

**NATURAL RESOURCES CONSERVATION AND  
DEVELOPMENT LEVEL II**

**Learning Guide -26**

**Unit of Competence: - Participate in Plantation Work**

**Module Title: - Participating in Plantation Work**

**LG Code: AGRNRC2 M03 0919 LO1-LG-26**

**TTLM Code: AGRNRC2 TTLM 0919v1**

**LO 2- Plant forest tree seedlings**

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

Assessing and preparing planting site

- Assessing and preparing planting site
- Selecting methods of Tree seedling plants
- selecting and planting Tree stock
- Identifying and resolving Problems
- Maintaining and storing equipment

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to

- *assess and prepare* Planting site for suitability in accordance with tree stock and work order requirements
- Tree seedlings planting methods and patterns are selected to suit particular operation and make efficient use of equipment and available time and resources
- *Select and plant* tree stock is in accordance with production target, quality, safety and specific job requirements
- identify *Problems* and resolved in accordance with site procedures
- maintain and store Equipment is in accordance with manufacturer's recommendations and workplace procedures

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3, Sheet 4, and Sheet 5”.
4. Accomplish the “Self-check 1, Self-check 2, Self-check 3, Self-check 4, and Self-check 4” in page -5,10,18, 23 and 27 respectively.

Information Sheet-1	Assessing and preparing planting site
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## 2. Assessing and preparing planting site

### Preparing the planting site

- clearing vegetation

On most sites trees, bushes and grass have to be cleared away to prevent them from competing with the young plants. This is very important when using light-demanding trees such as Eucalyptus, Pine or Cupressus. If more shade-tolerant species are chosen, existing trees do not have to be cleared.

Total clearing of the grass and bushes is needed on moist grassland sites and for species sensitive to grass competition, like some Eucalyptus.

On sites where ground vegetation is below one meter, it is normally sufficient to clear patches around the plants or strips along the lines of plants. The strips should be about one meter wide. Patches a radius of about 1 meter radius can be cleared with the hoe when digging the planting hole.

Between the cleared patches and strips the vegetation should be cut short, except on sites where reduction of the vegetation may result in increased erosion. There the vegetation between the cleared patches should be left as intact as possible.

Existing trees should only be removed when they seriously disturb the development of the plantation. Around water sources a vegetation belt of at least 15 to 25 meters should be preserved. Trees along rivers and old trees providing shade and beauty should always be saved.

#### 2.1. Ground preparation

Ground preparation is needed to soften the soil, and to allow the roots to affix firmly and deeply. Since nutrients are washed out in the surface soil layer, it is also important to mix soil for the deeper.

layer with soil from the surface layer to guarantee availability of the nutrients needed by the seedling.

The method depends on the site and the species planted. Usually digging holes and uprooting grasses with the planting hoe about one meter around the planting hole is enough.

The work should be carried out along the contour line, not up and down the slope; otherwise rain water may start to wash away the soil and form gully's.

In sites with crusts, hard pans or other hard soil layers it may be necessary to use mechanized soil preparation. For this a bulldozer, a sub-soil or a scarifier drawn by a tractor can be used.

## 2.2. Marking the planting spots /planting patterns

The most commonly used planting patterns are square spacing or triangular spacing where the distance between the rows are the same as along the rows. If strip clearing or weeding is used, a rectangular pattern, where trees are closer in the rows, than between the rows might reduce labor input. For very harsh climates and on poor soils, it might be appropriate to plant in clusters.

The appropriate spacing varies with the site, the purpose of the plantation and the species chosen. It is also a compromise between expected yield and the cost of establishing the plantation.

Wider spacing (more than 3x3 m) is preferred:

- For fruit trees;
- when planting on agricultural or grazing land;
- to reduce the cost of planting;
- in arid areas to avoid competition for water and nutrition;
- to reduce the number of thinning (if the aim of the plantation is large diameter timber)

Closer spacing (3x3 m or closer) is preferred:

- to avoid expensive replacement planting;
- to give early soil cover;

- when weed competition needs to be suppressed by early tree canopy closure;
- for slow-growing species when aiming for good quality sawlogs, i.e. small
- branches/knots;

- when there is a market for smaller dimension wood from thinning
- for fast-growing species such as Willows and Eucalyptus, when using short
- rotation to produce mostly smaller dimension wood (e.g. for fuel)

On dry sites most trees are now planted with an average of 3 or 4 meters between trees (i.e. 1100 or 625 trees/ha, respectively). On fresh sites in tropical highlands and in temperate climates a spacing of 2 square meters (i.e. 2500 trees/ha) is common.

