



Practical 1

VISIT TO A BAMBOO NURSERY

OBJECTIVE

After completing this practical you will be able to identify various varieties of bamboo.

PRINCIPLE

The bamboo plant can grow many forms as follows:

TREE FORMS

These are bamboos up to 35 meters in height, and with large or medium sized, usually thick-walled, culms. Examples *Bambusa balcooa*, *Dendrocalamus hamiltonii*, *Dendrocalamus strictus*. Most bamboos in India are tree forms.

REED FORMS

These are medium sized bamboo, which commonly grow as reed brakes. They have thin-walled culms up to 9 meters in height with long internodes. Example: *Ochlandratra vencorica*. Reed bamboos are common in Kerala and adjacent parts of south India.

STRAGGLER FORM

These are medium-sized bamboos up to 15 meters tall, with the tip of the culm arching or drooping down or climbing on adjacent trees. Example: *Melacalamus compacti florus* (climbing bamboo). Straggler forms are rare in India.

SHRUB FORMS

These are erect short forms of bamboo found in temperate species. They mainly occur at high altitudes, and have very thin culms that rise to a height of up to 5



Notes

meters. Examples: *Arundinaria cernua*, *Sinarundinaria falcata*. Shrub forms are widespread in India's Himalayan regions, near the snowline in Arunachal Pradesh, Uttarakhand, Himachal Pradesh and Sikkim. They also occur in the Eastern and Western ghat areas of Kerala and Karnataka.

REQUIREMENT

Bamboo nursery or field or forest with different forms of bamboo.

PROCEDURE

1. Visit to a nearby bamboo nursery.
2. Contact the nursery In-charge and visit the nursery.
3. Note down the following :
 - (i) Different varieties of bamboo present in the nursery.
 - (ii) Names of the different bamboo types (common names).
 - (iii) The difference in the appearances of all the varieties of bamboo present in the nursery.
 - (iv) Segregate them into tree, reed, shrubs or the straggler forms of bamboo.

OBSERVATIONS

- (i) Name and address of the nursery visited
- (ii) Time of the year when visit was made
- (iii) Name of the bamboo varieties seen in the nursery
- (iv) Differences in the characters like height, diameter of the stem, leaf shape and size, and any other difference that you observe
- (v) Group bamboo varieties present there into tree, herb, shrub or reed forms

RESULTS

Visited nursery and observed the following varieties of bamboo:

1.
2.



3.

4.

Notes

PRECAUTIONS

- Visit the nursery only with prior approval of the In-charge.
- Do not cause damage to the plants in the nursery.
- Carefully observe the characters of the bamboo plant to segregate into different varieties.

NOTES

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

(Instructor’s Signature)



Practical 2

FAMILIARIZING WITH THE BAMBOO PLANT

OBJECTIVE

After completing this practical you will be able to identify different parts of the bamboo plant.

PRINCIPLE

The bamboo plant consists of two sets vegetative axes: one above the ground and the other below the ground (rhizome system with roots and buds on it).

RHIZOME

The rhizome grows laterally under the soil surface and is branched. It helps the plant to spread its area of growing. The rhizome consists of nodes from which roots emerge (comes out). Buds come from it and develops into more rhizomes under the ground. On rhizome, nodes are very close to each other and are protected by sheaths (covering). There are two broad types of rhizomes in bamboo:

- **Pachymorph (sympodial):** clump forming, that is, many bamboo stems (culms) come out close to each other from the rhizome. They form a close group (Fig.2.1).
- **Leptomorph (monopodial):** non-clump-forming, that is, the bamboo stems (culms) coming out from rhizome are not very close to each other (Fig. 2.2).

Sympodial rhizome

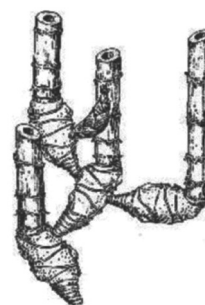


Fig. 2.1



Monopodial rhizome

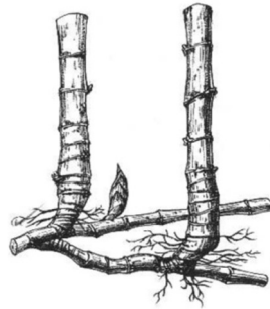


Fig. 2.2

Most Indian bamboos have sympodial rhizomes, and are therefore clump-forming.

Some bamboos have both sympodial and monopodial rhizomes. They have characters common to both types. These are called amphipodial rhizomes.

CULM

The stem of the bamboo is called culm. It is like a hollow cylinder that becomes narrow towards the top (Fig. 2.3). It is also the most widely used part. There are many uses of culm that ranges from basket making, furniture or timber etc. The culm emerges (comes out) from the ground as a shoot. It then grows fast and turns woody. It reaches its full height and girth within 80–110 days. Most bamboo culms are green in color but some can be yellow, black, rust or even purple-black. Some bamboos are striped also, in yellow or green. In many species, the color changes as the culm matures.

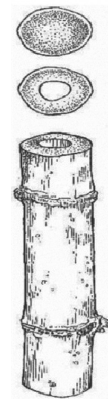


Fig. 2.3

SHOOT

Bamboo shoots are the new bamboo culms (stem) that come out of the ground (Fig. 2.4). Young bamboo shoots or bamboo sprouts of many species are edible (which you can eat). They are conical and creamy-colored when young.

Shoot



Fig. 2.4

Culm node



Fig. 2.5

Culm internode



Fig. 2.6



Notes

NODES AND INTERNODES

When you observe the rhizome, culm and branches of the bamboo plant, you will see that they are divided by lines. These lines are actually the nodes (Fig. 2.5). These are the points from where new shoots and rhizomes develop and grow. The portion between two nodes is called an internode (Fig. 2.6).

