



MODULE
NO.

7

TEA RESEARCH

Institute of Tanzania



Eucalyptus Tree Nursery in East Usambara



Tree plants ready for transplanting

TRAINING MODULE
ON
FUEL WOOD PRODUCTION

MAY2005

FOREWORD

This is the seventh of a series of Training Modules prepared by the Tea Research Institute of Tanzania (TRIT). The first was on Rehabilitation of abandoned Tea fields, the second on Fertilizer and manure, the third on Tea plucking and Quality control, the fourth on Weed control in Tea bushes, the fifth on Establishment and Management of Tea Nurseries and the sixth on Tea Pruning and Tipping. The performance of tea sector depends on a sustainable mechanism which will contribute to provision of a renewable and fairly reliable source of energy to both, the tea factories and smallholders.

Fuel wood production may lead to utilisation of poor land unsuitable for tea cultivation or other crops. As a result, may increase smallholder family's income after selling firewood to the nearby tea factories. Besides, fuel wood plantations prevent soil erosion and degradation in steep slopes and hence, will safeguard the environment in the tea districts.

This module is meant for tea factory authorities, tea smallholders to take practical initiatives to plant fuel wood trees as a renewable and fairly reliable source of energy.

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TRAINING PROGRAMME

INTENDED FOR: Tea Estate Managers, Technical staff and smallholder farmers
NUMBER: Maximum 20 participants per session
OBJECTIVES: As a result of this two days module the technical officers will be able to :

1. Fully understand the techniques and procedures of raising, in the nursery, good quality eucalyptus and black wattle seedlings which are strong and vigorous with a well balanced shoot of fibrous root system for planting out in the field for fuel wood production and pass the knowledge to farmers.
2. Encourage smallholder tea growers to establish fuel wood plantations and harvest firewood for sale to nearby tea factories in order to increase the family's income, utilize poor land not suitable for tea or other crops and have enough firewood and timber for domestic use.
3. Take practical initiative to persuade smallholder tea farmers to plant fuel wood trees in order to prevent soil erosion and degradation in steep slopes to safeguard the environment in the tea districts.
4. To encourage tea factories to continue using eucalyptus and black wattle fuel wood as a renewable and fairly reliable source of energy.

CONTENTS:

- A.. 1. EUCALYPTUS (GUMS) PLANTATIONS
2. NURSERY PRACTICE AND TECHNIQUES
3. FIELD ESTABLISHMENT

B. BLACK WATTLE (*Acacia mearnsii*)

1. SEEDS
2. RE-ESTABLISHMENT
3. FELLING, STACKING AND EQUIPMENT
4. PROTECTION OF THE PLANTATIONS
5. **RECORDS**

C. FUEL WOOD PRODUCTION IN RUNGWE DISTRICT

METHOD OF DELIVERY:

The course is participative and designed to:-

- Provide a comprehensive balance between theory and practice.
- Visits to nearby fuel wood plantations will be an important aspect of the course
- Participants will be able to attempt theory and practical confidence building exercises.

INTRODUCTION

In the present economic climate low yielding tea fields become an economic burden rejuvenation or total replanting of tea fields can in some cases reverse the economic disadvantages. The current availability of high yielding clones means that the output of a bigger tea plot could be produced from a smaller tea area. Some of the tea areas can therefore go out of production, it is reasonable to eliminate tea areas which are disadvantaged by poor soil, steep slopes, poor accessibility danger of water logging or other similar factors. It is however, important to have some alternative activities of these plots, in view of the pressure for land in many tea districts in the country. An alternative activity that becomes essential is fuel wood plantations

Every tea estate and smallholder tea grower has a need for fuel wood. There must be enough for domestic use (timber and firewood) by all residents and nearby homesteads to ensure that tea pruning are allowed to remain in the tea field after pruning. Factories have used wood fuel for many years. Others have used oil or coal. The established big tea estates have their wood fuel supplies from own fuel wood plantations. The smallholder tea growers usually plant trees for their own use as firewood, timber or poles. It is desirable for extension officers to advise smallholders that they should plant enough trees to meet all their domestic requirements without using tea pruning.

There are a variety of species which are suitable for planting as fuel wood. Several species of eucalyptus are highly favoured. Other fuel species grown are black wattle (*Acacia mearnsii*) which also produce bark sold for tanning extracts, cypress and *grevillea robusta* also produce timber and rubber trees produce rubber products

This module has been prepared for trainers or facilitators to conduct theoretical and practical sessions to farmers and tea estate managers on establishment of fuel wood plantations.

The guidelines are also developed for subject matter specialists, supervising officials and trainers of field staff to facilitate the training of front line extension and development agents. Some chapters need to be tailored to meet the education level of target groups and in house rules of particular companies.

This training module provides techniques and procedures in raising good quality eucalyptus and black wattle seedlings in the nursery and management practices of the tea plantations.

The topics are presented in chapter form to facilitate understanding the course materials. These include:

- Instructions for course organizers, trainers and trainees (Presented in annex 2, 3 and 4).
- Three chapters containing theoretical and practical materials on management of eucalyptus and black wattle tree nurseries and efforts being taken by WATCO in collaboration with TRIT in planting fuel wood trees in Rungwe..
- Exercises, Planned visit, Action plan, Idea sheet and Course Evaluation (Presented in annex 5, 6, 7, 8 and 9 respectively)
- References are presented in annex 1

Although considerable material has been provided, the trainer must base on the participants' existing knowledge to decide on the appropriate subject matter, practical, visits etc., before conducting the courses.

The main text of the first two chapters could be used as background material for the trainer but is also suitable for reproduction as handouts which could preferably be given out at the end of each session. Chapter three is an example to copy.

EUCALYPTUS PLANTATIONS (GUMS)

TYPES OF EUCALYPTUS

There are over 600 species of eucalyptus (gums) which are provenance in Australia. Some of these species are *E. Saligna*, *E.grandis*, *E. maidenii*, *E. butryoides*, *E. bicostata*, *E.pellita*, *E.camaldulensis*, *E.tereticornis*, *E.paniculata*, *E. punctata*, *E. propinqua*, *E.cloeziana*, *E. pilulera*, *E. radiata*, *E. calophylla*, *E. ficifolia* and so on.

The taxonomy or classification of these species is based on the following characters:-

- i. Flower structure (anther groups)
- ii. Leaf size, shape and venation
- iii. Number, arrangement and attachment of the fruit capsules
- iv. Size, shape of the capsules and their lids
- v. The number of the capsules valves
- vi. The nature of the bark

Bark characteristics play an important role in determining the vulnerability of different species to fire damages:-

- i. Smooth barks – The bark is smooth throughout or most of the tree length e.g. *E grandis* and *E. saligna*
- ii. Half barks – The bark is partly rough and partly smooth in appropriately equal proportions e.g. *E. radiata* and *E. butryoides*
- iii. Flaky barks – The bark is rough and persistent on the stem and branches, chips off in plate like flakes e.g. the ornamental type's *E. calophylla*.
- iv. Iron barks – The bark is rough, deeply furrowed and somewhat corky e.g. *E. paniculata*.

