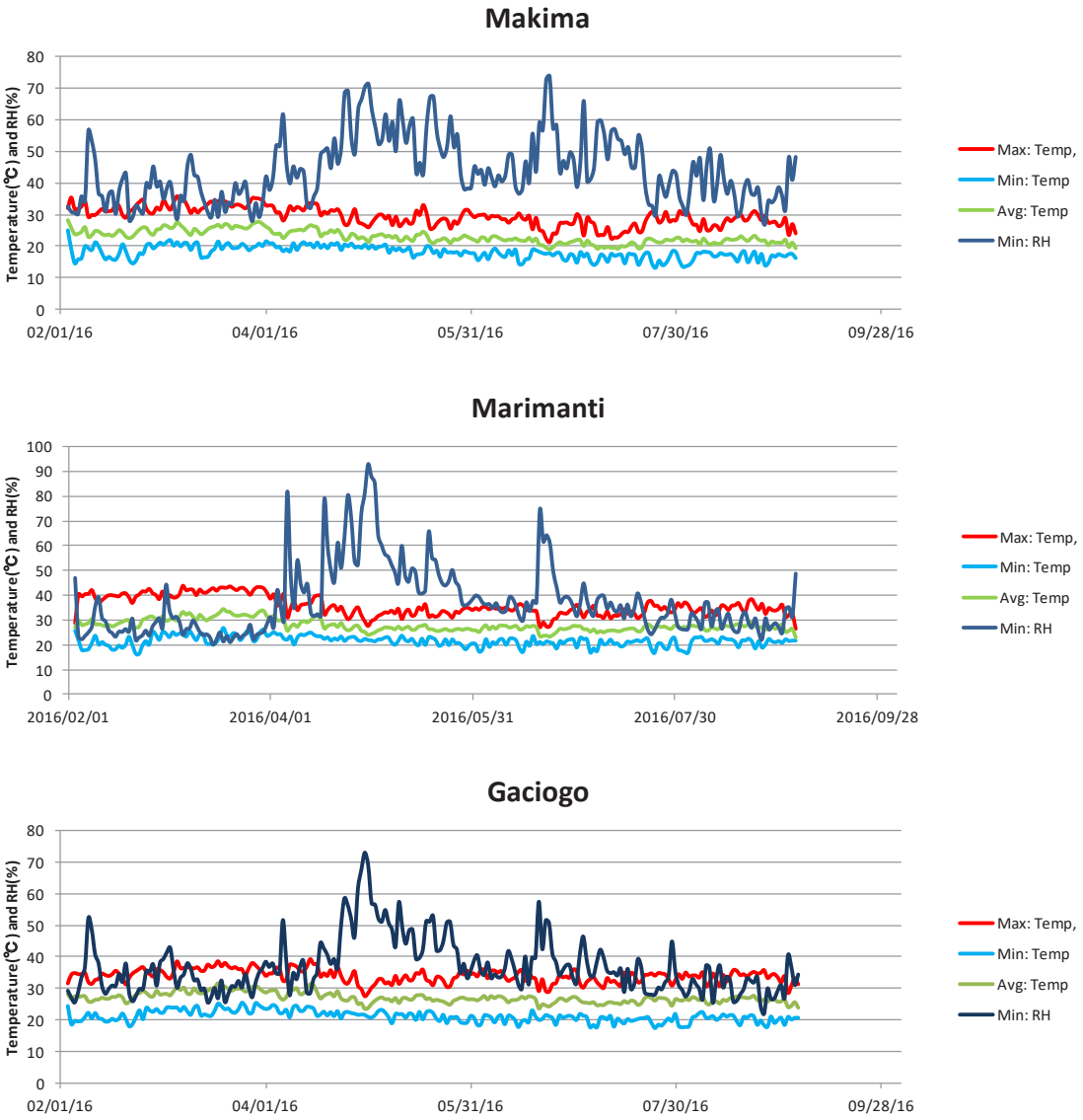


Fig.8-2 Changes of temperature and humidity.

2.3. The comparison of stem growth among Melia clones.

[Activities]

The stem growth of Melia volkenssi was measured using dendrometer method from Jul. 2015 to Aug. 2016 in Tiva and Kibwezi seed orchard to reveal the growth characteristics of fast growth and slow growth clones. The clone of fast growth were no.18,29,40,49 and those of slow growth were no.31,39.54. Stem growth at 80cm height of stem was measured by dendrometer (1µm resolution type), and three individual trees were used for one clone.

[Results]

The change of stem growth at Tiva and Kibwezi orchard was shown in fig.9. The data in fig.9 expressed an average of three individual trees. Two times of growth period were observed in Tiva, and the growth of fast growth clone was larger than that of slow growth clone. There were two remarkable characteristics to fast growth clones, namely, long growth period and large growth rate

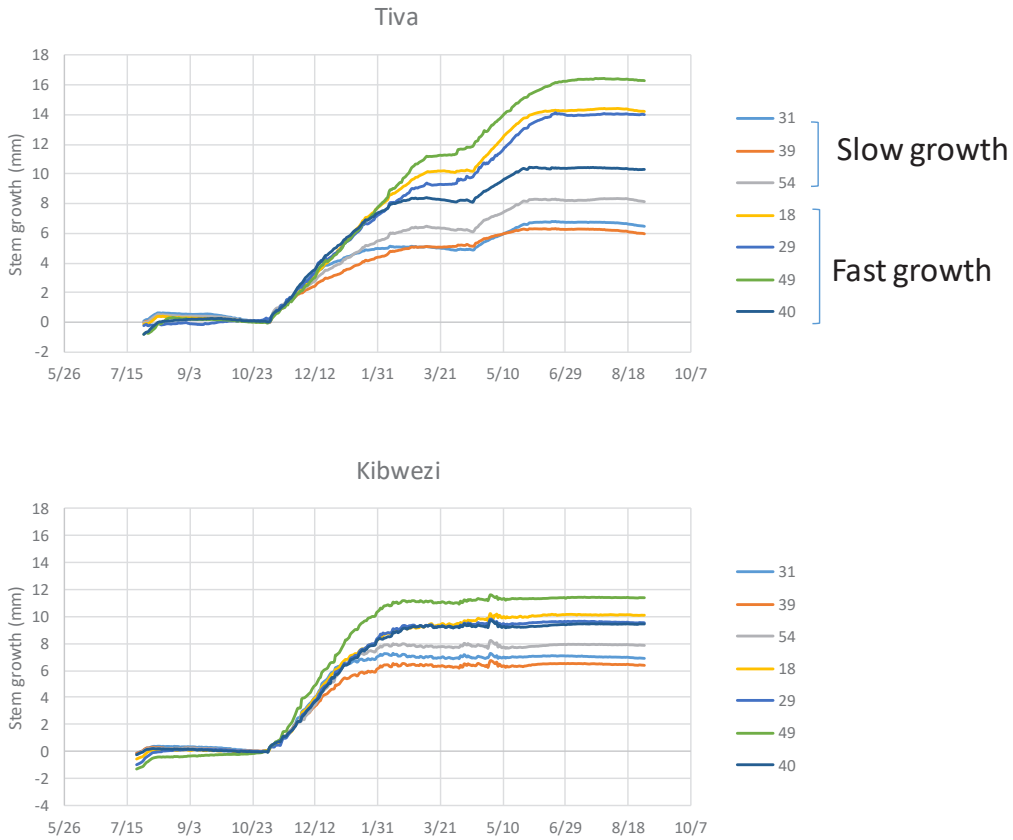


Fig.9 Stem growth changes of fast and slow growth clones in Tiva and Kibwezi.

The growth rate of fast and slow growth clones were shown in fig.10. The growth rate increased rapidly after the heavy rain of October and after that it changed differently with fast and slow growth clone. Fast growth clone in Tiva could keep high growth rate for a long time, but the growth rate of slow growth clone decreased gradually after the heavy rain. In kibwezi, growth rate

decreased gradually in both of fast and slow growth clone, but the decreasing rate of slow growth clone was faster than that of slow growth clone. These results indicate that fast growth clone might have a high growth rate and can keep the high growth rate for a long time. To achieve the high growth rate, fast growth clone may have the characteristics of high photosynthesis ability, high drought tolerance, and long photosynthetic period. More research work about water stress or leaf phenology are needed to develop the water stress index of Melia volkensii.

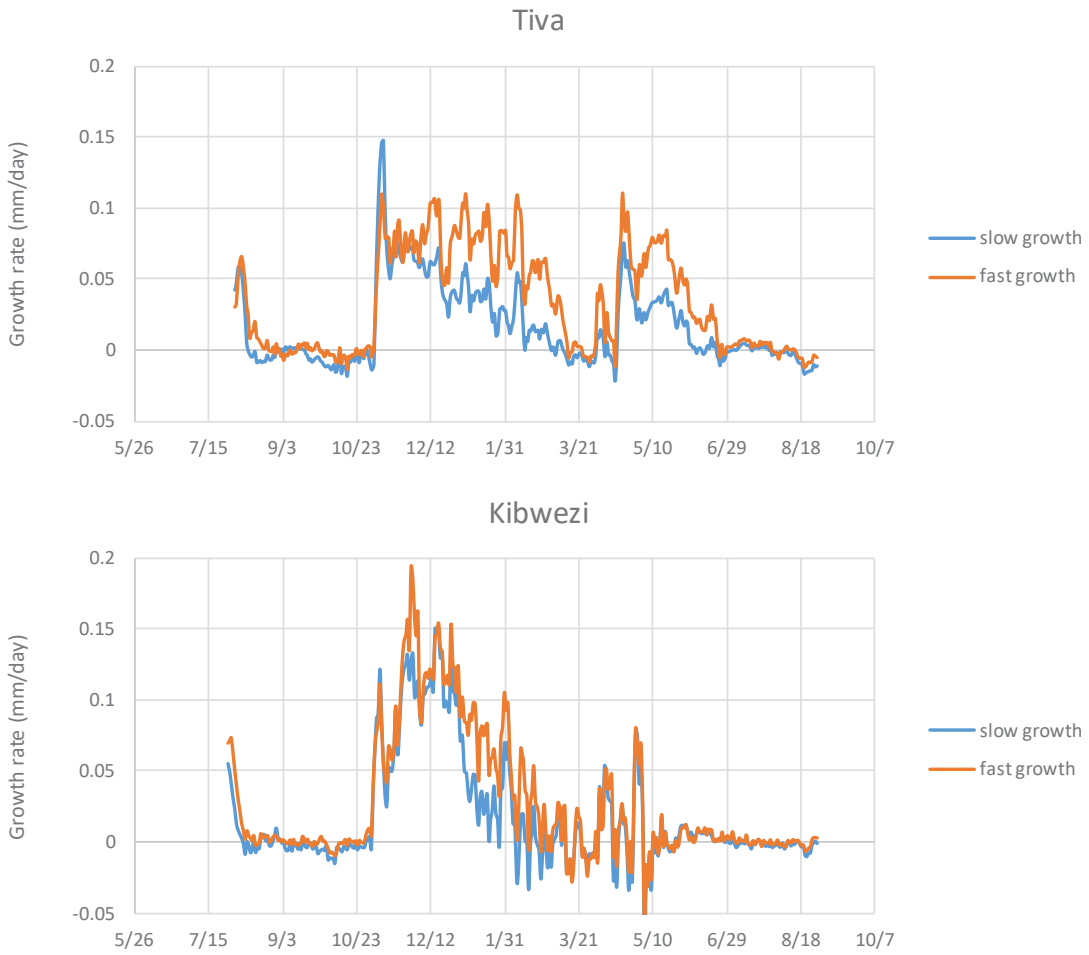


Fig.10 Changes of stem growth rate of fast and slow growth clones in Tiva and Kibwezi orchard.

2.4 Characteristics of stem chlorophyll contents of Melia volkensii

[Activities]

M. volkensii can grow even in severe water conditions of semi arid zone. It doesn't have leaves during the dry season, but it can bloom a lots of flowers and can produce many fruit during the dry season. So, we can predict the unknown system that it can endure these severe conditions.

There was a lot of chlorophyll under the bark skin of M. volkensii (fig.11). We can think that the

photosynthesis of stem chlorophyll would be helpful for its strategy during the dry season. The purposes of this activities are to reveal : ① the relationship between chlorophyll contents and stem diameter, ②the relationship between surface area of stem and stem diameter. ③the difference of chlorophyll contents among Melia clones.

Fig. 11 Stem chlorophyll of M. volkensii.

[Results]

①The relationship between chlorophyll contents and stem diameter

A tree of 10cm diameter was fallen at Tiva nursery. Bark discs of 1cm diameter were collected from deferent size of stem. The chlorophyll contents of each disc was measured by chlorophyll meter (SPAD-502plus:Konica Minolta). The relationship between stem chlorophyll contents and stem diameter was shown in fig.12. The stem chlorophyll contents increased correspond to stem diameter. This result shows that stem chlorophyll were producing newly in the stem. We compared the chlorophyll contents with those of 38 tree species growing in warm-temperate area. The chlorophyll contens of M. volkennsii was about twice of those of warm temperate area.

②The relationship between stem surface area and stem diameter

A branch of 5cm diameter was samples from the tree measured the stem chlorophyll content. The relationship between stem surface area and stem diameter was shown in fig.13. A linear relationship was obtained between the two factors, and we can estimate the stem surface area of 5cm diameter stem was 1.1m^2.