BUDS AND BRANCHES

Buds are small structures which can grow into a branch. They are present on the nodes arranged on the sides of the culm.

LEAVES

Like all plants, the branches of the bamboo plants bear leaves. They are important for photosynthesis by which plant makes its food. They also protect the plant from the rain and frost. They are a good source of fodder (food for cattle). You may be familiar with a carpet of leaves under bamboo plants. These are leaves fallen from the bamboo plant and are rich source of organic matter and silica for the plant.

ROOT

The roots come out from rhizome nodes and culm nodes that are below the soil surface (Fig. 2.7). In some species, roots may also be present on the aboveground portions of culms and branches. Roots provide anchor and hold the plant tight in the soil. They are responsible for taking up water and nutrients from the soil and give it to other parts of the plant.



Fig. 2.7: Bamboo roots

FLOWERS AND FLOWERING

In bamboo, the flowering occurs occasionally and at long intervals. It varies from one year to even a hundred years. Flowering takes place in clusters of specialized



leaves on bamboo (Fig 2.8). They are important for reproduction which finally forms the seed. Bamboo flowers vary in color, size and other characteristics.

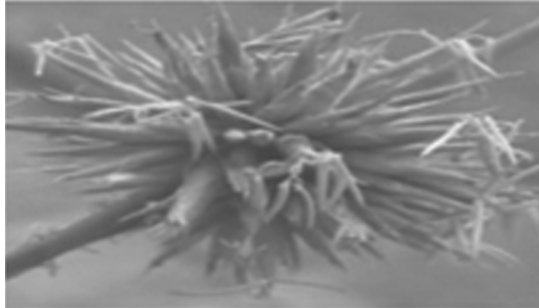


Fig. 2.8: Bamboo inflorescence

REQUIREMENT

Field area with bamboo plants growing in it.

PROCEDURE

1. Visit a nearby bamboo farm or plantation/ cluster/ forests.
2. Contact the Farm-in-charge or manager and seek permission to visit the farm.
3. Select a well grown healthy bamboo plant.
4. Note down the different parts of the bamboo plant with their color and appearance.
5. Note down the types of rhizome present.
6. Enquire about the date/cycle of flowering of the bamboo plant that you have selected from the In-charge, if no plant is in flowering.

OBSERVATIONS

The different parts of the bamboo plant observed by you are:

| | |
|-----|-----|
| 1. | 2. |
| 3. | 4. |
| 5. | 6. |
| 7. | 8. |
| 9. | 10. |
| 11. | 12. |



Notes

RESULTS

You have identified number of parts of bamboo plant. Few are:,,, and

PRECAUTIONS

- Visit the farm only with approval of the In-charge or manager.
- Do not cause damage to the plants in the farm.
- Carefully observe the different parts of the bamboo plant.

NOTES

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

(Instructor’s Signature)



Notes

Practical 3

USES OF BAMBOO

OBJECTIVE

After completing this practical you will be able to use bamboo plant for a variety of uses.

PRINCIPLE

Bamboo is an important resource in the India with around 1500 recorded uses. It is a fast growing, widespread, easily renewable, low cost, environment-friendly resource. It has potential to provide livelihood in the years to come, in both rural and urban areas. Apart from its traditional uses, bamboo in the raw, along with its engineered (reconstituted) products, has various new applications as an eco-friendly alternative to wood and other more expensive, but ecologically detrimental materials, like plastic, cement blocks, bricks, etc. It is widely used in construction, either in its natural form or as a reconstituted material like laminated boards, panels and composites of bamboo, jute and plastic.

Some of the uses are as follows:

- Composite and wood substitutes
- For building normal and air-conditioned houses, schools, hospitals, etc.
- For fiber-making, clothes that have antifungal/ antibacterial properties
- To make accessories and utility items.
- For making furniture
- For medicinal purposes
- As food for people and animals
- For scaffolding



Notes

- To make durable utensils.
- As fuel
- For making paper
- As wind breaker breaks and fencing
- As soil binder
- For making exotic handicrafts

REQUIREMENT

Bamboo Development Agency (BDA)/State Bamboo Mission

PROCEDURE

1. Visit your BDA or State Bamboo Mission Office.
2. Contact the In-charge of the office.
3. Note down the different products that are made up of bamboo.
4. Also note down the products made directly out of bamboo while those made after processing the bamboo.
5. Note down the part/ parts of the bamboo plant used in the product.

OBSERVATIONS

| Bamboo - direct use | | | |
|--------------------------------|---------------|-----------|---------|
| S. No. | Product / Use | Part Used | Utility |
| | | | |
| | | | |
| | | | |
| Bamboo - used after processing | | | |
| S. No. | Product / Use | Part | Utility |
| | | | |
| | | | |
| | | | |



Notes

RESULTS

You have listed uses of Bamboo directly and uses of processed bamboo.

PRECAUTIONS

- Visit the office only with prior approval of the In-charge.
- Do not touch the products without permission of the authority.
- Do not cause any damage to the products.
- Carefully observe the use and plant part used.

NOTES

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

(Instructor’s Signature)



Practical 4

TYPE OF PLANTING MATERIALS USED IN BAMBOO PLANTATIONS

OBJECTIVES

After completing this practical you will be able to

- identify different types of planting materials used for growing bamboo in plantations;
- select appropriate planting material based on its advantages and disadvantages.

PRINCIPLE

You are well aware that plants can be propagated through different methods. Some plants are propagated by seeds, for e.g. rice, wheat, pulses etc. whereas many plants are propagated by vegetative propagation like potatoes, mango, rose etc. Bamboo can also be propagated through seed or through vegetative means. Each of these methods has its own advantages and disadvantages. Large-scale planting of bamboo requires nursery-raised planting material.