The **three common patterns of planting** are:

➤ *Line or rectangular planting*

In this patterns two or more lines form rectangles. Each plant in the successive row is opposite to the previous one.

➤ *Square planting*

In this pattern, the distance between line-to-line and plant-to-plant is the same and plants are at the corner of each successive square.

➤ *Triangular Planting*

**In this pattern, each** plant in the succeeding row gets position in the middle of the proceeding row so that they are at the corner of each adjacent equilateral triangle.

Self-Check	Written Test
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*Directions:* Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is triangular planting method (5)
2. Write the three common patterns of planting (5)

**Note: Satisfactory rating - 18points**

**Unsatisfactory - below 18 points**

Answer Sheet

Score = _____
Rating: _____

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Short Answer Questions

1. \_\_\_\_\_
2. \_\_\_\_\_

## 2.2. Selecting methods of Tree seedling plants

### 2.2.1. The three common patterns of planting methods

#### .Line or rectangular planting

In this patterns two or more lines form rectangles. Each plant in the successive row is opposite to the previous one.

#### ✓ Square planting

In this pattern, the distance between line-to-line and plant-to-plant is the same and plants are at the corner of each successive square.

#### ✓ Triangular Planting

In this pattern, each plant in the succeeding row gets position in the middle of the proceeding row so that they are at the corner of each adjacent equilateral triangle.



## ❖ Determination of Total Amount Seedlings Required

The total number of plants (N) in a pattern is calculated as follow:

- A. Line planting
- B. Square planting
- C. Triangular planting

### 2.2.2. Digging holes

If the soil is not too hard, the holes might be dug in advance during the dry season. This will reduce the need for labor during the actual planting. They can also be dug at the same time as the actual planting.

### 2.2.3. Conservation measures for a forestation

In arid and semi-arid areas it is almost impossible to get the seedlings to survive without some water conservation measures. In high rainfall areas and on unstable soil, particularly on slopes, the soil often needs to be protected against erosion until the tree crowns shelter the site. The aim of all soil and water conservation measures is to reduce or retard the flow of surface run-off water (water harvesting). This will diminish the erosion damage and cause the water to soak into the soil, increasing the amount of soil moisture available for the seedling.

### 2.2.4. Storing seedlings

If the seedlings have to be stored a few days before planting, keep them in a dark and cool place, a cool cellar or elsewhere in the shade. If bare-rooted seedlings are packed in bags, the bags should not be opened.

Source: ILO 1993 supporting a forestation 2011

Bare-rooted seedlings which cannot be planted in a few days must be healed-in close to the planting site to minimize later transport. "Healing-in" means temporarily putting bare rooted seedlings in moist soil, under shade, until they can be used for planting. Healing-in should be avoided but it may sometimes be necessary.

Hoe an area of about 1 square meter around the planting holes. The area should be cleared of all vegetation to eliminate competition for nutrients and water. Dig the planting holes. Holes are required for all containerized plants and for big bare-rooted seedlings. The digging can be done at the same time as planting or some weeks in advance. If holes are dug before the rainy season, labor demand will not interfere with the agricultural season and the actual planting work will be faster. Even when the holes are dug in advance, the plantation worker should bring a hoe to be able to make the holes deeper or to adjust them.

For containerized forest trees the holes should be about 20-40 centimeters in diameter and slightly deeper than the length of the container. For fruit trees the hole should be larger (up to 60 x 60 x 60 cm). The harsher the site, the deeper the holes should be.

For bare-rooted seedlings make sure that the hole is deep enough to allow the taproot to hang down vertically without bending its tip.

Pile the soil on the sides of the hole without scattering it too much. Loosen, if necessary with a pickaxe, the bottom of the hole to make it easier for the plant roots to penetrate the soil.

On favorable sites small bare-rooted seedlings and cuttings may also be planted by just making a slot with a planting hoe

#### 2.2.5. Distribution of the seedling to planting site

The supply of plants should be arranged so that planting is never held up for lack of plants. At the same time, the number of plants kept in temporary storage near the work site should be as small as possible.