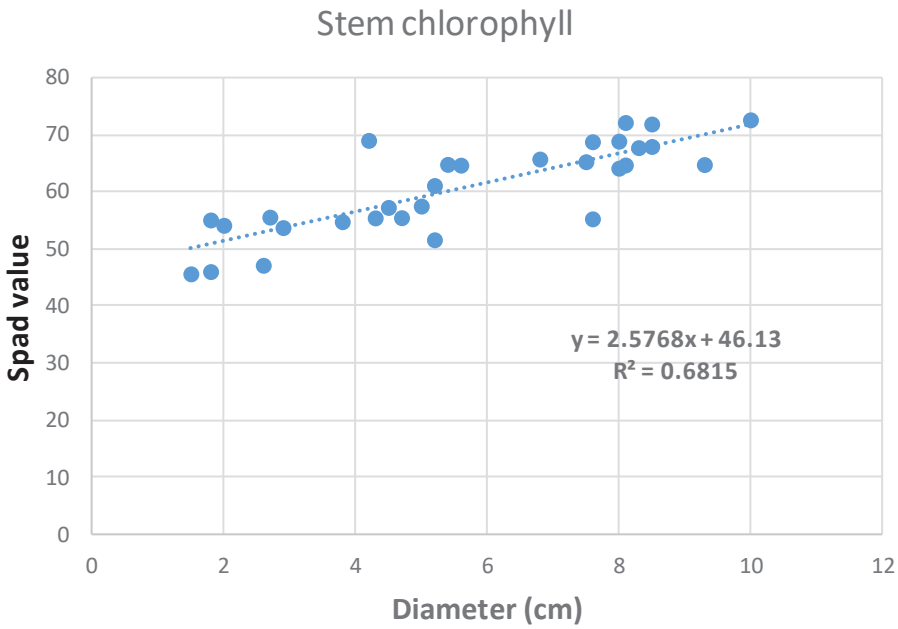


Fig.12 Relationship between stem chlorophyll content and stem diameter

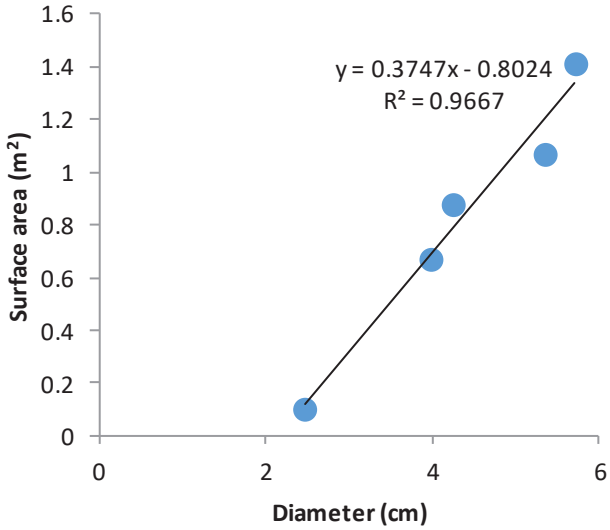


Fig.13 Relationship between stem surface area and stemdiameter

③Chlorophyll differences among M. volkensii clon

Chlorophyll contents of fast and slow growth clones were measured at Tiva and Kibwezi orchard, and the chlorophyll contents of leaf were measured at Tiva (fig.14). The clone no. of fast growth were no.18,29,40,49, and that of slow growth were no.31,39,54. The chlorophyll content of stem was larger than that of lead (fig.14upper). The stem chlorophyll content of tree species growing in warm-temperate area was smaller than that of leaf. Then, we can conclude the chlorophyll content

of M. volkenssii is classified in the high stem chlorophyll content tree species. There were not significant differences between fast and slow growth clone (fig.14).

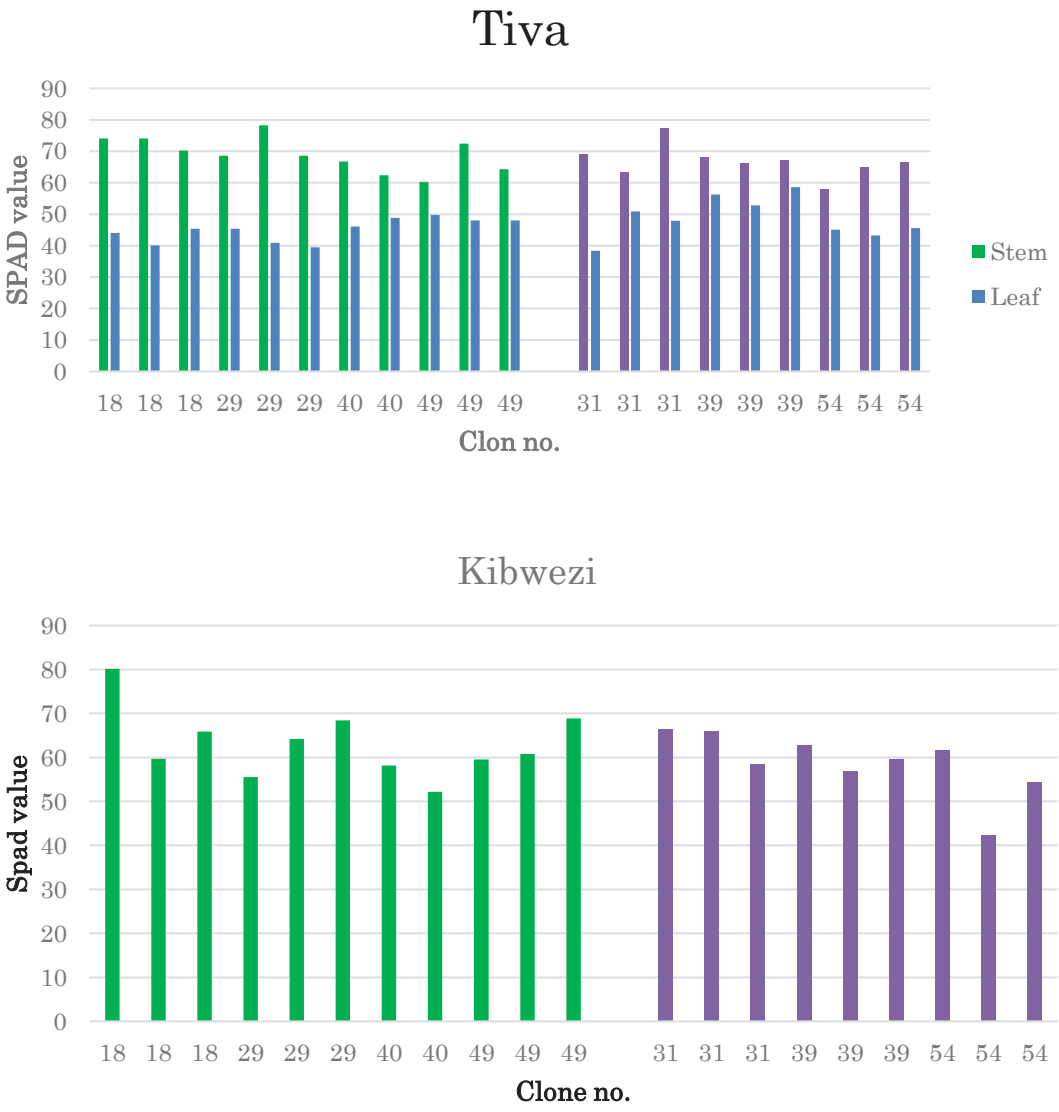


Fig.14 Comparison of stem chlorophyll content between fast and slow growth clone of M. volkensii.

Appendix 4-5-4 Report of short term expert (Drought Tolerant)

Expertise	Name	Term
Drought Tolerant	Dr. Michito Tsuyama	30 Aug.～11 Sep. 2016

1. Schedule

	AM	PM	Accommodation
08.30 (Tue.)		20:00 JAL330 Fukuoka-Haneda 21:40	
08.31 (Wed.)	00:30 EK313 Departure (TOKYO/HANEDA)	14:45 EK719 Arrival (NAIROBI)	Kitui
09.01 (Thr.)	move to Kibwezi	Investigation of leaf phenology	Kibwezi
09.02 (Fri.)	Investigation of leaf phenology	Investigation of leaf phenology	Kibwezi
09.03 (Sat.)	Investigation of leaf phenology	Investigation of leaf phenology	Kibwezi
09.04 (Sun.)	Investigation of leaf phenology	Investigation of leaf phenology	Kibwezi
09.05(Mon.)	move to Kiui	Data arrangement	Kitui
09.06 (Tue.)	Investigation of leaf phenology	Investigation of leaf phenology	Kitui
09.07 (Wed.)	Investigation of leaf phenology	Investigation of leaf phenology	Kitui
09.08 (Thr.)	Investigation of leaf phenology	Investigation of leaf phenology	Kitui
09.09 (Fri.)	Data arrangement	Wrap-up meeting	Kitui
09.10(Sat.)	Travel to Nairobi (3hours)	16:40 EK720 Nairobi-Dubai 22:40	
09.11 (Sun.)	3:00 EK316 Dubai-Osaka 17:10	19:35 NH1709 Osaka-Fukuoka 20:45	

A candidate of drought tolerant clone of *Melia volkensii*

The purpose of my research was to screen clones of *Melia volkensii* with high tolerance to drought conditions. To do this, I searched clones with leaves in Kibwezi orchard. That is, I assumed that the tree that remains leaves has higher tolerance to drought stress, because in general *Melia* drop or shed their leaves in dry season (Fig. 1).

Fig. 1. A photo of *Melia* clones in Kibwezi (Block 1) in dry season (Sep. 2, 2016).

First, to make a quick survey of all the clones of *Melia* in Kibwezi orchard, I walked around the orchard and looked all the 3,000 trees from 100 clones. Table 1 shows the number of trees or individuals which remained leaves during this dry season (Fig. 2). In those trees, most leaves were dropped, but some leaves remained sparsely. In this quick survey, trees planted on/around the edge of orchard (i.e., the lanes 1 and 62 and the lines 1 and 50) are excluded, because many trees had leaves in there, which is probably due to low competition for water among trees. Consequently, it was found that (1) in 1 tree of the clones 10, 11, 14 and so on, had leaves. Because 30 trees had been planted in total for each clone in the orchard, 1 tree corresponds to 3.3% (=1/30). (2) Similarly, 2 trees (6.6%) of the clones 8, 33, and 34 had leaves. (3) Further, 3 trees (9.9%) of the clones 6, 38, and 60 remained leaves. Because the 3 trees were the maximum as the number of trees with leaves, the clone 6, 38, and 60 suggested to be more tolerant than other clones.

Table 1. The number of trees/individuals which remained leaves in dry season in Kibwezi orchard (Sep. 1-4, 2016).

Number	Clone													
1	10	11	14	18	20	23	24	30	40	42	44	47	49	54
2	8	33	34											
3	6	38	60											

Fig. 2. Examples of trees which remained leaves in the dry season. (Left) clone no. 38, location 54-8; (Right) clone no. 42, location 46-6.

The trees with leaves were found relatively more in the area between the lanes 21-30 and lines 7-15 than in other areas (Table 1-2, dashed circle). This is assumed to be due to that there are much water under the ground, because the land in the area appeared to be lower than that in the others. Actually, weeds and seedlings of shrub (e.g., *Maerua subcordata*) were seen frequently. The clones with asterisk in Table 1-2 are included in the area, and thus care must be taken to regard those clones to be drought resistant.

Next, to see more carefully regarding to the three clones no. 6, 38, and 60, I looked all the trees in block 3 and 6 in the orchard. In this survey, Trees planted on/around the edge are included, to secure the number of trees being screened. Table 2 shows the number of trees which survived and remained leaves. As expected, the leaf abundance or phenology linked or interlocked to the surviving ratio. For example, in clone 6, 6 trees out of the 10 trees (which had been planted in the 2 blocks) survived. Of the 6 trees, two trees had leaves. Importantly, the clone 38 was the most excellent. 9 trees out of the 10 trees survived, and among the 9 trees 4 trees had leaves. Unexpectedly, clone 60 did not survive in block 3 and 6. On the other hand, I selected clone 1, 2 and 3 as control, because none of the trees of these clones was found out in the quick survey of 3,000 trees (Table 1). Although the surviving ratio of the clone1 was high, leaves were fallen or dropped almost completely in the three clones. For comparison, the same observations were repeated in Kitui-Tiva orchard (Table 3).

Probably because of much precipitation, surviving ratios and leaf abundance were higher in Kitui-Tiva than in Kibwezi, suggesting that the observation was successful to some extent.

Table 1-2. Location of selected trees in the quick survey shown in Table 1.

