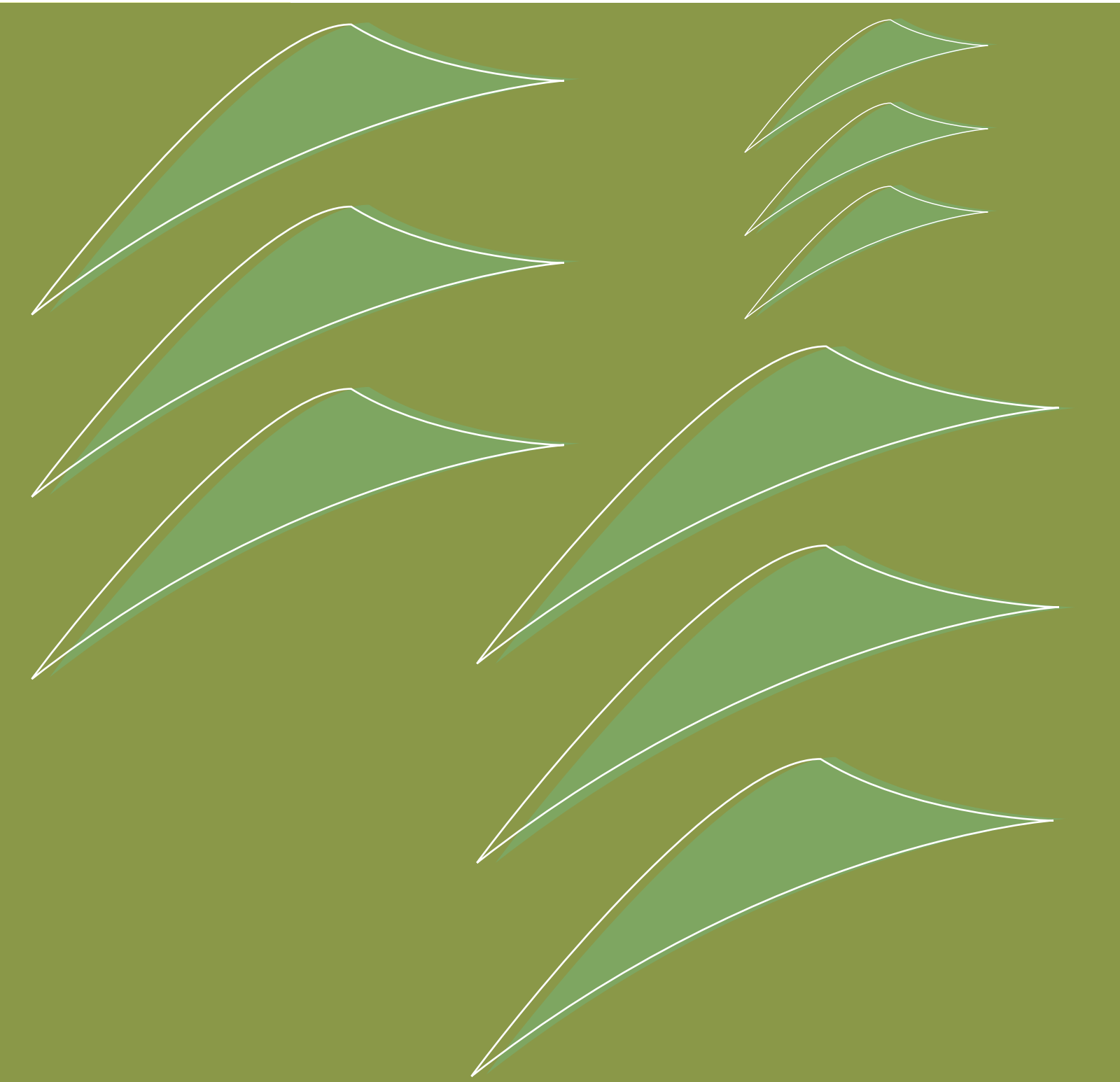
NMBA
National
Mission on
Bamboo
Applications

FIELD GUIDE

FG 01 07/11

The Bamboo Book



FIELD GUIDE

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The Bamboo Book

19 Selected Indian Species

NATIONAL MISSION ON BAMBOO APPLICATIONS
Technology Information, Forecasting, and Assessment Council (TIFAC)
Department of Science and Technology, Government of India

The National Mission on Bamboo Applications (NMBA) has been established by the Department of Science and Technology (DST), Government of India. Implemented by the Technology Information, Forecasting and Assessment Council (TIFAC), the Mission is tasked with providing a new impetus and direction to the bamboo sector. It supports technological upgradation, develops indigenous capacities and enterprise, provides linkages with markets, functions as a platform for exchange of knowledge and technology and encourages association and cooperation amongst sectoral constituents and stakeholders.