PROPAGATION BY SEED

Bamboo regenerates naturally with seed (Fig. 4.1) as planting material. This method of propagation is easy and inexpensive. Seeds have the advantage of 'known physiological age', but other traits like vintage/cycle of flowering is uncertain. By visual inspection of the mature plant, you cannot identify the type of propagation. Therefore, plants produced through seeds exhibit wide variation in growth and productivity. Seedlings also take longer to produce full-sized, mature culms than rhizome offsets and culm cuttings.



Fig. 4.1: Bamboo seeds



PROPAGATION BY VEGETATIVE METHODS

Planting material of vegetative origin produces a replica of the parental stock. This can be a major advantage as the origin (including year of flowering) is certified by the nursery. Bamboos can be propagated vegetatively (Fig. 4.2) by various planting materials of vegetative origin like:

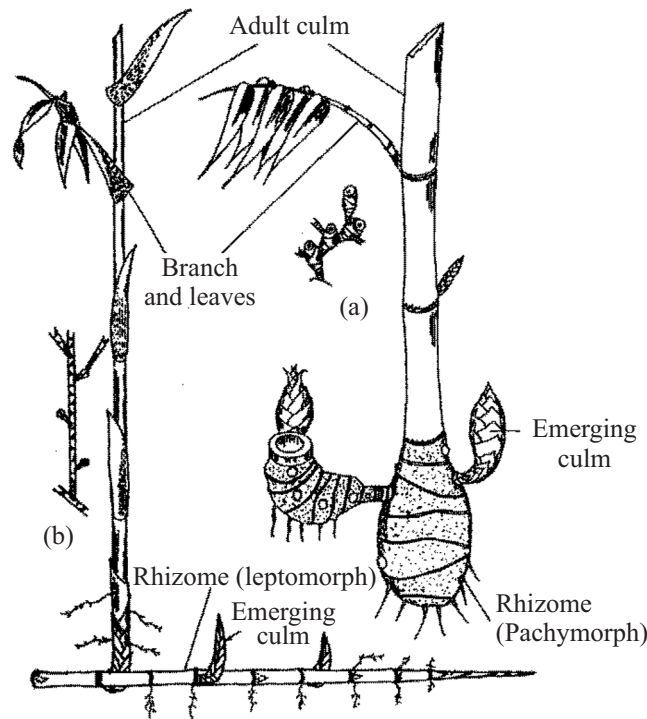


Fig. 4.2: Vegetative propagation in bamboo

Rhizomes: Segments of the underground modified stems have traditionally been used for raising new plants. New shoots and roots arise from the nodes present in the rhizomes.

Offsets: The underground rhizome along with a portion of the over-ground stem is detached and planted as a separate plant.

Cuttings: Section of a culm or branch that can be made to root is placed in soil to raise new plants.

Layering: Bringing a culm or branch in contact with the soil to induce root formation at nodes which are then separated into individual plants.



Notes

Propagation by vegetative methods has the following advantages:

- Plants produced by vegetative methods are identical to the mother plant.
- Since all the traits of the mother clump are passed on to the progenies, the growth performance of the progenies is predictable.
- The processes and steps involved in vegetative propagation are easy to implement.
- The commercial gestation period of vegetatively multiplied plants is shorter than those of seed or tissue culture origin.

However, vegetative propagation has the following disadvantages also:

1. Offsets, being bulky, are difficult to take out, stock and transport.
2. The propagation method is labor-intensive.
3. Plant material can be produced only in limited numbers due to scarce availability of mother plants with desired traits.
4. Success in vegetative propagation is restricted to thick-walled bamboos. Its extent also varies with species.
5. Propagation is season-specific and is also influenced by the age of the culm.
6. Uncertainty about the life span of the plant if the age of the mother clump from which the propagule has been derived is not known.

MICROPROPAGATION OR TISSUE CULTURE

In addition to these traditional methods of propagation by seeds or by vegetative propagules, bamboo can also be propagated using tissue culture or micro-propagation protocols (Fig. 4.3). Tissue-cultured planting material based on superior bamboo plants which are hardened for field condition is now available for some species. The cost is high but can be borne by a commercial plantation. Such material normally has faster growth, carries lower mortality (death) risks and will produce good-quality culms of uniform size and characteristics.

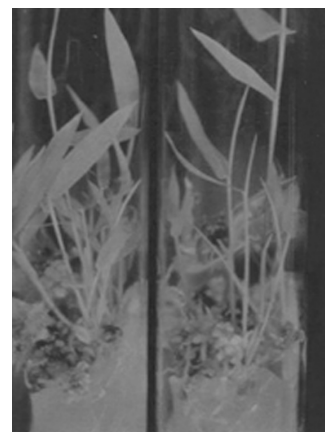


Fig. 4.3: Micro-propagation in bamboo



Notes

REQUIREMENT

Bamboo farm/plantation or bamboo nursery caretaker.

PROCEDURE

1. Visit a nearby bamboo farm/plantation or nursery.
2. Identify a person who is involved in planting the bamboo plants and growing them.
3. Enquire in detail from him the following :
 - (i) Different types of planting material for bamboo they are using in the field/ farm/ plantation.
 - (ii) The advantages and disadvantages of the different planting materials they use.
 - (iii) The most preferred planting material according to him.

OBSERVATIONS

Record your observations in following table

| S. No. | Type of Planting Material | Advantage | Disadvantage | Source of Planting Material |
|--------|---------------------------|-----------|--------------|-----------------------------|
| | | | | |
| | | | | |
| | | | | |

RESULTS

1. The planting material used in bamboo fields/farms/plantation are:

.....

