THE NEOTIA UNIVERSITY

ज्ञानम् आत्म प्रदीपाय

Introduction to Forestry

Practical Manual

Course code- CC-AGP 104 Credits - 2(1+1)

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Content

Practical-1

Topic: Identification of tree species

Aim - To identify forest tree species

Objectives - 1. To observe the types of leaf, leaf size, shape etc.

2. To identify forest tree species with some noticeable characters.

Introduction:

Identification of tree species is very important in forestry to get good practical knowledge on the different tree species available in the locality, their characters, benefits and uses. Tree identification can be done based on the morphological characters of the tree species. Different characters of a tree are, leaf shape and margin, leaf position, bark characteristics, tree shape, flower colour, fruit etc.

Materials required: Different tree species, pen/pencil, record

Procedure: Identify the tree based on the morphological characters of the tree (leaf shape and margin, leaf position, bark characteristics, tree shape, flower colour, fruit etc) and write down the observations.

Observations to be recorded:

Table 1 Identification of tree species

Sl. No.	Common name	Scientific name	Family	Morphological characters	Uses

Conclusion-

Practical Significance- In forestry, it is necessary to learn the characteristics of different plants in order to distinguish one kind from another. The information will helpful for study of forest trees.

Practical-2

Topic- Diameter measurement of trees by measuring tape

Aim - To measure diameter of tree

Objectives- To learn the process of measuring diameter of standing trees in order to estimate the volume of forest products that may be obtained from the trees.

Relevant information- Diameter at breast height, or DBH, is the standard for measuring trees. **DBH refers to the tree diameter measured at 1.37 m. (4.5 foot) above the ground.**

DBH can be measured quickly with a specially calibrated diameter tape, often referred to as a d-tape that displays the diameter measurement when wrapped around the circumference of a tree and also by using calipers. If we don't have access to a d-tape, we can find the diameter of the tree by using a measuring tape, a thumb tack, and a calculator.

Materials required

Measuring tape, String, Thumb tack, Calculator

Procedure

1. With the measuring tape, measure 1.37 m. (4.5 foot) up the trunk of the tree from the ground. Use a thumb tack to mark the height on the tree.
2. Wrap your string around the tree trunk at 1.37 m. (4.5 foot). Make sure the string is straight and tight around the trunk, and mark or cut the circumference on the string.
3. Measure the length of string to get the circumference of the tree.
4. Convert the circumference measurement to diameter by dividing the circumference by pi (**π**).

Examples-

a. When the trunk is straight, the trunk is measured at 1.37 m. (4.5 foot) from the ground, diameter of trunk is measured by measuring tape (Figure 1).

b. When the trunk is at an angle or is on a slope, the trunk is measured at right angles to the trunk at 1.37 m. (4.5 foot) along the center of the trunk axis, so the height is the average of the shortest and the longest sides of the trunk (Figure 2).

c. When the trunk branches or splits less than 1.37 m. (4.5 foot) from the ground, measure the smallest circumference below the lowest branch (Figure 3). If the tree has a branch or a bump at 1.37 m. (4.5 foot), it is better to measure the diameter slightly below or above the branch/bump.

d. For multi-stemmed trees, the size is determined by measuring all the trunks, and then adding the total diameter of the largest trunk to one-half the diameter of each additional trunk (Figure 4). A multi-stemmed tree has trunks that are connected above the ground and does not include individual trees growing close together or from a common root stock that do not have trunks connected above the ground.

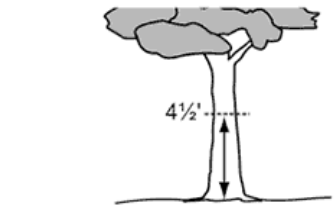


Figure 1

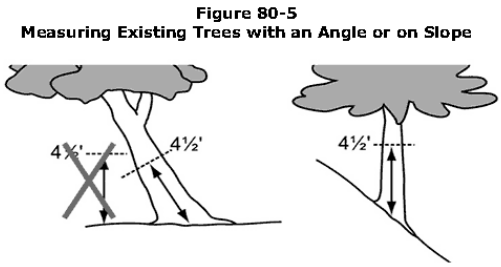


Figure 2

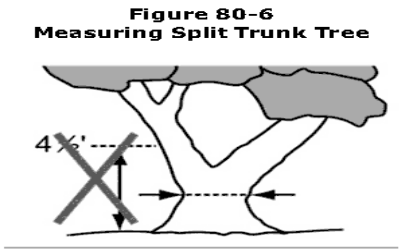


Figure 3

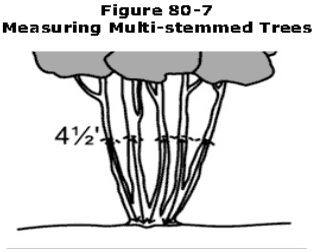


Figure 4

Observations to be recorded-

Sl. No.	Tree Species	Type of Trunk	Circumference (cm)	Tree diameter (cm)

Conclusion-

Important things to know:

Presumption: Measurement of DBH with tape is based on presumption that tree cross sections are circular, which is rarely the case.

Accuracy: That is why tape is less accurate than calipers. However, tape is preferred to calipers for bigger stems as the calipers are bulky and difficult to handle.

Precautions: Tape should not be old (elasticity and expansion).

Should not twist and lie in a plane perpendicular to the axis of tree.

Practical significance- Tree diameter measurement is very essential to estimate total volume of tree, volume per acre and volume of product before selling timber.