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PREFACE TO THE FIRST EDITION

SPURRED by the increasing interest in bamboo, this handbook has been developed in response to a long-felt need – for a guide to identify common and commercially significant bamboo species. Written, illustrated and presented in a user-friendly manner, it is meant for use by a wide variety of people – including those who may not have a background in taxonomy, or who may not be functionally familiar with bamboo and its forms.

Responding to the challenge, the task of demystification was taken up by Dr Muktesh Kumar of the Kerala Forest Research Institute, Peechi. He developed the introductory portions dealing with bamboo and the field keys in just a couple of months, drawing on his extensive and prior fieldwork. He also collected and matched photographs and illustrations, and, as a part of the process, retook hundreds of photographs.

The material was then developed and validated by Suneel Pandey of the National Mission on Bamboo Applications, who brought to this work both passion and a sense of purpose. Almost seventy drawings and sketches were added to the document, to make it more illustrative and explanatory. The handbook, an uncommon guide to common Indian bamboo, is therefore a truly collaborative effort.

In the handbook, field keys have been prepared based on easily observable and distinguishable field and vegetative characteristics of bamboo species. I have no doubt that it will be useful – and a precursor and model for further work. ■

Vinay Sheel Oberoi
Mission Director
February 2004

PREFACE TO THE SECOND EDITION

The response to the first edition of the Field Guide has been overwhelming. Researchers, lay persons, cultivators and government agencies have all used and appreciated the guide.

The second edition, released just about a year later, has been significantly updated. Five additional species have been incorporated, and the morphology segment added to. The chapters on species have been strengthened, on the basis of responses and information received from users in different parts of the country.

Dr Muktesh Kumar of the Kerala Forest Research Institute (KFRI), Peechi, provided information on additional species, and a large number of photographs from his collection. Dr Ratan Lal Banik of INBAR contributed extensively to the second edition. He reviewed the morphology segment and the information on individual species, in particular on *Bambusa balcooa, Bambusa tulda, Bambusa polymorpha, Bambusa vulgaris, Melaconna baccifera, Teinostachyum dullooa and Thyrsostachys oliveri.* L.R. Bhuyan of the State Forest Research Institute, Itanagar, reviewed the species descriptors and, based on his extensive field experience in the North East, provided information on distribution, usage, propagation and local names for many species. Dr Anil Sood of the Institute of Himalayan Bioresource Technology (IHBT), Palampur, reviewed the species description of Dendrocalamus hamiltonii.

Suneel Pandey and Deepti Dabas of the NMBA painstakingly collated the many responses, and guided the process of bringing out this edition. Indira Chandrasekhar edited the publication, and Mugdha Sethi provided additional drawings and illustrations.
We hope that this edition will spur even greater interest in the field of bamboo in India.

Vinay Sheel Oberoi
Mission Director
May 2005

PREFACE TO THE THIRD EDITION

NMBA launched the first edition of the Field Guide "The Bamboo Book" in February 2004. It received raving reviews from cultivators, researchers, bamboo entrepreneurs and government agencies. The second edition has also been sold out. NMBA now feels pleasure in presenting the third edition of "The Bamboo Book" for the use and reference of all who are intensely associated with bamboo.

In the third edition, an additional chapter on *Guadua angustifolia*, a bamboo species found in South America and introduced by NMBA in Kerala and Karnataka has been included. In addition, compiled information on uses of various bamboo species, list of NMBA supported Vegetative Propagated Centers for availability of bamboo plants is also included in the Appendices.

Dr.Syam Vishwanath of the Institute of Wood Science and Technology (IWST), Bangalore, has provided information and photographs for *Guadua angustifolia*. Dr.Muktesh Kumar of the Kerala Forest Research Institute (KFRI), Peechi, has provided information on systematic placement of *Guadua angustifolia* in classification of bamboo by adding sub tribe *Guaduinea*. Dr.Ratan Lal Banik, independent Bamboo consultant, has reviewed the whole publication and provided valuable inputs.