Carrying seedlings is heavy work, especially when containerized seedlings with plenty of water-soaked earth are being carried. Appropriate tools for carrying should be available and work rotation used. Teams may change between, for example, distribution and planting work every 2 hours. Supporting A forestation 2011

During planting, great care must be taken to ensure that the seedlings do not dry out. The roots should always be moist and never exposed to sunlight. This is especially important with bare-rooted seedlings. Seedlings whose roots are exposed to the sun for only a few minutes can already be seriously damaged and may not survive. Wet spongy material, for example grass, should cover the bottom of baskets, boxes or trays used for carrying the seedlings. With containerized seedlings the soil in the pot should always be moist at the time of planting. If the distribution and planting of the seedlings is done by the same person, it is easier to ensure that the seedling will not dry out.

Self-Check	Written Test
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*Directions:* Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is tree seedling triangular method (5)
2. Write the three planting method (5)

**Note: Satisfactory rating - 18points**

**Unsatisfactory - below 18 points**

Answer Sheet

Score = _____
Rating: _____

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Short Answer Questions

1. \_\_\_\_\_

2. \_\_\_\_\_

### 2.3. Selecting and planting Tree stock

Planting: It is most common used method. For a surer success of a forestation and reforestation works the planting out is carried out by utilizing nursery raised seedlings, root-shoot cuttings (stumps), branch cuttings, etc.

#### 2.3.1. Planting techniques

##### 2.3.1.1 Planting techniques depend on types of seedlings.

a. Notching: is used only for bare rooted plants and consists of cutting a slit in the ground with a spade or conical planting hoe, opening the slit wide enough to insert the roots or the plant, and finally closing the slit by pressing with the foot.

This is common technique with small bare rooted plants in temperate zones. It could be applied in planting of bare rooted eucalyptus on cultivated sites. The important thing is to make the slit deep enough so that roots are stretched straight. Notching techniques cannot be practiced on very sand or clayey soils.

b. Hole (pit) planting is used for all types of seedlings. Holes sufficiently large to accommodate the container or the roots or the seedling usually 30cm x 30cm x 30cm will be prepared. Digging has to be done several days before planting. Then the plastic is slit open and removed carefully so that the soil cylinder remains as intact as possible. The soil is placed back in to the hole so that the soil cylinder is covered 3 – 5 cm deep. Preferably, only topsoil should be used for filling the hole. It is advantageous particularly for uncultivated land. At the end, the soil around the plant is firmed with feet.

Bare rooted plants are put in to the hole so that their roots are spread in a natural position. None of the roots should turn upward.

### 2.3.2. Planting seedlings

- digging the holes
- Distribution of the seedling to planting site

The supply of plants should be arranged so that planting is never held up for lack of plants. At the same time, the number of plants kept in temporary storage near the work site should be as small as possible.

Carrying seedlings is heavy work, especially when containerized seedlings with plenty of water-soaked earth are being carried. Appropriate tools for carrying should be available and work rotation used. Teams may change between, for example, distribution and planting work every 2 hours.

Hoe an area of about 1 square meter around the planting holes. The area should be cleared of all vegetation to eliminate competition for nutrients and water. Dig the planting holes. Holes are required for all containerized plants and for big bare-rooted seedlings. The digging can be done at the same time as planting or some weeks in advance. If holes are dug before the rainy season, labor demand will not interfere with the agricultural season and the actual planting work will be faster. Even when the holes are dug in advance, the plantation worker should bring a hoe to be able to make the holes deeper or to adjust them. For containerized forest trees the holes should be about 20-40 centimeters in diameter and slightly deeper than the length of the container. For fruit trees the hole should be larger (up to 60 x 60 x 60 cm). The harsher the site, the deeper the holes should be.

For bare-rooted seedlings make sure that the hole is deep enough to allow the taproot to hang down vertically without bending its tip.

Pile the soil on the sides of the hole without scattering it too much. Loosen, if necessary with a pickaxe, the bottom of the hole to make it easier for the plant roots to penetrate the soil.

On favorable sites small bare-rooted seedlings and cuttings may also be planted by just making a slot with a planting hoe

During planting, great care must be taken to ensure that the seedlings do not dry out. The roots should always be moist and never exposed to sunlight. This is especially important with bare-rooted seedlings. Seedlings whose roots are exposed to the sun for only a few minutes can already be seriously damaged and may not survive. Wet spongy material, for example grass, should cover the bottom of baskets, boxes or trays used for carrying the seedlings. With containerized seedlings the soil in the pot should always be moist at the time of planting. If the distribution and planting of the seedlings is done by the same person, it is easier to ensure that the seedling will not dry out.

