Kenya Forest Service

A Study Guide for

Farm Forestry Field Schools

Compiled by
Jane N. Ndeti
Shinji Ogawa
J. M. Kimondo
P. M. Kariuki
Shinji Abe
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PREFACE

The development of this guideline has been necessitated by the challenges posed in the preparations of technologies within the framework of Farmer Field Schools (FFSs) weekly meetings. A number of groups have carried out some of these activities in the past and therefore found the first edition of the Guideline rather too confining with very few alternatives. While the authors anticipated that both the foresters and the farmer facilitators would go out of their way to include and try other technologies not in the first edition, this was not realised and groups kept to the few Participatory Technology Development (PTDs) that were prescribed. Further, a number of FFS have come on board whose main thrust is in nursery enterprises. Technologies in tree nurseries were not provided in the first edition. Finally the importance of Income Generating Activities (IGA) cannot be overemphasised. For sustainability of the graduating FFS, Intensified Social Forestry Project (ISFP) realised the need to incorporate an IGA on bee keeping as part of the learning process.

The guideline therefore has three major areas. These are the Farm Enterprises which is the backbone of FFS methodology and mainly refocuses on the enterprises highlighted in the first edition. The second part deals with the nursery issues. These are subdivided into four subsections for the purpose of clarity and simplicity. They include the seed bed stage that deals with the sowing of seed and their management at that level. The next subsection deals with seedling growth stage and what a farmer needs to know to raise health seedlings for own planting and/or for sale. The third subsection deals with an important emerging technical issue of shortening the maturation period of fruit trees on the farm through simple but sequential steps of learning the best way of grafting mangoes. Finally the fourth subsection deals with the nursery management issues of how to ensure that the developing seedlings do not only survive but also develop into material that shall survive in the field and are not interfered with by factors that could easily be avoided.

The guideline emphasis is on self guiding as it is written in simple straight forward language for both technical staff as well as the farmer facilitators. The implementation of this guideline shall go along way in improving the performance of the different groups and shall greatly provide diversity of options for the farmer field schools not only in the ISFP project area but in other areas as well.
ACKNOWLEDGEMENTS

The authors would like to thank the District and Divisional Forest Extension Officers from Kitui, Mbeere and Tharaka districts for their enormous contribution in ideas and suggestions during the information sharing workshops. These contributions formed the main basis for improving the earlier version of the guideline therefore making it more practical and field oriented. We owe our special thanks to the many members of different Farmer Field Schools who silently demanded for alternative enterprises, a challenge that was taken very seriously by the project management team. We salute them all and hope that they shall find the revised edition of more use even after the termination of the project.

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1. Farm Enterprises
1 (a) *Melia Volkensii* / Other Potential Timber Species Planting in Agricultural Crop Land

In this trial you will test the effect of overall increase in income from a unit area of land by introducing high value timber tree species in your agricultural farming system. You shall compare the yield of three different varieties of maize/sorghum/millet.

**Materials**

Implements for land preparation and cultivation, supply three varieties of maize/sorghum/millet seeds and pigeon peas seeds, seedlings of *Melia volkensii* and other identified potential timber species, tape measure, ruler, sticks, string, note books and pencil.

**Procedure**

1. Select a piece of land measuring 35m by 25m with relatively uniform soil characteristics on a flat or gently sloping area. This land should be provided by one member of the group – host farmer.

2. Prepare the land by clearing of bushes and shrubs before the rain season starts. The land should also be ripped using oxen plough to increase infiltration of rainwater.

3. Select and stake out with sticks the rest of the plot (30m by 20m) in small six plots of 10m by 10m before the rains start as shown in the layout below:

   ![Diagram](image)

4. Dig tree planting holes measuring at least 30cm by 30cm wide and 30cm deep and at a spacing of 10m by 10m.

5. Before the onset of the rains, identify where seedlings of *Melia volkensii* or the other identified potential timber species are available, purchase and deliver them near the planting site.

6. Sow three different varieties of the following crops including the common one: maize, sorghum and millet in each small plot of 20m by 10m at the same spacing and density as recommended by agriculturists for the area.
7. Plant pigeon peas in the strip of 2.5m surrounding the plot. This will be done to ensure that the whole plot is protected from animals for a long period even after harvesting the food crops.

8. After the onset of the rains, plant the tree seedlings of *Melia volkensii* or the other identified potential timber species in the five small plots (one plot should be left to act as control) as early as possible so that they can take advantage of the rains for a long period.

9. Weed the plot according to normal farming practice. Oxen ploughs should be used to plough the land between crops to improve water infiltration and its subsequent conservation.

10. At regular intervals during the season, monitor crop and tree growth i.e. tree survival, tree damage, tree height, crop length, number of life and dead leaves and record the observation of at least three maize plants of each variety within the plot of 20m by 10m. Observe pest and disease both in trees and crops.

11. When the crops are ready, the group should meet and agree on the day to harvest.

12. From each of the three (3) plots of 20m by 10m harvest carefully each plot separately and measure the yields from each of the sub plots.

Questions to discuss

- Was there a crop yield difference between the three different crop varieties in the small sub plots of 20m by 10m?
- What measures has the group put in place to ensure harvesting is done by the whole group?
- Were there any advantages and/or disadvantages of intercropping trees with food crops noticed probably in the second year?
- What were some the problems encountered in the establishment and management of the trees in the farmland?
1 (b) *Melia volkensii/*other Potential Timber Species Planting in Agricultural Crop Land Using Fertilizer/Manure

In this trial you will test the effect of overall increase in income from a unit area of land by introducing high value timber tree species in our agricultural farming system. You shall compare the yield of maize/sorghum/millet using manure and fertilizer.

**Materials**

Implements for land preparation and cultivation, supply of preferred variety of maize/sorghum/millet and pigeon peas seeds, locally available organic manure, chemical fertilizer, seedlings of *Melia volkensii* or other identified potential timber species, tape measure, ruler, sticks, string, note books and pencil.

**Procedure**

1. Select a piece of land measuring 35m by 25m with relatively uniform soil characteristics on a flat or gently sloping area. This land should be provided by one member of the group.
2. Prepare the land by clearing of bushes and shrubs before the rain season starts. The land should also be ripped using oxen plough to increase infiltration of rainwater.
3. Select and stake out with sticks the rest of the plot (30m by 20m) in small six plots of 10m by 10m before the rains start as shown in the layout below:

   ![Diagram](image)

4. Dig tree planting holes measuring at least 30cm by 30cm wide and 30cm deep and at a spacing of 10m by 10m.
5. Before the onset of the rains, identify where seedlings of *Melia volkensii* or the other identified potential timber species are available, purchase and deliver them near the planting site.
6. Sow the most preferred variety of maize/sorghum/millet in each small plot of 10m by 10m at the same spacing and density as recommended by agriculturists for the area.
During planting apply fertilizer in one plot (2 teaspoonful per planting hole), another plot (two handfuls of manure per planting hole), both fertilizer and manure in a third plot while the other three plots shall be left as control as shown in the layout above.