Shri Sudhir Kumar Pande, the ex-DG of Forest of India and currently Advisor of NMBA, has made fruitful suggestions while reviewing the current edition of Guide. Ms.Tajinder Kaur and Ms.Manju Arya of NMBA have painstakingly compiled the responses for updating the third edition and carefully edited the Guide.

NMBA expects that this edition will further the interest of a large number of bamboo communities for easier identification of bamboo species and in turn promote overall development of bamboo sector in the country.

Sanjiv Nair
Mission Director
July 2011

INTRODUCTION

BAMBOO is a woody and fast growing grass, which occurs naturally on every major continent except Europe. There are almost 1200 species of bamboo in the world, distributed across 110 genera.

Bamboo is a strong, versatile and highly renewable material – one that people and communities have known and utilised for thousands of years. It has been an integral part of India's cultural, social and economic traditions. Millions of people still depend on it for their livelihood, and for household and functional uses. In return, communities have nurtured and protected the bamboo, and are repositories of vast knowledge and skills related to its propagation, processing and use.

India is uniquely endowed in the bamboo sector, with its large resources of raw material, and deep-rooted legacy of traditional skills and usage. India's bamboo resources are the second largest in the world. There are about 130 species in the country, belonging to 18 genera. Some are introduced species, brought in from other countries. Most grow naturally at heights ranging from sea level to above-3500 metres, in an extraordinary range of habitat – in almost 10 million hectares of forest land, and on homestead land and private plantations.

Bamboo is currently in the process of being 'rediscovered' in India. Its attributes and potential are increasingly recognised. The expectation is that bamboo can be an important vehicle for sustainable and widespread development, augmenting economic opportunity, income and employment.