- Carrying out planting

### 2.3.3. Planting containerized seedlings

When planting containerized seedlings, fill topsoil back into the hole until the hole is as deep as the container: Cut the container open with a knife or the edge of the hoe and remove the bag. Care should be taken not to break up the earth ball. Place the earthball into the planting hole; the upper part of the ball should be slightly deeper than the surrounding soil surface. Put the remaining soil into the hole until it is filled to the rim.

Firm the soil carefully with your hands or with your heel. Do not leave air pockets around the ball or the plant will dry out and die. Check that the firming is sufficient by gently pulling the plant. The plant should rest firmly in the ground.

Seedlings should never be left in their containers. It will restrict the growth of the root system and cause the death of the young tree some years later. The most critical factor for all kinds of vegetation on dry to semi-dry land is access to water. After the hole is filled, a layer of loose soil is left around the plant. Shape the loose soil into a shallow depression. This will cause the surface water to concentrate around the seedlings and they will get as much water as possible.

### 2.3.4. Planting larger bare-rooted seedlings

When planting bare-rooted stock, put the seedling into the hole with the root collar 2cm - 3cm below ground level. The roots should be well centered. They must not be bent or curved and must never be allowed to get twisted or bent in the planting hole.

If the tap root is too long it should be cut to about 20-25 cm. Put the soil back into the hole. Make sure that the seedling stands straight. At the same time sorts out stones and green grass. Firm the soil with the heels or hands from two or three directions to remove air pockets. Take care not to damage the seedling.



**2.3.5 .Fertilizer application:** For some species and on poor sites fertilizers may be needed. Manure can be used if only a few trees are being fertilized close to home. In plantations choose a well balanced complete chemical fertilizer containing nitrogen, phosphorus and potassium. If a chemical fertilizer is used, mix one tablespoon of fertilizer with the soil at the bottom of the planting hole. Direct contact between the roots and the fertilizer should be avoided as it would "burn" the roots. If 2,500 seedlings per hectare are treated with 1-2 tablespoons (about 20 grams) of fertilizer, one bag (50 kg) will be needed per hectare. Supporting For soil conservation, for example, fast-growing species with an extensive root system are preferable. They quickly cover and bind the soil, protecting it from rain and wind. A plantation aimed primarily at construction poles or timber will require trees with relatively heavy, durable wood and a straight stem. For fodder production, ample leaf and seed production are essential and good regrowth after coppicing and browsing. If you grow trees together with agricultural crops or to rehabilitate wasteland, leguminous varieties (for example, the Acacia family) would be a good choice because of their soil-improving ability. (Most leguminous and some other tree species can extract nitrogen from the air with the help of little nodules on their roots. They then add nitrogen to the soil when the leaves fall off). Multipurpose tree species may combine a variety of different uses.

If local, indigenous, tree species, that you know grow well in the area, are available; it may be safer to use them than to try other, exotic ones. It is essential to select species that will be able to survive the first crucial years, that will withstand the environmental conditions on the specific site and that are easy to handle both in the nursery and in the field. Good coppicing ability (i.e. putting out new shoots from the stump after cutting) may be a special advantage.

- ❖ Plating Trees

- ✓ clearing vegetation

On most sites trees, bushes and grass have to be cleared away to prevent them from competing with the young plants. This is very important when using light-demanding trees. If more shade-tolerant species are chosen, existing trees do not have to be cleared.

On sites where ground vegetation is below one meter, it is normally sufficient to clear patches around the plants or strips along the lines of plants. The strips should be about one meter wide. Patches a radius of about 1 meter radius can be cleared with the hoe when digging the planting hole.

- ✓ Ground preparation

Ground preparation is needed to soften the soil, and to allow the roots to affix firmly and deeply. Since nutrients are washed out in the surface soil layer, it is also important to mix soil for the deeper layer with soil from the surface layer to guarantee availability of the nutrients needed by the seedling.