7. Plant pigeon peas in the strip of 2.5m surrounding the plot. This will be done to ensure that the whole plot is protected from animals for a long period.

8. After the onset of the rains, plant the tree seedlings of *Melia volkensii* or the other identified potential timber species in the five small plots (one plot should be left to act as control) as early as possible so that they can take advantage of the rains for a long period.

9. Weed the plot according to normal farming practice. Oxen ploughs should be used to plough the land between crops to improve water infiltration and its subsequent conservation.

10. At regular intervals during the season, monitor crop and tree growth i.e. tree survival, tree damage, tree height, crop length, number of life and dead leaves and record the observations of at least three plants in each plot of 10m by 10m. Observe pest and disease both in trees and crops.

11. When the crops are ready, the group should meet and agree on the day to harvest.

12. From each of the six plots of 10m by 10m harvest carefully each plot separately and measure the yields from each of the sub plots.

**Questions to discuss**

- Was there a crop yield difference between maize/sorghum/millet in the different sub plots with fertilizer, manure, mixture of fertilizer and manure and the control (one of 10m by10m plot without manure and fertilizer)?
- What measures has the group put in place to ensure harvesting is done by the whole group?
- Were there any advantages and/or disadvantages of using fertilizer or manure on the crop yields?
- Were there any advantages and/or disadvantages of intercropping trees with food crop noticed probably in the second year?
- What were some the problems encountered in the establishment and management of the trees in the farmland?
2. Woodlot for Timber with Agricultural Crops

In this trial you will compare the performance of two timber species planted with agricultural crops at a moderate spacing and also the crop yields during the first one or two years.

Materials

 Implements for land preparation and cultivation, supply of maize/sorghum/millet and pigeon peas seeds, seedlings of species 1 or species 2 as chosen by the group, sticks, tape measure, ruler, string, note books and pencil.

Procedure

1. Select a piece of land measuring 29m by 17m with relatively uniform soil characteristics on a flat or gently sloping area. This land should be provided by one member of the group – host farmer.
2. Prepare the land by clearing of bushes and shrubs before the rain season starts. The land should also be ripped using oxen plough to increase infiltration of rainwater.
3. Divide the plot into two equal plots of 12m by 12m for two (2) tree species before the rains start as shown in the layout below:
4. At the same time, divide the plot into two equal plots of 24m by 6m for agriculture crop testing: compare a new variety of maize against local variety; compare one crop variety with manure against without; or compare one crop variety with fertilizer against without.
5. Stake out the two plots at a spacing of 4m by 4m before the rains start.

![Tree and crop layout diagram]

6. Dig tree planting holes measuring at least 30cm by 30cm wide and 30cm deep.
7. Before the onset of the rains, identify where seedlings of the selected species are available, purchase and deliver them near the planting site
8. Plant pigeon peas in the strip of 2.5m surrounding the plot. This will be done to ensure that the whole plot is protected from animals for a long period after harvesting of crops.
9. After the onset of the rains, plant the tree seedlings of the two selected species as early as possible so that they can take advantage of the rains for a long period.
10. Weed the plot according to normal farming practice. Oxen ploughs should be used to plough the land between crops to improve water infiltration and its subsequent conservation.

11. At regular intervals during the season, monitor crop and tree growth i.e. tree survival, tree damage, tree height, crop length, number of life and dead leaves and record the observations of at least three (3) maize plants in each plot of 24m by 6m. Observe pest and disease both in trees and crops.

12. When the crops are ready, the group should meet and agree on the day to harvest.

13. From each of the two plots of 24m by 6m harvest carefully each plot separately and measure the yields from each plot and compare the yields.

14. Compare the survival and height of the two tree species selected.

Questions to discuss

- Was there a crop yield difference between the two different plots?
- Was there any difference in tree height and survival between the two selected species in year one and year two?
- Were there any advantages and disadvantages of intercropping each tree species with food crops?
- What were some of the problems encountered in the establishment and management of the woodlot?
3(a) Woodlot for Poles and Firewood
In this trial you will compare the performance of two wood fuel species planted with agricultural crops at a close spacing and also the crop yields during the first one year.

Materials
Implements for land preparation and cultivation, supply of pigeon peas and beans / green grams seeds, seedlings of species 1 or species 2 as chosen by the group, sticks, string, tape measure, ruler, pencil and note books.

Procedure
1. Select a piece of land measuring 29m by 17m with relatively uniform soil characteristics on a flat or gently sloping area. This land should be provided by one member of the group – host farmer.
2. Prepare the land by clearing of bushes and shrubs before the rain season starts. The land should also be ripped using oxen plough to increase infiltration of rainwater.
3. Divide the plot into two equal plots of 12m by 12m for two (2) tree species before the rains start as shown in the layout below:
4. At the same time, divide the plot into two equal plots of 24m by 6m for agriculture crop testing: you may compare a new variety of maize against local variety; compare one crop variety with manure against without; or compare one crop variety with fertilizer against without.
5. Stake out the two plots at a spacing of 3m by 3m before the rains start.
6. Dig tree planting holes measuring at least 30cm by 30cm wide and 30cm deep.
7. Before the onset of the rains, identify where seedlings of the selected species are available, purchase and deliver them near the planting site.
8. Plant pigeon peas in the strip of 2.5m surrounding the plot. This will be done to ensure that the whole plot is protected from animals for a long period after harvesting the food crops.
9. After the onset of the rains, plant the tree seedlings of the two selected species as early as possible so that they can take advantage of the rains for a long period.
10. Weed the plot according to normal farming practice. Oxen ploughs should be used to plough the land between crops to improve water infiltration and its subsequent conservation.

11. At regular intervals during the season, monitor crop and tree growth i.e. tree survival, tree damage, tree height, crop length, number of life and dead leaves and record the observations of at least three (3) maize plants in each plot of 24m by 6m. Observe pest and disease both in trees and crops.

12. When the crops are ready, the group should meet and agree on the day to harvest.

13. From each of the two plots of 24m by 6m harvest carefully each plot alone, measure the yields from each of the plot and compare the yields.

14. Compare the survival and height of the two tree species selected.

**Questions to discuss**

- Was there a crop yield difference between the two different plots?
- Was there difference in tree height and survival between species 1 and species 2 after one and two years?
- What were some the problems encountered in the establishment and management of the woodlot?
- Were there any advantages and disadvantages of intercropping each tree species with food crop?
3(b) Woodlot for Poles and Firewood

In this trial you will compare the growth of planted wood fuel species in wood lot and native wood fuel species in natural stands of firewood collection area.

Materials

 Implements for land preparation and cultivation, supply of pigeon peas and beans/green grams seeds, seedlings of one favourable wood fuel species as chosen by the group, sticks, string, tape measure, ruler, pencil and note books.