19 Selected Indian Bamboo Species

Bambusa balcooa

Bambusa bambos

Bambusa nutans

Bambusa pallida

Bambusa polymorpha

Bambusa tulda

Bambusa vulgaris

Dendrocalamus brandisii

Dendrocalamus giganteus

Dendrocalamus hamiltonii

Dendrocalamus hookeri

Dendrocalamus sikkimensis

Dendrocalamus stocksii

Dendrocalamus strictus

Melocanna baccifera

Ochlandra scriptoria

Ochlandra travancorica

Teinostachyum dullooa

Thyrsostachys oliveri

The Species at a Glance

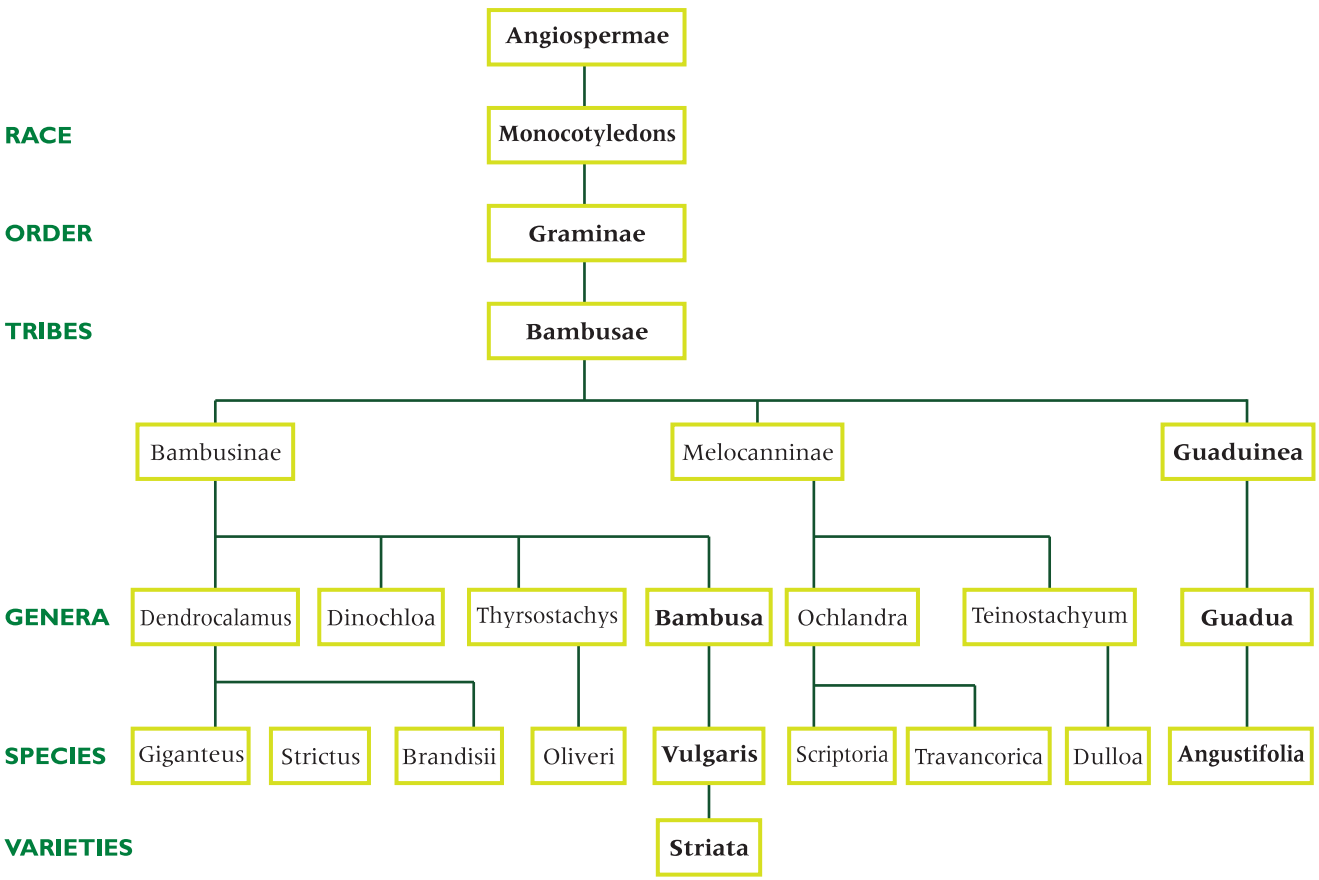
Species	Form	Altitude (in metres)	Distribution in India	Culm height (in metres)	Flowering habit	Flowering cycle (in years)
Bambusa balcooa	Tree	0–600	Bihar, Jharkhand, North East, Orissa, Uttaranchal, West Bengal	20–25	Gregarious, but isolated and rarely sporadic	35–45
Bambusa bambos	Tree	0–1000	Throughout the country, common in Central and South India	20–25	Gregarious, occasionally sporadic	40–60
Bambusa nutans	Tree	600–1500	North East, Orissa, West Bengal	20–25	Gregarious / Sporadic	35, 15
Bambusa pallida	Tree	700–2000	North East	15–20	Sporadic	40
Bambusa polymorpha	Tree	0–800	Arunachal Pradesh, Assam, Manipur, Meghalaya, Tripura, West Bengal	20–25	Gregarious / Sporadic	55–60
Bambusa vulgaris	Tree	0–1200	Assam, Madhya Pradesh, Meghalaya, Orissa, Tripura, West Bengal	20–25	Rarely flowers, sporadic	80
Bambusa tulda	Tree	0–1500	North East, West Bengal	20–25	Gregarious / Sporadic	30–60
Dendrocalamus brandisii	Tree	0–1300	Andamans, Kerala, Manipur, Nagaland, West Bengal	20–25	Gregarious / Sporadic	40–45
Dendrocalamus giganteus	Tree	0–1200	Bihar, Northwest Himalayas, North East, West Bengal	30–35	Sporadic	80–90
Dendrocalamus hamiltonii	Tree	0–1200	North Bengal, Bihar, Himachal Pradesh, Manipur, North East, Uttaranchal	20–25	Gregarious	30–40