.....

.....
2. The most widely used planting material is



Notes

PRECAUTIONS

- Visit the farm only with prior approval of the In-charge.
- Carefully listen to the observations of bamboo grower.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor’s Signature)



Practical 5

PRACTICES USED IN BAMBOO PLANTATION

OBJECTIVE

After completing this practical you will be able to use different practices namely, intercropping, irrigation, pruning, weeding and nutrient management in bamboo plantation effectively.

PRINCIPLE

Once you have established a bamboo plantation, it is necessary to maintain it. The maintenance is very important as it will decide the commercial and economic viability of the plantation. It is required for getting a continuous and a good yield of bamboo culms or shoots. The different practices like intercropping, irrigation, mounding, mulching, pruning, cleaning, thinning etc. can be done in a plantation for a healthy and good yield of bamboo.

INTERCROPPING

Intercropping is a farming method in which more than one crop is grown at the same time and on the same piece of land. You must have practiced intercropping in the crop you grow in your field. Intercropping can also be done with bamboo. It can be beneficial if done in the early years of a bamboo plantation, before the clumps attain maturity and canopy formation is completed.

You should be careful in selecting the crops for intercropping. The plants should not be such which can have intense competition with the bamboo for nutrients. Further, the crops should not be placed too close to the bamboo plants. This increases the competition for sunlight and space. Several other crops like off-



Notes

season tomatoes, soybean and maize have also been found to be successful for intercropping in bamboo plantations.

IRRIGATION

Bamboo grows the best when there is adequate moisture in the soil. In the initial years of a plantation, the young plants need extra care and water. Lack of moisture in the soil adversely affects the growth of rhizomes and the culms. Irrigation of the plantation reduces mortality (death) in young plants, and improves the health and productivity of bamboo clumps.

The requirement of irrigation will vary with the local climatic conditions and the soil type. There are various irrigation methods that can be used. The type of irrigation to be used will be determined by the actual moisture in the soil, especially in the growing season. Various types of irrigation methods are as follows:

- Channel irrigation
- Drip irrigation
- Wick method of irrigation

It is recommended in the dry season. It should be done at least once a week. In an area where water is less, drip irrigations should be used. It is found to be cost-effective, but this requires technology and investment during site preparation.

The traditional earthen pitcher with a wick method of irrigation is effective and uses water frugally (simple and not costing too much). A 2 litre pitcher would require refilling thrice a week.

WEEDING

Weeding is the process of removing unwanted plants from the plantation. In the initial years of the plantation, regular weeding is necessary to prevent weeds and other vegetation from competing with the young bamboo for resources like sunlight, nutrients from soil and space. Intensive weeding is required at least for the first 2 years after the rains, and towards the end of the wet season.

PRUNING

Pruning is the process of cutting the tips of the branches. In some species of bamboo, there is heavy branching at the lower nodes of the plant. Pruning of these



branches reduces clump congestion and helps provide a healthy, airy environment within the clump. Mild pruning should be undertaken in the second and third years of growth, and intensive pruning from the fourth year onwards. It should be completed before the end of the dormancy period (winter months when the growth is very less) well before the shoots emerge. Good months to carry out pruning are December and January.

NUTRIENT MANAGEMENT

Nutrient Management is an important part of the management practices in the intensively managed plantations. Bamboo plants need much nutrition and it responds well to fertilizers and manures. They grow more vigorously with fertilizer application than without it.

CHEMICAL FERTILISERS

In general, bamboo needs the complete range of fertilizers including Nitrogen Phosphorous, and Potassium (NPK). In-fact they often require a higher amount of nitrogen. The chemical and commercially available fertilizers offer established and straightforward solutions for their nutrition requirements. However, it is a good idea if you carry out soil analysis prior to establishment of the plantation and at annual intervals thereafter, to fix and confirm the fertilizer dosages. Overdose of fertilizer is not good for bamboo yield. Under normal soil conditions, the composition of NPK can be in ratio 5 : 2 : 1 or 4 : 2 : 1.

The fertilizer doses may vary depending on the purpose of the plantation. Plantations targeted for bamboo shoots need to have more fertilizers than that for culm plantations. In the case of cultivation for culms, chemical fertilizer application may be to the extent of 1,500 kilograms per hectare per year. Cultivation for shoot will require additional nutrients, and the fertilizer application required may go up to 4,000 kilograms per hectare per year.

You should apply fertilizer first during planting when the fertilizer should be placed and mixed in the pits. After that, you should apply fertilizers within two months of planting, and then again, in the later part of the dormancy period, preferably around 4–6 weeks before shoot emergence.

You must be careful that chemical or strong fertilizers are not applied directly to the rhizome and other sensitive parts of the plant. The applied fertilizer should not



Notes

touch sprouting shoots, to avoid damage. Fertilizer should be applied in ditches around the clump when the soil has enough moisture, and then covered with soil.

It is also possible to cultivate bamboo without the use of chemical fertilizers, relying on compost, vermicompost and leaf litter for the necessary nutrients. In fact, organic farming of bamboo has more demand in market of bamboo shoot and even bamboo culm. They are also higher priced than that grown under chemical fertilizers. There is also increasing concern that although chemical fertilizers boost production, in the long run they adversely affect soil health and fertility. To increase productivity, and to cater to the needs of organized and intensively managed plantations, however, it is necessary to systematically plan and implement an organic farming regime.

Organic fertilizers can provide a range of nutrients to the soil. They encourage microbial activity, which allows the fertilizer to provide nutrients over a longer period of time. Unlike chemical fertilizers, the nutrients in organic fertilizers are less likely to leach away in rainwater.