Use depends on type of eucalyptus, that is for: _

Paper and pulp
 Fibre boards
 Veneer and plywood
 Tanning extracts
 Wood distillation
 Kinols and ratin
 Human food
 Essential oils

Telegraphic/electricity poles
Charcoal
Woodfuel

The calorific value (percentage measured by Bomb calorimeter), the rate of growth and wood conformation are important considerations in determining which species of eucalyptus to grow. For drying tea in the factories using wood fuel, it has been found that for every 3 hectares of tea will require one hectare of fuel wood plantation (Ratio 3:1). Due to the small sizes of the smallholdings the smallholders require fuel wood species which can be grown in tea fields, along the hedges, boundaries or roadsides without adversely affecting the tea plants and other crops. The wood fuel is a bulky commodity it should be produced within reasonable distances in order to keep its prices down, especially by large estates. Wood fuel is a renewable resource, if the wood fuel plantations are managed properly can be available perpetually.

The eucalyptus species commonly grown in East Africa for fuel wood and timber are *E. grandis* and *E. saligna*. The two species could be differentiated as follows:-

characteristics	<i>e. grandis</i>	<i>e. saligna</i>
Bark	Smooth white/silvery Sometimes greenish	Smooth bluish Sometimes greenish
Buds	Larger with a bluish bloom	Small with less bloom
Roots	Swellings (lignotubes) Absent	Swellings (lignotubes) Present
Fruits	Bluish bloom, valves predominantly 5	No bloom, valves predominantly 3 - 4


SEED PRODUCTION

- i. **Seed production** – Eucalyptus seed production increases with age. The average tree produces one kg of seed and chaff per year (one kg of seed will produce about 140,000 plants.) Pollination is predominantly by insect.
- ii. **Seed collection** – Only ripe capsules are collected from trees with desirable characteristics. The capsules are spread on a flat surface in a still dry warm place and stirred for 7 to 10 days at regular intervals. Sieve out the capsules and store seed in a cool dry place in woven fabric bags.
- iii. **Seed viability** – Seed viability is to a very large extent influenced by the following:-
 - (a) Storage temperatures – the lower the better
 - (b) Moisture levels – the lower the better

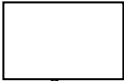
iv. **Seed storage** – Dry the seeds well, then store in insect proof containers at low temperature, humidity and light. At $1^{\circ} - 4^{\circ}\text{C}$ ($33.8^{\circ}\text{F} - 39.2^{\circ}\text{F}$) seeds will remain viable for 8 – 10 years.

NURSERY PRACTICE AND TECHNIQUES

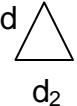
- (a) **Why a fuel wood nursery?** The need for a fuel wood nursery arises because plants are required; therefore, assessment of the correct state of eucalyptus plantations is essential. Assess the following:-
- Coppiced eucalyptus plantations-for infilling and inter-planting where spacing is wide and plant population is low.
 - Newly planted eucalyptus plantations for infilling to replace dead and dying plants
 - Potential land – for new eucalyptus planting
- (b) **Planning** – Plan the number of plants needed that is locality, hectares and spacing.

- i. Square planting  d is distance: $\frac{10000}{d^2}$
 Spacing (1) $2.5\text{m} \times 2.5\text{m} = 1600$ plants/ha

- (2) $2.2\text{m} \times 2.2\text{m} = 2066$ plants/ha
 (3) $1.8\text{m} \times 1.8\text{m} = 3086$ plants/ha

- ii. Rectangular and contour planting  d $\frac{10000}{d \times d_2}$
 d and d_2 are distances

- Spacing: (1) $2.5\text{m} \times 1.5\text{m} = 2667$ plants/ha
 (2) $2.0\text{m} \times 1.8\text{m} = 2778$ plants/ha
 (3) $2.74\text{m} \times 1.37\text{m}$ ($9' \times 4.5'$) = 2664 plants/ha

- iii. Triangular (equilateral) planting  $\frac{11547}{d^2}$

- Spacing:: (1) $2.5\text{m} \times 2.5\text{m} = 1848$ plants per hectare
 (2) $2.2\text{m} \times 2.2\text{m} = 2386$ plants per hectare
 (3) $1.8\text{m} \times 1.8\text{m} = 3564$ plants per hectare

Add 20% mortality level in all cases. Remember, fresh seeds have a higher viability level than old seeds. Use Tetrapoline chloride (TTC) to determine viability.

(c) Nursery

- i. Nursery site – Topography – Slightly sloping (5%)
 - Soils - Well drained and friable
 - Frost - Frost free area
 - Wind - Not vulnerable to strong winds
 - Accessibility - Easily accessible for ease of transport and other operations
 - Water - Availability of water (piped water) if possible
 - Security - Safe area from vermin and vandalism
 - Location - Western facing site preferred.
 - Trees - should not be over shadowed

- ii. Nursery size – The required size of the nursery can be determined by the number of plants the farmer needs to plant in a specified size of the eucalyptus plantation, that is:-
 - Copied eucalyptus plantations for infilling and inter-planting
 - Eucalyptus plantations newly planted for infilling
 - New eucalyptus plantations for new planting + 20% for infilling

Example: Tupege is a widow; she wants to remove the low yielding tea field (2.7ha) and plant eucalyptus. This is the advice of the Tea Technical Officer who assures her that Katumba Tea Factory will buy all her firewood once the eucalyptus are harvested (1) How many plants will she need to plant her 2.7ha? Add 20% for infilling (2) what size of a nursery will she need to produce good quality plants (sturdy plants) with well balanced shoots of fibrous root system? *Note* that her choice of spacing is 1.8m x 1.8m square planting.

- 1. Calculation of plants per hectare is as follows;-
 - Spacing 1.8m x 1.8m (square) = 3.24m²
 - 1 hectare = 10,000m²
 - The number of plants in one hectare will be 10,000m² divided by 3.24m² = 3086 plants per hectare x 2.7ha = 8332 plants

- 2. Add 20% for infilling 2.7ha
 - Planting 3086 x 2.7ha = 8332
 - 20% infilling = 1666
 - Total plants required = 9998
 - Say 10000 plants.

- 3. It is assumed that 1kg of eucalyptus seeds will produce 140000 plants.
 - For producing 10000 plants she will need 140000 plants = 1kg of eucalyptus seed
 - 10000 plants = 0.07kg seed or 70 grams.