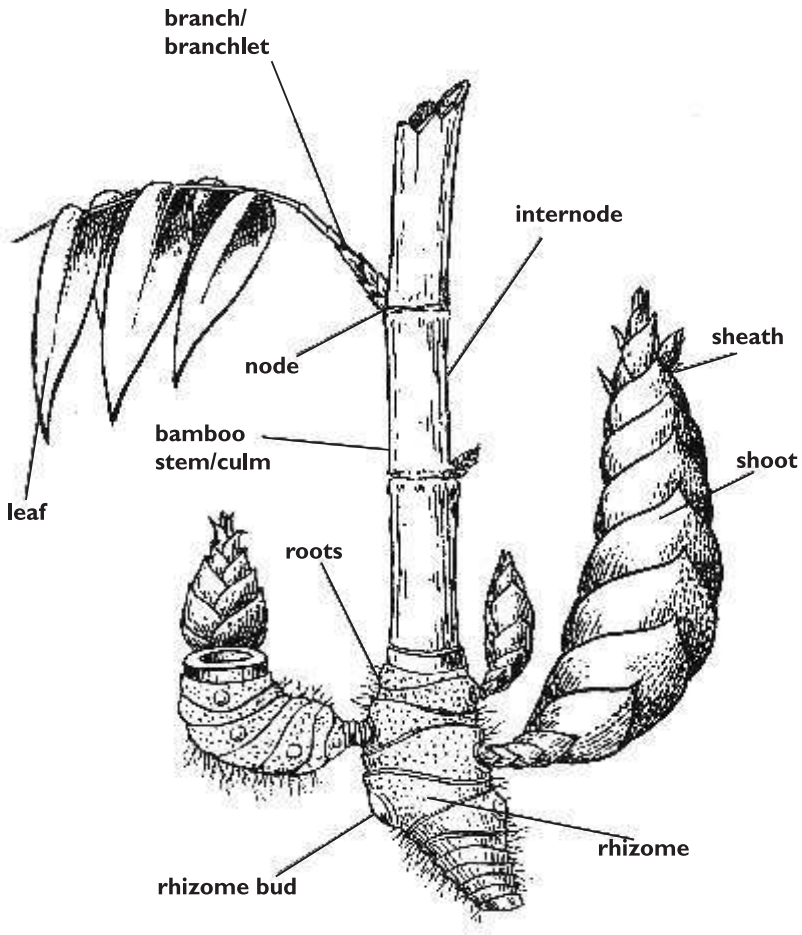
Species	Form	Altitude (in metres)	Distribution in India	Culm height (in metres)	Flowering habit	Flowering cycle (in years)
Dendrocalamus hookeri	Tree	300–1800	Arunachal Pradesh, North Bengal, Meghalaya, Mizoram, Nagaland, Sikkim	20–25	Sporadic	55–60
Dendrocalamus sikkimensis	Tree	0–2100	North East, Sikkim, West Bengal	20–25	Sporadic	50
Dendrocalamus stocksii	Tree	0–800	Northern Kerala, Karnataka along the Konkan Coast	10–15	Sporadic	7–15
Dendrocalamus strictus	Tree	0–1000	Throughout the Country, newly introduced in North East	10–15	Gregarious / Sporadic	24–28, 40–45, 65
Melocanna baccifera	Tree	0–600	Mizoram, South Assam, Nagaland Manipur, Meghalaya, Tripura, West Bengal	10–15	Gregarious / Sporadic	60, 30±35, 45–48, 60–65
Ochlandra scriptoria	Reed	0–600	Western Ghats	6–9	Sporadic	4–10
Ochlandra travancorica	Reed	0–1000	Kerala, South Karnataka, Tamil Nadu	6–9	Gregarious	7–15
Teinostachyum dullooa	Tree	0–1200	Tripura, North Bengal, Assam, Meghalaya, Manipur, Sikkim	10–15	Gregarious / Sporadic	15, 35, 45
Thyrsostachys oliveri	Tree	0–650	Tripura	15–20	Gregarious	48–50
Guadua angustifolia	Tree	0-1400	Introduced in Kerala and Karnataka. Native of South America.	20-25	Not reported in India. Sporadic at South America	80-100

What is Bamboo?

IF YOU were to ask a botanist this question, the reply would probably be that bamboo belongs to the sub-family *Bambusoidae* of the *Poaceae (Graminae)* family.

To be able to study the world of plants botanists classify them into groups, the members of which share common features and characteristics. One of several such major





plant groups is 'Angiospermae', the group of flowering plants.

Each group is further divided into families, which comprise plants with common characteristics. Each family of plants is subdivided into further groupings, each of which is called a genus. Within each genus plants are divided into species.

For example, species in the Dendrocalamus genus include *Dendrocalamus strictus* and *Dendrocalamus hamiltonii.* (Botanical names are written in italics, with capitals only for the genus and not for the species).

Subdivisions of species are often combined under the heading 'variety' (var.), as they carry relatively minor variations (e.g., *Bambusa vulgaris var. striata*).

There are 110 genera and over 1200 species of bamboo in the world. In India, over 130 species belonging to 18 genera have been identified. Of these, 87 are naturally occurring species; the rest have been introduced from outside the country.

It is also possible to describe bamboo in a way that is easily understood by non-scientists, as follows.