Manure and compost are established sources of nutrients, and simple to prepare and use. There are many other sources of organic and naturally occurring fertilizers.

REQUIREMENT

Bamboo plantation and office of District Agriculture Officer/Forest Officer.

PROCEDURE

1. Visit your District Agriculture Officer/Forest Officer.
2. Discuss the advantages and use of the following practices in agriculture:
 - (i) Intercropping
 - (ii) Irrigation
 - (iii) Pruning
 - (iv) Weeding
 - (v) Nutrient management
3. Visit a bamboo plantation and collect information on above mentioned practices followed there.



Notes

OBSERVATIONS

| S. No. | Practices | Advantage/Benefit of the Practice | Additional Information |
|--------|---------------------|-----------------------------------|---|
| 1. | Intercropping | | Plants used for intercropping with bamboo |
| 2. | Irrigation | | Type and frequency of irrigation followed |
| 3. | Pruning | | Frequency followed |
| 4. | Weeding | | Frequency followed |
| 5. | Nutrient Management | | Organic or inorganic used |

RESULTS

The practices followed in the farm you visited are:

.....

.....

.....

.....

PRECAUTIONS

- Visit the farm only with prior approval of the In-charge.
- Carefully listen to the observation of the bamboo grower.
- Use safety precautions while using inorganic chemical fertilizers like mask, gloves etc.
- While doing pruning or weeding, proper tools must be used.
- While entering a bamboo clump, care should be taken not to bruise yourself with the bamboo branches.
- Care must be taken to avoid any wastage or overuse of water while irrigating bamboo.



Notes

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor’s Signature)



Practical 6

INTEGRATED PEST MANAGEMENT IN BAMBOO PLANTATION

OBJECTIVES

After completing this practical you will be able to

- identify different pests and insects attacking the bamboo;
- identify the symptoms in different bamboo plant parts ;
- control insect pests using different strategies.

PRINCIPLE

There are several pests that attack bamboo leaves, shoots, culms, rhizomes and even harvested culms. They are very harmful and can sometimes damage the entire bamboo crop. These pests are diverse and include 40 families of leaf-feeders, 50 borers, 130 scales, 30 aphids, 60 bugs, 5 families of timber insects. In addition to the insects many species of fungi also attack bamboo. There are 73 species of fungi such as *Aciculosporium* spp., *Ceratospheeria* spp. and *Fusarium* spp. which infect bamboo. Timely control of pests and diseases are an essential part of sound management practice. The control measures may be silvicultural (such as weeding or soil loosening), biological, behavioral or chemical.

The insects attacking bamboo can be broadly divided into two categories:

Insects attacking bamboo in field: The major ones include insects which attack seeds, foliage and culms. The nature of damage includes foliage feeding, sucking the sap and making bore holes on culms and shoots. They belong to insect orders including Orthoptera, Hemiptera, Lepidoptera, Hymenoptera and Coleoptera. The shoot and culm borers cause more damage to bamboo clumps as compared



Notes

to other groups of insects. Most defoliating (the one which feeds on leaves) remain low in population and hence, are generally considered pests of minor importance. However, some of them show periodic fluctuations in population which may cause epidemics and can even cause total defoliation (total loss of leaves) of bamboo crop. Damage caused by leaf feeders reduces the surface area available for photosynthesis, affecting vigor, growth and survival of plants.

A large number of insects feed on the sap of leaves, branches, culms, shoots, roots and rhizomes. They have highly modified piercing-sucking mouthparts. These insects can damage bamboos in four ways:

1. Removing the plant fluid,
2. Causing mechanical injury,
3. Injecting toxic compounds into the plant, and
4. Transmitting diseases,

All these result in defoliation, wilting of young shoots and branches, and even death of the culm. Compared to defoliators and sap suckers, culm and shoot borers have less impact on the overall plant physiology.

Insects attacking post-harvested bamboos and finished products: The finished products made out of bamboos are also prone to attack by insect borers. The post-harvest pests are from the order Coleoptera, especially families Bostrychidae, Lyctidae and Anobidae. Of all these, Bostrychidae are the most prevalent. Nearly 16 species of Bostrychids are reported to attack postharvest and finished bamboo products. They pose major threat in their storage yards in bamboo industry in many places. Although, nearly 180 insect species are reported to be associated with bamboos in India, the pest status of many species is not known.

About 43 species of insects have been found associated with harvested and stored bamboos. They cause heavy damage to bamboo plant and sometimes render them useless for all practical purposes. The boring beetles are of economic concern and popularly known as 'powder-post beetles', because they turn the bamboos into fine powder by feeding. They are also called as '*ghoon*' or shot-hole borers. From the economic point of view, the genus *Dinoderus*, of the family Bostrychidae comprises the most destructive pest of stored bamboos. You must note that the starch content of the bamboos at the time of harvest would be responsible for the severity of borer attack. A few termites are also known to attack bamboos under storage.



Notes

To prevent the bamboo plants from the insects and pests, insecticides can be used. However, in modern times, you must avoid use of insecticides and resort to pest management strategies in bamboo stands involving cultural and biological methods. In case of harvested bamboo, treating the green bamboo with preservative chemicals can also increase the service life. However, in the open storage yards, it has been seen that proper stacking methods alone can reduce borer attack. Some of the traditional practices which are eco-friendly and easy to replicate like water soaking, baking over open fire, clump curing, biological preservative, etc. are promising, but need to be taken up on a large-scale and methods of treatment to be regulated to suit the local conditions.

REQUIREMENT

Bamboo plantation/ Farm affected by various insect-pests, hand lens.