4. Sowing seeds in a germination bed.

For one bed 30m long she needs soil + seeds = $\frac{1}{2}$ kg seed to $\frac{1}{2}$ wheel barrow soil (ratio 0.5:0.5)

One wheel barrow = 20 karais

For 0.07kg seed = $\frac{0.07 \times 0.5 \times 20}{0.5 \times 2} = 0.7$ karais

Therefore, 70 grams eucalyptus seeds will be mixed with 0.7 karais of soil.

$$\frac{20}{2 \times 0.7} \text{ karais} = \text{one bed } 30\text{m long by } 1\text{m wide } (30\text{m}^2)$$

$$\frac{0.7 \text{ karais} \times 30\text{m}^2}{10 \text{ karais}} = 2.1\text{m}^2$$

The germination bed will be 2m^2 that is 2m long by 1m wide, should be covered with a piece of polythene sheet to speed up germination because it prevents loss of soil moisture, preserves a high atmospheric humidity, increases the air temperature and keeps the temperature range inside the polythene cover low.

5. Swaziland bed – Prick seedlings into Swaziland beds at a spacing of 8cm x 8cm square.

One plant occupies $8\text{cm} \times 8\text{cm} = 64\text{cm}^2$

One metre = $100\text{cm} \times 100\text{cm} = 10000\text{cm}^2$ divide by 64cm^2 the product is 156.25 plants per square metre.

For transplanting 10000 seedlings she will need:-

$$\frac{10000}{156.25} = 64 \text{ square metres}$$

She will therefore, need 8 beds @ 1m x 8m

The size of nursery will be:-

Length $1\text{m} + 8\text{m} + 1\text{m} = 10\text{m}$

Width $1\text{m} + (1\text{m} + 0.5) + (1\text{m} + 0.5\text{m}) + (1\text{m} + 0.5\text{m}) + (1\text{m} + 0.5\text{m})$
 (path 0.5m) bed 1 bed 2 bed 3 bed 4

$(1\text{m} + 0.5\text{m}) + (1\text{m} + 0.5) + (1\text{m} + 0.5) (1\text{m} + 0.5) + 1\text{m} = 14\text{m}$
 bed 5 bed 6 bed 7 bed 8

by calculation $1\text{m} + (1\frac{1}{2}\text{m} \times 8 \text{ beds}) + 1 = 14\text{m}$

size of nursery $10\text{m} \times 14\text{m} = 140\text{m}^2$

Add germination bed = $\frac{2\text{m}}{142\text{m}^2 \text{ or } 0.0142\text{ha}}$

6. There are two types of nursery shade. One is low shade and the other is high shade. As the nursery seems to be small, a low shade nursery will be ideal and cheap for her, a high shade nursery would be unnecessarily expensive.

7. Materials for construction of the low shade nursery are poles and thatching grasses for overhead shade which allows dappled light. For building walls (cladding), woven bamboo laths, sacking, bracken, tree branches and bricks.

The nursery beds should be one metre wide and eight metres long (in this case), filled 10cm above the ground with good forest soil. Beds should be oriented across the slope preferably in a North to South direction, should be 50cm apart allowing free access to each bed and sloping slightly down hill to remove excess water.

Soil

- Loose, friable and fine soil (forest soil)
- Not very rich in organic matter content
- Should not easily compact or dry out
- Must be sieved to remove grit
- Sterilize with Methyl bromide (CH₃Br)
1/2 kg per cum of soil.

- iv. Fertilizers – Add 3kgs of NPK 25:5:5 plus 15 grams Borax per ton of soil.

- v. Sowing seeds in germination beds

Sowing can be done by:-

- Hand sowing
- Mix with soil (ratio: 1/2 kg seeds: 1/2 wheelbarrow full of soil) broadcast
- Blowing with paper

Seeds can be soaked in cold water 2 – 3 days before sowing. Seeds should be sown in December in germination beds, under polythene sheet to speed up germination. Watering should be done twice a day that is early a.m. and late p.m. use a can with fine roses or a knapsack sprayer or a pneumatic hand sprayer.

- vi. *Pricking* – Seedlings should be pricked into Swaziland beds, trays or sleeves in January and February, 3 – 6 weeks after sowing when seedlings are 3 – 4 pairs of leaves or 3 – 4cm high at a spacing of 8cm x 8cm. Beds must be 10cm deep and filled with good forest soil to which has been added a 3:4:1 mixture of sulphate of ammonia, triple super phosphate and muriate of potash at a rate of 2kgs per cu.m of soil. During pricking watering is important to avoid warm humid air pockets which may predispose off seedlings.

- vii. Nursery care

Weeding and watering

- The nursery should be kept clean and weed free as much as practicable by hand pulling at least weekly.

- Hand watering by a can fitted with fine roses, avoid splashing of water, use knapsack sprayer.
- Two applications of water at a rate of 60 litres per 1000 transplants per day.

Root and shoot pruning

- Root prune 3 to 4 weeks after transplanting to promote lateral feeder roots and to prevent tap root growing further down.
- Move the sleeves in a different position or under cut beds with a steel wire every second week, as soon as the roots reach the bottom of the bed (10cm).
- Also on alternative weeks use a large kitchen knife to cut between the line of plants to a depth of 10cm, one week one way and one week the other way.
- Shoots can be clipped back periodically to a convenient height of not less than 15cm using a pair of sharp clippers, this should be done four weeks to transplanting to the field. Plants should be 30cm tall when put out in the field. Plants in Swaziland beds should be carefully cut out of the bed in blocks of 25 or 30 and put into boxes for transporting to the field.

- Security – Constant supervision is vital, in certain circumstances, a 24 hours watchman may be necessary.

- Diseases and insect pests

- Downy mildew – Fungicidal treatment – Ridomil
- Damping off – Avoid over watering
- Cutworm } spray with Endosulfan
- Chafer grub }
- Termites } control with Diazinon, Furaden
- Leaf eating caterpillar } and other insecticides.

- viii. Cross breeding and clonal selection – A start has been made with *E. grandis* + *E. saligna* and is in good progress in other countries, the out come could be very useful in fuel wood production.

FIELD ESTABLISHMENT

- Area – Choose the location and survey the area
- Land preparation – Where possible plough disc twice then sub-soil along planting lines or slashing and burning or pit planting, where pit planting is practiced, pits must be as large as economically possible.
- Lining – should be accurate to ease post plant management practices
- Plant population – yields increase with increasing number of stems per hectare, so do costs of establishment, felling and removal.