Procedure

1. Select a piece of land measuring 17m by 17m with relatively uniform soil characteristics on a flat or gently sloping area. This land shall be provided by one member of the group.
2. Prepare the land by clearing of bushes and shrubs before the rain season starts. The land should also be ripped using oxen plough to increase infiltration of rainwater.
3. Mark the inner plot of 12m by 12m.
4. Stake out the inner plot of 12m by 12m at a spacing of 3m by 3m before the rains start as shown in the layout below:

5. Dig tree planting holes measuring at least 30cm by 30cm wide and 30cm deep.
6. Before the onset of the rains, identify where seedlings of the selected species are available, purchase and deliver them near the planting site.
7. Before the onset of rain go to nearby firewood collecting site. Find the small wildlings (one foot or same size as the seedlings to be planted in the wood lot) of commonly used firewood species and mark by paint at least 10 wildlings very well so you can monitor the growth for some years.
8. In the woodlot sow the favourable beans/green grams varieties at the spacing recommended by the agriculturists in the area.
9. Plant pigeon peas in the strip of 2.5m surrounding the plot. This will be done to ensure that the whole plot is protected from animals for a long period.
10. After the onset of the rains, plant the tree seedlings in the wood lot as early as possible so that they can take advantage of the rains for a long period.
11. Weed the plot according to normal farming practice. Oxen ploughs should be used to plough the land between crops to improve water infiltration and its subsequent conservation.

12. At regular intervals during the season, monitor growth of the crop, seedlings and wildlings i.e. seedling survival, seedling damage, seedling height, wildling survival, wildling damage, wildling height, record the observations of at least three (3) beans/green grams plants in the woodlot. Observe pests and diseases in both trees and crops.

13. When the crops are ready, the group should meet and agree on the day to harvest.

14. From the plot of 12m by 12m harvest carefully and measure the yields from the plot.

15. Compare the survival and height of the trees in the woodlot and wildlings in the field.

Questions to discuss

• Was there a crop yield difference between the first and second year?

• Was there difference in tree height and survival between trees in woodlot and wildling in the field after one and two years?

• What were some of the problems encountered in the establishment and management of the woodlot and in monitoring wildling in the field?

• Were there any advantages and disadvantages of managing woodlot and the trees in the field?
4. Fodder Planting for Livestock

In this trial you shall discover the benefits of growing fodder trees on the farm for feeding livestock. Fodder is green vegetation from trees that is harvested and fed to animals without allowing the animals to feed directly on them. This helps to ensure provision of feed to animals during the dry season.

Materials

Implements for land preparation and weeding, supply of seedlings/cuttings of the two selected species and seeds of pigeon peas and beans/green grams, sticks, notebooks, pencil, ruler and tape measure.

Procedure

1. Select a field with relatively uniform soil characteristic on a flat or gently sloping land.
2. The land should be at least 25m by 15m so that two species may be tried on plots of 10m by 10m each.
3. Before the rainy season, clear the land of bushes and shrubs. This should also be ripped using oxen plough to increase infiltration of rainwater.
4. Stake the plots for the planting spots at spacing of 1.50m by 0.75m. Dig the holes of 30cm by 30cm by 30 cm for the planting of the fodder tree species seedlings as shown in the layout below:

5. Before the onset of the rains, identify where seedlings of the selected two species are available, purchase and deliver them near the planting site.
6. Plant beans/green grams between the rows of trees in the two plots uniformly using the spacing recommended by agriculturists for the area.
7. Plant pigeon peas in the strip of 2.5m surrounding the plot. This will be done to ensure that the whole plot is protected from animals for a long period after the food crops.
8. After the onset of the rains, plant the fodder tree seedlings as early as possible so that they can take advantage of the rains for a long period.

9. Weed the plots according to normal farming practice. Oxen ploughs should be used to plough the land between crops to improve water infiltration and its subsequent conservation.

10. At regular intervals during the year, monitor the following in all the plots: i.e. height growth of the planted trees, survival of the trees and the number of branches. Observe pests and diseases in both trees and crops

11. Harvest the crops from all the plots separately and record the yields.

12. When the fodder is ready for harvesting, measure the weight of the fodder harvested in each plot every time in kilograms. Feed the same to specific number of animals and compare with the common animal feeds.

13. Do a cost benefit analysis to evaluate the advantages and disadvantages of growing the two different fodder tree species together with agricultural crops.

Questions to discuss

- Is there any difference in yield i.e. weight of material cut of the two species, what do you think was the reason?
- What are the advantages and/or disadvantages of cutting and carrying the feed to the animals?
- Was there a noticeable health change and milk production among the animals fed on the fodder?
- Was there any species preference among the livestock?
- Were there any problems encountered while introducing the animals to the fodder?
5. Fruit Tree Orchard

In this trial you shall test the performance of different varieties of fruits e.g. mangoes or citrus in terms of size and quality of fruits, the flowering and fruiting time and pest and drought resistance.

Materials

Implements to prepare the land and undertake cultivation, seedlings of different grafted mango varieties, maize/sorghum/millet, pigeon peas and bean/green grams seeds, notebooks, pencils and measuring tapes to be obtained.

Procedure

1. Select a relatively flat field of 26 by 26 metres
2. Before the start of the rains, clear the piece of land bushes and shrubs. This should also be ripped using oxen plough to increase infiltration of rainwater.
3. Mark the points of planting at a spacing of 7m by 7m in 21m by 21m plot so that the plot has 9 fruit trees. Dig the holes of 90cm by 90cm by 90 cm for the planting of the fruit tree seedlings. This is only applicable for mangoes; for the other fruit tree seedlings, use 60cm by 60cm by 60cm as shown in the layout below:
4. At the same time, divide the plot into two equal plots of 21m by 10.5m for agriculture crop testing: you may compare a new variety of maize against local variety; or compare one crop variety with manure against without or compare one crop variety with fertilizer against without.

5. In each hole put a third of a 90kg bag of animal manure. Mix it with the topsoil to fill the hole.
6. Select three appropriate fruit varieties (Mango: Apple, Kent, Ngowe, Tommy Atkinson, and Van Dyke among others.)
7. Before the onset of the rains, identify where the selected varieties of mango fruit seedlings are available, purchase and deliver them near the planting site.

8. Plant the agriculture crops between the rows of fruit trees using the recommended spacing by agriculturists for the area.

9. Plant pigeon peas in the strip of 2.5m surrounding the plot. This will be done to ensure that the whole plot is protected from animals for a long period.

10. Immediately after the onset of rains, plant the three different varieties of mango fruit tree seedlings each in its own row of three trees.

11. Weed the plot according to normal farming practice. Oxen ploughs should be used to plough the land between crops to improve water infiltration and its subsequent conservation.

