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CURIOUS BAMBOO

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Abstract

Bamboo is a grass belongs to the grass family Poaceae (Gramineae) subfamily Bambusoideae. Bamboo is a renewable source of fuel which has a heating value comparable to that of timber from trees. Over 1200 different species grow worldwide. Various species can reach heights of 30 m and more. More than1500 applications of Bamboo have been documented, of these major ones include usage as building material, agriculture implements, furniture, musical instruments, food items, handicraft, raw material for large bamboo-based industries such as paper, pulp and packaging. Bamboo is found in a wide variety of soil and climatic conditions across the world. It originates from South-east Aisa. It is widespread and found in tropical, subtropical, evergreen, deciduous and temperate zone of all region except Europe and Western Asia. Bamboo occurs East Asia, Northern Australia and India. Bamboo provides considerable environmental benefits. It is used for ecological purposes such as soil stabilization and erosion prevention on hill slopes and verges. It is a very important forestry plant which is harvested from existing natural forests, plantations and mixed agroforestry systems. Bamboo is an important source of livelihood for the rural folk. Bamboo is a multipurpose plant with a myriad of applications ranging from construction materials, furniture, ply bamboo panels, flooring, fences, handicrafts, traditional implements, pulp and paper, medicines, edible shoots, and animal fodder. It is extensively used in construction of rural housing as posts, walls, roofing, fencing etc., and is often referred to as poor man's timber.

Introduction

Bamboo is a grass belongs to the grass family Poaceae (Gramineae) subfamily Bambusoideae. It is the fifth largest flowering plant family. It is a fast-growing woody plant. Bamboo is a renewable source of fuel which has a heating value comparable to that of timber from trees. Over 1200 different species grow worldwide. Various species can reach heights of 30 m and more. More than1500 applications of Bamboo have been documented, of these major ones include usage as building material, agriculture implements, furniture, musical instruments, food items, handicraft, raw material for large bamboo-based industries such as paper, pulp and packaging. Bamboo popularly called 'Tree Grasses' attain height up to 44 meters e.g. *Dendrocalamus giganteus* and up to 30 cm in diameter e.g. *Dendrocalamus sinicus.*Bamboo is very different in its properties to timber, with a much higher tensile strength along it's length culms can handle high levels of load in tension and compression as long as supported to resist buckling and joined well.

Bamboo Distribution

Bamboo is found in a wide variety of soil and climatic conditions across the world. It originates from South-east Aisa. It is widespread and found in tropical, subtropical, evergreen, deciduous and temperate zone of all region except Europe and Western Asia. Bamboo occurs East Asia, Northern Australia and India. In India, bamboo is found naturally almost throughout the country, except in Kashmir. More than half of the bamboo species in India are found in Eastern India, including Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, and West Bengal. Other areas rich in bamboo in India include the A & N Islands, Chhattisgarh, Madhya Pradesh and the Western Ghats. There are 136 species found in Indian which approximately 10 species of Bamboo are being commercially exploited i.e. *Bambusa arumdinacea, B. affinis,*

B. balcooa, B. tulda, B. bambos, Dendrocalamus strictus, D. hamiltoni, D. asper, Oxytenanthera stocksii and O. travancorica.

Forms of Bamboo Plant

The bamboo plant can grow in many forms as follows:

Tree Forms: These are bamboos up to 35 meters in height, usually with thick-walled, culms. Examples: *Bambusa balcooa, Dendrocalamus hamiltonii, Dendrocalamus strictus*, *Dendrocalamus giganteus.* Most bamboos in India are tree forms.

Reed Forms: These are medium sized bamboo, which commonly grow as reed forms. 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 in southern 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: *Meloacalamus compactiflorus* (climbing bamboo). Straggler forms are rare in India.

Shrub Forms: These are erect, short forms of bamboo found as temperate species. They mainly occur at high altitudes and have thin culms that rise to a height of up to 5 meters. Examples: *Arundinaria racemosa, Sinarundinaria falcata*. Shrub forms are widespread in India's Himalayan regions, nearer the snowline in Arunachal Pradesh, Uttarakhand, Himachal Pradesh and Sikkim. They also occur in the ghat areas of Kerala and Karnataka.