Video link: https://youtu.be/UPId59LZq10

Practical-3

Topic- Diameter measurement of trees by caliper

Aim - To measure diameter of tree

Objectives- To learn the process of measuring tree diameter by using caliper.

Relevant information- Diameter at breast height, or DBH, is the standard for measuring trees. **DBH refers to the tree diameter measured at 1.37 m (4.5 foot) above the ground.**

A carefully defined point should be used for measuring the diameter of the tree. In many countries, especially India, this will be at 1.37 m above the base of the tree where the tree meets the ground. By convention, the diameter of forest trees is measured in centimeters at 1.37 m above the ground and is termed the "Diameter at Breast Height" or DBH. Because trees are measured with the bark on, this is also called the Diameter at Breast Height Over Bark (DBHOB).

Materials required

Measuring tape, marker/ chalk, tree caliper

Procedure

1. With the measuring tape, measure 1.37 m. (4.5 foot) up the trunk of the tree from the ground.
2. Use a chalk/ marker to mark the height on the tree.
3. Hold the tree caliper at marked height in a horizontal line. For ordinary work a single reading of caliper will suffice. However, since tree cross sections are not exactly circular, two caliper readings (D_1 and D_2) at right angles should be made and the average may be recorded as DBH.
4. Measure the diameter of the tree by taking caliper reading. D_1 and D_2 are two caliper readings in perpendicular directions. DBH = $(D_1 + D_2)/2$

Observations to be recorded:

Sl. No.	Tree Species	Type of Trunk	Tree diameter (cm)		
			D_1	D_2	DBH = $(D_1 + D_2)/2$

Conclusion-

Practical-4

Topic- Diameter measurement of forked, buttressed, fluted and leaning trees

Aim - To measure diameter of tree

Objectives- To learn the process of measuring tree diameter of forked, buttressed, fluted and leaning trees.

Relevant information- Trees do not grow like cylinders, but rather taper upward; a tree's diameter gets smaller as one gets closer to the top of the tree. Trees also have **butt swell**, a thickening of the wood and bark at the base of the tree to support the tree's mass. Butt swell can create a very large diameter on trees exposed to heavy wind, on steep slopes and in sparsely populated stands. Thus, to obtain truly useful diameter data, the question becomes, "Where on the tree should I measure?"

To make tree diameter measurements meaningful and easy to perform, a standard location and protocol have been developed. Diameters are measured outside the bark at 1.37 m. above the ground on the uphill side of the tree (Figure 3.3). This location, called **diameter at breast height** or **DBH,** is above most butt swell and brush. It is also at a comfortable arm position for most people.

Materials required

Measuring tape, marker/ chalk, pen/pencil, record etc.

Procedure

Forked tree:

Forked trees can be measured as one tree if fork occurs at or above 1.37 m. (4.5 foot). If fork occurs below 1.37 m, tree can be measured as two trees. (Figure1).

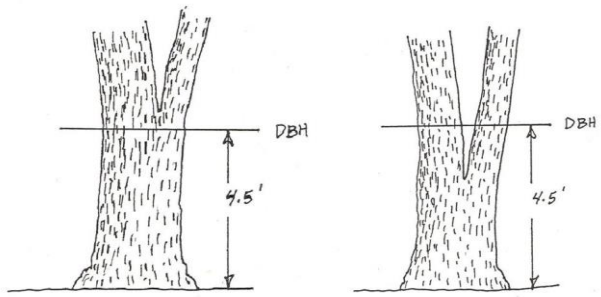


Figure- 1 Forked tree

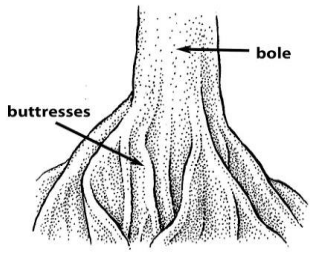


Figure- 2 Buttressed tree

Figure- 3 Fluted tree	Figure- 4 Leaning tree

Buttressed tree:

The diameters of buttressed trees are measured above the standard height of 1·37 m. (4.5 foot). DBH is measured at the lowest point above which the abnormal formation is not likely to extend. The measurement heights on individual trees are often moved upwards as buttresses grow (Figure2).

Fluted tree:

The diameter of a fluted tree (Figure3) shall be measured in this following way

Measure the diameter over the fluting; and

1. If the fluting occurs at various points around the bole and extends vertically to the top of the bole: Deduct: 2 × average depth of fluting, from the measured dbh.

2. If the fluting extends all the way round the bole and half way up the bole: Deduct: 1/2 × (2 × average depth of fluting), from the measured dbh.

3. If the fluting extends half way round the bole and half way up the bole: Deduct: 1/2 × (average depth of fluting), from the measured dbh.

Leaning tree:

When the trunk is at an angle (leaning tree), the trunk is measured at leaning side along the trunk at 1.37 m. (4.5 foot). Take the diameter of the tree by holding the tape/ caliper horizontal to the tree axis.

Observations to be recorded-

Sl. No.	Tree Species	Type of Trunk	Circumference (cm)	Tree diameter (cm)

Conclusion-

Practical-5

Topic- Height measurement of standing trees by shadow method

Aim - To measure the height of trees

Objectives- To learn the process of measuring tree height by shadow method.

Relevant information:

Tree height is one of the most important components for calculating the volume of tree. This is required for computing volume table and yield table. Height of the trees indirectly gives the idea about the productive capacity of the site or site quality.

In this method, the tree height is measured by using sunlight with the help of a pole of definite length.

Materials required: Pole (any convenient height), measuring tape, pen/pencil, record etc.