- Bamboo is a grass, typically woody, and fast growing.
- The bamboo plant has an extensive underground network, of which the singular feature is the rhizome.
- Over the ground, a stem (or culm) arises from the rhizome. The culm is normally a hollow cylinder, tapering towards its top.
- An emerging culm is called a shoot. It is protected by sheaths that stay with the culm till it develops fully.
- The growing rhizome is similarly protected by a sheath, which is however not normally visible since it is below the ground.
- Roots extend from the nodes of the rhizome and from that part of the culm which is closer to the soil surface.
- Most bamboos are monocarpic plants; they flower (and fruit) once in their lifetime and then die.

Growth Forms of Bamboo

TREE FORMS

These are bamboos up to 35 metres 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 bamboos, which commonly grow as reed brakes. They have thin-walled culms up to 9 metres in height with long internodes. Example: *Ochlandra travancorica*. Reed bamboos are common in Kerala and adjacent parts of south India.

STRAGGLER FORMS

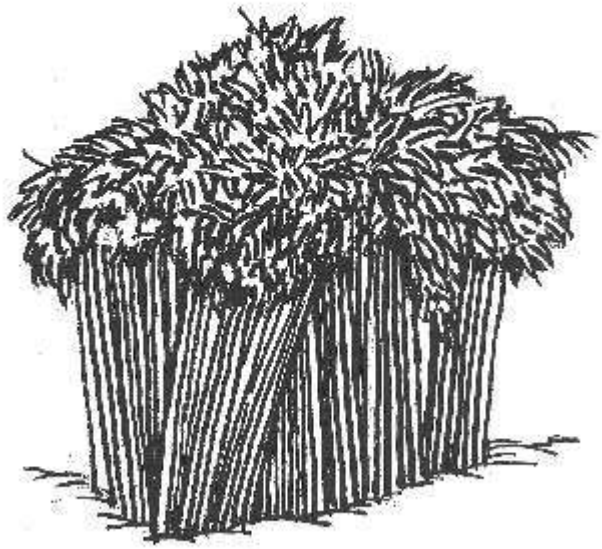
These are medium-sized bamboos up to 15 metres tall, with the tip of the culm arching or drooping down or climbing on adjacent trees. Example: *Melocalamus compactiflorus* (climbing bamboo). Straggler forms are rare in India.

SHRUB FORMS

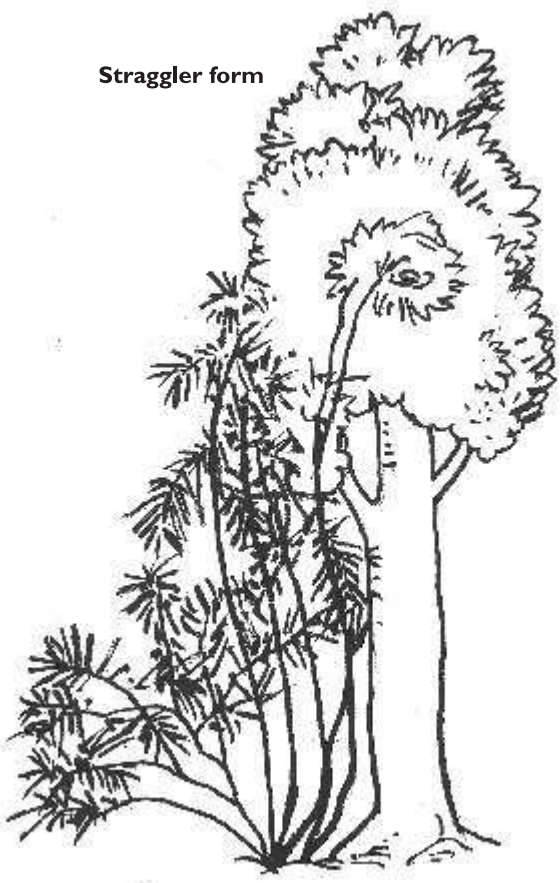
These are erect short forms of bamboo found in temperate species. They mainly occur at high altitudes, and have very thin culms that rise to a height of up to 5 metres. Examples: *Arundinaria racemosa, Sinarundinaria falcata*. Shrub forms are widespread in India's Himalayan regions, near the snowline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