Morphology

The bamboo plant is a complex system. It consists of two sets of similar vegetative axis, one above the ground and the other below the ground. The above ground axis consists of jointed, tall, cylindrical stems. They are called culms. The branches coming out from the culms laterally, form the secondary above ground axis. The underground axis is a solid rhizome system with roots and buds on it.

Roots

The roots come out from rhizome nodes and culm nodes that are below the soil surface. In some species, roots may also be present on the above ground portions of culms and branches. Bamboo has a shallow root system. Most of the underground roots of the bamboo plant are present in the upper layers of the soil at depths of up to 35 centimeters. Sometimes, the roots may penetrate more than a meter below the surface of the soil. Roots fix 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.

Rhizome

The rhizome is the underground stem of a plant. In bamboo, the rhizome grows laterally under the soil surface and is branched. It helps the plant to spread its area of growing. It contributes to growth and vegetative reproduction of the plant and also holds the food reserve. 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. There are usually two broad types of rhizomes in bamboo: Pachymorph (sympodial), A clump forming rhizome in which each axis of rhizome is dominant and secondary axis, clums arises from it. This can be subdivided in to two types, on the basis of long and short rhizomes neck. These are classified as long necked sympodial rhizome and short necked sympodial rhizome. Leptomorph (monopodial), A non-clump forming, that is, the bamboo stems coming out from rhizome are not very close to each other. 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

Clump

Bamboo usually doesn't grow alone but mostly grows in a group. The group of bamboos is called a clump. A bamboo clump can develop from a seed or from another clump that has been cut away. Bamboo clumps take 4–6 years to mature. Each year, culmps of larger height and girth (diameter) are produced. Clump can be tightly packed (as in *Dendrocalamus hamiltonii*, *Bambusa tulda*, *Bambusa bambos*) with many closely spaced culms, or they may be loosely spaced but still in a cluster (as in *Bambusa vulgaris*, *Oxytenanthera stoksii*).

Culm

The stem of the bamboo is called culm. It is originating from the rhizome as a bud, emerges from the ground as a shoot and then elongates to become a clum. It is like a hollow cylinder that becomes narrow towards the top. It is the most easily seen part of the plant and also the most widely used part.The culm 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. In the fourth year its strength is highest. Most bamboo culms are green in colour but some can be yellow, black, or even purple-black. Some bamboos are striped also, in yellow or green. In many species, the color changes as the culm matures. The internodes of the culm marked by sheath scar, a line indicating where the

sheath is or was attached to the clum. Young culms have a coating of wax. Nodes may bear small aerial roots or thorns.

Shoot

Bamboo shoots are the new bamboo culms that come out of the ground. Young bamboo shoots or bamboo sprouts of many species are edible. They are the good source of nutrition and fibre.They are conical and creamy-colored when young. The soft shoots are cut from the bamboo plant when they are about 15cm or 6 inches long. They have a nice flavor and crunchy feel when you eat them. They are in great demand for preparation of various dishes and products like soups, pickles etc.

Nodes and Internodes

The rhizome, culm and branches of the bamboo plant, that they are divided by lines. These lines are actually the nodes. These are the points from where new shoots and rhizomes develop and grow. The portion between two nodes is called an internode. Internodes are mostly hollow. They are covered by sheaths at the early stages of growth. After that, the sheath falls off as the plant matures. The length of the internode varies considerably across bamboo species. It ranges from 5cm to 60 cm.

Buds and Branches

Buds are small structures which can grow into a branch. They are present on the nodes arranged on the alternate sides of the culm. The number of buds at a node is directly related to the number of branches that will come out from that node. The buds at the nodes on the rhizome develop into culms coming out of the ground.

Clum sheath / Clum Leaf

The clum sheath is a protective cover typically a pointed shield that covers young shoots as well as culms. The sheath usually falls when the clum becomes mature. The clum sheath consist of a sheath and a blade, Blade is also called modified leaf. The sheath is attached to the culm. Clum sheath closer to the ground tend to be broader and have shorter blades. The culm sheath has a projecting tongue in the center called a ligule. It is a membranous out growth on the inner surface of the sheath. It also has ear shaped lobes or appendages on either side called auricles. The clum sheaths in most bamboo species have a pair of auricles. The blade is connected to the sheath at ligule.