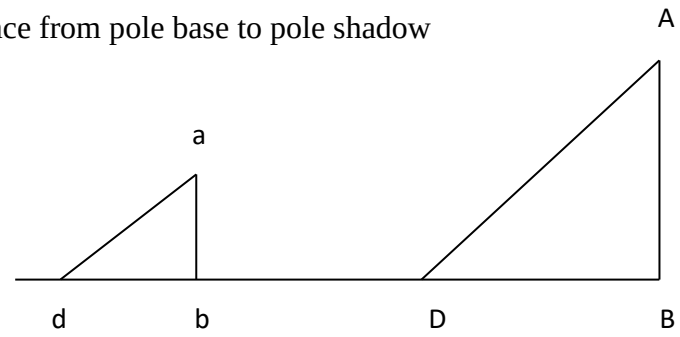
Procedure:

Fix a pole of definite length on the ground.
Measure the shadow caused by pole.
Measure the shadow caused by pole.
Calculate the tree height by using the following formula;

$$\frac{AB}{ab} = \frac{BD}{bd}$$

$$\text{Therefore, } AB = \frac{BD \times ab}{bd}$$

Where,
AB is tree height
ab is height of pole
BD is the distance from tree base to tree shadow
bd is the distance from pole base to pole shadow



Observations to be recorded:

Sl. No.	Tree species	ab (m.)	bd (m.)	BD (m.)	AB (m.)

Calculation:

Conclusion:

Precautions:

i. Clear sunny weather is required.
ii. Difficult to apply in dense forest lands.

Video link: https://youtu.be/u56HTeMK0Aw

Practical-6

Topic- Height measurement of standing trees by single pole method

Aim - To measure the height of trees

Objectives- To learn the process of measuring height of the trees.

Relevant information

Tree height is the straight line distance from the tip of the leaning shoot (height point of the crown) to the ground level, usually measured on slopes from the uphill side of the tree. The height of a felled tree is measured from the top to the base in a straight line without any allowance for curvature of stem.

The direct method for measuring tree height is simply measure the distance from ground to the top of a plant by using a measuring tape and scale. But sometimes it is not possible due to the vertical position of the tree. To measure plant height, one of the most important non instrumental method is single pole method.

Materials required

Measuring tape, Pole (1.5 m), pen/pencil and record

Procedure

1. Hold a pole (1.5 m) vertically at arm's length in hand in such a way that the portion of the pole above the hand is equal in length to the distance of the people from the eye.
2. Without changing position, the observer moves slowly forward or backward till the line is straight to the tip of the tree passes through the tip of the pole and that to the base of the tree through the point where the pole is held by hand.
3. Now the height of the tree is equal to the distance of the observer's eye from the base of the tree based on similar triangle principle.
4. Calculate the height of tree by using the following formula.

$$\frac{AB}{Ab} = \frac{EB}{eb}$$

$$\text{Or, } AB = \frac{EB \times ab}{Eb}$$

Where, AB is the height of tree

ab is the height of pole above hand

EB is the distance of tree from observer's eye

Eb is the distance of pole from observer's eye

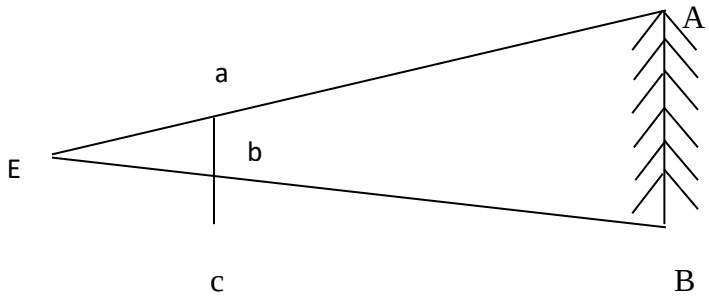


Figure 1: Single pole method

Observations to be recorded:

Sl. No.	Tree species	Height of pole above hand (m)	Eye to pole distance (m)	Eye to tree distance (m)	Tree height (m)

Conclusion:

Practical significance- Tree height measurement is very essential to estimate total volume of tree, site quality and finally the yield potential of tree species.

Video link: https://youtu.be/MwlrqVJe9PI

Practical-7

Topic- Height measurement of standing trees by hypsometer

Aim - To measure the height of trees

Objectives- To learn the process of measuring tree height by hypsometer.

Relevant information:

The height of a standing tree is usually measured by using hypsometer. Although there are many alternatives, for measuring tree height. The principal of hypsometer is trigonometry. The height is calculated through the measurement of the other sides and an angle in the triangle composed by tree top, bottom, and the viewer. The angles are measured using the gravity clinometers or gravity sensor. The readings of angles are displayed optically (read it on dial plate) or by electronics (digital numbers). The distance between the tree and the viewer was usually measured using tapes.

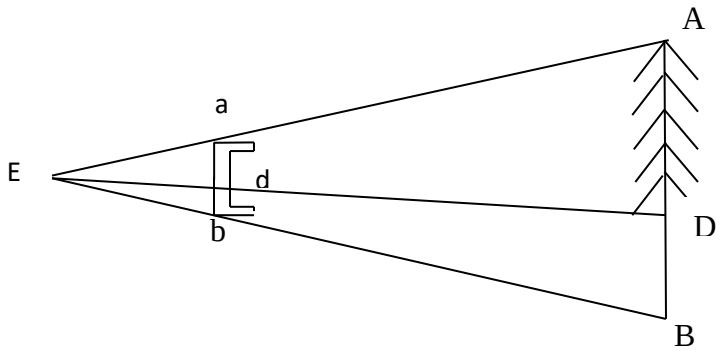
Materials required: Christen's hypsometer, measuring tape, string, weight, pen/pencil, record etc.