12. During the growing season also monitor the crop growth rate, count the number of leaves, number of cobs, and record other observations of three (3) maize plants in each plot of 21m by 10.5m. Also observe pests and diseases.

13. At regular intervals, monitor the fruit seedling survival, height and count the number of branches and branchlets of the fruit trees, any pest and disease problems and monitor the time of flowering for each fruit tree species.

14. When the crops are ready, the group should meet and agree on the day to harvest.

15. From each of the two (2) plots of 21m by 10.5m carefully harvest each plot separately and measure the yields from each of the sub plots.

Questions to discuss

- At what time did the different fruit varieties flower and fruit?
- Is there any difference in crop yield in the first and second year? What is the probable cause?
- Which variety among the three performed best?
- What are the advantages and disadvantages of having different varieties of fruit trees?
2. Nursery Enterprises
a. Seed sowing stage
1. Seed pre-treatment using water
The process of germination starts once the seeds have obtained adequate amount of water thus causing the development of the young embryo. The intake of this water varies with species depending on the prevailing condition. In this trial, you are to learn through comparison whether pre-treating seeds with hot water or soaking them in cold water overnight improve their germination.

Treatments are:
- Soak seeds in cold water overnight
- Pre-treat seeds with hot water
- Control (do not soak)

Diagram

![Soaked seeds](image1.png) ![Hot water pre-treatment](image2.png) ![Control (No treatment)](image3.png)

**Duration**
1 Month

**Procedure**
Select a tree species for trial and obtain some seed of the same. Divide some 300 seeds into three equal portions of 100 seeds each. Subject one portion to hot water pre-treatment; soak one portion in coldwater overnight while you leave the other portion untreated. Sow the three portions under similar conditions. Check everyday and water the seedbed when it is dry.

When germination starts, count germinated seedlings from each treatment on a daily basis and prick out.
**Timing**
For slow growing species - December to February and April - May for fast growing species.

**Possible results**
Pre-treated seeds germinate faster.

**AESA parameters**
Number of germinated seedlings and time taken

**Summary table**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Germination</th>
<th>No. germ seedlings</th>
<th>%</th>
<th>Remark</th>
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<tbody>
<tr>
<td>Soaked</td>
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<tr>
<td>Hot Water</td>
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<tr>
<td>Control (No treatment)</td>
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**Question to discuss**
- How many seedlings germinated in each seedbed?
- How many days did it take for the seed to start germinating in each bed?
- How long did it take for germination to end in each seedbed?
- Apart from the time of germination, is there any difference in the characteristics of seedlings?
- What were the advantages and disadvantages of the three different pre treatments?
2. Species germination performance
After sowing of seeds of different species, some will germinate immediately while others shall take time. While delay in germination is not a negative effect, it is necessary for you to know which species germinate fast and those that are slow. This shall therefore guide in the future planning of nursery activities so that seedlings are retained in the nursery for as little time as is necessary to produce a health sturdy stock.

Treatments
The various commonly sown species in the locality shall be divided in two general groups. These are the slow growing and the fast growing and sown in beds under similar conditions in specific parts of the bed.

Diagram

<table>
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<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>W</th>
<th>X</th>
<th>Y</th>
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Fast growing species

Slow growing species

Duration
1 Month

Procedure
A seedbed shall be prepared and divided into four sections. In each section 100 seeds of a single species shall be sown. The whole bed shall have the same soil media, watering regime and cover for shade if applied. The germinated seedling shall be counted and pricked out into the pots.

Slow growing species shall be germinated between December and February while the fast ones shall be sown between April and May.

Possible results
Some seeds may not germinate eventually.

AESA parameters
Number of germinated seedlings
Summary table

a) Fast Growing Species

<table>
<thead>
<tr>
<th>Species</th>
<th>No. of seedlings germinated</th>
<th>No. germ seedlings</th>
<th>Germ %</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
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b) Slow Growing Species

<table>
<thead>
<tr>
<th>Species</th>
<th>No. of seedlings germinated</th>
<th>No. germ seedlings</th>
<th>Germ %</th>
<th>Remarks</th>
</tr>
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<tr>
<td>W</td>
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3. To determine of difference between direct and indirect seed sowing

Seeds can be sown either directly into poly-bags where they are maintained until they are ready to plant out in the field or they can be sown in seedbeds and later pricked out into bags. Normally the procedure used depends on the size of the seed; for very small sized seeds, it is advised that the same are sown in seed beds while the big sized ones can be sown using either methods. This trial has the objective of determining among those large sized seed, the most appropriate method of sowing the seed.

Treatments
Direct and indirect sowing of seed

Diagram

| Indirect Sowing | Direct Sowing |

Duration
2 months

Timing
January - March for slow growing species and May - July for fast growing ones.

Procedure
Take 200 seeds of the same species and divide them into two sets of 100 seeds each. Sow 100 into individual pots and sow the remaining 100 into a seedbed. Subject the seeds to similar watering and shade if any is provided. Give time for germination to take place as observations are made regularly.

Possible results
The germination rate is the same in terms of time it takes for seed in the two treatments to germinate.

AESA parameters
Numbers of germinated seed
The period taken to germinate and
Number of seedlings established.
<table>
<thead>
<tr>
<th>Sowing method</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
<th>Week 7</th>
<th>Week 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct sowing</td>
<td>1 2 3 4 5 6 7</td>
<td>1 2 3 4 5 6 7</td>
<td>1 2 3 4 5 6 7</td>
<td>1 2 3 4 5 6 7</td>
<td>1 2 3 4 5 6 7</td>
<td>1 2 3 4 5 6 7</td>
<td>1 2 3 4 5 6 7</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>Indirect sowing</td>
<td></td>
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</tbody>
</table>
4. Pre-treatment of Mango seed

The mango seeds are normally hard and generally take long to open up and allow germination to take place. As different individual mango nut open up at different times, this results in production of seedlings of uneven sizes and age. In this trial you shall compare the germination rates of mango seeds that are either intact, cut on one side or whose cover has been removed altogether.

Treatment

Treatments are:

- Seed coat removed
- Seed coat cut one side
- Seed coat intact

Diagram

![Seed coat removed](image1)
![Seed coat cut 1 side](image2)
![Seed coat intact](image3)

Duration

1 month

Procedure

Obtain 300 nuts of freshly eaten mangoes, dry them all under shade and then randomly divide them into three portions of a 100 seeds each. For batch 1, remove seed coats completely; for second batch cut one side of the seed coat at the edge but do not remove it; while the third batch shall be left with no pre-treatment. Sow the three batches of seeds under similar conditions. Count germinated seedlings from each batch on a daily basis.
Possible results
Removal of seed coat reduces the germination period.