Leaves

Like all plants, the branch of the bamboo plant bear leaves. They also protect the plant from the rain and frost. They are a good source of fodder. There is carpet of leaves under bamboo plants. These are leaves fallen from the bamboo plant and are rich source of organic matter for the plant and soil.

Flowers and Flowering

The flowering behavior of the bamboo plant is one of its least understood aspects because it is infrequent and takes place at long interval. Flowering takes place in clusters of specialized leaves on bamboo branches. They are important for reproduction which finally forms the seed. Bamboo flowers vary in color, size and other characteristics. Flowering cycle in bamboo can be of two types: Gregarious type, when all the culms in a bamboo clump flower together and then the clump dies. Sporadic, when Some culms in a bamboo clump flower, and die after that. Bamboo have compound inflorescence, usually large and consisting of many flowers. The arrangement of the inflorescence is in cluster or loosely packed. The spikelets are usually one or two flowered. Each individual flower known as a florets. The florets are usually very small comprises a lemma, palea, lodicules, stamens and ovary with style and stigma.

Fruits

In bamboo, the fruit is an indehiscent, one seeded structure known as caryopsis. Depending on the species, three types of fruits caryopsis, glans and bacca are found in bamboos. In caryopsis the pericarp is membranous, thin soft and adhered to the seed coat. Glans has hard, smooth, crustaceous pericarp separated from the seed coat. In bacca, the pericarp is fleshy, thick and separated from the seed coat.

Regeneration

Natural regeneration occurs by vegetative methods and by seed. Vegetatively, the rhizome proliferates and produce many new culms every year during rainy season. The clums fall on moist ground, due to natural damage by wind, wild animals etc. also sometimes produce new plant by rooting at nodes. Other vegetative propagation are offset/rhizome, clum cutting, branch cutting, layering, macro proliferation and tissue culture. The flowers are generally produced from November to March and seed ripen during April and May in all Bamboo species. Seed fallen on the forest and start germination immediately after the rains. If the seed have fallen low lying places and other moist areas, they germinate even before rains.

Cultivation

Viable seeds of bamboo are germinated in germination chamber or sown directly in nursery beds. After germination the seedlings at the stage of 3-5 leaves should be transferred to polybags filled with growing medium. The transplanted seedlings should be kept in shade for about 7 days and then shifted to direct sun light. Maintain the seedlings by regular watering and weeding etc, till the time they attain 4-6 culms (tillers). This generally takes about 4-6 months. At this stage the seedlings are ready for multiplication. Multiplication of bamboo seedlings is called 'Tiller separation'. This is a form of clump division. Like many other grasses, bamboo has an inherent proliferating capacity and offset planting capability of reproducing itself. This capacity of the bamboos has been used in developing a method for multiplication of nursery stock. When the seedlings are at 4-6 culms stage, these are ready to be used for multiplication. Soil from the root system is washed off with water. The rhizomes are carefully separated with the help of a sharp secateur, in such a way that each separated unit has a shoot, rhizome and roots. A seedling at 4-5 culms stage can usually be made into about 3-4 such units or propagules. These separated units or propagules are then transplanted in polybags filled with soil mixture. The plants are kept in shade for 7-10 days and watered regularly. Thereafter the plants are shifted to the nursery under full sunlight. After about six months the plants may be used for field planting or the stock can be further multiplied, and the process can be repeated at least twice every year for a number of years. The method is not only very simple, but also ensure high success rates. Successful bamboo planting and growth are regulated by three important factors, loose and well aerated soil for rapid development of the rhizome, adequate growing space for rhizome during its life and moisture in the soil, particularly during the growing season from July to October.