Clone	Location		
10*	29-15		
11*	26-09		
14	19-36		
18*	24-8		
20*	23-8		
23	39-17		
24	56-14		
30*	25-08		
40*	30-9		
42	46-6		
44*	27-8		
47	56-19		
49*	25-10		
54*	25-7		
8*	21-11	29-26	
33	11-21	18-35	
34*	28-08	45-37	
6*	23-32	24-11	53-29
38	35-27	41-11	54-8
60*	24-33	29-13	30-22

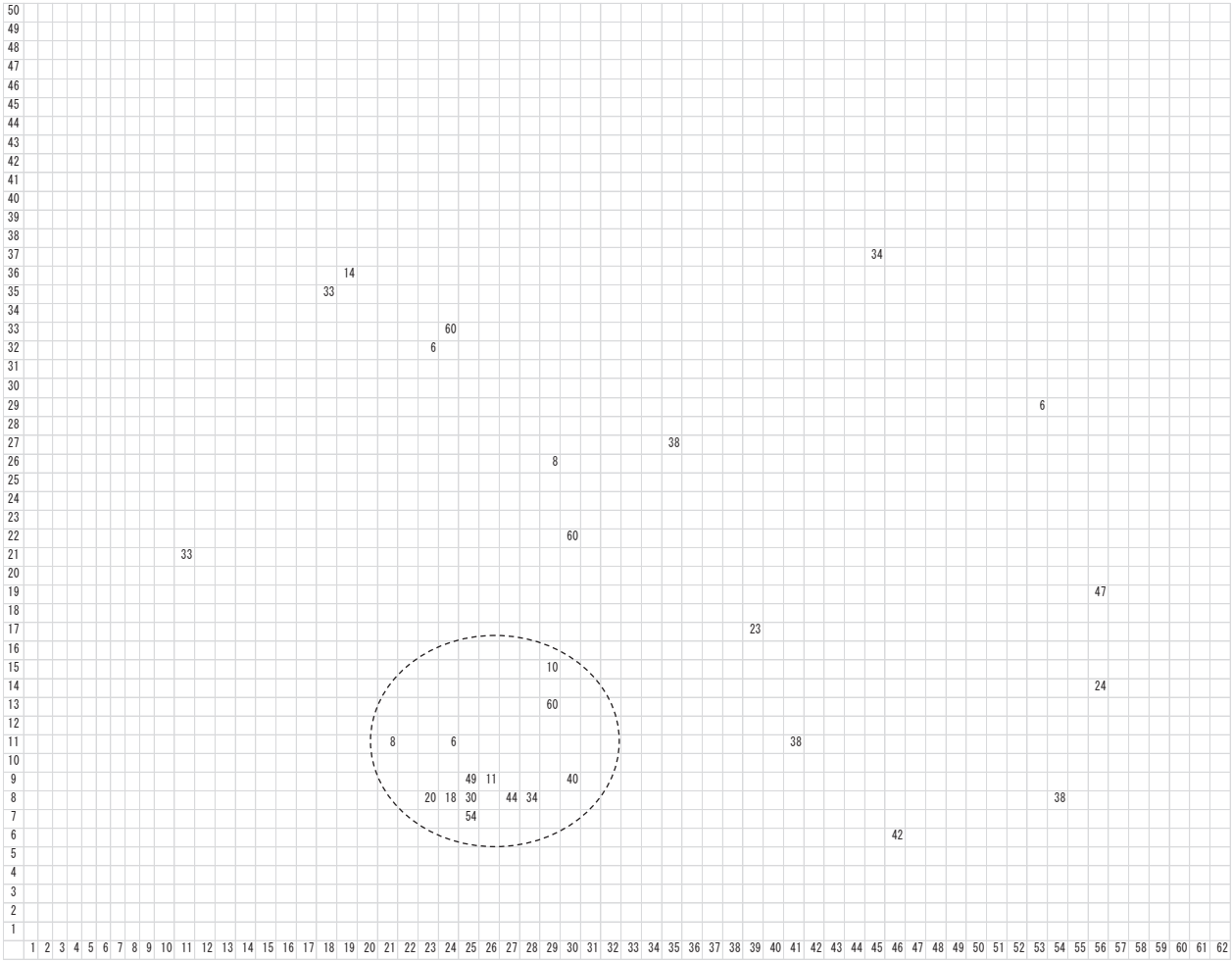


Table 2. The number of trees which survived and had leaves in block 3 and 6 in Kibwezi orchard in dry season.

Clone	Survived	Leaves
6	6	2
38	9	4
60	0	0
Control		
1	7	0
2	0	0
3	2	1

Table 3. The number of trees which survived and had many leaves in block 3 and 6 in Kitui-Tiva orchard in dry season.

Clone	Survived	Leaves
6	8	4
38	10	7
60	8	6
Control		
1	7	4
2	7	5
3	8	6

From these results I conclude that no. 38 is the most tolerant to drought stress among the 100 clones. The no. 38 clone might have not attract special attention thus far. However, one of the tree of no. 38 clone had many leaves, even when the tree leaned on one side probably because of strong wind (Fig. 3, left) (see Fig. 2 for comparison), suggesting the strong resistance to drought stress. On the other hand, care must be taken to see the photo (Fig. 3, left), because the tree had been planted on the edge of the orchard (i.e., location 57-50). That is, while no. 38 can maintain many leaves on the edge of the orchard (Fig. 3, right, location 34-1) as many other clones can do, the trees of the clone can also sustain leaves inside the orchard, where a competition for water among surrounded trees is likely intense. This is a difference between no. 38 and the others.

Fig. 3. Trees of clone no. 38 planted at 57-50 (left) and 34-1

Appendix 4-5-5 Report of short term expert (Project management)

Expertise	Name	Term
Project Management	Mr. Shizuo Kamizore	Oct.24 ～ 3 Nov. 2016
Nursery	Mr. Nobutaka Chiba Mr. Koji Hashimoto	Oct.24 ～ 3 Nov. 2016

1. Itinerary

Date	Activity
24 Oct.	Hitachi to Haneda
25 Oct.	Arrive at Nairobi Move to Kitui
26 Oct.	Study on Melia seed stock in soil Observation of Melia Seed orchard and PTS in Tiva
27 Oct.	Lecture of stem cut and branch pruning in Kitui Melia seed orchard Lecture of Melia cutting technique in KEFRI Kitui centre
28 Oct.	Observation and discussion on management of Kitui Acacia seed stand Move to Kitui
29 Oct.	Observation of Kibwezi Seed orchard and Kibwezi Progeny test sites Move to Nairobi
30 Oct.	Making report
31 Oct.	Meeting with Japanese experts, observation of seed centre in KEFRI Courtesy call to Director of KEFRI
1 Nov.	Report to JICA Office Move to Dubai
2 Nov.	Dubai to Haneda
3 Nov.	Haneda to Hitachi

2. Result of major activities

- Study on Melia seed stock in soil

  It is said that germination of Melia seed could be only available for several weeks after separating from the nut. In general, suitable moisture is needed to stock seeds with keeping germination ability. Circumstance in deep soil is considered to have the situation. so in this time study on seed stock in soil was carried out as trial in Kitui nursery.

- Study on Melia cutting technique

  Trial of Melia cutting have been carried out in several times without considering the cutting condition or clones, hoever some trials have succeeded in rooting.

  Based on the results of trials, we have started the development of Melia cutting technique as

a breeding study. Fast and slow growing clones, which would be selected by the tentative result of PTS survey, were tested. Provided clones were 5 respectively.
After more than 3 months, cutting seedlings will be checked for rooting.

- Lecture of stem cut and branch pruning in seed orchard

  Lecture of stem cut and branch pruning have been carried out several time so far to Kenya staff. Melia tree that was taken by stem cut and branch pruning last year keeps the suitable shape for fruit production. We take a lecture again how to cut stem and branches to introduce Melia tree for the suitable tree shape in seed orchard.

- Management of Acacia seed stand

  Acacia tultilis has a specific trait that grows to lateral direction in early stage after planting. We discussed how to manage the Acacia seed stand appropriately and came to the conclusion that the seedling must be supported by a pole so that the stem would grow straight up immediately.
  It is also found that some individuals are growing straight up slightly and it would depend on the trait difference between clones.

- Kenya forestry seed centre

  Kenya forestry seed centre was establish in 1993 supported by a grant aid of Germany. The facilities are located closed to KEFRI headquarters in Muguga. The centre has a lot of regional branches, which belong to KEFRI regional offices.
  Main duties of this centre are to collect and reserve seeds for forestry, and distribute the seeds to KFS, forestry enterprises, NGOs or harmers. Species in stock and prices have been up-loaded in KEFRI web-site. Total income a year from the sale is about 15000 US$ but the seed production cost exceeds the income. It seems that some purchase orders from foreign countries, Australia or USA for planting dry lands, are received. See attached photos 21-26.

- Others

  We talked about the component 4 “Tree Breeding Activities” of the new CADEP project.

Photo

1.Greeting from Dr. Muturi, project

2.Study on seed stock in soil

3. Study on deep planting

4.Succeeded Melia cutting seedlings (succeeded 2 by 33, implemented Feb

5.Melia cutting study by KEFRI staff (implemented Aug.-Sep. 2016)

6. Observation of the cutting to check the situation

7.Lecture of Melia cutting technique

8.Cutting seedlings by Kenyan staff

9.Situation of cutting pot covered with plastic bag (1 day after)

10.Lecture of stem cut and branch

11.Traial of Kenyan staff for stem cut and branch pruning

12.Dsiscussion on management of Melia PTS (planted 2015)

13.Tiva Melia PTS (planted 2015)

14.Discussion on management of Acacia seed stand (planted 2015)

15.Specific family of Acacia with many branches at ground level (planted 2015)

16.Specific family of Acacia with growing straight up (planted 2015)

17.Kibwezi Melia PTS (planted 2014)

18.Kibwezi Melia PTSs (right : planted 2015, Left : planted 2014)

19.Observation tower (under the construction) and Acacia seed stand in

20.Kibwezi Melia seed orchard）

21.Sales office of Kenya forestry seed centre

22.Seed selection machine made in Germany

23.Seed drying room for pine corns

24.Seed storage room (temperature 10℃)

25.Counter for seed number

26.Attached description of the seed distribution (including how to make seedling and some

Appendix 4-5-6 Report of short term expert (Drought Tolerant)

Expertise	Name	Term
Drought Tolerant	Dr. Koichiro Gyokusen	30 Aug.～11 Sep. 2016

1. Schedule

	AM	PM	Accommodation
02.01 (Wed.)		20:00 JAL330 Fukuoka-Haneda 21:40	
02.02 (Thu.)	00:30 EK313 Departure (TOKYO/HANEDA)	14:45 EK719 Arrival (NAIROBI) Move to Kibwezi	Kibwezi
02.03 (Fri.)	Downloadi of weather data at Kasiga and Voi	Download of weather and phot data at Kibwez	Kibwezi
02.04 (Sat.)	Download of weather data at Yikituki	Move to Embu	Embu
02.05 (Sun.)	Download of weather data at Marimanti and Gaciongo	Move to Kitui	Kitui
02.06 (Mon.)	Download of weather data at Tiva	Data analysis	Kitui
02.07 (Tue.)	Data analysis	Data analysis	Kitui
02.08 (Wed.)	Preparation for international congress with Mr. Muchiri	Preparation for international congress with Mr. Muchiri	Kitui
02.09 (Thr.)	Replacement of dendrometer at Tiva	Replacement of rain gauge at Kibwezi	Kibwezi
02.10(Fri.)		16:40 **EK720** Nairobi-Dubai **22:40**	
02.11 (Sat.)	3:00 EK316 Dubai-Osaka 17:10	**19:35 NH1709** Osaka-Fukuoka 20:45	

2. Activities and results

2.1. Weather conditions at Tiva and Kibwezi seed orchard

[Activities]

The weather data recorded from Sep. 2016 to Jan. 2017 in Tiva and Kibwezi, were downloaded and analyzed.

[Results]

- Weather conditions of 2015 and 2016 at Tiva and Kibwezi seed orchard were shown in table 1,

2 and fig.1, 2. The average temperature of 2015 in Tiva and Kibwezi were 22.8℃ and 24℃, and those of 2016 were 22.4℃ and 24.7℃, respectively (table1, 2). The average temperature of Kibwezi was 2℃ higher than that of Tiva in these two years. The precipitation of 2015 in Tiva and Kibwezi were 596mm and 441mm, and those of 2016 were 398mm and 342mm, respectively (table1, 2). The precipitation of 2016 was smaller than that of 2015, and that of Tiva was larger than that of Kibwezi.

- Seasonal changes of soil water potential at Tiva and Kibwezi from 2014 to 2016 were shown in fig. 3, 4. The soil water potential has synchronized to the pattern of precipitation. The soil water potential of 100cm depth had decreased from 2014 to 2017 in Tiva, and that of Kibwezi had decreased, too. This result shows that the drying of soil has been in progress for these three years.