AESA parameters
Number of germinated seeds and germination period

Summary table

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Germination</th>
<th>No. Germ.</th>
<th>Germ (%)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12 13 14.....19 18 20 21 22 23 24 25 26 27 28 29 30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coat removed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coat cut 1 side</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control No. cut</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Question to discuss

- How many seedlings germinated in each bed?
- How many days did it take for the seed to start germinating in each treatment?
- How long did it take for germination to end in each seedbed?
- A part from the time of germination, is there any difference in the characteristics of the seedlings?
- What were the advantages and disadvantage of the different pre- treatments?
5. Pre-treatment of *Melia volkensii* seed

The germination of *Melia volkensii* seed has remained a real challenge to tree growers. The nuts have to be cracked and the seed taken through a laborious pre-treatment process to realize some germination. In this trial, you will compare a control (no seed pre-treatment) and a full pre-treatment with some intermediate simple pre-treatments that include those that are normally carried out by the farmers.

**Treatments**

- Roasting of the nuts (A)
- Cooking the fruits in the sand (B)
- Burying the fruits in hot ashes (C)
- Cracking of nuts, seed removed and soaked in water (D)
- Cracking of nuts, seed removed, nipped and soaked in water (E)
- Control (F)

**Diagram**

[Diagram showing the treatments A to F]

**Duration**

1 Month

**Procedure**

Collect 600 mature fresh fruits of *Melia volkensii* and remove the pulp. Dry them slightly under shade. Divide the nuts into 6 equal portions of 100 nuts each.

- Batch 1 · Roast the *Melia* nuts on a pan until nuts cracks. Soak the seeds in cold water for 12 hours and sow.
- Batch 2 · Fill a clay pot with sand. Bury *Melia* fruits in the sand, cap and heat the pot for 30 minutes until nuts start cracking automatically with sound. Remove from heat to cool. Soak the seeds for 12 hours and sow them.
- Batch 3 · Bury *Melia* fruits in hot ashes until they crack automatically. Remove from the ashes to cool. Soak for 12 hours and sow.
- Batch 4 · Crack nuts carefully using a small panga, remove the seeds out and soak for 12
hours and sow.

- Batch 5 · Crack nuts carefully by small panga, remove the seed out, nip and soak in cold water for 12 hours and sow.

- Batch 6 · Soak the nuts for 12 hours. Sow nuts as they are (control).

Sow the six batches under similar conditions. Check daily and water the seedbed when it is dry. When germination starts, count and record germinated seedling from each batch and prick out.

Possible results

There shall be variation in germination among the different treatments.

AESA parameters

Number of germinated seeds

Summary Table

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Germination</th>
<th>No Germ.</th>
<th>Germ. %</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 ……19 20 21 22 23 24 25 26 27 28 29 30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
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<td>E</td>
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<td>H</td>
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</tr>
</tbody>
</table>

Question to discuss

- How many seedlings germinated in each bed?
- How many days did the seeds take to start germinating?
- A part from the timing, is there any difference in the characteristics of seedlings?
- What were the advantages and/or disadvantages of these treatments?
6. Effect of seed orientation during sowing on germination - *Melia volkensii*

*Melia volkensii* seeds germinate effectively only after some laborious pre-treatment procedures. This involves the nipping of seed coat, soaking in water overnight and eventually slitting the seed cover. During germination, *Melia volkensii* seeds germinate with their radials protruding in all directions. Whenever the radial is facing upwards, it must be lifted and placed facing downwards for effective development. This therefore causes the posing of the question; should *Melia volkensii* seed be oriented in a specific direction to give good germination?

**Treatments**

Seeds of *Melia volkensii* sowed standing vertically inside the media and seeds laying horizontally on the germination media. No orientation for germinating seed shall be done.

**Diagram**

![Seed vertically placed](image1)

![Seed lying horizontally](image2)

**Duration**

1 Month

**Timing**

July - August

**Procedure**

Take 200 seeds of *Melia volkensii* and pre-treat them by nipping their seed coat; soaking in cold water over night and then slit the seed coat just before sowing them. Divide the pre-treated seeds into two batches of 100 seeds each. Prepare sand media and divide it into 2 seedbeds. Sow one set of seed in one container with all seeds standing vertically upright. Sow the other batch with the seeds lying horizontally. Cover the seeds with sand and water them thoroughly. Ensure all seeds are fully covered in both beds. Cover the containers with polyethylene sheets to maintain moist conditions and high temperatures inside the containers during the germination period.
**Possible results**
The vertically standing seeds give uniform and better germination rate than the horizontally lying seeds.

**AESA parameters**
Number of seeds germinated and the period taken to germinate

**Summary table**

<table>
<thead>
<tr>
<th>Sowing direction</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical</td>
<td>1 2 3 4 5 6 7</td>
<td>1 2 3 4 5 6 7</td>
<td>1 2 3 4 5 6 7</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Horizontal</td>
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</tbody>
</table>
b. Seedling development stage
1. Media effect on seedling growth

In this trial you will learn through comparison the best soil mixture to use in rising seedlings. Some soils have adequate plant nutrients while others are deficient in a number some plant micro nutrients. As a result some soils shall greatly improve with addition of either manure or fertilizers but others will register minimal growth improvement. You will therefore compare the growth of seedlings of the same species in the usual soil on the farm with seedlings grown in the same soil mixed with manure, sand, fertilizer or a combination of the same.

Treatments

These are application of a mixture of:

- Soil(S₁), manure (M), sand(S₂) and fertilizer (F)
- Soil, manure and sand
- Soil and manure
- Soil only

Diagram

![Diagram of soil/manure mixtures](image1)

![Diagram of soil/manure/fertilizer mixtures](image2)

![Diagram of soil/manure/sand mixtures](image3)

![Diagram of soil only](image4)

Procedure

Assemble the materials at the nursery i.e. soil, sand, manure and fertilizer. Mix them into proper proportions. From each mixture, pot 100 containers of equal size. Transplant one hundred seedlings of the same species and size into the four different batches of containers. The pricking out should be done on the same day. All the seedlings should be given the same treatment thereafter as part of the management. Arrange each treatment in one block for easy identification. Observe the performance of the seedlings in each treatment every week and record the observation. Measure the height of all the seedlings in each treatment once a week as shown in the table below:

**Duration:** 2 to 3 months

Summary table

<table>
<thead>
<tr>
<th>Mixture</th>
<th>Parameters at Week</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Height 1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>Girth 1 2 3 4 5 6 7 8 9 10 11 12</td>
</tr>
<tr>
<td>S₁+ M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S₁+M+ F</td>
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<tr>
<td>S₁+S₂</td>
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<tr>
<td>S₁</td>
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</tbody>
</table>
Question to discuss

- Which kind of problems have you observed in each treatment?
- Are there any advantages and/or disadvantages of using either sand, fertilizer or manure in the potting soil?
2. Species performance
Different tree species grow at different rates under similar conditions. However, while many species are suitable for timber production, their growth rates are quite different. As a result some provide the products at an early age than the others.

The objective of this trial is to determine the growth rates of timber producing species at the nursery stage.