Tree form

Reed form



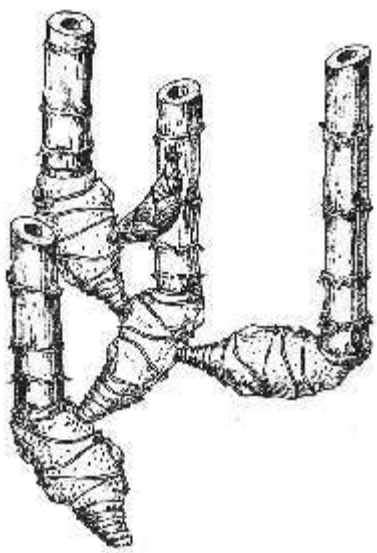
Straggler form



Shrub form

Morphology

Sympodial rhizome



The structure of a bamboo plant can be thought of as a series of vegetative axes, as follows:

- Rhizome
- Roots
- Culm
- Branches

The rhizome, culm and branches are segmented by solid nodes. The internodal sections are invariably, but not always, hollow. Each of them is marked by sheaths that surround and protect the nodes. Nodes are the key growth points, from where other vegetative axes develop and grow.

Roots are the only vegetative axes of the plant that are not segmented. They do not have protective sheaths either.

RHIZOME

The rhizome is the underground portion of the bamboo plant. Unlike trees, bamboos do not have a central trunk, and the rhizome serves as the foundation of the plant.

The rhizome grows laterally under the soil surface. It extends the domain of the plant, enlarging and consolidating its area. It also acts as a food reserve, and contributes to growth and vegetative reproduction.

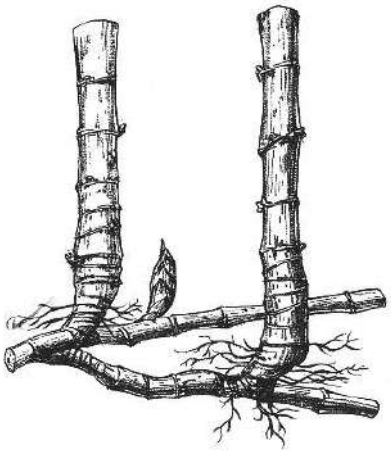
From the nodes of the rhizome emerge roots that forage for nutrition, and buds that develop over the ground into culms.

There are two broad types of rhizomes:

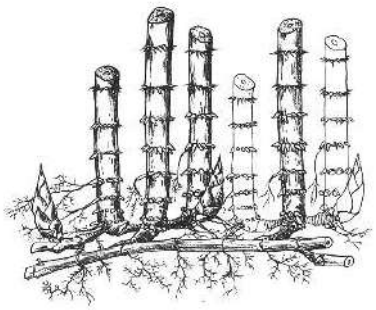
- *Pachymorph (sympodial) rhizome*
  A clump-forming rhizome in which each axis (rhizome) is dominant, and secondary axes (culms) develop from it.

  This can further be subdivided into two types, on the basis of whether the rhizome neck (the constricted portion that joins two rhizomes) is long or short. These are classified, respectively, as long-necked sympodial rhizomes and short-necked sympodial rhizomes.

Monopodiail rhizome



Amphipodial rhizome



Roots

Melocanna baccifera is an exception to the tightly packed clump formations typical of pachymorph rhizomes. It has an open and diffuse type of system with long rhizome necks; consequently, the culms are distinctively diffuse in distribution.

- *Leptomorph (monopodial) rhizome*
  A non-clump-forming, horizontally growing rhizome in which one axis (rhizome) is dominant and secondary axes (culms) develop from it as lateral buds.

Some bamboos have rhizomes that have traits common to both major types (sympodial and monopodial). These are called amphipodial rhizomes.

The rhizome is not normally a good – or practical – identifying characteristic of a bamboo plant, since the rhizome network lies below the ground and is not normally visible. The pattern of culm growth and culm position will, however, indicate whether the rhizome is clump-forming (sympodial), running or non clumpforming (monopodial), or mixed (amphipodial).

Almost all Indian bamboos have sympodial rhizomes and are therefore invariably clump-forming.

ROOTS

Roots provide anchorage in the ground and make possible the uptake and distribution of water and nutrients to other parts of the plant. They grow from the nodes of rhizomes and of the underground portions of culms. In some species, roots may also appear on the above-ground portions of culms and branches.

The root and rhizome system of the bamboo plant does not penetrate very deep below the soil surface. Typically, most of the network is within 60 centimetres of the soil surface, and all of it within a metre.