表1 Weather data at Tiva seed orchard

2014	A	S	O	N	D	Ave. or total
min RH	39.6	41.2	37.9	50.5	52.7	44.4
max. Tem	28.2	28.5	31.1	29.3	29.5	29.3
Min. Tem	15.6	16.2	17.3	17.9	17.2	16.8
Ave. Tem	21.3	21.4	23.4	22.3	22.1	22.1
Preci	0.0	1.8	24.4	226.4	9.6	262.2

2015	J	F	M	A	M	J	J	A	S	O	N	D	Ave. or total
min RH	32.7	32.7	34.4	49.8	55.3	48.1	46.2	43.8	36.1	38.0	55.5	64.4	44.7
max. Tem	32.2	33.5	32.5	30.2	28.5	28.0	27.2	27.6	30.1	31.9	29.4	29.9	30.1
Min. Tem	15.6	17.3	18.3	18.5	17.6	15.8	15.6	15.9	15.9	18.3	18.4	17.6	17.1
Ave. Tem	23.4	24.5	24.5	23.2	22.2	21.2	20.7	20.8	22.4	24.1	22.6	22.1	22.6
Preci	0.0	2.4	30.0	161.6	32.2	2.2	3.6	1.8	0.8	2.8	297.6	61.0	596.0

2016	J	F	M	A	M	J	J	A	S	O	N	D	Ave. or total
min RH	62.9	47.9	41.7	55.4	58.0	52.0	49.9	44.2	45.6	39.3	55.5	53.6	50.5
max. Tem	30.7	32.3	34.3	31.4	28.5	27.4	26.3	27.8	28.2	31.7	29.8	30.8	29.9
Min. Tem	17.8	17.3	19.5	19.1	17.1	16.2	15.0	15.4	15.7	16.9	18.4	17.1	17.1
Ave. Tem	22.7	23.4	25.6	23.8	21.7	20.9	20.1	20.7	21.0	23.4	22.7	22.4	22.4
Preci	36.8	35.4	1.0	180.6	3.0	2.2	0.0	0.0	0.0	0.0	139.2	0.0	398.2

表2 Weather data at Kibwezi

2014	A	S	O	N	D	Ave. or total
min RH	35.8	37.9	34.4	44.4	51.4	40.8
max. Tem	30.4	30.3	33.1	31.6	30.7	31.2
Min. Tem	16.9	17.8	19.5	20.1	19.9	18.8
Ave. Tem	23.1	23.3	25.3	24.9	24.3	24.2
Preci	0.0	6.0	2.6	79.4	123.8	211.8

2015	J	F	M	A	M	J	J	A	S	O	N	D	Ave. or total
min RH	31.6	32.0	31.8	39.7	46.7	40.9	41.6	39.8	34.7	36.2	49.6	57.1	40.1
max. Tem	33.8	34.9	34.6	33.6	31.4	30.6	29.5	29.5	31.7	33.0	31.8	31.1	32.1
Min. Tem	19.0	20.1	20.1	20.8	19.5	17.6	17.1	17.2	17.6	20.2	20.6	19.9	19.1
Ave. Tem	25.7	26.6	26.5	26.1	24.5	23.6	22.7	22.8	24.1	25.9	25.0	24.4	24.8
Preci	0.2	2.0	3.6	57.6	45.6	0.8	0.0	0.0	0.0	1.4	199.2	130.2	440.6

2016	J	F	M	A	M	J	J	A	S	O	N	D	Ave. or total
min RH	49.7	36.7	33.1	43.0	40.6	40.7	39.1	37.5	38.1	34.3	49.3	50.4	41.0
max. Tem	32.5	34.5	36.7	34.1	32.1	30.2	29.0	29.8	30.2	32.9	31.5	31.6	32.1
Min. Tem	20.2	20.2	21.5	21.1	18.7	17.8	16.1	16.7	17.7	18.6	20.1	19.7	19.0
Ave. Tem	25.0	26.3	28.2	26.2	24.8	23.4	22.3	22.7	23.2	25.1	24.6	24.2	24.7
Preci	6.2	5.6	12.8	33.4	3.6	2.4	1.2	0.8	1.2	0.8	205.2	68.6	341.8

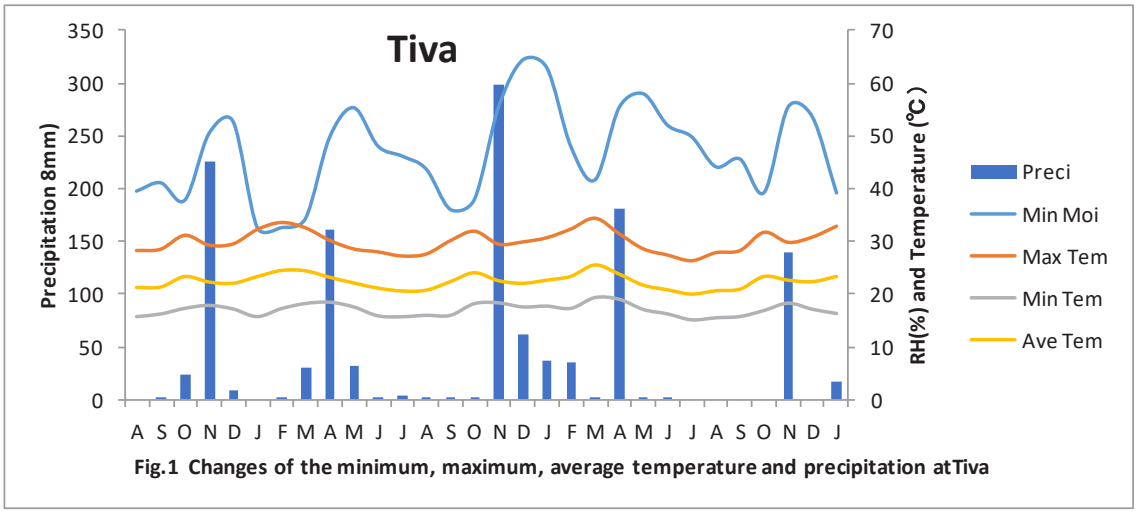


Fig.1 Changes of the minimum, maximum, average temperature and precipitation atTiva

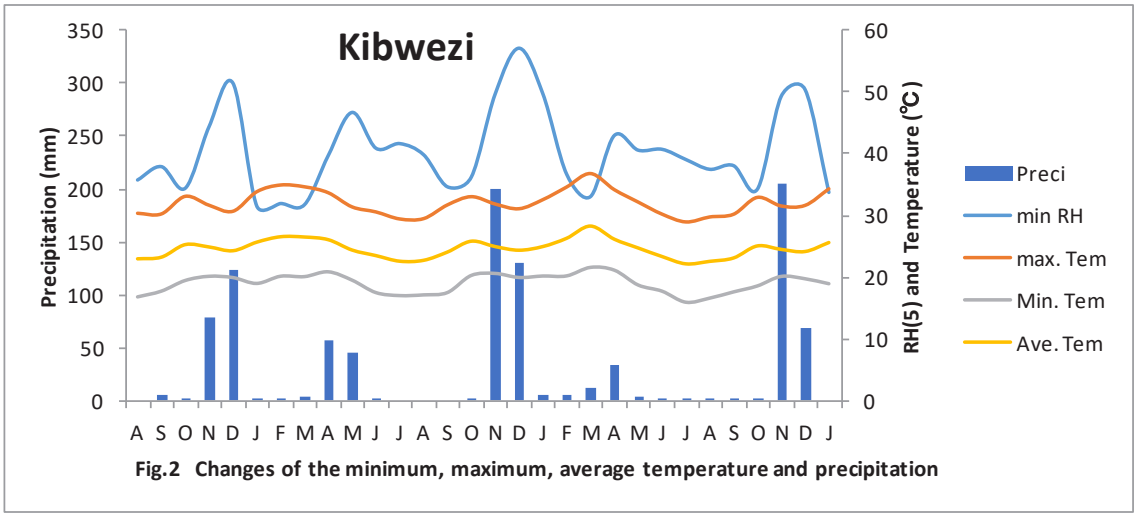


Fig.2 Changes of the minimum, maximum, average temperature and precipitation

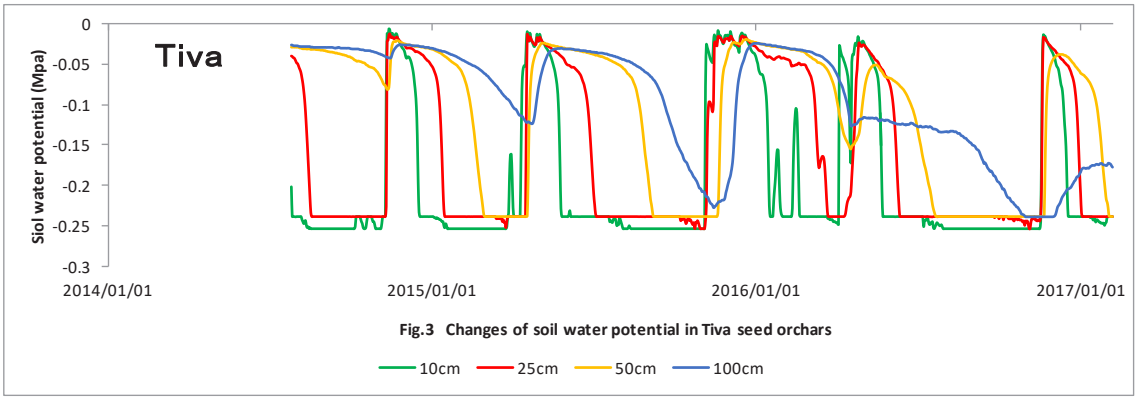


Fig.3 Changes of soil water potential in Tiva seed orchars

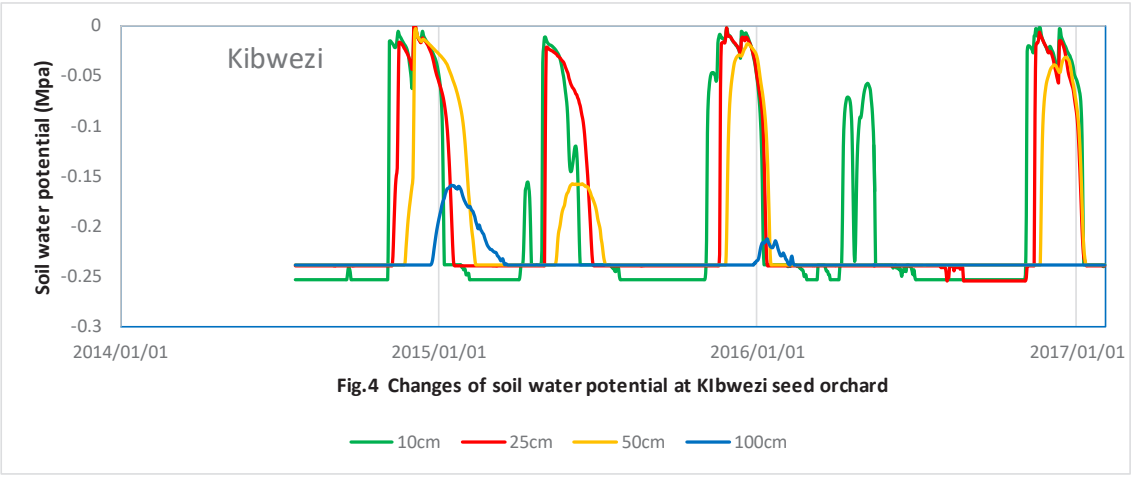


Fig.4 Changes of soil water potential at KIbwezi seed orchard

2.2. Weather conditions at progeny test site

[Activities]

Equipments for temperature and humidity were installed in Gaciongo, Marimanti, Makima, Yikituki, Voi, Kasigau progeny sites at Feb. 2016. The weather data recorded from Sep. 2016 to Jan. 2017 in Tiva and Kibwezi, were downloaded and analyzed.

[Results]

- The averaged minimum humidity, maximum temperature, minimum temperature, and average temperature were shown in table 3. The averaged temperature was the highest in Marimanti and that of Makima was the lowest. The temperature of order in 8 sites included the two seed orchards was Marimanti >Gaciongo >Kasigau >Voi >Kibwezi> Yikituki> Mkima >Tiva. The precipitation of Marimanti was 521mm and higher than that of Kasigau (310mm). The precipitation order in 4 sites was Marimanti > Tiva > Kibwezi >Kasigau.

Table 3 Averaged temperature and humidity at 6 progeny sites from Feb. 2016 to Jan. 2017.

	Min.RH (%)	Max.Tem (℃)	Min.Tem (℃)	Ave.Tem (℃)
Gaciongo	37.4	33.4	20.8	26.5
Marimanti	37.5	36.3	21.4	28.2
Makima	42.7	29.4	17.6	23.0
Yikituki	40.7	29.6	18.0	23.4
Voi	41.1	31.8	20.2	25.1
Kasigau	48.1	32.6	20.7	25.8

2.3. Comparison of the growth of superior and inferior clones in seed orchards

[Activities]

Dendrometers to measure the stem growth of superior and inferior clones were installed in Tiva and Kibwezi at Jul. 2015. The data collected from Sep. 2016 to Dec. 2016 were analyzed.

[Results]

Changes of stem growth and precipitation at Tiva and Kibwezi were shown in fig. 5, 6. There were very small precipitation in spring of 2016 at Kibwezi, and as a result, there were little growth in this season. However, a considerable amount of growth was observed at Kibwezi because of often

precipitation in autumn of 2016. On the contrary, the stem growth of Tiva in spring of 2016 was large, but that of autumn was small because of less precipitationl in autumn of 2016. These results indicate that the growth of *Melia volkennsi*i in semiarid area was mainly controlled by soil water regime.

