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LABORATORY MANUAL

Course: B.Sc. Agriculture
Semester: 5th
Subject: Introduction to Forestry

Contents

Experiment-1

Keys for Identification of Trees

Field visit for Identification

To identify the trees the following procedures are followed:

1st step:- Identifying type of Barks

a) More or less smooth

b) Flaky with shallow indentations

c) Flaky and saggy

d) Deeply fissured

e) Lightly fissured

f) Rough

g) Tiled, Prickly or warty

2nd step:- Identifying colour of flowers

Green / creamy green / creamy / creamy white / white / yellow / pink / brown / red

3rd step:- Identifying the type of fruits

Dry pods / dry splitting / fleshy / fleshy berry like / compound fruits / fleshy fruits / figs

4th step:- Identify the leaves

a) Simple untoothed

b) simple toothed

c) simple lobed

d) compound digitate

e) compound pinnate

f) compound twice pinnate

g) leaves with or without milky sap

Experiment No. 2

Measurement of diameter of trees in field

a) Through scale

b) Through tape

c) Through Calliper

In logs, the diameters are measured at thick end, thin end and at the middle of the logs. The average value is considered as a diameter of log.

In case of standing trees, the diameter or girth is measured at breast height. Breast height is taken as 4ft. 6 in. (1.37 m) above ground level.

Reasons for adoption of breast height

i) It is a convenient height
ii) The measurement at base is difficult due to presence of grasses & shrubs.
iii) Trees with swelling at base make the measurement more difficult.
iv) It is a uniform measurement.
v) It is more useful than measurement at stump height because stumps are never cut at uniform height.

Standard Rules for breast height measurement

1. BH is marked by using a measuring stick.
2. BH is marked by intersecting vertical & horizontal lines of 12 cm. in white paint.
3. On sloping ground, the BH is marked on uphill side.
4. In leaning trees, dbh is measured along the tree stem and not vertically.
5. In case of abnormality at bh, dbh should be shifted up or down slightly.
6. If tree is forked above the breast height, it is considered as single tree.
7. If the forking is below breast height, each stem is considered as single tree.
8. In case of buttresses, breast height is taken at the lowest point above which buttresses is not likely to extend.
9. Mosses, creepers, lichens and loose bark on the tree must be removed before measurement.
10. Diameter measurements should be recorded in centimeter and to the nearest multiple of two millimeter.

Instruments used in diameter measurement

1. Wooden scale :

It is of two sizes : 30 cm and 60 cm.

The eye should be just above the mark while reading measurement

2. Caliper

This consists of a graduated rule and two arms in which one is fixed at right angles to other. The other arm moves along the rule parallel to the fixed arm. Normally calipers exceeding 120 cm in length are rarely used.

Precautions to avoid errors :

a) Calipers must be placed with well opened arms and must not be forced on the tree.
b) The reading is taken before the caliper is removed from tree.
c) If the cross section of the stem is elliptical, it is necessary to measure two diameters corresponding to major and minor axes. Diameter is taken as the average of the two.
d) Calipers should be placed at right angles to the axis of the tree.
e) Two arms of the caliper must be in contact with the tree and the movable arm should be at right angle to the scale arm.
f) The scale arm must touch the tree stem.

Advantages of caliper

1. Diameter can be read directly in cm & mm.
2. The points of arms touching the tree are always in sight that reduces the error.
3. It is easily adapted by unskilled labour.
4. Errors are both positive and negative and they may neutralize each other.
5. It is more accurate than scale or tape.

Disadvantages of Calliper

1. It is not accurate when not in adjustment
2. Calipers big in size are difficult to carry
3. In steep hilly terrain, it is very difficult to take two measurements.
4. Movable arm often sticks when the scale is wet or dirty.

3. Tape

It is a band of reinforced clothe, plastic or steel about 1.5 cm. wide and of varying length. Tape is used to measure the girth of trees and logs. It is graduated in cm./inches.

The ends are plate with some metal to prevent tearing off.

Precautions in using tape

1. Tape should not be old to avoid expansion errors.
2. If the end is broken, the measurement should be taken from the next centimeter mark.
3. Tape must be flat against the tree and not in twisted manner.
4. Tape must lie in a plane perpendicular to the axis of the tree.
5. Sufficient care should be taken to see that no climber has vitiated around the stem.
6. The end of the tape should be in right hand of the measurer and starting point should be in the left hand.

Advantages of tape

1. Convenient to carry.
2. Does not require constant adjustment.
3. Requires only one measurement even with irregular trees.
4. In case of logs lying on the ground tape is more convenient than caliper.
5. It measures the size of the tree better than a caliper (touches the whole tree).

Disadvantages of tape

1. Rough bark of tree exaggerates the diameter
2. As the tape has to swung round the tree, it is frequently not applied to in a plane at right angles to the axis of the tree.
3. Difference in tension of the tape due to elasticity affects measurement.