Spacing will depend on:-

- Growth potential of the area – the better the site the wider the spacing
 - Management target – the closer the spacing the smaller the diameter and the wider the spacing the bigger the trees.
 - Mode of cultivation and harvesting – hand cultivation and harvesting will require closer spacing while mechanical cultivation and harvesting will require a pattern like hedge row planting. A spacing of 1.8m x 1.8m square is currently in use to give a plant density of 3086 plants per hectare.
- (e) Pitting – This is practiced where complete clearing is not done. When used the pits must be of adequate size at least 30cm deep and be circle weeded to a suitable diameter say one metre diameter.
- (f) Planting and Infilling – Planting is carried out as soon as the rains are established and preferably during overcast weather. The plants should be sturdy and between 25cm – 50cm high the transplants should be put into the hole upright with sleeve level or nursery soil being in line with the soil surface, 30 grams of NPK 25:5:5 must be thoroughly mixed with the soil in each planting hole and firmed by hand around the root ball. A round of infilling should be carried out about 6 weeks after planting and when the weather is favourable, with the aim of going into the dry season with 100% stand. Subsequent deaths will be infilled at the start of the following rains. In mature eucalyptus plantations, thinning of suckers is done in the year following felling. Infilling should therefore be undertaken in January immediately following felling. Only multiple vacancies should be infilled as single infills are normally unable to compete with regenerating trees.
- (g) Pests – Treat for cutworm at the start of the dry season by spraying the base of the plant with insecticide (alandrin) or diazinon. Areas of grassland are likely to have a large population of cutworms and will need particular attention. Cutworms only affect plants in the first dry season in the field, so do not bother to treat in the second dry season. Leaf eating weevils, rats, and grasshoppers are minor pests and the damage they can do can easily be seen
- (h) Weeding – Slashing followed by ring weeding (one metre diameter) can do until foliage canopies suppress weed growth. The sahanis must be kept clean to reduce weed competition and rat damage.
- (i) Replanting – Is only contemplated when yields are uneconomical. Interplanting is sound only when the original population has dropped by at least 20%.
- (j) Coppice regeneration – The first cycle of eucalyptus takes 8 – 10 years. Then the trees are felled for the first time. Coppice shoots are many immediately

after felling. These have to be thinned to 2 – 3 per stool after 6 – 8 months to provide the next harvest. Where possible the selected stems should be of even size, well spaced round the stump. If the felling is too much into peak dry weather, stump mortality increases. After two coppice rotations, interplanting or replanting may be necessary.

- (k) Productivity – Ratoon crop productivity is influenced by the following factors:-
- Stool height – too high reduces yield
 - Stool diameter – small stools produce the best coppice.
 - Stump mortality – felling into peak dry weather increases it
 - Coppice reduction – to maximise on yield this must be done properly. Identify dominant shoots before coppice reduction.
 - Protection of trees against the following is necessary; Wind, sun scorch, drought, pests, diseases and frost.
- (l) Harvesting: (i) Extraction roads – Extraction roads must be laid out before felling, so that as far as possible the maximum “carry” is 35 metres. On regular ground this will mean that the extraction roads are spaced 70 metres apart. They should be built not later than the dry season following planting while the plants are still small enough to see over. Maximum gradient for extraction by lorry is 1:8. It is often useful to put an extraction road round the bottom boundary of the plantation to also serve as a firebreak. Before felling in mature plantations extraction roads must be sickled and stumped, pot holes filled up. This will reduce damage to transport and show cutters where to stack. Any additional roads which may be needed must be built and graded before felling.
- (ii) Felling and stacking – Felling is normally on an 8 year cycle. The operation is carried out by using either axe, bow-saw or power saw. A bow-saw and power saw are preferred for felling trees at a low stump level, when axes are used for felling trees, cutters tend to raise stump height. Heavy machinery for harvesting may not be very convenient if the planting pattern did not take that into consideration. Trees must be cut as close to the ground level as possible (at least 20cm above ground). Regeneration will be from the stump and if this is appreciably above ground level, the regenerating suckers will tend to break away in high winds. Fuel wood will also be wasted and it will not be long before stumps are at head height.

Felling of trees should be done in such a way that there is minimum damage to the rest of the stand. Cutting and pushing over will do for small trees. Large trees, however, may be cut and back cut in the direction of fall or drawn down using a tree winch. Selection of planting material with uniform growth will make harvesting a lot easier as there will not be weaker trees which could easily be damaged when the big trees are falling. The trees are cut into logs of suitable size and length (1 – 2 metres long and 10 – 20cm diameter). Logs over 20 cm

diameter must be split and those which are less than 20cm diameter should not be split unnecessarily.

The logs should be properly stacked “match box” fashion, that is, all logs to be laid in the same direction. The logs are left out in the field to dry in order to reduce the cost of transport. At the time of use the moisture content of the fuel wood should be about 15 – 18%. The calorific value of the fuel wood is affected by the moisture content of the wood. The amount of water in the wood reduces the heat value of a fuel and some more energy is lost in evaporating water from the wood before it can burn, therefore, the fuel wood should be air dried before use. On the other hand completely dry wood fuel would burn extremely quickly making the control of heat temperature extremely difficult.

Felling and stacking of one area should be completed before moving to another. If the felling of an area is unduly protracted, falling trees may damage regeneration. Stumps must be cleared of trash as soon as felling and stacking are completed. Stocks should be removed by tractor and trailer or lorry. In dry weather, areas holding, say 200 stacks must be provided with a watchman night and day as a precaution against fire and pilferage.

- (m) Wood quality Vs quantity – Eucalyptus is grown as a wood fuel which makes its calorific value very significant. Unfortunately, there is very little variation within species in calorific value (19 to 20 mega joules per kilogram oven dry mass). This aspect makes biomass very important.

DISEASES AND PESTS OF EUCALYPTUS (GUMS)

(a) Diseases

- i. Powdery mildew (*Erysiphe* sp.) – Common in the nursery
Symptoms - A powdery appearance occurs on the leaves which later on become dull coloured
Control - Sulphur based fungicides e.g. karathene
- Specific mildewcides e.g. saprol.
- ii. Damping off (*Pythium* sp.) - Common in the nursery
Symptoms - The stem softens at the base region and the seedling falls over or dries up.
Control - Reduce amount of water
- Use soil drench fungicides such as captan or brassica.

(b) Insect pests

- i. White grubs
Symptoms - The larvae damage the bark of the seedling just below soil surface resulting into wilting of the seedling and eventually death.

Control - Use of an organo-phosphorus drench product e.g. Dursban at the rate on the label.

ii. Leaf eating caterpillars

Symptoms - Chewing marks on the leaves are clearly seen and even the caterpillars themselves.

Control - Use of synthetic pyrethroids e.g. Brigade, Decis, karate and other insecticides at rates on the label.

iii. Cutworm (Agrotis sp.) In the nursery and newly planted fields.

Symptoms - Causes considerable nursery damage by bark stripping at ground level.

Attacks transplanted seedlings in their first year in the field

Control - Use of soil drench products like dursban

-Use of bait or wheat bran mixed with insecticide such as endosulfan.