Procedure:

a. Tie string on the top and basal holes of christen's hypsometer.
b. Tie some weight with the lower string.
c. Measure the eye height of the observer by using measuring tape.
d. Mark (stuff) the same height (eye height of the observer) on tree trunk.
e. Hold the top string of hypsometer by hand.
f. Look at the tree by holding hypsometer in such a way that the top of the tree (A), observers eye (E) and the top of hypsometer (a) will come in a straight line.
g. Look at the marking (D) on tree trunk without changing the position in such a way that the marking (D), observers eye (E) and d will come in a straight line.
h. Look at the tree base by holding hypsometer in such a way that the base of the tree (B), base of hypsometer (b) and observers eye (E) will come in a straight line.
i. Calculate the tree height (AB) by using the following formula

$$\frac{AB}{Ab} = \frac{BD}{bd}$$

$$AB = \frac{BD \times ab}{bd}$$



Observations to be recorded:

Sl. No.	Tree species	ab	bd	BD	AB (tree height)

Conclusion:

Video link: https://youtu.be/3nqjIcsu9Xs

Practical - 8

Topic-Volume measurement of logs by using various formulae

Aim - To measure the volume of logs

Objectives– Followings are the objectives of measurement of logs.

a) To know the quantity of merchantable volume with reasonable accuracy.

b) To produce data which may be applied to standing trees in order to know the growing stock.

Parts of Merchantable Produce – Merchantable produce of a tree can be divided into following parts.

(i) Stem wood – consisting of (a) timber and (b) small wood

(ii) Crown or branch wood.

The division between timber and small wood or the minimum diameter of timber (log) is decided by market requirements. Small wood is more often sold as firewood (consisting of billets of about 5 cm diameter) and less frequently as posts of 7.5-10 cm diameter. In general, stem wood up to 3 inch (roughly 7 cm) may be treated as timber and the stem may be logged accordingly. If some parts of the branch wood are straight and large, they can be logged as timber, and the rest adds to small wood.

Materials required: Measuring tape/ tree caliper, Calculator, pen etc.

Procedure:

Length – Length of each log or section can be measured by a rod or tape. Length may be measured to the nearest 10 or 5 cm.

Circumference – Circumference is measured by a tape under bark, at the mid-length of the log.

Diameter – Diameter of a log can be measured by a caliper or measuring tape. Measurement is made at the middle of length of the log. Convert the circumference measurement to diameter by dividing the circumference by pi (π). To know the merchantable volume it is necessary to determine the diameter under bark (dub). In case of commercially valuable species like Sal (*Shorea robusta*) and Teak (*Techtona grandis*), the logs are debarked and brought to depot. So, for these trees diameter should be measured after debarking. However, there are miscellaneous species, timber of which is prone to rot and damage within a short time and it is not advisable to debark logs of such species. To find dub of these logs, a circular strip (ring) of bark of small width is removed at the mid-length of the log so as to permit measurement of diameter under bark (dub).

Radius – Calculate the radius of log by dividing the value of diameter by 2 to get the log's radius. For example, if the log diameter is 1.2 m., its radius would be 1.2/2= 0.6 m.

Volume- Calculate the log volume by using the following formula

Volume (V) = $\pi r^2 h$

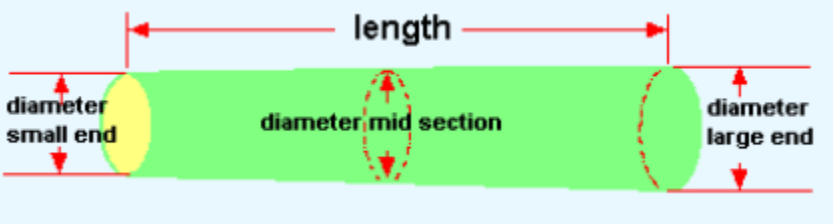
Where,

V= Volume of log in meter^3.

r= Radius of log in meter.

h= Length of log in meter.

Huber's Formula- Huber diameter is measured at mid section but could be calculated by adding the small end and large end diameters together and dividing this amount by 2.



Diameter small end + diameter large end / 2 = DIB mid section (M)

Volume (V) = L× M

Where,

V= Volume of log in m^3

L= Length of Log in Metres

M= Diameter at mid section in cm.

Observations:

Sl. No.	**Tree Species**	**Log length (m)**	**Log circumference (m)**	**Log diameter (m)**	**Log radius (m)**	**Log volume (m^3)**

Conclusion-

Practical significance- Estimation of the volume of log is essential in managing a forest for commercial timber production. Such an estimate is also important for determining biomass of the forest, the amount of carbon storage, fuel sources etc.

Practical – 9

Topic - Nursery layout

Aim: To prepare nursery layout

Objectives- To learn the process of nursery technique for raising seedlings.

Relevant information- Nursery is a place where planting material, such as seedlings, saplings, cuttings, etc., are raised, propagated and multiplied under favourable conditions for transplanting in prepared beds. Besides this the prevailing agro-climatic conditions in the area should also be taken into consideration while selecting the species.

Different species of trees and climbers planted in forests and used in 'social forestry', for example plantation along roads, gram panchayat land, gardens, etc., are mostly propagated by seeds. In short, social forestry refers to forests or plantations set up by communities and tribes. Rootstock of different forest plant species and mother plants are raised in a forest nursery. Seedlings of big trees are commonly found in a forest nursery.