Treatments
The species are *Melia volkensii*, *Senna siamea*, Neem.

Diagram

![Diagram of Melia volkensii, Senna siamea, Neem]

Procedure
Assemble 50 young seedlings of relatively uniform size and age of each of the three species: Mukau, Senna and Neem. Subject them to similar growing conditions but specifically ensuring no water logging conditions prevail at any time. Sample 5 seedlings randomly of each species during AESA taking every two weeks.

Duration
3 months

Possible results
Mukau growths fastest, followed by *Senna siamea* and then Neem

AESA parameters
Height of seedlings and the girth

Summary table

<table>
<thead>
<tr>
<th>Week</th>
<th>2&quot;</th>
<th>4&quot;</th>
<th>6&quot;</th>
<th>8&quot;</th>
<th>10&quot;</th>
<th>12&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ht (cm)</td>
<td>Girth (mm)</td>
<td>Ht (cm)</td>
<td>Girth (mm)</td>
<td>Ht (cm)</td>
<td>Girth (mm)</td>
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<tr>
<td>Mukau</td>
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<td></td>
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<tr>
<td>Senna</td>
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<tr>
<td>Neem</td>
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</tbody>
</table>
3. Shade effect
In this trial you shall test the effect of shade on the growth development of different species to determine those species that may require shade and those that can be raised in the open. You shall compare the growth development of seedlings of each species both under shade and under the open sun. The seedlings shall be tested both during the wet season of between March and April, and the dry season of between June and August. The other nursery treatments for the seedlings such as age of seedlings, watering, soil mixture or conditions shall be maintained the same so that the only difference is the shade applied.

Diagram

*Seedlings in the open*  
*Seedlings under shade*

**Procedure**
Stage 1: shading after pricking out for 2 months (March - April)

Place ten seedlings of a specific species under shade and ten in an open area. Observe one week and conclude the result.

Stage 2: shading during the dry season (June - August)

Place ten seedlings of the same species as in the one above under shade and ten in an open area. Water adequately to keep both treatments under the same moisture condition since the trial is for comparing seedlings in the sun and those under shade and not watering frequency (obviously in open area, the seedlings may require more frequent watering)

**Possible results**
In stage 1: Seedlings under the shade will have low mortality rate while in the open area, they will have higher mortality rate.

In stage 2: Seedlings in the open area will have higher growth rate if watered properly while
under the shade they will have retarded growth rate since most tree species require full sunshine to develop properly. The opposite may be true for those species that require shade for good development.

**AESA parameters**

Stage 1: Survival rate

Stage 2: Height, girth, number of leaves, survival and a statement of their growth vigour

**Summary table**

<table>
<thead>
<tr>
<th>Week No</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<th>6</th>
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<tr>
<td>Height (av.)</td>
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<td>No. of leaves (av.)</td>
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<td>Girth (av.)</td>
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<td>Surv.</td>
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</tbody>
</table>

**Graph**
4. Types of seedling bed
There are numerous types of seedling beds in use. However, some are more appropriate for use in different climatic zones than others. In this trial, you are expected to learn the type of bed to use in your area. Two types of beds shall be considered: these are the sunken beds and the raised beds. The other conditions shall be maintained the same, which is, the species, age of seedlings, spacing, size of pots and the watering regime.

Diagram

*Raised seedling bed*  
*Sunken seedling bed*

**Procedure**
Immediately after pricking out, put 50 seedlings into each of these two beds.

**Possible results**
The seedlings in sunken bed are healthy and have high survival rate, while those in raised bed are unhealthy and register low survival rate.

**AESA parameters**
Height, girth, number of seedlings, number of leaves

**Summary table**

<table>
<thead>
<tr>
<th>Month no</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<th>8</th>
<th>1</th>
<th>2</th>
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<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (av.) cm</td>
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<td>Number of leaves</td>
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<td>Number of seedlings</td>
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<td>Girth (cm)</td>
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</tbody>
</table>
It is possible to conclude this test even within a shorter period depending on the growth rate of the species.
5. Use of different water sources
In this trial you are expected to learn through comparison, the most suitable water source for seedling production in your area. It is assumed that in or near your area, you have both a river nearby with fresh water and a borehole, which may be discharging saline water. The main question then is - which water source is ideal for seedling for different tree species?

Procedure
Select 40 seedlings of different individual tree species for each treatment during the dry season. Divide them into two (2) groups and subject them to similar treatments except the watering. One group of seedlings should be watered with river water while the other shall be watered with borehole water. In all cases, equal amount of water shall be applied.

Possible results
Most seedlings require fresh water or water with minimal salinity

AESA parameter
Survival, height, girth

Summary table

<table>
<thead>
<tr>
<th></th>
<th>Fresh water</th>
<th>Borehole water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Month no.</td>
<td>1 2 3 4 5 6 7 8</td>
<td>1 2 3 4 5 6 7 8</td>
</tr>
<tr>
<td>Survival</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girth</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Graph

Height (cm) vs. Month

This trial may also be concluded within a shorter period than eight months depending on the growth rate of the species.
c. Seedling grafting stage
1. Types of grafting
In this trial, you are expected to learn the different grafting techniques for mangoes. The main question shall be; which among the various grafting techniques is more appropriate than the other? Two grafting techniques shall be compared; these are the side or splice grafting and the top or wedge grafting. The other conditions including the size of rootstock, the source and size of scion and the general management of the grafts shall be maintained as similar as possible. For mangoes, the best season for this practice is May. The grafts shall be observed for a period of four (4) weeks.

Diagram

Side grafting

Top/wedge grafting

Procedure
Select 50 rootstock of relatively the same size for two grafting treatments. Acquire 60 scions also of equal size as the root stock from a common source for mangoes. Prepare and graft 25 root stocks using top grafting and the other 25 using side grafting. Observe weekly and count the number of success.

Possible results
Top grafting establishes faster than side grafting

AESA parameter
Number of successful grafts, number of branches developed, girth.
### Summary table

<table>
<thead>
<tr>
<th>Month/weeks</th>
<th>Top grafting</th>
<th>Side grafting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Number of grafts alive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of branches</td>
<td></td>
<td></td>
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<tr>
<td>Girth (cm)</td>
<td></td>
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</tr>
</tbody>
</table>

### Questions to discuss

- Which method was more difficult and why?
- Which method was more successful and why?
- What were the advantages and disadvantages of both grafting techniques?
2. Post grafting management of seedlings

In this trial you are expected to learn through comparisons the most appropriate technique for successful grafting in as far as the covering of the grafts is concerned. The key question shall then be: do we need to cover the newly grafted seedlings with a polyethylene bag?

The treatments in this trial shall be: newly grafted seedlings covered with polyethylene bags and others not covered. The other management practices shall be maintained as similar as possible including the variety of fruits, the grafting technique and all other nursery practices.