PROCEDURE

1. Visit to a bamboo plantation or farm.
2. Discuss about the diseases or pest attack on bamboo that the growers are experiencing.
3. Note down the different types of diseases or effects of pest attack.
4. Also note down the measures taken by them to overcome it.
5. Enquire if they are experiencing any attack in case of harvested bamboo or the bamboo finished products also.

OBSERVATIONS

| Sl. No. | Disease/pest attack in standing bamboos in field | Measures taken to overcome the attack |
|---------|--|---------------------------------------|
| | | |

RESULTS

The following diseases/pest attacks were observed in the bamboo field visited:

.....

.....

.....



Notes

PRECAUTIONS

- Visit the farm only with prior approval of the In-charge.
- Carefully listen to the observation of the bamboo grower.
- Use hand gloves while handling insect / pest affected plants.
- Wash your hands after visiting insect pest affected plantation.
- Wash your hands after the visit to avoid spread of infestation or infection.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor’s Signature)



Practical 7

MATURITY MARKING SYSTEM IN BAMBOO PLANTATION

OBJECTIVE

After completing the practical you will be able to harvest bamboo culm at an appropriate age that is most suitable for utilization for various purposes.

PRINCIPLE

As you know that the bamboo culms can be used for a variety of purposes. Each of these uses has its own requirements of strength and other characters. So, culms can be harvested at different ages to put them at different uses. Some of them are highlighted below:

- For pulping, 2–3-year-old bamboo is preferred. Bamboo over 5 years old is not desirable for this purpose.
- For applications where mechanical strength is not required, like in craft and for mat-making, 2–3-year-old culms may be used. At this age, they are flexible enough to be easily woven.
- For board-making and for structural applications, only 4-year-old bamboo should be used. A 4 year old bamboo culm has the highest strength.

It is therefore important to know the age of the culm while harvesting. Only when they are harvested at the right time, the culm will have appropriate strength which is important for its use in products and applications. This can be done through a simple Maturity Marking System (MMS).

MATURITY MARKING SYSTEM (MMS)

Maturity marking systems are used and encouraged in several parts of the world. Such systems ensure that bamboo of the desired maturity is harvested.



Notes

In some countries, the year of culm emergence is engraved or written on the bamboo culm. This is an inexpensive and easy method. Engraving may however, damage the culm wall. Also the numerals tend to fade over time and become indistinguishable.

Another system uses multiple color bands, with one band added every year. Thus, a 2-year-old bamboo will have 2 bands, and a 4-year-old bamboo will have 4 bands. This is a laborious process, however, because painting on every bamboo difficult in the case of bamboo culms in the middle of a clump, which are not easy to reach.

SINGLE COLOUR BAND MATURITY MARKING SYSTEM

This is the simplest and most effective system. This is a maturity marking system that can reliably used to mark the age of bamboo culms. The essential feature of this system is placement of a colored band painted on the culm in the year in which it emerges (Fig. 7.1). Five colors are used, one for each year of a 5-year cycle. Culms that are 6 years old should not be retained in the clump, as they become weak and brittle and can be expected to die within a year or so. The colors and the years in which could be used are as follows:

| Color type | Shoot Emergence Year | | |
|---------------|----------------------|------|------|
| Red | 2005 | 2010 | 2015 |
| Yellow | 2006 | 2011 | 2016 |
| Blue | 2007 | 2012 | 2017 |
| White | 2008 | 2013 | 2018 |
| Black | 2009 | 2014 | 2019 |

Fig. 7.1 Color marking example for 3 bamboo cultivation cycles

- Marking is to be done after the culm attains its full height, that is, after it has stopped growing. The indication of the stoppage of further dimensional growth (length) is when branches begin to appear, normally first in the upper portion of the culm.
- The culm sheath should be detached from the culm before beginning to paint.
- The color band should be 3 inches (7–8 cm) thick. They should be placed at breast height and in the inter-nodal portion of the culm.
- The color bands should be placed clearly. Care should be taken not to let the paint drip down the culm.



Notes

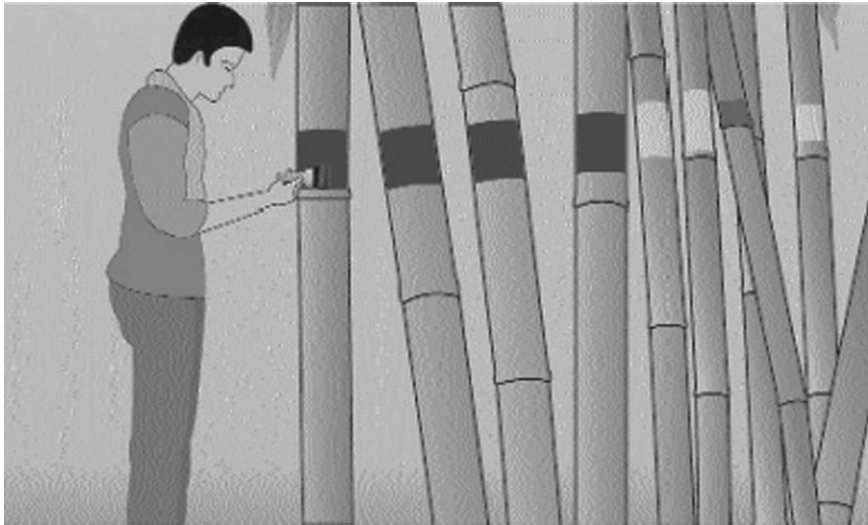


Fig. 7.1: Color marking

REQUIREMENT

Bamboo plantation which uses a Maturity Marker System, paints of different colors

PROCEDURE

1. Visit to the selected bamboo plantation.
2. Observe the type of maturity marker system followed there.
3. Note down in detail what steps are taken by them in the system used.