Utilization of Bamboo

Bamboo provides considerable environmental benefits. It is used for ecological purposes such as soil stabilization and erosion prevention on hill slopes and verges. It is a very important forestry plant which is harvested from existing natural forests, plantations and mixed agroforestry systems. Bamboo silviculture is an option for conserving and protecting tropical forests while creating enduring supplies for the wood and cellulose industries. Ecological awareness too has contributed to the recognition of bamboo as an environment-friendly material. Bamboo is renewable, versatile in application and has other qualities like strength, durability etc. Due to these, there has been increased commercial interest in the development and manufacture of bamboo-based materials. Bamboo is an important source of livelihood for the rural folk. Bamboo is a multipurpose plant with a myriad of applications ranging from construction materials, furniture, ply bamboo panels, flooring, fences, handicrafts, traditional implements, pulp and paper, medicines, edible shoots, and animal fodder. It is extensively used in construction of rural housing as posts, walls, roofing, fencing etc., and is often referred to as poor man's timber. In developing countries, it is a basic raw material with numerous traditional uses. It is highly suitable for handicrafts; it can be woven into numerous products including mats, baskets, trays, hats, lampshades, caps, lanterns, etc. Many bamboo products are functional while others serve decorative purposes. Apart from its manifold uses in cottage industries, bamboo is also widely used in modern wood and paper industries. Bamboo is also a source of food. The cone-shaped sprouts that emerge from the ground to form tall poles are edible vegetables when harvested young. When harvested young, they are a crunchy and nutritious vegetable. Young shoots contain up to 90% water, and are rich in vitamins, cellulose, and amino acids. They have a high nutritional value, are low in fat and high in fiber content.

Durability and lifespan

The durability of bamboo is directly related to how well it is treated at all stages of its use, including how it is grown, harvested, dried, stored, transported, and installed. Well grown and harvested bamboo, protected from excessive rain, sun and ground contact can last for 10's of years, while poorly treated bamboo may only survive a year or two at best. Bamboo fails most commonly through rot from excessive water contact, and attack from pests seeking out the sugars in the starch of the bamboo, harvesting when sugar levels are at their lowest, will greatly increase durability. The outer skin of bamboo is hard and salicaceous, unattractive to most pests, hence most pest infestation occurs at the joints and through cracks and holes. Reducing cracking through careful handling will greatly increase life expectancy as will surface treatments such as paint and oils.

Lifecycle

Woody Bamboo plants are most commonly cultivated from sections of a culm or rhizomes and take around 8-12 years to reach full maturity. Once mature they can be cropped by 20-30% per year for their lifespan. Each culm in the clump of bamboo grows to full height and width over one rainy season, sprouting leaves and branches over the first year. Over the next two years the culms toughen and dry, reaching full strength in their 3rd year at which time they are ready to harvest till around their 6-7th year. Local communities tend to know when bamboo is ready to harvest by its colour and or the sound it makes when tapped. Young bamboo has a fresh clean green colour and has a dull tone when struck, slowly toughening to darker or yellower colours

depending on the species and developing a tighter clearer tone. The freshly cut bamboo is soaked in rivers or streams to leach out sugars and saps to reduce pest infestation. Leaching should be done as soon as possible after cutting when vascular cells are still open. Leaching is more effective on smaller sections of bamboo, so cut to length or split prior to leaching. Knocking a hole through the Centre of each node along the length of bamboo will allows saps to wash away more rapidly. Where possible leach in flowing rather than stagnant water, placing bamboo in a flowing stream weighted down with rocks for a week or two is one common solution. If leaching, dry prior to use to avoid cracking.Bamboo will achieve it's greatest strength if dried prior to use. For best results dry evenly undercover out of direct sunlight, rotating regularly to avoid splitting from uneven drying.

Species Preferred for Industrial Uses

Though there are more than 136 species of bamboo in India but only 15 species are industrially suitable. They can be segregated according to their culm diameter. Culms of different diameters are used for different purposes. *Dendrocalamus giganteus, Bambusa balcooa*, *Bambusa bambos, Bambusa polymorpha*, *Dendrocalamus brandisii, Dendrocalamus hamiltonii*, *Dendrocalamus hookeri, Dendrocalamus sikkimensis* are some examples of bamboo which have very large diameter. They are mainly preferred for use in building material i.e. scaffolding and furniture. *Bambusa nutans, Bambusa pallida, Bambusa tulda*, *Bambusa vulgaris and Teinostachyum dullooa* are few bamboo species which have medium sized diameter. They find their use for making various handicrafts and furniture etc.

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