Types of nursery-

Open field nursery: Such a nursery is established in open areas without any permanent structure. Usually, raised, flat or sunken seedbeds are prepared. These are vulnerable to natural environmental conditions.

Hi-tech nursery: Such a nursery is established under protected structures. The protected structures in which the nursery can be successfully raised are as follows.

Thatched roof: In this type of nursery, a thatched roof is constructed over the nursery beds, which protects the seedlings from damage caused by extreme wind, rain, heat, etc.

Shade-net: Such a nursery is raised under shade-net houses. To give different amount of shade to plants based on their requirements, shade-nets of different colours and mesh sizes are used as covering material.

Poly-tunnel: The nursery is covered with a plastic film or sheet to form a tunnel. It is miniature structure, which produces greenhouse-like effect. Besides not being expensive, it is easy to construct and dismantle. The seedlings are protected from cold, wind, storm, rain and frost. Due to modified conditions, there is better germination and plant growth.

Poly-house: It is a framed structure covered by poly-film or shade-net so that the plants can grow under partially or completely modified environment. Such structures are ventilated and may have temperature and humidity controlling devices. The seedlings are raised inside the structure on raised beds or in plug-trays, and also for hardening of tissue cultural plants.

Nursery bed: It refers to a land, which is made free from weeds, stumps, stones, pebbles, etc., and is used for sowing of seeds to raise seedlings.

Materials required- Pro tray, coco peat, compost, rose can, seed, fungicide, Shed net, rope etc.

Procedure:

Preparation of the nursery bed: Nursery beds can be prepared in three different ways.

Sunken bed: They are prepared by excavating the soil in bed area. These beds are usually 10-15 cm deeper than the normal ground level. It prevents the out flow of water and conserves moisture. Seeds with hard coat are sown in these beds.

Raised bed: They are prepared by dumping soil about 10 to 15 cm above ground level. They are common in high rainfall areas to prevent water logging. These beds are good for the species which don't require more moisture for germination.

Level beds: The surface of this bed is perfectly flat or has a slight camber. Stones, wood or a line of pucca bricks are placed at the edges of bed to prevent crumbling in dry season

Size of bed: The best size is 1m × 10m. Length can be increased or decreased; width cannot be increased because it creates a problem in weeding, hoeing and other intercultural operations.

Steps:

a) Dig soil at a site where seedbeds are to be prepared.

b) Remove all weeds, stumps, stones, pebbles, etc., from the soil and crush the clods.

c) Mix required quantity of well decomposed compost/FYM.

d) Level the plot for preparing seedbeds.

Things to know

After proper selection of site, nursery should be laid out with the following nursery components such as fence, office room, store room, water source, mist tent, plant house, nursery yard, working space, waste pit, foot path, road and entrance.

Precautions to be taken

• The nursery bed must be prepared in fertile soil rich in organic matter content, having adequate drainage and aeration.

• Excess irrigation in sunken or flat bed may lead to rotting of seeds, seedlings and damping-off incidence.

• Soil-borne infections caused by nematodes, insect-pests and pathogens may be avoided by treating the soil in different feasible ways.

• Generally, the width of the nursery bed must not be more than 1 metre and the length must be according to the slope of the soil.

Conclusion:

Practical – 10

Topic – Seed sowing

Aim- To sow the seeds of forest species.

Objectives- To learn the process of seed sowing for raising seedlings.

Relevant information-

Seed is the fertilized mature ovule which is used for propagation of plants. Plant propagation from seed is one of the oldest methods used for plant propagation. It includes seed collection, seed treatment, sowing and after care.

Materials required- Good quality seed, chemicals for seed treatment, sandpaper, water and container.

Procedure-

a) Collect seeds of forest trees from a reliable source preferably from govt. forest department or nursery or from mature mother plant.

b) Drag the seed across the sand paper (scarification) if the seed coat is hard. Chemical treatment is also useful to soften hard seed coat. Example: Soaking of *Acacia nilotica* seeds for 10 minutes in sulphuric acid followed by washing in water.

c) Treat the seeds in Carbendazim or Pyroquilon or Tricyclozole solution at 2- 2.5 g/l of for 24-48 hours for better germination.

d) Remove the seeds from solution and dry it in shade for few minutes.

e) Sow the seeds in poly bags/ nursery bed (broadcasting/ line sowing)/ plug tray in a nursery.

f) Cover the seeds with soil mixture properly.

g) Sprinkle water on the seed bed by rose can.

h) Apply water regularly on the seed bed based on the water requirement.

Conclusion

Precautions

- The seeds must be healthy and free from pest and diseases.
- Small seeds are sown after being mixed with sand for equal distribution.
- The seeds must be sown at the right depth.
- The seeds must be sown at adequate spacing to avoid overcrowding. It also ensures that the seedlings get sufficient nutrients, water, sunlight and air. Besides, the soil must neither be too dry nor too wet to avoid drying or rotting of the seeds or seedlings.

Video link- https://youtu.be/H5G5A1gh9kA

Practical – 11

Topic – Vegetative propagation techniques

Aim- To grow saplings through vegetative propagation.

Objectives- To learn the process of cutting, layering and grafting.

Relevant information-

Vegetative Propagation was originally seen as a way to bulk up small amounts of rare and valuable material. Since, vegetative propagation is done from well-differentiated vegetative parts; the propagules maintain physiological condition of the propagated part and genetic consistence of the parent tree.

Methods of vegetative propagation can be broadly classified as macro propagation and micro propagation techniques. There are three main methods of macro propagation used in trees: cutting, grafting and layering. Latest in vegetative propagation of trees is the micro propagation through tissue culture techniques.