Experiment No. 3

Tree height measurement in field

1. Ocular estimate :

The height of the tree is assessed by visual judgment. For this purpose, initially few trees are measured using instruments. Thereafter the estimator can judge the height of trees by comparison.

2. Non-instrumental methods :

a) Shadow method :

This method is applicable only on sunny days and mostly in the morning or in the evening. In this method, a pole of definite length is fixed in the ground. The shadow caused by the pole and the tree are measured. Then height is measured from the following formulae.

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

or

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

AB ⇨ tree length
ab ⇨ Pole length
BD ⇨ Length of shadow of tree
bd ⇨ shadow of the pole

b) Single pole method :

The observer holds a pole (1.5 m length) 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 pole from the eye. Without changing position, the observer moves slowly forward and backward till the line of sight 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. 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.

Let AB be the tree and ac is the pole about 1.5 m. long held at a vertically so that distance from observers eye E to b is equal to ab.

$$\frac{AB}{ab} = \frac{EB}{Eb}$$

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

since ab = Eb hence AB = EB

Instrumental methods

(a) Geometric principles of similar triangles :

In similar triangles, the corresponding angles are equal and the corresponding sides are proportional. In the following similar triangles viz, ABC and A'B' C,

A'B' : AB : : B'C : BC

= A'B' X BC = AB x B'C

$$\text{So } A'B' = \frac{AB \times B'C}{BC}$$

A'B' ⇨ tree

AB ⇨ Man

BC ⇨ ground distance between tree and the point of the angle.

(b) Trigonometric principles

I) Tangent Method

This method utilizes the tangents of the angles to the top and base of the tree and the distance of the observer from the tree.

b I) On level ground :

Let AB is the tree, EF is the observer, DE is the horizontal distance from the tree and α is the angle to the top of the tree

AB = AD + BD

= ED tan α + BD (tan α + AD/ED)

= BF tan α + EF (ED = BF)

BF ⇨ Ground distance

EF ⇨ is the eye height of the observer

b. 2) On sloping ground : The top of the tree is above the eye level and base of the tree is below the eye level.

Let AB be the tree

α be the angle to the top

β be the angle to the base of the tree

ED be the ground distance from the observer to the tree.

$AB = AD + DB$

$= ED \tan \alpha + ED \tan \beta$

$= ED (\tan \alpha + \tan \beta)$

Instruments based on trigonometrical principles

1. Brandis Hypsometer :

It is a hollow metal tube of about 14 cm. long and rectangular cross section. A wheel enclosed in a circular metal case is attached to it on one side. The object to be sighted is seen through the hollow tube from the end.

The pivoted wheel attached to the tube should be in zero position when the instrument is horizontal. The outer rim of the wheel is graduated to show degrees that can be read through an opening in the metal case by a magnifying glass in eyepiece.

The observer should stand at a convenient place from where the top and base of the tree can be visible. He should press the spring while seeing the top as well as bottom of the tree.

The reading on the scale will give angles to the top and base of the tree. Distance from the observer to the base of the tree is measured and height of the tree is calculated by using tangent formula.

2. Abney's level

This is used for measuring height and contouring. It consists of a hollow tube with an eyepiece at one end and a sighting tube at the other end. The spirit level is fitted to the main tube. An index arm is attached to the spirit level and the arc is graduated to read whole degrees. A vernier and a magnifying glass are fitted on the index arm.

The observer stands away from the tree at a place from where the top of the tree and the base are visible, while sighting the top, the screw is rotated to bring the spirit level in a horizontal position.

As the spirit level approaches horizontal position, the spirit level is continued to be moved slowly to the position when the bubble image is bisected by the line of horizontal wire on the mirror and in the other half, the tree top is seen touching the horizontal wire. At this position, the index arm reads the angle of elevation to the top of the tree. Similarly, the angle of depression to the base can be read.

From these angles by using formulae height of the tree is determined.

3. Haga Altimeter

It consists of a pointer and a rotatable scale. The top of the case has an eye piece with a pinhole. The instrument has hexagonal bar inside which can be rotated by a turning knob. The bar has a separate scale on each of its face. The usual height scales are 15, 20, 25 and 30m. The scale and height readings can be read through a longitudinal narrow slit.

The gravity controlled pointer indicates the heights above or below the eye level when the top or base of the tree is sighted.

In order to use this instrument, the observer should stand at specific distance (15, 20, 25 or 30 m) by holding the instrument in such a way that the eye piece is towards the observer and the sight vane is towards the tree. After sighting the top, the trigger is depressed to lock the pointer. This gives the height of the tree above eye level. Similarly, the bottom of the tree is observed and the height of the tree below eye level is obtained. Both the values are added to get the height of the tree.

Experiment No. 4

Volume measurement of Trees

Form factor

It is the ratio between the volume of a tree to the product of basal area and height.

Form factor is useful in estimating the actual volume of standing trees.