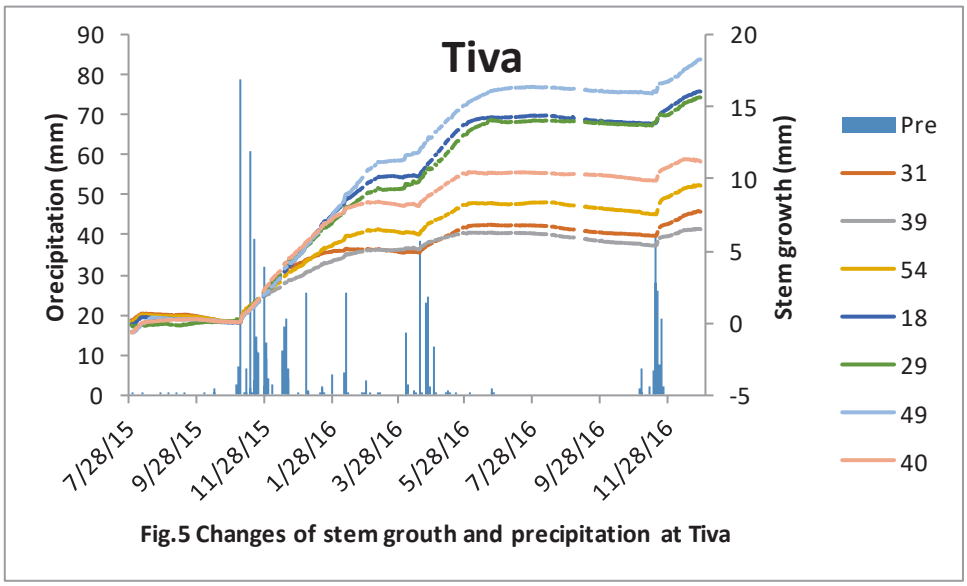


Fig.5 Changes of stem grouth and precipitation at Tiva

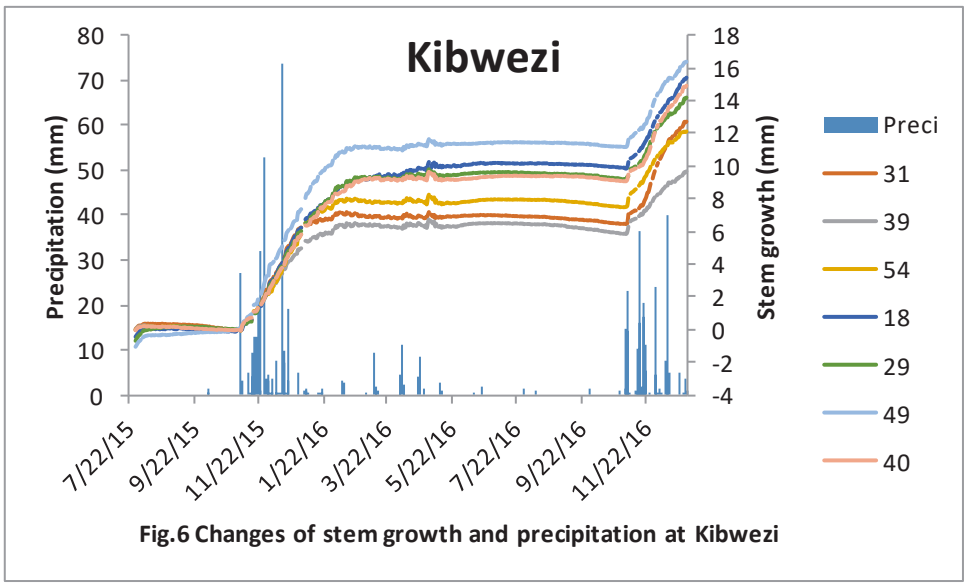


Fig.6 Changes of stem growth and precipitation at Kibwezi

Appendix 4-5-7 Report of short term expert (Project management, DNA analysis, Tree Breeding)

Expertise	Name	Term
Project Management	Dr. Masatoshi Ubukata Mr. Hideki Kawato Mr. Shizuo Kamizore	11 Feb. ～ 19 Feb. 2017
DNA analysis	Dr. So Hanaoka Dr. Michiya Matsushita	11 Feb. ～ 19 Feb. 2017
Tree breeding	Dr. Hisaya Miyashita	11 Feb. ～ 19 Feb. 2017

1. Itinerary

Date	Activity
11 Feb.	Hitachi to Haneda
12 Feb.	Arrive at Nairobi Move to Naiobi
13 Feb.	Attendance to Internal Conference
14 Feb.	Attendance to Internal Conference
15 Feb.	Move to Kitui Meeting with Japanese experts and staff of JICA Kenya office
16 Feb.	Observation of Kitui Seed orchard and Progeny test sites Move to Nairobi
17 Feb.	Report to JICA Office Move to Dubai
18 Feb.	Dubai to Haneda
19 Feb.	Haneda to Hitachi

2. Result of major activities

- International conference

  A lot of participants, who were from foreign countries, international organizations such as FAO and ICRAF etc., USAID, international NGOs and KEFRI and KFS staffs from Kenya. Prof. Wakhungu, Minister of MENR, Mr. Toshitsugu Uesawa, ambassador of Japanese emmbasy of Kenya and Mr. Watanabe, Director General of FTBC and Ms. Sano, representative of JICA Kenya office had opening addresses for starting the conference. Especially Prof. Wakhungu mentioned the all project activities in detail and praised them.

  This conference was held for 4 days that consisted of presentations on the results of project activities and a field trip to Melia seed orchards in Kitui and Kibwezi, progeny test sites and Melia

plantation site in which an advanced farmer made.

The title and outline of presentations in the conference are as follows. Every presentation was made by Kenyan staff and almost presentations except from special guests, were checked and revised by FTBC and Kyushu Univ. team.

- Report of Project activities

1. Breeding of drought tolerant *Melia volkensii*

Mr. Kariuki explained the outline of tree breeding how to select drought tolerant Melia using ordinary tree breeding technique through selection of plus trees.

2. Interim result of progeny trials of *Melia volkensii*

Mr. Kriuki also explained the interim result of Melia tree breeding. It was found that there is genetic difference between the clones at the result of analysis on progeny test.

3. Status of *Acacia tortilis* breeding

Selection of candidates plus trees and establishment of seed stands of *A. tortilis* were implemented in the project as well as Melia.

4. Development and use of DNA molecular markers

Dr. Omondi presented that Simple Sequence Repeat(SSR) marker was developed to analyze genetic diversity or differentiation of Melia and Acacia. This study is reported on an international scientific magazine “Conservation Genetics”

5. Population Genetics of *Melia volkensii*

Dr. Omondi also presented that suitable distribution area of *Melia volkensii* in Kenya was predicted through SSR analysis mentioned in Ⅳ and ecological niche modeling. This result is introduced from the analysis of genetic differentiation on the north, central and south in Kenya.

6. Population Genetics of *Acacia toritilis*

It was reported that genetic differentiation of *A. tortilis* in the north and the south in Kenya was also found as well as Melia by SSR analysis. This shows that appropriate control and management of genetic resources on Acacia and Melia should be required.

7. Mechanism of drought tolerance in *Melia volkensii*

Mr. Muchiri explained study on mechanism of drought tolerance of Melia in cooperation with Kyushu university. The study consists of comparing and analyzing between photo synthesis capacity, chlorophyll density or water potential of Melia and meteorological data or growth of Melia

8. Status of Seed Production in *Melia volkensii* clonal orchards

Mr. Kamondo reported seed production capacity and phenology of Melia in Kitui and Kibwezi seed orchards. He reported also that 1 ton seeds were produced from about only 10 % of Melia trees in seed orchards in 2016, and more amount of seed production would be expected.

9. Variation of wood properties in *Melia volkensii*

Ms. Oduor presented the relationship between growth and wood property on *Melia volkensii.* It is found that DBH and wood density are positively correlated through measuring annual

rings and wood density distribution.

10. Clonal variation in wood properties in *Melia volkensii*

Dr. Ndufa presented measurement of wood density using Pirodin, which can measure the wood density by a sound wave without cutting stem. This shows the difference between clones.

11. *Melia volkensii* enterprises for enhanced livelihoods in semi-arid areas in Kenya

Mr. Luvanda presented a market research of Melia that consisted of seed and seedling production and the distribution, and price, use and distribution of Melia timber or wood in Kenya. This research was reported from KEFRI in 2015.

12.Distribution system of improved *Melia volkensii* seeds and seedlings

Mr. Mushoki explained the system of distribution and use of improved Melia seed and seedlings that has been developed in the project. This system is published as a text book of "Guideline on Production, Distribution and Use of Improved Melia Sed and Seedlings in the Drylands of Kenya" in 2016.

13.Process and implementation of FFFS

Mr. Njoroge, who is in charge of forestry extension in regional office of KFS, explained extension activities in Farm Forestry Fields School (FFFS) adopting the distribution system mentioned in above presentation.

- Special presentations of guests from other countries

1.Report of forestry and climate change sector in Ethiopia

Dr. Adefires Worku, Director, Climate Science Research Directorate of Ethiopian Environment and Forest Research Institute(EEFRI), introduced research activities on prediction of influence of climate change to forest in Ethiopia.

2.Climate Change research in Tanzania

Dr. Chekestino Balama, Tanzania Forestry Research Institute (TAFORI), introduced Farm Forestry in semi-arid area of Tanzania which aimed a mixture of agriculture and forestry introducing aspects of ecology and socio economy.

3.Future Breeding plan of improved Melia

Dr. Ubukata, FTBC, presented the roadmap of breeding on *Melia volkensii* with introducing tree breeding aspect of Japanese cedar.

- Observation of the project sites

a. Melia seed orchard and Progeny test sites and Acacia seed stands

We observed Melia seed orchard and Progeny test sites and Acacia seed stands. Dr. Ndufa, Director of KEFRI Kitui center, explained the management of seed orchard or seed stand and progeny test site. Dr. Worku from Ethiopia got surprised by the fast growing of Melia and suggested strongly that every forester concerned should observe this project sites.

b. KEFRI Kitui Center

We observed the facility of KEFRI Kitui Center, which was established by Japanese grant aid

through JICA in 1988. The facility has been maintained and managed appropriately by KEFRI. Melia seeds distribution unit was established in a room of the center.

c. Crossing ceremony

Crossing ceremony of the International Conference was fold in conclusion. Mr. Gatharra attended the ceremony and made a short address for crossing. Mr. Watanabe, FTBC, also had a word for admiring the project finally.

3. Others

a. The final JCC will be held on the middle of Jun. and short term experts will dispatched from FTBC to attend the meeting

b. A meeting with Japanese experts including CADEP project and staff of JICA Kenya office was held in Kitui center to discuss tree breeding activities in component 4 of CADEP project and necessary future measures. It should be considered that a mission from FTBC would be dispatched to discuss the matter with Kenyan side, especially two activities such as establishment of local Melia seed orchard and support to training course are controversial matter as component 4 activities.

Photo

1.Address from Mr. Watanabe, Director General of FTBC, on opening ceremony

2. Address from Prof. Wakhungu, Minister of MENR on opening ceremony

3.Group photo with attendance

4.Confference room

5.Presentaion from Mr. Kamondo (KEFRI)

6.Presentaiton from Dr. UBUKATA

7.Welcome reception
(Center :Mr. Watanabe)

8. JCC meeting (Chairman : Mr. Gathaara, Conservation Secretary, MENR)

9.Field observation (Kitui Seed orchard)

10.Explanation of project activities
(measurement of stem strength using Pirodin)

11.Observation of Acacia seed stand

12.Entrance to Melia progeny test site

13.Expalanation of the Melia progeny test site from Dr. Ndufa, Direcor of KEFRI Kitui centre

14.Observation of Melia PTS planted Dec.2014

15.Melia Distribution Unit in KEFRI Kitui Centre

16.Varel to stock Melia nuts at the Distribution Unit

17.Melia seeds

18. Furniture made from Melia wood

19.Observation of laboratories in KEFRI Kitui Centre

20.Closing address from Mr. Watanabe

21.Closing address from Mr. Gathaara

Appendix4-5-8 Report of short term expert (Project management)

Expertise	Name	Term
Project Management	Mr. Hideki Kawato Mr. Shizuo Kamizore	9 Jun.～17 Jun. 2017

1. Itinerary

Date	Activity
9 Jun.	Hitachi to Haneda
10 Jun.	Arrive at Nairobi
11 Jun.	Making material Meeting with Japanese experts
12 Jun.	Attendance to JCC meeting Meeting with Japanese experts
13 Jun.	Observation of Kasigau PTSs and Voi sub- PTS Move to Kibezi
14 Jun.	Observation of Kibwezi PTSs Move to Kitui Observation of Tiva PTSs and KEFRI Kitui centre
15 Jun.	Report to Embassy of Japan in Kenya Move to airport and depart to Dubai
16 Jun.	Dubai to Haneda
17 Jun.	Haneda to Hitachi

2. Result of major activities

- 7th JCC Meeting

  The final Joint Coordination Committee meeting (7th) was held on 12 Jun. at the office of Ministry of Environment and Natural Resources. Mr. Takeda, Chief advisor of the project, explained the outline of project activities and results on the project. The both Kenyan and Japanese sides accepted the results and praised the fruitful all activities through much efforts and studies by KEFRI researches and Japanese experts.

  FTBC expressed appreciation for kind cooperation of Kenyan staff to tree breeding research activities and mentioned the outline of tree breeding activities on the new project.

- Observation of experimental sites

  We observed the southern experimental sites on Kibwezi, Kasigau and Voi.

  All PTSs are managed well and almost trees have grown satisfactory. It is found that some trees planted in 2014 in Kibwezi have less growth, which can be seen in the restricted area.

  Stem and branch pruning was being carried out in Melia seed orchard of Kibwezi. It was

observed that KEFRI CP personnel guided workers how to cut and prune the branches appropriately. The pruning had been already carried out in Melia orchard of Kitui. It seemed that the cutting would be just light or mild.

As Acacia seed stands, almost trees are needed to be supported with poles to growth straight up, however, some trees can be expected to grow straight up spontaneously.

- Courtesy call to Embassy of Japan in Kenya with Mr. Takeda and Mr. Narumi

  Mr. Kawato expressed our appreciation for attendance of Ambassador to the project international conference held on Feb. 2017 and explained that all activities of the project have progressed well and the results was praised from Kenyan and Japanese sides. Mr. Uesawa, ambassador of the embassy of Japan, praised much efforts of Japanese experts, Mr. Takeda and Mr. Narumi, and also suggested that a long term technical cooperation could be required in Kenya and the project activities should be continued.

- Other Issues

  CADEP project, Capacity Development Project for Sustainable Forest Management in Kenya, has started since Jun. 2016, and “Tree Breeding Activities” is going to join to the CADEP project as a component after finishing this project.

  The activities of tree breeding in CADEP have been discussed with Kenyan and Japanese sides and it was agreed that the component should consist of 3 main activities, improving Melia (continue), study on artificial crossing of Melia (new study) and improving Acacia (continue) at a meeting held on 25 May. It is obvious that the appropriate management of Melia seed orchards and progeny test sites are most important subjects to achieve the tree breeding activities and it, therefore, must be considered how to reduce the maintenance cost and manage them appropriately and efficiently.