Materials required- grafting budding knife, rooting hormone, grafting tape, string, secateurs, compost, rose can, sand, pot/ poly bag and soil.

Procedure-

i. Cutting:

Cutting is a detached vegetative part of a plant, which on separation and planting is able to regenerate the missing parts and develop itself into a new plant. Cutting as a method of propagation is cost-effective compared to other vegetative propagation methods and they result in good plant type.

Steps-

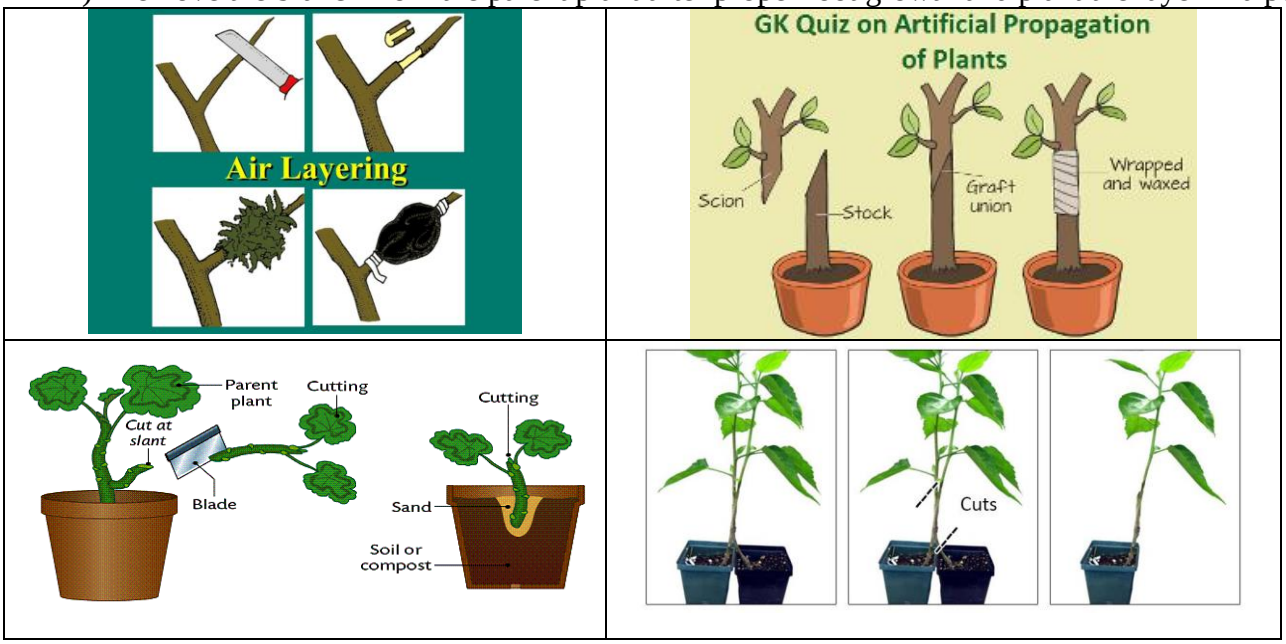
a) Select one year old branch (pencil thick) of suitable length (7.5-15 cm.) from a healthy tree.
b) Cut the branch with the help of secateur/ knife.
c) Remove maximum leaves from the collected branch except few leaves.
d) Give a slant basal cut just near the vegetative bud.
e) Dip the base of the cuttings in IBA @ 5000 ppm solution.
f) Plant the cuttings in slanting position in a suitable rooting medium (Sand/ soil/ coco peat etc.).
g) Water it regularly to keep the medium moist.
h) New growth on cutting indicates proper rooting.

ii. Layering:

In this method, roots are allowed to develop on the covered portion of the stem while still being attached to the mother plant. After the emergence and development of the roots, this portion is separated from the mother plant and allowed to grow as a new plant on its own root stem. Such root stem is known as ‘layer’. Several types of layering are used for making saplings (i.e. Trench layering, Mound layering, Simple layering) but air layering is the most commonly used method.

Steps for air layering-

a) Select healthy, vigorously growing aerial branch having pencil-size thickness. The selected branch must be of the past growing season.
b) Girdle the selected branch up to 2−3.5 cm wide just below the node 15–30 cm back from the tip of the shoot.
c) Remove a strip of the bark from the girdled portion.
d) Scrap the girdled portion, which helps in the removal of phloem tissues and prevents formation of bark at the girdled portion.
e) Put IBA @ 5000 ppm solution (rooting hormone) on the cut surface and wait few minutes to dry the solution.
f) Prepare a mixture by taking 50% soil and 50% compost/cow dung manure and water. Water soaked coco peat or sphagnum moss is also useful.
g) Place this mixture over the cut portion.
h) Carefully wrap a piece of polyethylene film around the branch to cover the mixture completely.
i) Tie string on both the ends of the polyethylene film to make it airtight.
j) Observe the root growth through the transparent polyethylene film.
k) Remove the branch from the parent plant after proper root growth and plant the layer in a pot.



iii. Grafting:

The method of joining parts of two plants in a manner that they form a unit and function as one plant is known as ‘grafting’. This involves the removal of a vegetative part from the parent tree (the scion) and its attachment to a part with its own root (the stock) so that the tissues fuse. Different methods of

grafting i.e. approach grafting, tongue grafting, veneer grafting, side grafting, Cleft grafting, stone grafting etc. are useful.