- ✓ Marking the planting spots /planting patterns

The most commonly used planting patterns are square spacing or triangular spacing where the distance between the rows are the same as along the rows. If strip clearing or weeding is used, a rectangular pattern, where trees are closer in the rows, than between the rows might reduce labor input. For very harsh climates and on poor soils, it might be appropriate to plant in clusters.

The three common patterns of planting are:

Line or rectangular planting

In this patterns two or more lines form rectangles. Each plant in the successive row is opposite to the previous one.

In this pattern, the distance between line-to-line and plant-to-plant is the same and plants are at the corner of each successive square.

#### Triangular Planting

In this pattern, each plant in the succeeding row gets position in the middle of the proceeding row so that they are at the corner of each adjacent equilateral triangle.

#### Determination of Total Amount Seedlings Required

The total number of plants (N) in a pattern is calculated as follow:

- A. Line planting
- B. Square planting
- C. Triangular planting

- digging holes

If the soil is not too hard, the holes might be dug in advance during the dry season. This will reduce the need for labor during the actual planting. They can also be dug at the same time as the actual planting.

#### Packing and transportation of seedlings

The time between the seedlings, leaving nursery and their being planted should be as short as possible. They must be constantly protected from strong light, heat and drying out. There are small root hairs that will dry out and wither in seconds if left exposed to the sun or dry winds.

Self-Check -4	Written Test
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Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

- 1. What is planting? (5)
- 2. Write the basic Planting techniques depend on types of seedlings (5)

**Note: Satisfactory rating - 5points**

**Unsatisfactory - below 5points**

Answer Sheet

Score = _____
Rating: _____

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Short Answer Questions

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_

## 2.4. Identifying and Resolving Problems

Equipment faults and malfunctions, quality of stock, unsuitability of stock, common diseases, pests, nutritional deficiencies, communication misunderstandings, environmental issues or damage, production quality and safety.

### 2.4.1. Beating up

Beating up is a planting operation done shortly after major plantation establishment to replace failures occurred for various reasons.

Mortality after the main planting activity is inevitable. This initial mortality may be due to:

- Deterioration of seedlings by mishandling
- Improper planting technique
- Occurrence of bad weathers after planting
- Attack by insect pests and diseases
- Seed competition
- Animal damage

Beating up is expensive as this involves larger holes, larger stock, and long distance per plant. Therefore, it is carried out if the established stocks considered to be unacceptably low.

Up to 20% mortality is accepted but if survival is less than 25% the plantation needs a complete replanting. It is also influenced by the pattern of mortality. If it occurs in an evenly distributed pattern, the need for beating up could be lesser. But if it is patchy creating scattered large gaps, we need to carry out beating up.

The time of beating up vary with the growth rate of the species. For fast growing species like eucalypts, the beating up needs to be done with in the season- usually 3-4 weeks after planting.

For slow growing species, it can be done after a year or the next growing season. When it is done in the same season an extra amount of seedlings in the same stock must have been kept, so that they will be of the same size with the previously planted seedlings. Beating up should mainly consider areas of concentrated or continuous mortality. All single isolated failures need not necessarily be planted. Seedlings used must be robust healthy and having good root development.

### 2.4.2. Weeding

Weeding is a tending operation done to eliminate or suppress all undesirable vegetation that could impair the growth of the plantation stock. The main objective of weeding is to promote the growth development of plantation crop, while keeping the costs of the operation with in acceptable limit. For this reason proper understanding on how weeds affect each particular crop is needed.

Most crops would benefit from a form of total weeding, but very often this is neither feasible nor economically justifiable.

A less intensive weeding regime may be adopted with species, which are to some degree tolerant of weeds. Tree species intolerant of weed competition require thorough and frequent weeding until the canopy closes.

### **2.4.3. Weeding methods**

The main methods of weeding are suppression and elimination. Both can be done manually, mechanically or by chemical techniques. Weed suppression is done by beating down or crushing the weeds, or by cutting them back to near ground level weed elimination is achieved by killing the weeds, either by destroying the whole plant by cultivation or by the use of chemicals.

#### *Weed suppression methods*

**a. Trampling: Simplest** method, trample or beats down weeds away from plantation trees (in some countries 15cm x 3cm boards in section is used). It can be mechanized but such an implement cannot operate very close to the tree stem.

**b. Slashing: The** most common manual method of weed suppression is to cut the weed back by using such cutting tools as sickles and brush hooks. Also this operation can be mechanized by using tractor – powered machines. It is a usual practice to slash between hoed spots or strips.