Photo

1.JCC meeting (explanation of project activities and results from Mr. Takeda)

.2. Kibwezi Melia Seed Orchard (fruits)

.3. Kibwezi Melia Seed Orchard
(stem and branch pruning)

.4. Kibwezi Melia Seed Orchard

5. Kibwezi Acacia Seed Stand
(planted 2015)

6.Kibwezi Melia PTS (planted 2014)

9.Kibwezi Melia PTS (planted 2015)

10. Kasigau Melia PTS (planted 2014)

10. Kasigau Melia PTS (planted 2015)

11. Voi Sub-PTS (planted 2015)

11.Tiva Melia Seed Orchard
(stem and branch cut)

12. Tiva Acacia Seed Stand
(planted 2015)

15. Tiva Acacia Seed Stand

16. Tiva Melia PTS (planted 2014)

17. Tiva Melia PTS (planted 2015)

Appendix 5 Training in Japan

Appendix 5-1 Training in Japan 2012

Appendix 5-1-1 Report on Training in Japan (DNA analysis)

1. Outline of training course

(1) Name of course "DNA analysis for Kenya tree breeding project" (J1221696)

(2) Period From July 4th 2012 To Aug 24th 2012

(3) Participants Mr. Joseph Mwangi MACHUA, Mr. Stephen Fredrick OMONDI (two participants)

2. Results

(1) Achievement

- Trainees obtained necessary skills of DNA analysis such as identification of microsatellite markers.
- Substantially trainees got understandings of the genomic DNA extraction, a couple of PCR method, clonig, plasmid DNA extraction, sequencing reaction and etc.
- Trainees successfully identified 144 of microsatellite SSR markers of *Acacia tortilis* by themselves.
- Trainees got a handle on the sequencer manipulation.
- Trainees got a handle on tissue culture propagation.
- Trainees studied many relative issues of tree breeding and understand the importance of DNA analysis for tree breeding activities.

(2) Main contents

Period	Contents	Organization
July 5 ~6	Briefing, meeting about project activities	FTBC
July 9	Presentation by trainees	FTBC
July 10~13	Tissue culture, DNA extraction	FTBC
July 17~Aug 3	Development of SSR marker	FTBC
Aug 5~6	Courtesy call to FFPRI	FFPRI
Aug 7~10	Development of SNP marker	FTBC
Aug 13 ~15	Progeny test field observation	FTBC
Aug 16~23	SSR marker screening	FTBC
Aug 24	Final presentation and evaluation	FTBC

3. Evaluation

(1) Composition

In order to economize the training time, the training curriculum skipped basic lecture based on trainees' back ground experience. Lecturers tried to compose ideal curriculum, and to combine laboratory experiments and its description for each step. Although much effort as above, due to time constraints this course could not cover all of necessary issues

of DNA analysis. This course may resume next year. Also much useful information written by Japanese may be translated and provided to trainees.

(2) Involvement

This course is designed as OJT like curriculum, thus trainees were involved very much. As a fact, during the course, trainees could identify SSR markers by themselves.

(3) Facilities

FTBC provides necessary facility to the trainees. Lecturers use latest model of apparatus such as multi channel pipette. Using such a sophisticated tool much speedups their experiment, but has some potential risks. Because, once technician mishandles a tool, for example holding a pipette with unacceptable angle, it may critically affect to the result of experiments. Trainees should understand this kind of basic mechanisms if they want to introduce same type of apparatus.

(4) Training materials

Lecturers prepared necessary materials for training course. Trainees satisfied those preparation. In addition, there are a lot of good reference information written in Japanese. The project may translate some of them, and provide to KEFRI.

(5) Selection of trainee

Responsible counterparts are selected as trainees, and they are earnest, and have a good patience. If they continue making steady efforts of skill up, they may obtain necessary skills of DNA analysis.

(6) Application of training result

This course dedicated for rapid skill up of DNA analysis because of sequencing machines will be provided by Japanese Grant Aid in 2012. Lecturer will be dispatched and instruct trainees again in Kenya.

(7) Environment of trainee

FTBC doesn't facilitate any accommodation for trainees, thus trainees rent a room in a hotel in Takahagi city. They suffered lacking of kitchen facility and are fed by boxed lunch every day. The other hand, trainees tried to communicate with local residents, and enjoyed local festival and so on.

(8) Other remarks

In order to accelerate SNP marker identification, large size deciphering may be applied by using next generation sequencing technology. With preliminary data of chloroplast DNA, trainees can focus on the target area and proceed SNP identification by using equipped sequencer.

Appendix 5-1-2 Report on Training in Japan (Tree Breeding Project Management)

1. Outline of training course

(1) Name of course: "Tree Breeding Project Management for Kenya tree breeding project" (J1221790)

(2) Period: From August 6th 2012 To August 10th 2012

(3) Participants: Director of KEFRI, Dr. Ben Chikamai (one participant)

2. Results

(1) Achievement

- Director met board members of FFPRI and other high ranking officers of Japanese government who are responsible for the project implementation. They exchanged their view of forest sector of Kenya and the importance of mutual cooperation.
- Director studied many relative issues of tree breeding activities and re-acknowledged the application of the tree breeding project in Kenya.

(2) Main contents

Period	Contents	Organization
August 6 ~7	Courtesy call to FFPRI, FTBC, JICA-HQ, MAFF-Forestry Agency	FTBC
August 8~10	Field trip to observe tree breeding activities	FTBC-Kansai

3. Evaluation

(1) Composition

Even thought short term period of training course, Director could meet many distinguished people in this field, and could observe actual tree breeding activities in Japan. Also he observed the other training courses of the project and confirmed the effectiveness of the trainings.

(2) Involvement

Director fully enjoyed the training course with eager interest, and even more he made a presentation at the international seminar in FTBC.

(3) Facilities

FTBC provided necessary facilities for the fulfillment of the training course.

(4) Training materials

Not so many but necessary training materials are prepared by lecturer.

(5) Selection of trainee

Trainee is the project director.

(6) Application of training result

This course dedicated for project management skill. Director could communicate with key person in Japan. Also he was introduced tree breeding activities in Japan.

(7) Environment of trainee

Trainee didn’t face to any difficulty of staying in Japan.

(8) Other remarks

None.

Appendix 5-1-3 Report on Training in Japan (Tree Breeding Management)

1. Outline of training course

(1) Name of course "Tree Breeding Management for Kenya tree breeding project" (J1221698)

(2) Period From July 23th 2012 To August 10th 2012

(3) Participant Dr. Gabriel Mukuria MUTURI (one participant)

2. Results

(1) Achievement

- Trainee met board members of FFPRI and other high ranking officers of Japanese government who are responsible for the project implementation. They exchanged their view of forest sector of Kenya and the importance of mutual cooperation.
- Trainee met all of JICA experts and lecturers of FTBC.
- Trainee observed most of key techniques of project implementation.
- Those information will be helpful for discussing project activities among project members.

(2) Main contents

Period	Contents	Organization
July 23~24	Lecture and exercise of physiological analysis	Kyusyu Univ
July 25~Aug 3	Lecture and field exercise of tree breeding	FTBC-Kyusyu
August 6 ~7	Courtesy call to FFPRI, FTBC, JICA-HQ, MAFF-Forestry Agency	FTBC
August 8~10	Field trip to observe tree breeding activities	FTBC-Kansai

3. Evaluation

(1) Composition

Training curriculum contained general information lectures of tree breeding, information exchange with Japanese side key persons of project implementation, and observation tour to the actual tree breeding activities in Japan. It helped trainee to understands and obtains necessary perception of the project management.

(2) Involvement

Trainee attended the training course with eager interest, and made a presentation at the international seminar in FTBC.

(3) Facilities

FTBC provided

(4) Training materials

Lecturers prepared and provided necessary training materials.

(5) Selection of trainee

Trainee is the project manager.

(6) Application of training result

This course dedicated for project management skill. Trainee could communicate with all of FTBC researchers and engineers who are appointed as JICA experts, and key persons of FPRI, JICA and MAFF-FA as well. Also he was introduced tree breeding activities in Japan.

(7) Environment of trainee

Trainee didn’t face to any difficulty during his stay in Japan.

(8) Other remarks

None.

Appendix 5-1-4 Report on Training in Japan (Tree Breeding Theory)

1. Outline of training course

(1) Name of course "Tree Breeding Theory for Kenya tree breeding project" (J1221596)

(2) Period From July 4th 2012 To August 11th 2012

(3) Participant Mr. Jason Gathirwa KARIUKI, Mr. David Kimani MUCHIRI (two participants)

2. Results

(1) Achievement

- Trainees studied basic theory of tree breeding.
- Trainees and FTBC staff who appointed JICA expert discussed project implementation directory.
- Trainees exercised basic components of tree breeding such as plus tree selection, clone bank, scion garden, seed orchard, progeny test field. More over they studied phenological analysis, wood market and so on.

(2) Main contents

Period	Contents	Organization
July 5~6	Briefing, meeting with experts	FTBC
July 9	Presentation by trainee	FTBC
July 10~13	Lecture and exercise on Breeding theory	FTBC
July 17~20, Aug 3, Aug 8	Exercise on breeding, observation of breeding application (wood market)	FTBC-Tohoku, FTBC
July 23~24	Lecture and exercise of physiological analysis	Kyusyu Univ
July 25~Aug 29	Lecture and field exercise of tree breeding	FTBC-Kyusyu
July 30 ~Aug 2	Lecture and exercise on subtropical species tree breeding	FTBC-Iriomote
August 6~10	Preparation of project implementation, course evaluation	FTBC

3. Evaluation

(1) Composition

Training curriculum consists from general guidance of tree breeding activities, basics of breeding theory, field exercise of tree breeding, scientific analysis, and field observation of tree breeding application.

Training on application theory such as statistical evaluation of breeding value will be conducted next year.

(2) Involvement

Trainee attended the training course with eager interest, and self-evaluated their achievement. Most of lectures and exercises are including many practices with questions and answers session.

(3) Facilities

FTBC provided necessary facilities for trainees. Mostly trainees stayed at the hotel nearby.

(4) Training materials

Lecturers prepared and provided necessary training materials.

(5) Selection of trainee

Trainees are the main staff member of the project, and in charge of tree breeding section of KEFRI. They are responsible for the seed orchard construction.

(6) Application of training result

This course dedicated for obtaining tree breeding theory. Trainees had to start seed orchard construction just after the training, and at the result, it shows reasonable progress.

(7) Environment of trainee

Trainee had some problem with meals during their stay in Japan. Also they said that they enjoyed but somehow it was difficult to communicate with local people in Japan.

(8) Other remarks

None.

Appendix 5-1-5 Report on Training in Japan (Tree Breeding Technology)

1. Outline of training course

(1) Name of course "Tree Breeding Technology for Kenya tree breeding project" (J1221697)

(2) Period From July 4th 2012 To July 28th 2012

(3) Participant Ms. Mary Wambui MWANGI Ms. Frouza Mwende MAINGI (two participants)

2. Results

(1) Achievement

- Trainees studied basic technology of tree breeding, especially grafting propagation and nursery management.
- Trainees and FTBC staff who are appointed as JICA expert discussed project implementation directory.

(2) Main contents

Period	Contents	Organization
July 5~6	Briefing, meeting with experts	FTBC
July 9	Presentation by trainee	FTBC
July 10~13	Lecture and exercise on Breeding technology	FTBC-Tohoku
July 17~20	Field trip to private nursery and man-made forest management	FTBC-Tohoku
July 23~24	Lecture and exercise of physiological analysis	Kyusyu Univ
July 25~Aug 29	Lecture and field exercise of tree breeding	FTBC-Kyusyu

3. Evaluation

(1) Composition

Training curriculum consists from general guidance of nursery management and propagation techniques. Lectures and exercises are mixed and matched alternately in order to keep trainees interest. Each subject covers large range of techniques, therefore lecturers tried not to concentrate the lectures in one time.

(2) Involvement

Trainee attended the training course with eager interest, and self-evaluated their achievement. Most of lectures and exercises are including many practices with questions and answers session.

(3) Facilities

FTBC provided necessary facilities for trainees. Mostly trainees stayed at the hotel nearby.

(4) Training materials

Lecturers prepared and provided necessary training materials.

(5) Selection of trainee

Trainees are the in charge of nursery management section of KEFRI. They are responsible for the grafting propagation for seed orchard construction.

(6) Application of training result

This course dedicated for obtaining nursery management and grafting propagation skill. Trainees had to start grafting propagation of candidate plus trees just after the training, and at the result, it shows reasonable progress.