Steps (Approach grafting) -

a) Raise root stock by using seeds (mango, citrus etc.) sown in poly bags.
b) Once they reach the stage of growth, they are used as rootstocks for grafting.
c) Select a healthy disease free branch from the mother plant (scion).
d) Bring the selected rootstock and scion close together.
e) Find out the most comfortable point of contact.
f) At the point of contact, remove a thin slice of wood along with a 2.5 to 5-cm long bark from the rootstock and the scion.
g) The operated size must be uniform on both the stems of the rootstock and the scion.
h) The cut surfaces are then brought together so that they cover each other completely by overlapping. Press them firmly together and tie them with a waxed string or polythene tape, so that water does not enter.
i) After successful union, head back the rootstock above the union and cut the scion below the union.

iv. Micro Propagation through Tissue Culture:

The latest among the technologies for vegetative propagation are micro propagation through tissue culture techniques. Tissue culture refers to the culture of cells with the potential mitotic activity, in an appropriate medium under aseptic conditions. Micro- propagation using tissue culture method provides unique opportunities to rapidly multiply the elite trees either through organogenesis or through somatic embryogenesis.

Conclusion-

Precautions-

- Select healthy disease free one year old branch from mother plant for cutting, layering or grafting.
- Rainy season is best for cutting and layering.
- Best time for grafting is March-May.
- Sanitize tools properly before use.
- Use sharp tools for vegetative propagation.

Video link: https://youtu.be/IPvTKKbbYaI

Practical – 12

Topic- Forest plantation

Aim- To plant forest trees

Objectives- To learn the techniques of forest plantation.

Relevant information

1. Plantation work - Plantation work is the procedure of artificial regeneration, and aims to renew the forest crop by sowing and planting. It involves a number of operations.

2. Choice of species- The selection of species should be based on the (a) locality factors, (b) existing vegetation and (c) local needs of the community and (d) economic interests.

3. Selection of site- Selection of site is important and involves study of various factors in order to ensure success of plantation work. The major factors to be taken into consideration while selecting site are – a) Aspect and topography; b) Soil conditions; c) Choice of method of sowing and planting and d) season of planting.

4. Spacing- Spacing refers to the distance between successive plants put out in a forest plantation. Spacing to be adopted in a plantation depends on the species and growth habit of the species. However, in general, in north Bengal, 2m × 2m and in south Bengal, 2.5m × 2.5 m. is ideal for most of the species. A 2m × 2m spacing means 2500 plants per ha, and 2.5m × 2.5m spacing gives a crop density of 1600 per ha.

5. Season of planting- Season or time of planting depends on the local climatic conditions, the species and the method of planting. Monsoon is the main planting season in India, as most parts of the country receive bulk of the precipitation from south-west monsoon (June- Sept.).

Materials required- Hand hoe/ post hole digger, tree saplings, knife, measuring tape, thread etc.

Procedure-

a) Dig the soil by hand hoe/ post hole digger and make rectangular pits (Length- 60 cm at top and 45 cm at bottom, 45 cm wide and 45 cm deep) on the selected area.

b) Fill the pits with a mixture of manure and dug up soil.

c) Plant the sapling with the potting medium at the centre of the pit.

d) Make a heap by placing the remaining dug up soil at the base of sapling.

e) Put water at the base of sapling.

f) Place one wooden/ bamboo stick at the base of the sapling and tie one thread to give the extra support to the sapling.

g) Apply water time to time based on the requirements.

Conclusion

Things to know

A number of planting pattern has been in vogue from place to place.

In West Bengal, the most common pattern adopted is the ‘square planting’. However, in certain models of plantation ‘line planting’ was also adopted.

Precaution

Handle tools and implements carefully.

Remove the sapling from plastic bag/ pot with potting mixture carefully before planting.

Practical – 13

Topic- Management of forest trees

Aim- To manage forest trees

Objectives- To learn the techniques of establishment and management of forest plants.

To increase the production of various forest products in a sustainable manner.

Relevant information

Sowing and planting is never cent percent successful, therefore replanting of new planting material is necessary. Competition among the plants will increase with increasing age. In order to get a good plant stand and maximum yield, number of steps have to be taken with the progress of the tree i.e. weeding, cleaning, mulching, fertilizer application, pruning, irrigation, plant protection pruning etc.

Materials required- Hand hoe, insecticides, fungicides, herbicides, secateurs, Long handle loopers, foot sprayer, water etc.

Procedure-

Weeding-Cleaning

a) The operation of weeding and cleaning comes after the planting operation.

b) Remove the grasses, weeds unwanted species and climbers from around the base of the plants and the space between the plants by using hand hoe/ khurpi etc.

c) Apply herbicide in areas where weed menace is very serious.

d) Cleaning is to be carried out till the plantation becomes 5 years old.

e) In south-west Bengal where weed growth is less intense, normally 3 cleanings are done in the first year, and cleaning with fewer frequencies is continued till the third year.

Mulching

Mulching is necessary not only to control weeds but also for moisture conservation. Commonly used much materials are- black polythene sheet (25-50 micron), crop residues, dry grass etc.

a) Clean the required area by removing the stones, pebbles, weeds etc.

b) Cut the required size of mulch film from the main roll. Mulching area should preferably be equivalent to the canopy of the plant.

c) Cover the film to the entire area around the tree.

d) Prepare a small trench around the periphery of the mulching area to facilitate anchoring of the mulch film.

e) In case of straw mulching, place 5-7.5 cm. thick layer of paddy straw or crop residue at the base of the tree.