#### *Weed Elimination methods*

##### **a. Spot hoeing**

- Hoeing is confined to a circle 1 – 2m in diameter around each plant.
- Wider hoeing in drier areas
- Most common because of its cheapness

##### **b. Total (clean hoeing)**

- ✓ Practiced with eucalyptus and cypress
- ✓ Recommended in dry area
- ✓ It is expensive, exposes soil surface to intense sunlight and increases the risk of erosion.

##### **c. Strip hoeing**

The operations confined to a strip about 75 cm wide along the rows of plants. It is practiced where ground cultivation was done by strip hoeing or ploughing.

##### **d. Chemical methods**

It involves the use of herbicides.

##### ➤ **Climber control**

Climbers should be cut at early stage, before they damage or distort trees. Cutting is done at the base and the climber should be untwined from the tree stem as dead climbers can persist on trees for a long time.

## ➤ **Thinning**

Thinning is the process of removing part of the standing crop of trees to allow the remaining, selected trees to grow at their optimum rate to reach the size required by the objects of the plantation, within the period of rotation.

### ***Objectives of thinning***

To redistribute the growth potential of the stand to optimum advantage and to utilize all merchantable material produced by the stand during rotation.

### ***Effects of thinning on wood***

- Diameter grows with height usually unaffected.
- Thinning changes tree shape; over all, the trunk tapers more rapidly.
- Increased bark thickness and delayed natural pruning

All these effects of thinning continue only before between trees competitions again become intense. If rapid growth of individual trees is sought, thinning is repeated at intervals during the life of a stand.

### **Methods of thinning**

**1. Systematic thinning:** In systematic thinning no regard is paid to the canopy class or kind of trees removed. The commonest form is line or row thinning. Varying the proportion of rows removed alters thinning weight.

**2. Selective thinning:** Trees are thinned or left, depending on the subjective judgment of the person marking the thinning.

#### **( i ) Low ( thinning from below )**

- Trees are removed from the lower crown class.
- The smaller, less vigorous trees are removed and are very largely a speeding up of natural processes.
- There is an element of selection for vigor .The final crop consists of trees, which have always grown faster than average and with good form.

#### **(ii) Crown thinning (thinning from above)**

It is developed to overcome the limitations of low thinning. That is the thinning operation will have the major objective of reducing competition to best trees and getting reasonably better economic return. Thinning is done to remove some trees in the middle and upper crown classes (are removed to favor most promising trees by alleviating crown competition). Best trees are selected from dominant trees and some from co-dominant trees. Main distinguishing features from low thinning are:

- The principal cutting is made in the upper crown class.
- Bulk of the intermediate classes and healthier portion of the over topped classes remains after thinning.
- Immediate cash return is higher.
- Resulting growth increment is higher.
- Require relatively greater skill.
- Most appropriate in stands of shade tolerant species.

#### **2.4.4. Pruning**

Pruning is the removal of live or dead branches or multiple leaders from standing trees for the improvement of the tree or its timber. Pruning is classified in to two: - **natural and artificial.**

**1. Natural pruning:** The process of natural pruning consists of three steps:

- (i.) Death of the branch (ii) shedding of the branch and
- (ii). Occlusion or healing over of the branch stub.

The rate of dying of the lower branches in a tree is determined by the species, the density of the stand and the vigor of individual trees.

Hard wood species, for example eucalypts and *Aningeria* are good self-prunners: artificial pruning seldom needed. On the other hand, exotic conifers such as cypress and pines have their lower branches very persistent in the tree so that artificial pruning for the production of knot – free timber is an essential part of the tending program all over where these species are grown.

The denser the stand, the quicker the branches die and fall off. On the other hand, the more vigorous the tree, the slower branches die. When the branch dies, it is attacked by saprophytic fungi and insects and is weakened and eventually falls off. Occlusion is the healing over of the short stub left by the fallen branch. Occlusion is achieved by growth of new wood derived from the new cambium layer. The rate of occlusion depends largely on the rate of diameter growth of the stem and of the length of the stub.

#### **2. 4.5.Artificial pruning**

If knot – free wood is the overriding interest in the management object, artificial pruning is required. Natural pruning can only be used for species with remarkable natural pruning ability. Otherwise very dense stocking is required that prolongs rotation.