BLACK WATTLE (*Acacia meamsii*)

INTRODUCTION

To some extent, black wattle (*Acacia mearnsii*) is grown in fuel wood plantations; the black wattle also produces bark which is sold for tanning extract. The smallholders prefer black wattle instead of eucalyptus (gums) because eucalyptus are heavy water feeders and being very tall, eucalyptus trees affect other crops grown near them including tea. As a leguminous plant, black wattle adds fertility to the soil and rehabilitates poor soils.

- (a) **SEED PRODUCTION** – Black wattle seed production increases with age. Pollination is predominantly by insects.
- (b) **SEED COLLECTION** – Only ripe pods are collected from desired trees. The pods are spread on a flat surface in a still dry warm place and stirred for 7 to 10 days at regular intervals. Remove the pods and clean the seeds by removing twigs and leaves.
- (c) **SEED VIABILITY** – Seed viability is to a large extent influenced by the following:-
- (i) Storage temperatures – the higher the better
 - (ii) Moisture levels – the lower the better
- (d) **SEED STORAGE** – Dry the seeds well, then store in containers at moderate temperatures, humidity and light. At 36°C – 40°C (96.8°F – 104.0°F) seeds will remain viable for 6 – 12 months (untreated).
- (e) **NURSERY PRACTICE AND TECHNIQUES** – Black wattle (*Acacia mearnsii*) seedling may be raised in the nursery as follows:-
- i. Immerse the seeds in boiling water
 - ii. Leave the seeds to cool and soak in the water for 24 hours.
 - iii. Dry the seeds in the shade
 - iv. Sow seeds in a germination bed in December
 - v. Cover with soil about 2.5cm (forest soil)
 - vi. Cover with polythene sheet (tent) to speed up germination
 - vii. Prick the seeds into polypots 10cm long and 6.25cm diameter (10cm lay flat) OR into boxes filled with forest soil or into plug trays (speedling trays) or into swaziland beds at a spacing of 5cm x 5cm square, swaziland beds should be 10cm deep with good forest soil mixed with a mixture of sulphate of ammonia, triple super phosphate and muriate of potash (ratio 3:4:1) 2kgs of mixture to one cubic metre of soil.

- viii. Move polypots or boxes every other week after about six weeks from transplanting.
 - ix. Cut the roots at the bottom of the swaziland beds with a steel wire and cut with a large kitchen knife between plants one way this week and another way the next week.
 - x. Treated seeds should not be kept for sowing in the following season.
- (f) **DIRECT SOWING IN THE FIELD** - Black wattle (*acacia mearnsii*)
 Seeds can be sown direct in the field, the procedure is as follows:-
- i. Immerse the seeds in boiling water
 - ii. Leave the seeds to cool and soak in the water for 24 hours
 - iii. Dry the seeds in the shade
 - iv. Sow in lines during the period of heavy rain
 - v. Cover lightly with soil about 2.5cm
 - vi. Thin out to give a spacing of 1.8m x 1.8m square (3086 plants per hectare)
 - vii. Keep the young plants free from couch and excessive weed growth at least at a diameter of one metre.

Black wattle (*acacia mearnsii*) may be established in pure stand or undersown in cereals such as wheat and maize which could be suitable to smallholder tea farmers.

- (g) **EXTRACTION ROADS** – Before felling, extraction roads must be laid out so that as far as possible the maximum “carry” is 35 metres. On regular ground this will mean that the extraction roads are spaced 70 metres apart. They should be built not later than the dry season following planting while the plants are still small enough to see over. Maximum gradient for extraction lorry is 1:8. It is often useful to put an extraction road round the bottom boundary of the fuel wood plantation. Before felling in mature plantations, extraction roads and fuel wood plantation boundaries must be sickled, stumped and pot holes filled up. This will reduce damage to transport and show cutters where to stack.
- (h) **FELLING, STACKING AND EQUIPMENT** – The felling of black wattle trees is normally done 7 – 10 years after planting. The black wattle trees do not coppice, should therefore be replaced or regenerated after harvesting. Felling is done either by axe, bow-saw or power-saw. A bow-saw and a powersaw are preferred for cutting trees at a low stump level to avoid wastage of fuel wood. When axes are used for felling trees the cutters tend to raise stump height. The stump height should be 20cm above ground. The trees are cut into billets (logs) of suitable lengths (1m – 2m long) and 10 – 20 cm diameter, logs over 20cm must be split and logs below 20cm must not be split unnecessarily. Tools to include Panga, Hammer and wedges.

The logs should be properly stacked “match box” fashion, that is, all logs to be laid in the same direction. The logs are left out in the field to dry in order to reduce the

cost of transport. At the time of use in the tea factory, the moisture content of the fuel wood should be about 15 – 18%. The calorific value of fuel wood is affected by the moisture content of the wood. The amount of water in the wood reduces the heat value of a fuel and some more energy is lost in evaporating water from the wood before it can burn, therefore, the fuel wood should be air dried before use. On the other hand complete dryness of wood fuel would burn extremely quickly making the control of heat temperature extremely difficult.

PROTECTION OF WOOD PLANTATIONS

Either workers or villagers in the neighbourhood should protect both eucalyptus and black wattle plantations once established from fire, theft and vandalism. Adequate external wide fire-breaks should be maintained during dry season. Plantations can be split into blocks interspersed by wide roads which may be planted to grass used for grazing. Constant supervision is vital especially when stacks are still laying about in the field, a fire could be very destructive and frustrating indeed. If necessary engage a watchman night and day, the cost involved is justifiable. In some areas, plantations must be protected from domestic animals during the first year from planting. Also must be protected from wild animals, both types of animals feed on the young barks and leaves of eucalyptus and black wattle.

RECORDS

New eucalyptus and black wattle plantations must be properly surveyed and mapped after planting.

Old eucalyptus and black wattle plantations must be properly surveyed and mapped if this was not done or old records have been misplaced.

- Detailed records of fuel wood plantations must be kept.
- Details for each area must include:-
 - (a) Location
 - (b) Surveyed map
 - (c) Reference number
 - (d) Area in hectares (ha), population, spacing, seed source
 - (e) Date of planting (new), infills and number of plants.
 - (f) Date of felling.
 - (g) Amount of fuel wood (total stacks) felled and stacked
 - (h) Yield per hectare (stacks per ha).
 - (i) Date of coppicing
 - (j) Incidences of Pests and Diseases nursery, young plants and mature
 - (k) Any other useful information

NOTE: Eucalyptus should not be planted within 30 metres of tea or any water source.

FUEL WOOD PRODUCTION IN RUNGWE

INTRODUCTION

Following a survey result on fuel wood demand in Rungwe district, it was revealed that the rate of eucalyptus usage outstrips its availability due to excessive tree cutting with little or no replacement which endangers the environment and water sources. Annual district tree harvesting based on the survey could be 745,650 trees (894.78 ha) for domestic use, 20,402 trees (24.48 ha) for Katumba and Tukuyu Tea Estate (TTE) tea factories and 21,364 trees (27 ha) for timber and other uses. The total area under Eucalyptus trees in Rungwe is 1,274 ha, therefore 5,349.82 ha (4,458,183 trees) will need to be planted.