Diagram

Covered grafts

not covered

Timing

June- July
**Duration**
21 days

**Procedure**
Graft 50 seedlings of mangoes of the same variety and cover them on top with polyethylene bags. Graft another 50 seedlings using the same batch of scions and root stock and leave them uncovered. Put all the grafts close together such that they are tended together at all times including the watering.

**Possible results**
Covered graft gives better success

**AESA parameter**
Number of successful grafts

**Summary table**

<table>
<thead>
<tr>
<th>No of days</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>21</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<th>7</th>
<th>8</th>
<th>9</th>
<th>21</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of grafts</td>
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</tbody>
</table>


3. Effect of age of root stock on rate grafting success
While undertaking grafting it is often that the rootstock are not available in the nursery. These are consequently obtained from other nurseries, where they are normally remnants from the previous year’s stock (which are generally old) or the newly raised stock, which are most of the times very young and tender. The key objective of this trial is to establish which is the most appropriate rootstock to use for grafting in such situations?

Treatment
Two types of rootstocks of the same species shall be obtained: old and young. These shall be grafted with scions from the same source and grafted using the same technique. For each batch, 20 grafted seedlings shall be prepared. All of them shall be subjected to similar nursery practices.

Diagram

Old rootstock

Young rootstock

Time
June - July

Duration
21 days.

Procedure
Graft 20 old seedlings of mangoes and another 20 young ones using the same batch of scions. Put all the grafted seedlings together but in a manner that is easy to identify each of them. Give the grafts similar nursery management practices.

Possible results
The old seedlings as rootstocks establish better as grafts than the young ones.
AESA parameters
Number of successful grafts

Summary table

<table>
<thead>
<tr>
<th>No of days</th>
<th>Old Root Stock</th>
<th>Young Root Stock</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of day</td>
<td>1 2 3 4 5 6 7 8 ……… 17 18 19 20 21</td>
<td>1 2 3 4 5 6 7 8 ……… 17 18 19 20 21</td>
</tr>
<tr>
<td>Grafts successful</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Graphs
No. of Grafts
d. Nursery management stage
1. Effect of position of seedling in a seedling bed on growth performance
This trial presupposes that the position of a seedling bed has some bearing on the tending and therefore the health of the seedling. The key question then is does the position of the seedling in a bed affect its growth?

Treatment
A total of 144 seedlings of the same species shall be pricked out on the same day into polyethylene tubes/bags of the same size filled with the same soil medium. These shall be arranged in a 12 by 12 arrangement in a bed. The seedlings shall then be subjected to similar tending practices.

Diagram

![Seedlings in a bed](image)

Time
August - November

Duration
3 months

Procedure
After pricking out, arrange the seedlings in rows of 12 until the 12th row. Seedlings in the outer row on all 4 sides shall be considered as being in the periphery while those in the inner 8 by 8 rows shall be considered to be in the middle. Therefore, 80 seedlings are in the periphery while 64 are in the middle.

Possible results
Seedlings at the periphery grow better than those in the middle and therefore, the need to keep changing the position of the seedling in their beds. Farmers will observe the growth variation of
seedlings in different positions.

**AESA parameters**
Survival, height growth, girth

**Summary table**

<table>
<thead>
<tr>
<th>No. of weeks</th>
<th>Seedlings at periphery</th>
<th>Seedlings in the middle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16</td>
<td>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16</td>
<td></td>
</tr>
<tr>
<td>Height (cm)</td>
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<tr>
<td>Girth (mm)</td>
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<tr>
<td>Survival %</td>
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</tbody>
</table>

**Graphs**

- **Height**
- **Diameter**
- **Survival**
2. Effect of fertilizer and manure on seedling growth
The soil in our farms is normally deficient in terms of plant nutrients due to the continuous cultivation of the same. However, this is the only soil available on the farm for raising the forest trees before planting them in the field.

While the growth rate may be negatively affected by lack or limited plant nutrients, addition of the same may improve the growth rate and therefore shorten the nursery duration. The key question in this trial therefore is: is there any effect on the growth rate of seedlings as a result of adding either fertilizers or manure?

**Treatment**
Select 300 young seedlings of the same species, age and in similar container. Divide them into 3 batches. In batch 1 add fertilizer (approximately 5 gm per seedling). In batch 2 add manure (2 handfuls per seedling and then mix thoroughly with the soil and water heavily. Batch 3 shall be left as the control.

**Diagram**

![Diagram showing Fertilizer, Manure, and Control]

**Time**
July - September

**Duration**
3 months

**Procedure**
Put 300 seedlings of relatively the same size in 3 batches of 100 seedlings each. Among the first batch of 100 seedlings, add fertilizer at the rate of 1 teaspoonful per seedling. In the second batch add manure at the rate of one handful per seedling while the third batch shall be left as it is.

Subsequently give similar treatments to the 3 batches

**Possible results:**
The seedlings with fertilizer show immediate high growth rate while the one with manure respond slowly. The control maintains a slow growth rate.
AESA parameters:
Height growth, girth

Summary table

<table>
<thead>
<tr>
<th>Weeks</th>
<th>1</th>
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<th>4</th>
<th>5</th>
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<th>Remarks</th>
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<td>Fertilizer Ht (m)</td>
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3. Watering frequency

The common believe among tree growers in the ASALs is that water is the main limiting factor to raising of healthy seedlings in the dry areas. As a result there is a general tendency of over watering of seedlings in such situations, at times causing retarded growth or death of seedlings. This is especially so among the *Melia* (Mukau) seedlings. Consequently as tree growers, you need to know how frequently you should water the seedlings of different species.

**Treatment**

Treatments involving different watering frequency shall be applied. These are:

- Water once daily
- Water twice per week
- Water once per week

**Diagram**

- Seedlings watered once per day
- Seedlings watered twice per week
- Seedlings watered once per week

**Duration**

4 month

**Procedure**

Select 150 seedlings of the same species that are relatively young and of the same size. Divide them into 3 batches of 50 seedlings each.

Seedlings in batch 1 are to be watered once daily, batch 2 to be watered twice a week while batch 3 shall be watered once a week. All other nursery practices should be maintained the same for all the three batches. For example you shall use the same water source, seedlings put in pots of same size and watering must be done properly and at the same time (either evening or morning for all seedlings whenever it is done).

**Possible results**

Farmers shall be able to establish the most appropriate watering frequency through observations and comparing the different seedlings.
**AESA parameters**

Height growth, girth, survival

### Summary table

<table>
<thead>
<tr>
<th>Week No.</th>
<th>Height (cm)</th>
<th>Girth (mm)</th>
<th>Survival (%)</th>
<th>Remarks</th>
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</table>
4. Effect of root pruning on growth of seedlings

Root pruning involves the cutting back of roots of seedlings that normally develop beyond the confines of the container. It is done to ensure that the seedlings do not get established in the nursery. Therefore it remains easy to shift seedlings in the nursery from one point to the other including taking them to the field during planting. However, this operation interferes with the normal growth of the seedlings. Consequently, considering that it is essential that sturdy seedlings of the right size must be raised in the nursery, the key question is, is it necessary to root prune?