(7) Environment of trainee

Trainees had some problem with meals during their stay in Japan, but they could managed

(8) Other remarks

Non

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

Genetic Research

FFPRI/TBC

Machua, Joseph
Omondi, Stephen

Examples Forest molecular genetic studies at KEFRI

1. Genetic Diversity of some *Melia volkensii* populations based on RAPDS markers
2. Genetic Diversity of *Brachylaena huilensis* populations based on RAPDS Genetic Diversity of some *Jatropha curcus* populations based on RAPDS
3. Genetic Diversity of some Acacia senegal populations based on SSRs and RAPDS
4. Genetic Diversity of some *Prosopis juliflora* populations based on RAPDS Genotyping of improved *Eucalyptus grandis* lines based SSRs

KEFRI human capacity for forest genetic studies

- 1 PhD - Scientist
- 2 Msc Scientist
- 1 PHD student
- 3 Msc Students
- Two molecular genetics technicians

KEFRI laboratory capacity

Basic equipment

- PCR machine
- Refrigerators and freezers (-20, 4°C)
- Electrophoresis systems
- Gel documentation system
- Phytotrons for Tissue Culture
- Glashouses
- Data analysis techniques

Broad Objective

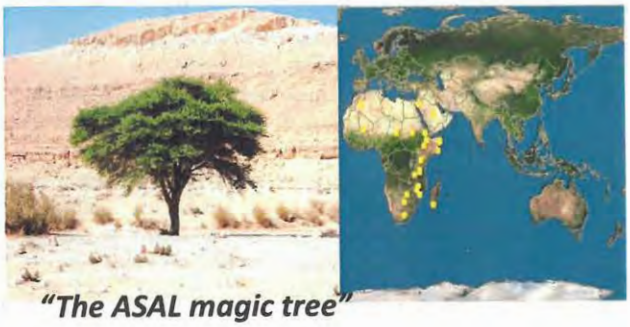
Melia volkensii

Increase drought tolerance

TISSUE CULTURE

Clonal multiplication of the plus trees

Acacia tortilis



"The ASAL magic tree"

Broad Objective
Acacia tortilis

Understand the genetic diversity to enable selection plus trees for improvement of livestock fodder and enhanced drought tolerance

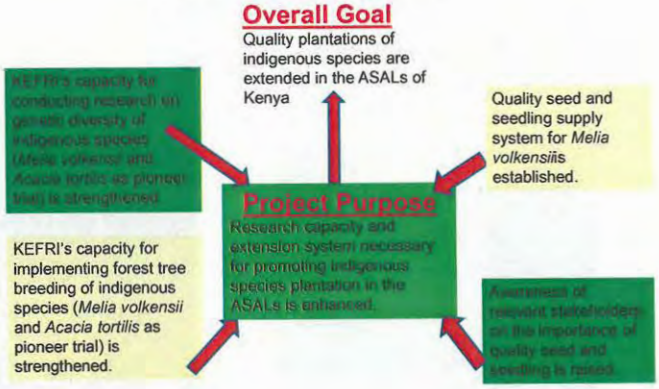
Candidate Plus Tree (CPT) Selection for fodder

Project implementation

Project plan of operation (PO)
MELIA PROJECT¥PO_Kenya_0320.xlsx

Project design Matrix PDM
PDM_Kenya_0320.docx

PROJECT DESIGN MATRIX



Thank you

Arigatoō gozaimasu

Development drought tolerant trees (*Melia volkensii* and *Acacia tortilis)* for adaptation to climate change (Breeding component)

J. Kariuki,
D. Muchiri,
Mary W.,
Frouza M

IMPACT OF CLIMATE CHANGE TO FORESTRY

Climate change is already forcing most tree species and plant associations to adapt either through shifting habitats, changing life cycles, or the development of new physical traits such height.

Climate change may also lead to alterations in the range, distribution and population density of many plants.

Climate change is also expected to significantly alter Kenya's forest diversity as species struggle to adapt to changing climatic conditions.

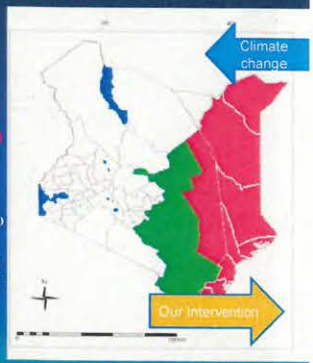
In general, those species with restricted climatic envelopes (such as *Melia volkensii* -Mukau), small populations and limited ability for dispersal are most likely to suffer in the face of rapid climate change.

Introduction

- *Melia volkensii, (Mukau)* belongs to the family Meliacea and is endemic in drylands of East Africa.
- *Melia* is fast growing and tolerant to drought conditions
- *Melia* is valued for both its timber and non-timber products such as sawn timber, and poles 1994)
- *Melia* has been overexploited due to its high quality timber and termite resistant poles.
- Habitat fragmentation and loss of the species natural population is also on the increase especially in the highly settled areas.
- Melia is now the candidate species for dryland rehabilitation and plantation development
- Selection and Breeding for high yielding varieties is high on demand

Justification

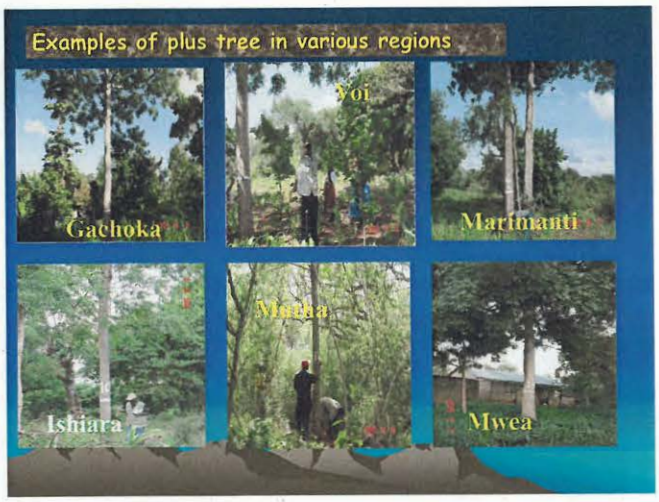
- Development of drought tolerant varieties of Melia through selection and genetic modification is necessary for improving its adaptability in the target areas.
- The developed varieties are expected to extend Melia's range of growth and increase its adaptability to effects of climate change.
- Melia grows in agroclimatic zones IV and V However, the breeding for Melia is expected to extend it to the harsher agroclimatic zone VI.
- Improved Melia varieties can also be used for carbon sequestration to mitigate the effects of climate change and for carbon credits.

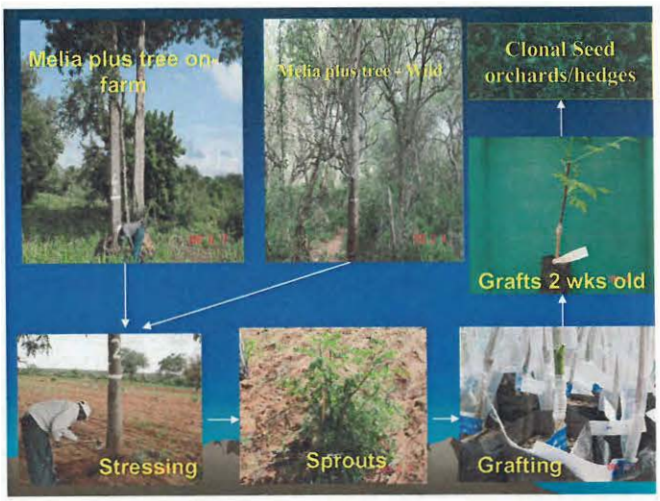


Sites and transects used for selection of Melia plus trees

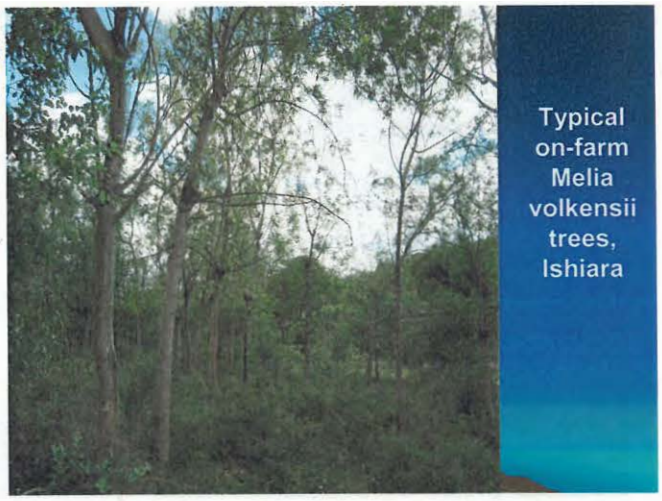
Table 1: Distribution of plus trees of *M. volkensii* in various regions of Kenya

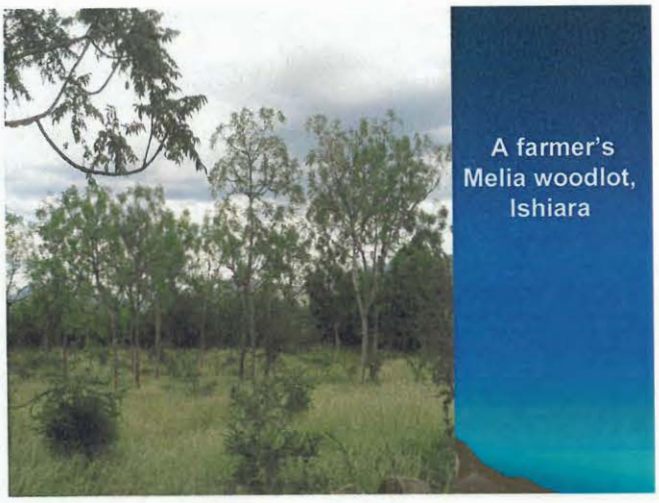
No	TRANSECT	Region	N plus trees
1	Voi – Taveta	Coastal	8
2	Mutha - Inyali	South Eastern	12
3	Kavisuni - Katulani -	Central Eastern	7
4	Mwingi - Tseikuru	Eastern	8
5	Mwingi - Nuu	Eastern	7
6	Embu - Ishiara	Eastern	7
7	Siakago - Gachoka	Eastern	8
8	Isiolo-Kina-Tharaka	Northern	7
9	Mwea Special	Central	1


Examples of plus tree in various regions
Gachoka
Voi
Marimanti
Ishiara
Mutha
Mwea

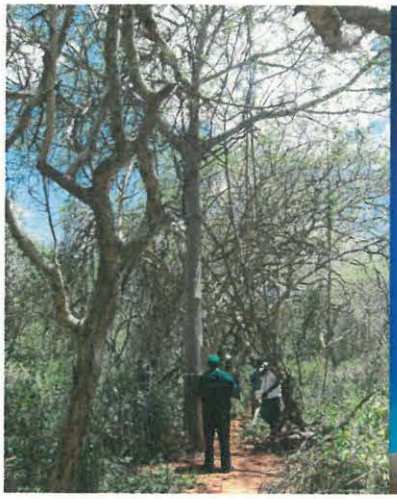

Melia plus tree on-farm
Melia plus tree - Wild
Clonal Seed orchards/hedges
Grafts 2 wks old
Stressing
Sprouts
Grafting


Typical Melia trees on farm, Tseikuru


Typical on-farm Melia volkensii trees, Ishiara


A farmer's Melia woodlot, Ishiara


Melia volkensii plus tree in Homestead, Mbeere

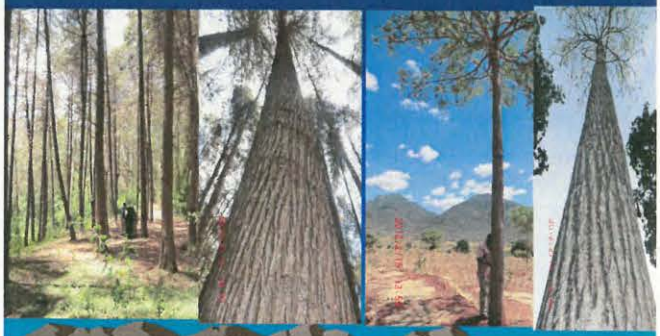


Melia volkensii select tree in the wild, Mutha

- 10 year old Melia tree, Mwea
- 47.2 cm DBH
- (1.5m circumference)

Cypress plantation at Museve Hill (Kitui central) planted with selected materia

Mukau (Melia) plus trees selection in Tharaka



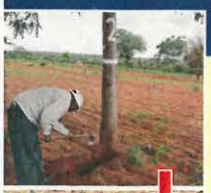
Overall Goal

- To develop drought tolerant tree species of for adaptation to climate change.

Project objectives

- To enhance KEFRI'S capacity to undertake 'state of the art' breeding
- To screen drought tolerant trees and select candidate plus trees
- Establish clonal seed orchards for *Melia volkensii* and seedling seed orchard for *Acacia tortilis*
- To undertake genetic diversity of *Melia volkensii* and *Acacia tortilis*
- Disseminate the result to farmers and other stakeholders

Selection and multiplication of plus trees



- Develop selection criteria for drought tolerance
- Select preliminary drought tolerant trees
- Collect seed for testing and root stock
- Undertake nursery and greenhouse screening trials and identify tolerant trees
- Collect seed and scions from the most drought tolerant trees

PROJECT PLAN OF OPREATION (PO)

PO_Kenya_0320.xlsx

PROJECT DESIGN MATRIX

Overall Goal
Quality plantations of indigenous species are extended in the ASALs of Kenya

KEFRI's capacity for conducting research on genetic diversity of indigenous species (*Melia volkensii* and *Acacia tortilis* as pioneer trial) is strengthened.

Quality seed and seedling supply system for *Melia volkensiis* established.

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

KEFRI's capacity for implementing forest tree breeding of indigenous species (*Melia volkensii* and *Acacia tortilis* as pioneer trial) is strengthened.

Awareness of relevant stakeholders on the importance of quality seed and seedling is raised.