OBSERVATIONS

Maturity Marker System (MMS) used:

Starting Date/Year of the MMS:

Upto what age, could the bamboo culms be differentiated using the system:
.....

Any limitation of the method they experienced:
.....
.....



Notes

RESULTS

..... system of Maturity Marker System is used in the bamboo plantation visited.

PRECAUTIONS

- Visit the farm only with prior approval of the In-charge.
- Carefully listen to the observation of the bamboo grower.
- Use hand gloves while handling paints.
- Remove sheath from the bamboo culm before painting.
- Bamboo clumps should not be come crowded for safety purposes.

NOTES

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

(Instructor’s Signature)



Practical 8

GRADING, SIZING AND BUNDLING OF HARVESTED BAMBOO

OBJECTIVES

After completing this practical you will be able to:

- grade bamboo on various parameters;
- store bamboos safely to avoid deterioration in the quality during the storage.

PRINCIPLE

There are certain things that you must keep in mind while harvesting the bamboo culm. They can be summarized as follows:

- The number of harvested mature culms should not normally exceed the number of healthy shoots that sprouted and grew into young culms in the previous year.
- Aborted, stunted (short) and diseased shoots should be removed from the clump as soon as they are identified.
- The clump should be visually examined and the culms to be harvested should be selected before beginning cutting operations.
- Adherence to a maturity marking system will facilitate selection. There are various systems like writing or engraving year in which culm emerged. Another system use adding different colored band on bamboo every year so by seeing the number of bands, age of culm can be ascertained.
- Branches extending from the lower nodes of the selected culms should be removed. This makes cutting and extraction easier.



Notes

- The culm should be harvested at least one, preferably two nodes, above the ground. This reduces the risk of injuring the rhizome.
- The culm should be cut obliquely, that is, with a slanted cut. This ensures that rainwater, debris and twigs do not collect in the uncut portion above the last remaining node and become a breeding ground for fungus, parasites and insects.
- Twigs and remnants of branches should be removed from the area surrounding the clump.
- The felled culms should not be dragged along the ground to the collection or stacking point. This may injure or scratch their epidermal layer, lowering their value.

GRADING AND SIZING

Once the bamboo is harvested they are segregated or graded on the basis of certain characters. This grading is very important to feed different bamboo industries with right raw material. Some of the criteria used for grading are:

Internodal Distance

Usually the diameter and wall thickness are defined at hollow region of bamboo culm between two nodes i.e. internode.

Mechanical Property

It is a measurable property of bamboo associated with both culm geometry and bamboo material properties. It describes the behavior of the culm under the effects of applied load or stress.

Moisture Content

Amount of water content in culms is a very important property. Portion of culm weight consisting of water is expressed as percentage (after drying in oven).

Physical Properties

The measurable or observable property of bamboo that describes its behavior in response to external influences other than stress or strain make up the physical properties. It is generally used in reference to density, moisture content, etc.



Notes

STACKING AND STORAGE

Stacking and storage of the harvested bamboo are essential features in the bamboo plantation management. They may have to be stacked and stored for a period of time at or near the plantation. Certain factors must be taken care to avoid the degradation of culm quality or loss of culm during storage.

Immediately after harvesting and through the storage period, culms should be stacked vertically rather than horizontally. Horizontal stacking puts pressure on culms at the bottom of the pile and can injure, deform or break culms. Vertical stacking of green bamboo is better, because a larger surface area is exposed. This facilitates uniform and quicker drying.

If possible, the stacking area should have a permanent (*pucca*) floor. In case of imperfect or temporary (*kutchha*) floor or soil, when the culms come in contact with the ground, they become vulnerable to borers and termites. There are other less expensive options like using polythene sheets and tarpaulin on the floor. A covered, or at least shaded, area is recommended for storage, to protect the bamboo from direct sunlight and rain. Exposure to rain will lead to re-absorption of moisture and delay the drying process. Exposure to sunlight may cause rapid drying, resulting in splits and cracks.

REQUIREMENT

Bamboo plantation, tools required for harvesting bamboo culm.

PROCEDURE

1. Visit to a bamboo plantation or supplier and contact the In-charge.
2. Note down the precautions followed by them while harvesting the bamboo culms.
3. Note the basis of grading the harvested culms on various parameters.
4. Also note the precautions taken while storing and stacking the bamboo culms.

OBSERVATIONS AND RESULTS

Following considerations are made while harvesting bamboo for a good quality bamboo harvest:

- (i)
- (ii)
- (iii)



Practical 9

PRESERVATION AND TREATMENT OF BAMBOO

OBJECTIVE

After completing this practical you will be able to preserve and treat bamboo culms at the plantation itself using appropriate low-cost methods.

PRINCIPLE

As you are aware, bamboo culms can be infested with pests and diseases making them lose their economic value. So the freshly harvested culms are subjected to some measures in order to reduce the sugar and starch content. Some of them are highlighted below:

- Timing the harvest
- Standing the bamboos
- Washing or leaching the bamboos
- Soaking the bamboo poles in a water tank
- Heating the bamboo poles
- For bamboo used outdoors

REQUIREMENT

Bamboo plantation which uses preservation and treatment techniques.

PROCEDURE

1. Visit to the selected bamboo plantation.



Notes

2. Observe the preservation and treatment techniques followed there.
3. Note down in detail what steps are taken by them in the system used.

OBSERVATIONS

Preservation and treatment techniques used:

Starting Date/Year of the Preservation and treatment:

What advantages do they find of using the Preservation and treatment system?

.....

.....

.....