For most species of conifer pruning is required. Since pruning is very costly and labor insensitive, it must be justified economically (costs of operation must be less than increase in value). Markets that differentiate between knot free and knotty lumber should exist. Artificial pruning should only be practiced for species with unsatisfactory natural pruning ability.

For species, which are sensitive to insect and fungi attack pruning should be done on the most vigorous trees and in good stands.

Pruning should be confined to crop trees (those trees which are retained for final harvesting).



Self-Check	Written Test
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*Directions:* Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is thinning? (5)
2. Write the process of natural pruning consists (5)

**Note:** Satisfactory rating - 5points

**Unsatisfactory - below 5 points**

Answer Sheet

Score = _____
Rating: _____

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Short Answer Questions

1. \_\_\_\_\_

2. \_\_\_\_\_

## 2.5. Maintaining and storing equipment

### 2.5.1. Correct handling of materials, tools and equipment

All tools and equipment as well as materials should be handled according to the manufactures guidelines. Tools and equipment should be maintained regular and arranged in groups of similarity. Tools and equipment should be checked for any problem regularly. Broken tools should be identified, maintained and made ready for work. Plant debris and waste materials produced during nursery work activities should be identified, separated and stored safely for further processing. *Biodegradable* waste materials such as plant debris should be separated from *none-biodegradable* one, such as plastics, and stored separately. These materials should be prepared and processed in an appropriate and safe manner. Plant debris can be used for the preparation of compost, one of the important soil components, in the nursery. Surplus west materials should be stockpiled for removal and safe disposal out of the nursery site after transporting seedlings to planting area. A clean and safe work site should be maintained while completing planting activities.

After completion of activities, all tools and equipment must be cleaned. The nursery working environment should be kept clean of any west materials and plant debris.

If there is any broken tools and equipment, it should be maintained. Broken handles and blunted tools should be checked on time, maintained and made ready for work.

All tools and equipment should be well organized and stored in groups of similarity after maintenance.

### 2.5.2. Maintenance tools

➤ **Sharpening stones**

*Traditional sharpening stone:* abrasive stones are often shaped to have a traditional rectangular or square sharpening bed.

➤ *Revolving grindstone:* it consists of a sand stone wheel, equipped with a crank, stone and a water container.

➤ *Whetstone:* there are two main types of whetstones, natural and synthetic. The granules of the synthetic stones are extremely hard and cut steel very well. Honing the edge with

a whetstone requires water, which speeds the sharpening and makes the edge smoother.

- **Files:** The file is the most common general-purpose tool for sharpening saw and various kinds of edged implements. The cutting patterns of files can be described as either double-cut or single-cut.
- **File maintenance:** oil and grease are removed from a new file by putting the file in to warm water. Alternatively, the file is rubbed (in the direction of the teeth) with a Harwood stick, pieces of charcoal, or wire brush, during use the steel particles, which collect in the file, can be removed in the same way, or by tapping the file against a block wood.
- **Rasps:** Rasps are used to shape soft materials like wood for tool handles and the hooves of draft animals. Rasps are not used on metals.
- **Filing vices:** A stump vice is suitable to help hold two man cross cut saws for filling or for setting teeth. A portable wooden vice can be useful for both bow saw and crosscut saws.
- **Maintenance of axes:** An axe is sharpened in a series of steps. First blade taper is measured with a taper gauge. The grindstone is used to reshape the edge. After the edge has the desired symmetric shape, the grindstone is used to sharpen the edge on both sides. The whetstone is then applied for final honing. Often it is necessary to remove a broken axe handle. On one method, the first step is to saw off the top of the handle stub (close to the eye) to make a flat surface.
- **Maintenance of Hand saws:** Before beginning maintenance of the bow saw blade it must be verified that the saw blade is straight (not twisted) in the frame.
  - **Cleaning the saw blade:** Resin, rust, oil and dirt are wiped off the blade with a cotton cloth moistened in cleaning fluid. A suitable cleaning sedition consists of 70% kerosene, 20% turpentine, and 10% engine oil. A burr knife, made of a discarded bow saw blade also can be used for cleaning. Care must be exercised so as not to scratch the saw blade.
  - **Jointing, shaping, setting and filing the teeth**
- **Jointing:** the saw blade is effective only if the top of all teeth is at the same height. The teeth are brought to the same height with the help of a flat file and a jointer.
- The jointer acts as gauge to keep the file perpendicular to the edge of the saw blade at the desired tooth height.
- A self-made wooden jointer for the bow saw blade can be checked for accuracy with the help of pocket mirror. The kerf of the jointer is perpendicular to its sides, than the line of the kerfs and their reflections in the mirror should be perfectly parallel. A self-made wooden jointer for the crosscut blade may be checked in the same way.
- The jointing is done by pushing the file forwarded over the top of the jointer does the jointer. The jointing stroke should be touching all of the teeth. Because the blade wears most heavily in the middle, extra filing strokes may be necessarily at the ends of the blade. After jointing, each tooth should have a clearly defined flat top of 0.5-1.0 mm. This flat top will diminish in to a small dot during the filing of the tooth bevels.
- **Shaping:** The correct height and form of the teeth are obtained by shaping depending on the gullets between them (For inexpensive bow saw blades, it is not worthwhile to file