Form factor is described in equation form as

$$\text{Form Factor (F)} = \frac{V}{S \times b}$$

F ⇨ Form factor

V ⇨ Volume of the tree

S ⇨ basal area at breast height (4.5 ft.)

b ⇨ height of the tree

Volume of the Tree= $\pi r^2 h$ * form factor

Volume Table

Volume table is defined as a table showing for a given species, the average contents of the trees, logs or sown timber for one or more given dimensions.

It is used to estimate the volume of a given crop. Volume tables are prepared based on the actual measurement of sufficiently large number of trees.

The variables used for volume table preparation are diameter, height and taper form.

Experiment No. 5

Preparation of Nursery

Planting seedlings with ball of earth :

This is defined as the planting of seedlings with a ball of earth containing their roots without any disturbance to roots.

For this purpose, the mature seedlings are detached from the wetted nursery bed with a ball of earth. This is planted in a similar way as the naked seedling.

In this method during transportation the balls get damaged & this also is labour intensive process.

Planting seedlings in containers :

This is the safest method of planting, the plant containers may be Donas, baskets, polybags etc. In this method, the plant containers are removed before planting in the pits without disturbing the roots.

NURSERY ESTABLISHMENT

Size, location, availability of water, skilled labour force and market for the seedlings.

Basic considerations for a nursery site The ideal nursery site should have at least ¾ of the following requirements

1. Easily accessible,

2. Good permanent water supply e.g. spring, river, well, piped water system.• The bore hole is preferable but usually not reliable at times, Gently slopping, well drained site,

3. Good supply of suitable soil materials.

Avoid the following sites Heavy clay soils, Swampy valley bottoms and Exposed hilltops.

Materials needed for Nursery establishment :-

In all these, nursery operators are encouraged to use locally available material where feasible e.g. Jerry cans, hoes, basins, winnowers, pangas, tins and banana fibres, Poles, timber, grass, mats and nails.

Steps to be taken while preparing new nursery site

1.Cut down all the trees/ shrubs on site

2. Destroy any termite mound,

3. Dig the area thoroughly,

4. Allow some time for the grass to grow and stabilize;

Procedure for nursery establishment Level the site of the beds and firm the soil,

Mark out the shape and sizes of the beds,

Erect the beds using durable poles,

For the shade, one can use any local material available,

Erect rivets (sawn timber or poles) around the beds,

Common mixtures for the nursery seed beds and transplant beds

i) Standard seed- bed soil mixture (SSM): This is composed of 50% sieved black forest or top soil and 50% sieved sand. Therefore the ratio of soil to sand for SSM should be 1:1 but can keep varying depending on whether clay or sand component is higher in the soil build up. Use of components The forest soil give sufficient moisture holding capacity to promote good germination where as the sand is to produce a very porous, textured soil which allows good penetration of the roots of the germinating seeds and easy to lift when pricking out.

ii) Standard transplant bed mixture (STM) This is the mixture of soil that can be used in the transplant bed or polythene tubings and gives the seedlings the most favourable growth conditions. It contains; 60% Un-sieved forest soil, 10% sand, 10% small stones (1cm diam), 10% clay and 10% composite manure.

The above mixtures can be left to mature for 2-4 weeks before use. Keep it moist.

Nursery Lay out To obtain the maximum effect of the shade, beds should be orientated to run East- West to avoid direct sunshine. During March to September when the sun is in the northern hemisphere the shade should slope towards the north and the rest of the year when it is in the southern hemisphere, it should slope towards the south.

When seed is old or when the germination is low or unknown, use a seedbed to test viability before filling too many containers and wasting resources, If seed does not store very well.

i) Broadcasting: This is the method of spreading seed on top of the SSM, either by hand or a mechanical broadcast. This mainly applies to small sized seeds.

ii) Drill -sowing: Is the method of making ruts or drills in the SSM into which seeds are linearly dropped in and lightly covered with SSM. When seed is old or when the germination is low or unknown, use a seedbed to test viability before filling too many containers and wasting resources,

iii) Direct sowing: Is when sizeable (large sized seeds) are directly sown into containers or to the field. Depending on the conditions in your nursery, including the tree species (size of the seed), number of plants to be produced and labour availability, a combination of direct sowing and use of seedbeds may be your best way of operating.

Most nurseries use seedbeds to germinate seeds. a) Direct sowing of seed into containers/pots Direct sowing of seeds into containers saves time, labour and money, because the extra step of preparing a seedbed and transplanting is eliminated. Even if it takes a little longer to plant small seeds directly in the containers, it is easier and cheaper than pricking out. Direct sowing allows undisturbed seedling growth and thus reduces stress for the seedlings. b) Direct sowing of seeds into the field Some trees/shrubs can be established by sowing the seeds directly into an area or field where they are to grow until harvest time. This method is known as direct sowing. This method can be done in areas which receive reliable rainfall. Direct sowing can be a

good method for species and technologies which require very many trees/shrubs, e.g. live fences, dense woodlots and improved fallows.