Project Outputs

- Genetic structure and diversity of candidate species identified and mapped
- Selection and screening for drought tolerance of candidate species undertaken
- Massive Clonal propagation undertaken
- Clonal orchards of drought tolerant candidate species established
- Seedling seed orchard established for *A. Tortilis*
- Training of farmers and other stakeholders on the use of superior germplasm of drought tolerant species

Mandate of Participants

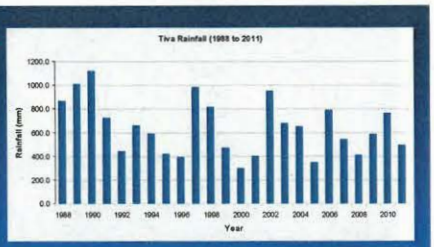
- SEE ATTACHED MSWORD: Plan…

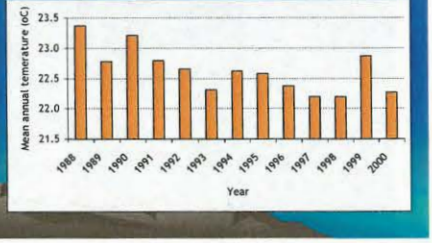
Background information on nursery

- The nursery site for raising rootstock seedlings was established at Kitui Research centre.
- A total of 8,000 Melia was sown in February 2012.
- Soils are obtained from forest sites and mixed with sand and also fertilized. The soil is fumigated to kill all unwanted microorganisms, potted in 4x6 tubes in readiness to transplanting. The soil: sand mixture is 3:1 and 1kg DAP/tonne

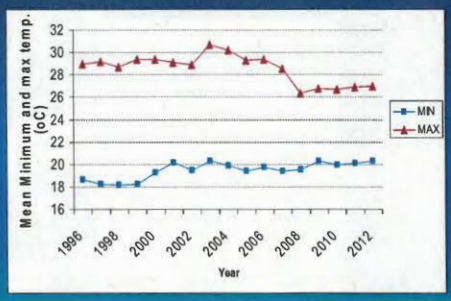
Description of Kitui Site

- Kitui is one of the planting sites for the seed orchard. The planting season is in October/November or December when there is enough rain
- The main wheather conditions of Kitui are as shown
- The planting season for Kibwezi is similar to the Kitui timing
- Seed orchards to be planted in KEFRI land of Government University land for a start





Kibwezi temp data



Timing of Nursery Activities

- December-January – Soil collection
- February- Soil treatment, seed collection and processing
- February/March- Seed sowing and transplanting into tubes
- August/September – Scion collection/ Grafting
- October/November - Planting

Thank you

Tree Breeding Theory Training in Japan
Japan 4th July – 10th August 2012

Training Report

Kariuki J. G. **Muchiri D. K.**
Kenya Forestry Research Institute, Nairobi

FTBC Forest Tree Breeding Center

JICA

INTRODUCTION

- The background to the training held in Japan – Project on '***Development of Drought tolerant trees for adaptation to Climate Change' in Kenya***'.
- One of the Project objectives is '***To enhance KEFRI'S capacity to undertake 'state of the art' breeding***'
- To achieve the objective, short-term trainings are to be held in Japan on various aspects related to the Project.
- The training reported in this presentation was on 'Tree Breeding Theory" held between 5th July 2012 and 10th August 2012
- Training had 3 main components
  - Core Lectures – Mainly held at FTBC 10th – 13th July
  - Field Visits:
  - Practicals – Both at FTBC and Field
- Discussions of New Project

1: *Core Lectures*

- Lectures were held everyday from 10th August 2012 to 13th August 2012
- The topics covered included a wide range of issues that are relevant to implementation of the new project:
- LEC 1: Evaluation and selection of plus trees based on quantitative genetics
  - ✓ Mass selection
  - ✓ Quantitative genetics principles and estimation of genetic parameters- h2, BV, GCA, GxE interaction
  - ✓ Evaluation and selection of plus trees – Use of breeding values, GCA, various forward and backward selection methods were studied
  - ✓ Short vs long term breeding and the need to balance gain and breeding value

LEC 2: Use of REML in Tree breeding

- Calculation of BLUP in linear mixed models and advantages over linear models as ANOVA such as:
  - Efficient handling of missing values,
  - Calculation of Breeding values
  - Use in backward selection
  - Use in calculation of G/E interactions
  - BLUP calculates the breeding value

LEC 3: Forest Tree improvement in Japan

- The lecture dealt in detail with tree improvement practice in Japan
  - Forest types, area and species distribution
  - Wood demand
  - Main objectives of improvement for *C. japonica*: Growth, hardiness, pollinosis

- Zonation of tree improvement: 5 zones and differences in climate and therefore species emphasis
- Main steps in Tree improvement from
  - Consideration of current state and decision making on focus of target species and traits to improve eg of Cryptomeria
  - selection of candidate trees, Orchards, Progeny tests, deployment of material and subsequent generations
- Establishment of seed orchards
  - Collection of scions and when/position to collect
  - Design and management of orchards (cutback, fertilizer hormone treatment disease control
  - Seed Supply, (59 orchards in Kanto) Miniature orchards
- Detailed Progeny testing procedure
  - Different types according to objectives and may include advance generation breeding, genetic evaluation
  - Deployment of improved material

- Mating designs
  - Open pollinated, Polycross, single pair mating (not good for estimation of parameters), diallel and factorial designs
- Field design: Normal tests and genetic tests
- Provenance testing
- Data Analysis
- Advanced generation breeding
  - Use of controlled crossing
  - Use of diallel and factorial designs
  - Early selection using individual BV
  - Wood testing

LEC 4: Propagation

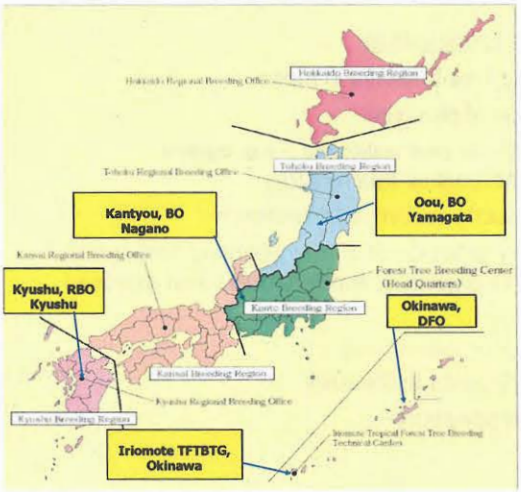
- **Goals of Tree breeding in Japan**
- **Selection of plus trees**
- **Selection for pest resistance – e.g. against *Bursaphelenchus mucronutus***
- Seed purity testing and research
- Nursery practice at FTBC: Seedling and clones, potted vs bareroot; Nursery pests and diseases
- Grafting:
  - Stock: Scion matching
- Nursery pests & diseases
- Mass propagation

- Scion collection procedures, including timing, proper labelling, storage; Q: best time for collection for Melia?
- Seed collection, sowing, soils fumigation, nursery bed preparation

LEC 4: New methods for pedigree and individual management in seed orchards & trial sites

- Review of steps in tree breeding, emphasising importance of accurate data collection
- Possible stages where mistakes occur in data collection and documentation from scion collection to assessment
- Examples of mistakes in handling of documentation
- Accurate Management of pedigree and evaluation using DNA fingerprinting at FTBC (Time constraints)
- Challenges of contamination
- Current methods of documentation: – Waterproof label, number tape
- New methods: - PDA (Personal digital assistants and RFID (radion tag

FIELD VISITS



Site Visit areas

RBO: Regional Branch Office;

BO: Branch Office

OOU BRANCH OFFICE OF TOHOKU

Activities observed

- Gene conservation- protected species of Cryptomeria and demonstration of scion garden with C. japonica
- Miniature size seed orchard of *Cryptomeria japonica*
- Clone bank –snow pressure resistant varieties of *Cryptomeria japonica*
- Less pollen varieties of *Cryptomeria japonica* with 56 clones

- Plus trees of *Pinus thunbergii*
- Plus trees of Cryptomeria japonica
- Breeding orchard -Plus trees of C. japonica
- Foundation stock garden maintained at 1.3 m

NAGANO BRANCH OFFICE

- Established in 1957 as Kanto Forest breeding station
- Currently is a branch office of FTBC
- Area -33.29Ha
- ALT.920-1050M
- Conducts forest tree improvement /forest tree breeding for Japanese larch
- Other spp- *Abies homolepis, A. veltchi etc*
- *Plus tree trees preserved here include Japanese larch,spruce, Korean pine, shirabe fir and Uraziro fir*

Types of activities

- *gene conservation- area 12.95 ha*
- Clone bank 5 ha
- Breeding orchard 7 ha
- Trials 0.72ha
- Wind break 3.41ha
- Nursery 0.66ha

- Marigold cultivated to kill wilt in soil in rotation of 4yrs

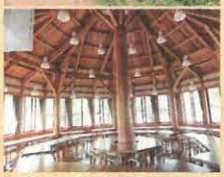
4 blocks 1 every year with marigold.

- Marigold also used as mulch
- European red pine trial for wilt resistance .seedlings raised from seedlings
- Collaboration with finish institute for wilt problem
- Increase in temp increase wilt activity
- Wilt dispersed by insects like long horn beetle

WOOD UTILISATION SITES

WADA PRIMARY SCHOOL

- Wada village population - 2,500
- Rebuild school in 1998 by use of wood in Japanese traditional post and beam technology
- 130 Japanese larch trees and 12 Japanese cedar were used
- Solar air heating system is applied for heating in winter
- Student population in year 2004-Class 1-6 is 109, Teachers 18


ZENKOUJI BUDDHIST TEMPLE

- Over 1000 old
- Strong wooden beams and post used.
- Joints no nails used



M-wave stadium

- Used for winter Olympics
- Inner roofing made of wood reinforced with metal



KYUSHU UNIVERSITY

- A presentation was made on

Evaluation of drought tolerant Melia volkensii using physiological parameters

- Discussions held on implementation of new project in Kenya
- Objective
  - Evaluation of drought tolerant Melia using physiological parameters
  - Identification of physiological related with drought tolerance of *Melia volkensii* and its application to breeding operations

Activities to achieve objectives

- Studies on Leaf morphology and nutrient characteristics
  - Leaf morphology –Leaf size, specific leaf area, water content, stomata size and density
  - Leaf nutrient- Nitrogen content and chlorophyll content

Leaf phenology and stem growth phenology

-Leaf flushing, leaf fall and stem growth pattern

- ***Leaf and twig water relations***

-Comparison of water conductance- transpiration

-Comparison of leaf water parameters- Pressure volume curve method

Practical lesson/demonstrations carried out on -

- Leaf area measurements
- Photosynthesis measurements
- Water potential measurements


KYUSHU REGIONAL BREEDING OFFICE

- General outline including development of new varieties for timber, pine wilt resistance
- Area has tropical and subtropical areas
- High Production in forest products of Sugi
- Highest natural distribution of sugi is in Kyusyu-Yakushima island
- 15 permanent staff
- 10-20 temporary staff
- 4 departments- General affairs division, Breeding Division, Genetic resources Division and Technical advice office

Activities

1.Execution of tree breeding program for timber production

-Selection and propagation of candidate clones for advanced generation

2.Development of pine wilt nematode resistant varieties

3.Development of pollen free or lesser pollen variety of Sugi and Hinoki

Amakusa cooperative of forest owners

- Membership 7000
- Karimata area not suitable for rice crop farming. Mountanous
- This favour tree seedling production
- Local variety of Sugi planted in shrines
- 3 farmers are producing saplings from root cuttings
- Number of producers is decreasing due low demand and youth not taking up the enterprise.

Visit within station

- Hedge
- Crossing garden,
- Sugi conservation stand
- Orchard
- Nursery
- Innoculation site

- NB Large scale farmers producing over 500,000 seedling their children take up the business. Less than 10,000 they refuse
- Price of timber decreasing e.g. 10 yr ago,1m sold at 1000 yen. Today 1m sell at 100yen due to free trade policy of importing cheap timber
- Nursery owners are contracted by forest owners to produce seedlings to plant in cut areas
- Price of resistant pine 400 yen

Melia azaderach in Minohara area

- Used for Furniture and indoor work
- 1m^3 sells at 200,000 yen
- 3 Planting densities – 3000, 5000 and 7000
- Management aims at producing straight stems through
- High density
- Removal of lateral bud
- Pruning. Trees that have poor form are cut to coppice. Best coppice is left to mature
- Annual growth is 5m/yr
- Canker is a major problem on branches and are easily broken by wind

Iriomote island site

Island is 29,000 ha, forests are 90%, pop 2330 and 350,000 tourists per year

Major component is international cooperation

Theme from 2011 to 2015

- 1- Breeding research about functional trees at amami and sakisima islands
  - Inter- and intraspecific variation of traits concerning *Nothapodytes foetida* and *N. amanianus*
  - Establishment of propagation technology concerning Cinchona
  - Breeding study about wind tolerant calophyllum inophyllum trees II Development of superior Acacia hybrid and promotion of evaluation method
- 2- Examination of pollen storage
  - Comparative test of acquired seedlings between reciprocal crossing
  - Investigation of initial growth of hybrid

Major Trees grown

- Cinchona planted at Iriomote island 70 years ago
- Cut down when malaria disease spread around the island
- Bark of cinchona trees contains anti-malaria drug
- Eucalyptus spp
- Acacia spp used for timber, Truck flooring and pulp
- Callophylum inophylum
- Casuarinacea

OKINAWA DISTRICT FOREST OFFICE

- Two main forests-
  - Okinawa-12,000 ha
  -Iriomote-24,000ha. Protected ecosystem and research
- High diversity of flora and fauna
- No direct management of forest
- rented to US Army for training ground
-Rented to Okinawa prefec. Governt

Tropical Dream Centre

- A collection of tropical and subtropical plants planted and conserved here
- A good site for tourism

JAPAN HOUSING AND WOOD TECHNOLOGY CENTRE

- Timber strength testing centre for construction industry
- Preservation of very old log of different species.
- Preservation done under controlled conditions – temp and humidity
- Japanese cedar over 500 yrs

CHUGOKU MOKUZAI WOOD PROCESSING FACTORY

- Largest wood processing company in Japan
- Imports wood from USA
- Factory machines fully automated
- Activities
  - Timber processing
  - Drying kilns
  - Lamination – Douglas fir and Cryptomeria
  - Production of wood chips for pulp and paper
  - Utilization of saw dust and bark for generation of power
  - 60% of wood produces timber
  - 40%chips, bark, saw dust
- **NOTHING GOES TO WASTE**