the gullets.) Once the gullets are deepened, the burrs need to be removed. This can be done with a hard flat file or whetstone. The whole side of the whetstone must rest against the blade.

- **Setting:** teeth are set by bending them alternately to the right and left. Thus the kerf is always wider than the thickness of the blade. For example, the width of the kerfs will be 1.3mm for a blade thickness of 0.90mm and a setting of 0.20mm. Settings are wider for soft woods than for hard woods as follows:

	<u>Soft wood</u>	<u>Hardwood</u>
	<u>(Setting in mm)</u>	<u>(Setting in mm)</u>
➤ <b>Bow saws</b>	0.20 – 0.30	0.15 – 0.20
➤ <b>Crosscut saws</b>	0.30 – 0.50	0.20 – 0.30

Different setting devices are available. Precise setting can be achieved with a setting iron and a simple wooden setting indicator.

- **Filing:** Filing sharpens the teeth so that they slice through the fibers of the wood oblique bevels (half bevels) are made when only the outer (upper) part of the tooth is filed. Oblique bevels are needed for two-man crosscut saws. Full bevels are made when the whole side of the tooth is filed. Full bevels are made on bow saws only.
- **Removing burrs:** When filing bevels, burrs are formed on the reverse side of the teeth. If they are left there, they make it difficult to file the other bevels. For a bow saw blade, a burr knife is held against the blade with the thumb. Burrs are first removed from the bottom of the tooth. The burr knife is side up the tooth, and down the bevel of the other side.

Burrs are removed from a crosscut blade with a whetstone. The whetstone is rested flat against the blade and passed slightly along both sides of it.

- **Making a sawing test:** Having carried out the preceding steps in saw maintenance, the worker evaluates the results. A visual inspection is followed by a sawing test at a felled tree of at least **15 –20cm** diameter. A smaller tree may not correctly test the saw's performance. The sawing test will show if the saw runs obliquely, pinches, or jumps.

Self-Check	Written Test
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*Directions:* Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is maintenance? (5)
2. Write materials at least four (5)

**Note: Satisfactory rating - 5points**

**Unsatisfactory - below 5 points**

Answer Sheet

Score = _____
Rating: _____

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Short Answer Questions

1. \_\_\_\_\_

2. \_\_\_\_\_

## Reference

- Evans.J. 1992. Plantation forestry in the tropics. Oxford University press, New York.
- ILO. 1993. Planting trees, all illustrated and technical guide and training manual. Booklet
- No.7
- Yemiru. T and Abram, Plantation Establishment and Management Hand out (unpublished material)
- Vinod,K. . Nursery and Plantation Practice in Forestry, IFS
- Phil O'Callaghan, Frank Delahunty and Gaynor Baker. 2008. OH&S: A quick reference guide for broad acre agriculture. Publication No. 06/111. [www.rirdc.gov.au](http://www.rirdc.gov.au). Accessed on December 2010
- Takele Tadesse and Mengesha Admassu. 2006. Occupational Health and Safety. [www.cartercenter.org/resources/pdfs/health/ephti/library/lecture\\_notes/env\\_health\\_sci](http://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/env_health_sci). Accessed on July 2011.
- Toni Rosenbaum. 2005. Effective Communication Skills. Ithaca, New York 14853-5701. [www.clrp.cornell.edu](http://www.clrp.cornell.edu). Accessed on July 5, 2011