Any limitation of the method they experienced:

.....

.....

What is your learning and how can you improve bamboo treatment method:

.....

.....

RESULTS

..... Preservation and treatment System is used in the bamboo plantation visited.

PRECAUTIONS

- Visit the farm only with prior approval of the In-charge.
- Carefully listen to the observations of the bamboo grower.
- Be careful while doing the bamboo treatment.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....



Notes

(Instructor's Signature)



Practical 10

TOOLS AND EQUIPMENT USED IN BAMBOO PLANTATION

OBJECTIVE

After completing this practical you will be familiar with the tools and equipment that are used for various purposes in bamboo plantation.

PRINCIPLE

You should be familiar with the common tools that are used routinely in bamboo cultivation. They are required for variety of purposes like soil preparation, cutting and felling of bamboo culms, cleaning etc. (Fig. 10.1 – 10.11). Tools such as spades, picks, pruning scissors, and hand wheelbarrows are necessary equipment for manual operations in bamboo plantation. Such equipment are affordable and don't require high investment. A wheelbarrow (Fig. 10.0) is multipurpose handy equipment which can help in carrying loads all over the plantation and help reduce dependence on limited labor.



Fig. 10.0: Wheel barrow



Notes

Interculture



Fig. 10.1: Khurpi or weed scraper

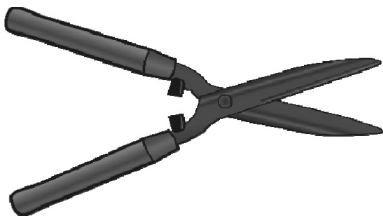


Fig. 10.2: Pruning shears

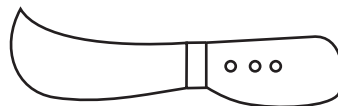


Fig. 10.3: Pruning knife

Harvest



Fig. 10.4: Harvesting bamboo from the 2nd node upwards



Fig. 10.5: Hacksaw



Fig. 10.6: Cutting the shoot



Notes

Other



Fig. 10.7: Machete

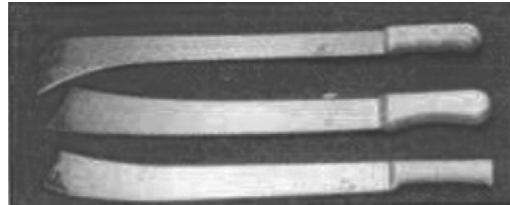


Fig. 10.8: Dao sword

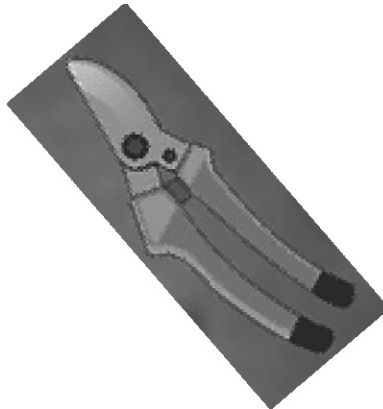


Fig. 10.9: Cutter



Fig. 10.10: Knife



Fig. 10.11: Spade

These pictures are representative.



Notes

REQUIREMENT

Various tools and equipments used in bamboo fields operations

PROCEDURE

1. Visit to a bamboo plantation.
2. Note down the tools and equipment that are used in bamboo fields and their uses.
3. Also note the precautions to be taken while using these tools and equipments.

OBSERVATIONS AND RESULTS

| S.No. | Tool/Equipment | Uses | Precautions |
|-------|----------------|------|-------------|
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |

PRECAUTIONS

- Visit the plantation only with prior approval.
- Carefully handle the tools as they may have sharp edges.
- Do not use the tools on standing bamboo plants without the permission of the officer.



Notes

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor's Signature)



Practical 11

WEB BASED INFORMATION ABOUT BAMBOO

OBJECTIVE

After completing this practical you will be able to access and utilize different websites dedicated to various aspects of bamboo.

PRINCIPLE

A web-based experiment or Internet-based experiment is an experiment that is conducted over the Internet. By visiting the websites, a particular site which is maintained by the institutions dedicated to bamboo you can come to know about all the information related to it. You can know about the various uses of bamboo that are there in India as well as world. You also come to know about the various initiatives, programs and assistance that are available by the government for growing bamboo. You can also get the assistance about the basic knowledge to start a bamboo plantation.

REQUIREMENT

Computer/Laptop/Mobile with internet connection

PROCEDURE

1. Open internet browser in your computer/ laptop or smart phone.
2. Type *www.nbm.nic.in* in search bar.
3. The site of National Bamboo mission will open.
4. Identify the various schemes under the mission available for bamboo growers and its applications from the site.



Notes

5. Similarly open www.nectar.org.in in your browser.
6. Identify the support provided under the BAANS program to the bamboo growers.
7. Also identify the various bamboo structures that can be constructed.

OBSERVATIONS

On visiting *www.nbm.nic.in* the following information was collected:

1. Name of the organization hosting the website:
2. Schemes available for bamboo growers:
 - (i)
 - (ii)
 - (iii)
3. Applications of Bamboo

On visiting *www.nectar.org.in* the following information was collected:

1. Name of the organization hosting the website:
2. Schemes available for bamboo growers:
 - (i)
 - (ii)
 - (iii)
4. Applications of Bamboo
 - (i)
 - (ii)
 - (iii)

RESULTS

Visited the two websites hosted by and Schemes like and are available to promote bamboo sector.



Notes

PRECAUTIONS

- Visit only the authentic websites.
- Go through the website thoroughly before noting down the observations.
- Mobile or the laptop or computer you are using should have good internet speed.

NOTES

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Instructor’s Signature)