STRATEGIC PLANS

In efforts to protect the environment and assurance that there is sustainable supply of fuel wood for both household and factory use, WATCO through TRIT extension unit involved people in planting eucalyptus in the villages by providing seeds and technical backups on establishment and management of eucalyptus tree nurseries.

1. Village based eucalyptus tree nurseries
Village based nurseries can be established by involving farmers whereby WATCO may supply seeds and farmers to be trained on how to establish and manage these nurseries on agreement that plants will be belong to farmers themselves. This has already been started with few farmers and already there are about 342,000 eucalyptus seedlings from 24 villages. Sensitisation to farmers may start in August and planting can start in September up to November before the start of rains in Rungwe. About 1,000,000 plants (2 kg of unclean seeds) may be raised annually.
2. WATCO may establish eucalyptus tree nurseries and sell the plants to farmers at cheaper price at least to cover some of the costs.
3. WATCO to review firewood purchase contract WATCO may plan and arrange to buy fuel wood direct from farmers and pay money direct to farmers instead of purchasing the wood through contractors. This will encourage farmers to properly take care of their Eucalyptus forests (proper harvesting, infilling, fire protection) and plant new trees, as more money will be going to them and not to middlemen/contractors. WATCO will need to work on and agree with

CASPIAN on prices/costs of transporting the fuelwood from farmers to the factory.

4. Research into high yielding eucalyptus will need to be instituted. TRIT will need to liaise with TAFORI on this.
5. Improved and simple cookers that can use less wood may be introduced in villages. One NGO involved in environmental issues may be identified and consulted and be ask to do this.

FUEL WOOD TREE PLANTING

Total of 29,168 of eucalyptus trees were planted in 2004 of which 24,950 trees came from farmers' backyard nurseries, 3,200 from Kyimbila nursery and 1,018 from own farmers existing eucalyptus forests. Some 38,970 plants were still in nursery which will be due for planting in 2005.

According to the district forest office, some institutes and NGOs have joined efforts in planting trees in the villages such as the Tanzania Social Action Fund (TASAF), World Wide Conservation Society project (WCS), Rungwe Natural Environmental Conservation (RUNEC), Youth Organisation Development and Environmental Association (YODEA) and Kyimo ward in collaboration with Heifer project International.

NOTE: Other districts, particularly in tea growing areas can copy the Rungwe strategy of planting fuel wood trees.

ANNEXES

ANNEX 1: REFERENCES

1. TEA CULTIVATION TO CONSUMPTION

Edited by: K. C. Wilson
M.N. Clifford

2. TEA GROWERS' HANDBOOK

The Tea Research Foundation of Kenya
4th Edition 1986

3. JOHNSON'S NOTE BOOK FOR TEA PLANTERS

By R. J. Johnson
3rd Enlarged Edition 1955

4. TEA PLANTERS' HANDBOOK

The Tea Research Foundation of Central Africa
First Edition, April 1990

5. NUTRITION OF THE TEA PLANT

Fertilizers and Manures
TRIT Training Module No.2

**6. ESTABLISHMENT AND MANAGEMENT OF
TEA NURSERIES**

TRIT Training Module No.5

**7. FINDINGS OF SURVEY ON FUEL WOOD DEMAND IN RUNGWE
DISTRICT**

TRIT Occasional Publication No. 3

ANNEX 2: DETAILS OF THE TRAINING

A. EUCALYPTUS (GUMS) PLANTATIONS

1. TYPES OF EUCALYPTUS
 2. TAXONOMY OR CLASSIFICATION
 3. SEED PRODUCTION
 - (a) Seed production
 - (b) Seed collection
 - (c) Seed viability
 - (d) Seed storage
 - 4. NURSERY PRACTICE AND TECHNIQUES**
 - (a) Why a fuelwood nursery?
 - (b) Planning
 - (c) Nursery
 - i. Nursery site
 - ii. Nursery size
 - iii. Soil
 - iv. Fertilizers
 - v. Sowing seeds in germination beds
 - vi. Pricking
 - vii. Nursery care
 - viii. Cross breeding and clonal selection
 - 5. FIELD ESTABLISHMENT**
 - (a) Area
 - (b) Land preparation
 - (c) Lining
 - (d) Plant population (spacing)
 - (e) Pitting
 - (f) Planting and Infilling
 - (g) Pests
 - (h) Weeding
 - (i) Replanting
 - (j) Coppice regeneration
 - (k) Productivity
-

- (l) Harvesting
 - i. Extraction roads
 - ii. Felling and stacking
- (m) Wood quality against quantity

DISEASES AND PESTS OF EUCALYPTUS (GUMS)

(a) Diseases

- i. Powdery mildew
- ii. Dumping off

(b) Insect pests

- i. White grubs
- ii. Leaf eating caterpillars
- iii. Cutworm

B. BLACK WATTLE (Acacia mearnsii)

1. INTRODUCTION

SEED PRODUCTION

- (a) Seed production
- (b) Seed collection
- (c) Seed viability
- (d) Seed storage

3. NURSERY PRACTICE AND TECHNIQUES

4. DIRECT SOWING IN THE FIELD

5. EXTRACTION ROADS

6. FELLING AND STACKING

PROTECTION OF THE FUELWOOD PLANTATIONS

RECORDS

C. TOOLS:

Bow saws, power saws, axes, pangas, sledge hammers 161b(7kgs.), Tape measure 3^m, wedges 15cm(6"), helmets, gumboots and goggles, First Aid kit must be available.

SPECIMEN:

1. Eucalyptus saligna plantation due for harvesting (felling)
2. Black wattle plantation due for harvesting (felling)
3. Woodfuel nursery for eucalyptus and black wattle
4. Felled fuelwood plantations of both eucalyptus and black wattle.

PLANNED VISIT SHEETS

ARRANGEMENTS

1. Visit eucalyptus and black wattle plantations due for harvesting (felling).

2. Visit eucalyptus and black wattle plantations already felled, preferably last dry season.
3. Visit eucalyptus and black wattle nursery.