Fertilizer application

Application of fertilizer is not conventionally practiced in forest plantations. Since, in general, the forest land is fertile and rich in organic matters, fertilization is not considered necessary. However while raising plantation on infertile lands, or undertaking afforestation outside forest area, application of fertilizer becomes necessary to establish the plantation. For example in most of the forest land in laterite

zone of south west Bengal, the soil lacks in nutrients, thereby necessitating addition of nutrient from outside. In general application of NPK fertilizer is carried out in the plantation in the first year. About 100 gm of NPK (3:2:1) fertilizer is applied per plant either in single dose or at times in two split doses.

Pruning

It refers to the removal of live (green pruning) or dead branches (dry pruning) or multiple leaders from standing trees for the improvement of the tree. Long handle loopers and hand saw is commonly used for pruning.

Irrigation

Forest plantations are mostly rain-fed. Conventionally the plantations are not irrigated, as it does not require irrigation. However there may be exceptions for plantations in dry arid areas where soil moisture goes very low during part of the year. The situation of moisture stress is often found in the laterite tract of south-west Bengal. From the month of December till the next monsoon the soil becomes so dry that young seedlings, particularly those of the exacting species, suffer mortality. Monthly 2 irrigation is required for young saplings during dry months.

Plant protection- most insects and fungi are selective of the host species. In their natural environment, trees and shrubs normally attain a state of equilibrium with indigenous pests. However, when exotic trees and shrubs are planted, exotic pests can also be introduced. Quite often, these exotic pests readily adapt themselves to the conditions of their new habitat. For many insects and fungi, no control measures are available; when this is the case, the best precaution is to plant tree and shrub species or varieties known to be resistant to the pests.

Care taken in establishment and maintenance operations during the early years of a plantation (resulting in healthy vigorous young trees or shrubs) can help to make a plantation more resistant to insects and fungi. However, when evidence of pest attack appears, it should be investigated promptly and the cause identified. Various control measures are available; these may be silvicultural, chemical, biological, or mechanical.

Nurse crop

Nurse crop is the crop of trees or shrubs grown to foster the growth of another and more important tree crop in its early stages. Its function is to help the growth of principal species which may remain tender in the initial stage. As soon as the purpose is served, the nurse crop is removed. In south-west Bengal, particularly in Sal (*Shorea robusta*) plantation, it has been an old practice to raise Cajanus (Arhar) between two and close to Sal lines. Tolerant of drought condition, Cajanus grows fast and provides shade to young Sal seedlings and reduces evapo-transpiration loss of moisture. The moisture stress is a critical factor for survival of Sal seedlings in the early stage after planting in south-west Bengal. Cajanus on being cut also serves as green manure at the site.

Conclusion-

Practical – 14

Topic- Forest mensuration

Aim- To measure the diameter, height, volume and age of tree

Objectives- To learn the process of diameter, height, volume of forest trees.

Basis of management.

Relevant information

It is a branch of forestry which deals with the determination of dimensions (diameter, height, volume etc.) of forest trees.

Exercise 1

Calculate the diameter of an *Azadirachta indica* tree by using the following data

Tree circumference at 1.37 m = 127 cm.

Exercise 2

Calculate the diameter of a multi trunk tree by using the following data

Trunk 1 circumference = 62

Trunk 2 circumference = 89

Trunk 3 circumference = 59

Trunk 4 circumference = 64

Exercise 3

Calculate the height (m) of a tree by using the following data

Height of pole above hand= 0.7m

Eye to pole distance= 0.7 m

Eye to tree distance= 15.8 m

Exercise 4

Calculate the volume (m^3) of a log by using the following data

Circumference at large end= 127.2 cm

Circumference at small end= 103.3 cm

Length of the log= 2.3 m

Conclusion-

Practical – 15

Topic: Visit to nearby forest nursery

Aim: To visit a forest nursery

Objectives- To study the method of growing saplings of different forest trees.

Relevant Information

The need for forest nurseries emphasizes an important difference between agriculture and forestry. Farmer sows seeds where his crop is to grow. The forester in most cases slows seeds and raises seedlings in a nursery and then plants them on land to be afforested. There are two reasons for this

1) Newly germinated seedlings of most tree species fell in competition with the plants and it is impractical to give each tiny seedlings 3 or 4 m. apart in a plantation, the care needed for survival. Therefore, seedlings are raised together free of any competition until they are strong enough for planting out.
2) Only a nursery can provide suitable growing conditions to raised healthy vigorous plants. Mainly for reasons of economic, the forest planting sites receives a minimum of soil preparation, fertilizing and maintenance.

Procedure-

Study visit should be planned well ahead and the authority of the nursery should be informed accordingly.

Student should interact with the nursery persons to know the techniques and technologies used to manage the nursery.

Observations to be recorded

Name of the nursery-

Address-

Name of the owner-

Table 1. Detailed information on plant species

Sl. No.	Name of species	Source of seed/ planting material	Type of propagation	Age	Average height (cm)	Price of seedling (Rs.)	Uses
1							
2							
3							
4							

5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Conclusion-

Practical – 16

Topic: Visit to a forest based industry

Aim: To visit a forest based industry

Objectives- To study the use of forest derived inputs for making valuable products.

Relevant information

India is one of fast growing forest-based industries in the world. Forest-based Industry includes- the paper industry, match industry, silk industry, plywood industry, lac industry, sports goods industry and handicraft.

Procedure-

Study visit should be planned well ahead and the authority of the industry should be informed accordingly.

Student should interact with the industry persons to know the techniques and technologies used to manage the industry.

Observations to be recorded-

Name of the industry-

Address-

Type of industry-

Owner of the industry-

Input material used-

Source of input materials-

Processing-

Final output-

Price of products-

Total number of employees-

Safety precautions-

Conclusion-