Treatment

After pricking out 100 seedlings into polyethylene bags, two groups of 50 seedlings shall be identified. The first 50 shall be subjected to root pruning whenever the roots develop beyond the confines of the container while the other batch of 50 seedlings shall be left with no disturbance. Other nursery operations shall be maintained in a similar manner as much as is practical. During weeding of seedlings not to be root pruned, the containers should not be lifted as this causes the roots to be severed.

Diagram

![Seedlings not root pruned](image1)

![Root pruned seedlings](image2)

Duration

4 months

Possible results

The farmers shall learn through observations the effect of root pruning on seedlings (if possible, the 2 groups of seedlings should be followed up in the field to observe their growth, establishment & survival.

AESA parameters

In the nursery: Height, girth
In the field: Survival, height growth
<table>
<thead>
<tr>
<th>Week No.</th>
<th>Height (Cm)</th>
<th>Girth (mm)</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Root pruned</td>
<td>Root not pruned</td>
<td>Root pruned</td>
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<td>1</td>
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</tbody>
</table>
3. Beekeeping Enterprises
Beekeeping
Beekeeping is one of the most important enterprises, which produces honey and other products and income in the short term (2 to 3 times a year depending on seasonal conditions). For learning purpose, the following PTDs, special topics, procedure and AESA can be considered.

Possible PTD

- Type of hive: Langstroth hive, Traditional log hive or Kenya Top Bar (KTP) hive
- Importance of Wax: With wax sheet or without wax sheet
- Hive wood Material: Cypress, Pine, Grevillea, Mukau, Commiphora
- Catcher site: Natural forest, plantation forest, open site, on farm
- Catcher height: On the Tree, On the ground
- Hive: Hanging or Sitting
- Pollination effect for crop e.g. beans: With bees and without bees
Possible Special Topic

a) Vegetation and Flowering plants:

At the beginning of the enterprise, you can ask members to carry out a detailed survey of all flowering plants around the site including crops e.g. Acacia, Eucalyptus, Beans, Sun flower so that they can understand the existing vegetations or resources which will benefit the bees. Since nectar and pollen are the principal diet for bees, it is good for farmers to understand which kinds of flowering plants are available in the area. Through long term AESA observation on flowers, farmers may realize and appreciate the importance of existing vegetation especially forest resources.

Procedure

Start preparing in February or August. March or September is good season for Beekeeping because intensity of sunlight is highest in March & September. March is also flowering season of many acacia trees.

Site selection and Preparation

Place for apiary should be far from human activity such as their homesteads and grazing areas. The site should have shade for hives and free from weeds and bushes, which will attract ants or other enemies.

Colonization

Initially start with only the Brood Box (without Super Box) in the apiary. When the time of bee swarms in the area start (usually end of March), hang or put the hives on the trees at the height of 2 to 3 m the usual height the traditional hives are hung. This is because swarms of usual bees fly at that height in the air. If natural forest is close to your place, you can hang the box temporarily in the forest to catch bees.
Transferring colonised hive to the permanent site and the first inspection:
After 2 weeks, put down the hive at the apiary and conduct the first practical/open hive inspection. If the colony has been developed less than 4 frames out of 10 to 11, you can conclude that it is a weak colony. In this case release the queen and hang hive again to catch another swarm. If more than 5 frames are occupied, you can conclude it is a strong colony and you can continue with the colony. Whether a colony is strong or weak will depend on the queen’s capacity but if you leave weak colony for a long time, this will attract wax moth which destroys colonies.

Weekly AESA observation (Visual Inspection)
Visual observations should be conducted during weekly AESA sessions. The following parameters are important to be considered:

General Site Observations:

- Cleanliness or sanitary condition: Weeds/ grasses
- Activeness of bees: Whether bees are flying in and out actively
- Pests and Enemies around:
  - Ants (Preventable by hanging hive with wire smeared with grease)
  - Big Beetles (Reduce the size of entrance holes in hive)

Others Surrounding Environment Analysis:

- Availability of Flowers: Flowering Plants, Species, Quantity
- Availability of Water: Source (Rivers, Ponds, Others), Distance

Information on which month different kind of flowers are available in the area or the phenological data of the different tree species collected by the groups will be a very good source of information for new farmers who want to start beekeeping and even for researchers.
An example of AESA sheet is as follows:

### Beekeeping AESA Chart

<table>
<thead>
<tr>
<th>Name of FFS:</th>
<th>Sub-group:</th>
<th>AESA No.</th>
<th>Week No.</th>
<th>Date:</th>
</tr>
</thead>
</table>

#### General Information
- Type of Hive: 
- Date of Colonization: 
- Date of putting Super Box 1: 
- Date of putting Super Box 2: 
- Age of Colony (weeks): 

#### Practical Inspection Data (Monthly)
- No. of Frames Occupied in Brood Box: 
- No. of Frames Occupied in Super Box 1: 
- No. of Frames Occupied in Super Box 2: 
- Occupied Frames Increased since last AESA: 

#### Visual Observation Data (Weekly)
- Weather: 
- Temperature: Very Hot/Medium/Cool
- Time of Observation: 
- Activeness of Bees:
  - Beehive 1: 
  - Beehive 2: 
  - Beehive 3: 
- Weeds/Grasses: 
- Pest/Diseases: 

#### Flowering Plants
- Species (Trees, Graps, etc): 
- Quantity (Plenty/Medium/Few): 

#### Water Availability
- Source (Rivers, Ponds, etc): 
- Distance (km): 
- Quantity (Plenty/Sufficient/Little): 

#### Observations
1. 
2. 
3. 
4. 
5. 

#### Recommendations
1. 
2. 
3. 
4. 
5.
**Monthly inspection**

Conduct practical open hive inspection monthly. Wear bee suits properly, use smoker to reduce aggressiveness of bees. Open hives to inspect pests and diseases, count how many frames are occupied by colony. For monthly AESA, both visual & practical open hive inspection data should be recorded. Practical AESA parameters are as follows:

- Colony assessment:
  - Number of frames occupied
  - Pests and enemies in the Hive
  - Diseases

If you found that all frames in brood box are fully occupied during monthly inspection and many
flowers are around, put queen excluder and super box on the top of brood box. Only honey will be stored in the super box since queen will not be able to lay eggs in the super box. If you found all the frames in the first super box are occupied and again many flowers are around, you can add 2nd super box for increased honey production.
Intensified Social Forestry Project in Semi-arid Areas

FOREST DEPARTMENT
P.O. BOX 30513, NAIROBI, 00100 KENYA
TEL: +254-20-3761487
FAX: +254-20-3764723
E-mail: isfp@forestry.go.ke
Web: http://www.isfp-fd.org