ACTIVITIES – OBSERVE, DISCUSS, COMMENT AND PRACTICALS

FILL IN PLANNED VISIT SHEET

GENERAL REQUIREMENTS

TRAINING MATERIALS

Item	Quantity
Handouts, Note books, Pens Pencils, Rubbers, Rulers, Files	One per each participant
Flip chart, Flip chart stand, watering can, a nursery site, OHP, polythene sheet, polythene tubes	One of each One roll, 1000 Pcs.
Marker pens, masking tapes, Writing pads	3 boxes 3
Stapler, staples, transparencies	1, 1 box, 1 box
Bow saw, power saw, axes, pangas, wedges(15cm) helmets, sledge hammer, Tape measure 3m	Two of each
Gum boots, goggles First Aid Kit	One pair each One box

(a) IMPORTANT PAPERS

Planned visit sheets	30
Idea sheets	30
Action arising from the day	30
Assessment sheet	30
Objectives	on transparency
Programmes (Day 1 & 2)	on transparencies
Exercises	-
Proficiency test	30
Key Action Plan	30

ANNEX 3 : COURSE PROGRAMME

DAY ONE

TIME	DETAILS	ACTION BY
7.45	ALL PARTICIPANTS ARRIVE	ALL
8.00	INTRODUCTION OF GUEST OF HONOUR TO OPEN COURSE	FACILITATORS
8.05	WELCOME COURSE LEADER COURSE PARTICIPANTS EXCHANGE EXPERIENCE	MANAGER LEADER
8.10	PROGRAMME, OBJECTIVES AND METHOD OF DELIVERY	FACILITATOR
8.15	INTRODUCTION FUELWOOD PLANTATIONS	FACILITATOR
8.20	TYPES OF EUCALYPTUS TAXONOMY	ALL
8.30	SEEDS: PRODUCTION COLLECTION VIABILITY STORAGE	ALL
9.00	NURSERY PRACTICE AND TECHNIQUES WHY A FUELWOOD NURSERY? PLANNING NURSERY ESTABLISHMENT AND MANAGEMENT	ALL
10.00	TEA BREAK	ALL
10.20	FIELD ESTABLISHMENT AREA, LAND PREPARATION, LINING, PLANT POPULATION PITTING, PLANTING & INFILLING, PESTS, WEEDING, REPLANTING, COPPICE REGENERATION, PRODUCTIVITY HARVESTING – i. EXTRACTION ROADS ii. FELLING & STACKING, WOOD QUALITY vs QUANTITY	ALL
12.00	DISEASES AND PESTS OF EUCALYPTUS (GUMS)	ALL
12.30	LUNCH	ALL
2.00	R E C A P	ALL
2.30	BLACK WATTLE (<i>Acacia mearnsii</i>) INTRODUCTION	FACILITATOR
2.35	SEED PRODUCTION – COLLECTION, VIABILITY & STORAGE	ALL
2.55	NURSERY PRACTICE AND TECHNIQUES	ALL
3.15	DIRECT SOWING IN THE FIELD	ALL
3.25	EXTRACTION ROADS	ALL
3.40	FELLING, STACKING AND EQUIPMENT	ALL
3.55	PROTECTION OF THE FUELWOOD PLANTATIONS	ALL
4.15	RECORDS	ALL
4.25	ACTION ARISING FROM THE DAY	PARTICIPANTS
4.30	END OF DAY ONE	

DAY TWO

TIME	DETAILS	ACTION BY
7.45	ALL PARTICIPANTS ARRIVE AND TEA	ALL
8.00	RECAP	FACILITATOR
8.15	DEPART FOR FIELD VISITS AND PRACTICALS	MANAGER
9.00	1. VISIT EUCALYPTUS & BLACK WATTLE PLANTATIONS DUE FOR HARVESTING 2. VISIT EUCALYPTUS AND BLACK WATTLE PLANTATION ALREADY FELLED LAST SEASON 3. VISIT EUCALYPTUS AND BLACK WATTLE NURSERY	PARTICIPANTS TO FILL IN PLANNED VISIT SHEET AND PARTICIPATE IN PRACTICALS
12.30	LUNCH	ALL
2.00	PLANNED VISIT SHEET DISCUSSION	ALL
2.15	CONFIDENCE BUILDER	PARTICIPANTS
3.15	SHARE THE CONFIDENCE BUILDER	ALL
3.35	KEY ACTION PLAN	PARTICIPANTS
3.45	IDEA SHEET	PARTICIPANTS
4.00	COURSE ASSESSMENT SHEET	PARTICIPANTS
4.20	GUEST OF HONOUR TO CLOSE COURSE SIGN AND PRESENT CERTIFICATES OF ATTENDANCE TO PARTICIPANTS	GUEST OF HONOUR
4.30	END OF THE COURSE	

ANNEX 4: SESSION PLANS

SESSION PLAN 1

TIME	CONTENTS	TECHNIQUES & AIDS
5MIN.	INTRODUCTION	
5MIN	COURSE PARTICIPANTS EXCHANGE EXPERIENCE, PROGRAMME	FLIP CHART Q & A
5MIN	OBJECTIVES AND METHOD OF DELIVERY	OHP
5MIN	FUELWOOD PLANTATIONS IN GENERAL	FLIP CHART
10MIN	TYPES OF EUCALYPTUS TAXONOMY	CARDS, "BRAIN STORM"
30MIN	SEEDS: PRODUCTION, COLLECTION, VIABILITY AND STORAGE	FLIP CHART
60MIN	NURSERY PRACTICE AND TECHNIQUES PLANNING NURSERY ESTABLISHMENT AND MANAGEMENT	FLIP CHART "BRAIN STORM" Q & A
20MIN	TEA BREAK	
100MIN	FIELD ESTABLISHMENT AREA, LAND PREPARATION, LINING, PLANT POPULATION, PITTING, PLANTING AND INFILLING, PESTS, WEEDING REPLANTING, COPPICE REGENERATION, PRODUCTIVITY, HARVESTING – i. EXTRACTION ROADS, ii. FELLING AND STACKING, WOOD QUALITY vs QUANTITY	Q & A TOOLS AND EQUIPMENT SAMPLES
30MIN	DISEASES AND PESTS OF EUCALYPTUS (GUMS)	Q & A
90MIN	LUNCH	
30MIN	RECAP	
5MIN	BLACK WATTLE (ACACIA MEARNsii) INTRODUCTION	
20MIN	SEEDS: PRODUCTION, COLLECTION VIABILITY AND STORAGE	Q & A
20MIN	NURSERY PRACTICE AND TECHNIQUES	FLIP CHART, "BRAIN STORM"
10MIN	DIRECT SOWING IN THE FIELD	Q & A
15MIN	EXTRACTION ROADS	-
15MIN	FELLING, STACKING AND EQUIPMENT	TOOLS & EQUIPMENT
20MIN	PROTECTION OF THE FUELWOOD PLANTATIONS	Q & A
10MIN	RECORDS	Q & A
5MIN	ACTION ARISING FROM THE DAY	
	END OF DAY ONE	

SESSION PLAN 2

TIME	CONTENTS	TECHNIQUES & AID
15MIN	RECAP DEPART FOR FIELD VISIT AND PRACTICALS	Q & A TRANSPORT, TOOLS AND EQUIPMENT
255MIN	1. VISIT EUCALYPTUS AND BLACK WATTLE PLANTATIONS DUE FOR HARVESTING 2. VISIT EUCALYPTUS AND BLACK WATTLE PLANTATIONS ALREADY FELLED LAST SEASON 3. VISIT EUCALYPTUS AND BLACK WATTLE NURSERY	PLANNED VISIT SHEET PRACTICALS, TOOLS PLANNED VISIT SHEET PRACTICALS, TOOLS PRACTICALS
90MIN	LUNCH	
15MIN	PLANNED VISIT SHEET DISCUSSION & TO COMPARE NOTES	"HUM GROUP"
60MIN	CONFIDENCE BUILDER	PAPERS
20MIN	SHARE THE CONFIDENCE BUILDER	Q & A
10MIN	KEY ACTION PLAN	SHEETS
15MIN	IDEA SHEET	SHEETS
20MIN	COURSE ASSESSMENT SHEET	SHEETS
10MIN	GUEST OF HONOUR TO CLOSE COURSE, SIGN AND PRESENT CERTIFICATES OF ATTENDANCE TO PARTICIPANTS	CERTIFICATES
	END OF THE COURSE	

ANNEX 5: EXERCISE

Name:.....Location:.....Date:.....

Please answer the following questions:

1. What is the name of the eucalyptus species most commonly planted in East Africa?
(a) Eucalyptus facifolia, (b) Eucalyptus saligna (c) Eucalyptus camaldulensis
2. What is the current spacing for Fuelwood?
(a) 1m x 1m (b) 1.8m x 1.8m (c) 3.0m x 3.0m
3. How many trees per hectare do we want?
(a) 1750 (b) 12,000 (c) 3086
4. What is the correct height above ground level for cutting the stem when harvesting Black Wattle?
(a) 5cm (b) 40cm (c) 20cm.
5. How many plants will you get from one kilogram of eucalyptus seed that we grow in East Africa?
(a) 140,000 (b) 1,000,000 (c) 100
6. What is the meaning of Provenance?
(a) The place of origin (b) The type of seed (c) The type of tree
7. What would be the best ratio of Fuel to Tea
(a) 1:3 (b) 1:5 (c) 1:10
8. What is the length of a felling cycle?
(a) 4 years (b) 8 years (C) 15 years
9. How long can eucalyptus seed be stored?
(a) 2 weeks (b) 5 years (c) 10 years
10. (i) What is the name of eucalyptus disease common in the nursery which affect seedlings?
(a) Damping off (Pythium sp.) (b) Chafergrub (schizonycha sp.) (c) Helopeltis (Helopeltis schoutendeni)

(ii)What are the symptoms of this nursery disease?

- (a) The stem softens; at the base region and the seedling falls over or dries up
- (b) The seedling changes colours from green to yellow
- (c) The seedling grows very fast.

(iii) Mention one control measure of the disease

- (a) Use of an organophosphorus drench product e.g. Dursban
- (b) Use of synthetic pyrethroids e.g. Brigade
- (c) Use soil drench fungicides such as captan or brassical.

11. (i) Which insect that attacks seedlings of eucalyptus both in the nursery and in their

first year in the field?

- (a) Purple mite (*calacarus carinatus*)
- (b) Citrus Aphid (*Toxoptera curantii*)
- (c) Cutworm (*Agrotis sp*)

(ii) What are the symptoms of attack of the insect you chose above?

- (a) Bark stripping at ground level
- (b) Leaves curls inwards
- (c) Dark brown spots appear on the youngest leaves and shoots.

12. Black wattle seeds will remain viable for a period of:

- (a) 5 – 10 weeks (untreated)
- (b) 6 – 12 months (untreated)
- (c) 5 – 10 years (untreated)

13. Eucalyptus (gums) should not be planted within:-

- (a) 5 metres of tea or any water source
- (b) 2 metres of tea or any water source
- (c) 30 metres of tea or any water source

NOTE: Tick – the right answer.(√)

ANNEX 6: PLANNED VISIT

Eucalyptus and Black Wattle plantations due for harvesting (felling)

PARTICIPANT:.....LOCATION:.....DATE:.....

1. Examine each of the following aspects within these fields
2. Score each one on the scale 1 – 10
3. Comment on each aspect

ASPECT		SCORE 1–10		COMMENTS	
		EU	BW	EU	BW
1.	Provenance				
2.	Approximate maximum gradient				
3.	Hectarage, spacing				
4.	Species of trees				
5.	Year in cycle				
6.	Extraction roads				
7.	Maximum “carry”				
8.	Trees over 20cm diameter				
9.	Seed production				
10.	Protection from fire, Theft and Vandalism				
11.	Records				
OVERALL RATING					
MAIN AREAS FOR IMPROVEMENT					

EU = Eucalyptus and BW = Black Wattle

NOTE: THE SCALE 1 – 10 (1 POOR – 10 EXCELLENT)

ANNEX 7: ACTION PLAN

NAME:.....LOCATION:.....DATE:.....

ACTION	EXPECTED RESULTS	INDICATORS	COLLABORATORS	BY WHEN

Trainees/nursery groups should fill in two copies of action plan. One copy will be returned to the trainer and another copy will remain with the trainee/nursery group for reference during implementation.

ANNEX 8: IDEA SHEET

NAME:.....**LOCATION:**.....**DATE:**.....
COURSE TITLE: FUELWOOD PRODUCTION

As a result of our discussions during this Training Module, I have the following suggestions to make to improve TRIT Training procedures

Serial No.	Suggestions	
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

ANNEX 9: COURSE EVALUATION

DATE:.....VENUE:.....

TITLE: FUELWOOD PRODUCTION

Please fill in this evaluation form so that we can assess whether we have met the objectives for the course. Mark how good the course was in helping you better to:-

1. Fully understand the techniques and procedures of raising, in the nursery, good quality Eucalyptus and Black wattle seedlings which are strong and vigorous with a well balanced shoot of fibrous root system, for planting out in the field for fuel wood production and pass the knowledge to farmers

Very Good *Good* *Poor* *Very Poor*

2. Encourage smallholder tea growers to establish fuel wood plantations and harvest firewood for sale to nearby tea factories in order to increase the family's income. Utilize poor land not suitable for tea or any other crop and have enough firewood and timber for domestic use.

Very Good *Good* *Poor* *Very Poor*

3. Take practical initiative to persuade smallholder tea farmers to plant fuel wood trees in order to prevent soil erosion and degradation in steep slopes to safeguard the environment in the tea districts.

Very Good *Good* *Poor* *Very poor*

4. To encourage tea factories to continue utilizing Eucalyptus and Black Wattle fuel wood as a renewable and fairly reliable source of energy

Very Good *Good* *Poor* *Very Poor*

5. Have you any other comments on the course which might help future planning?