CULM, NODES, INTERNODES

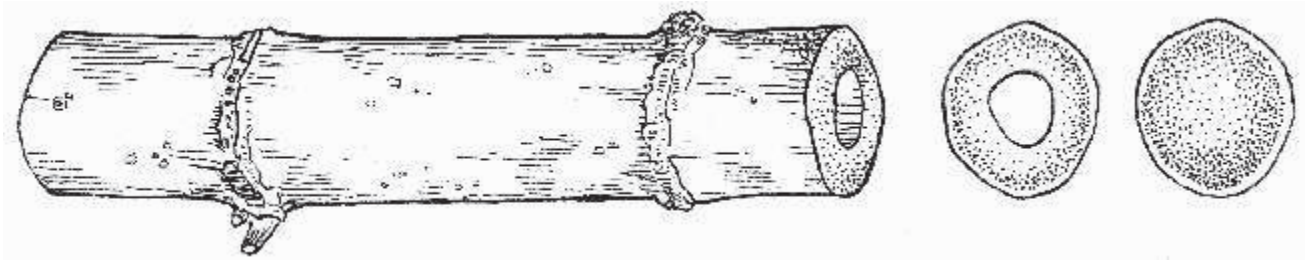
Like any grass, the bamboo plant has a stem. Also known as the culm, it is one of the axial systems of the plant. It originates from the rhizome as a bud, emerges from the ground as a shoot, and then elongates to become a culm. Initially tender, the shoot ultimately grows into a woody culm.

An individual culm attains its maximum diameter and maximum height in a single spurt of growth, typically in a period of 80–110 days after emergence from the ground.

The culm is jointed, with joints or nodes separating the culm sections. Each culm section starts and ends with a solid section called a node. The culm section between nodes is called the internode.

Tubular in structure, the culm develops as a cylinder that tapers towards the top. The culm is usually

Culm



Culm node

Culm internode

hollow but is sometimes solid.

The internodes of the culm are marked by a sheath scar – a line indicating where the sheath is or was attached to the culm.

The surface and diameter of the culm is an important identification feature, when taken from a mature bamboo clump. Young culms have a coating of wax, which can either be thick or furry, or thin, and either light or dark in colour. It may rub off quickly or may persist to give either a matt or dull appearance. Nodes of the culm may be raised or level, with rings of different colours. Nodes may bear small aerial roots or thorns.

CLUMP

Bamboos with sympodial rhizomes tend to form clumps. The culms are closely spaced and grouped together.

Bamboos with monopodial rhizomes do not form clumps. The culms are sparsely distributed. Bamboos with amphipodial rhizomes tend to develop dispersed clumps.

SHOOT

The shoot is an emerging bamboo stem or culm. It originates from the buds of the rhizome. When the shoot pierces the ground, it is fully formed, with each node and internode. At this point, critical bio-chemical processes start. These lead to rapid growth and hardening of the culm.

Harvested at the time that it emerges, or shortly after, the shoot can be eaten, and is a good source of nutrition and fibre.

CULM SHEATH (CULM LEAF)

The culm sheath is a protective cover, typically a pointed shield that embraces young shoots as well as culms. The sheath usually falls off when the culm becomes mature.

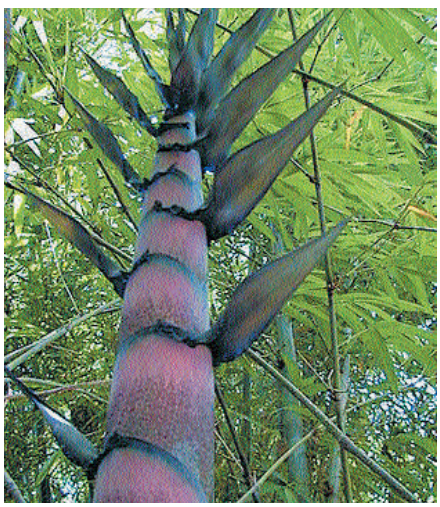
The culm sheath consists of a sheath and a blade; the latter is also called a modified leaf.

The sheath is attached to the culm. Culm sheaths closer to the ground tend to be broader and have shorter blades.

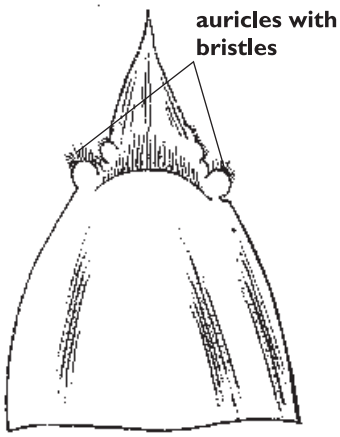
The culm sheath has a projecting tongue in the centre called a ligule, a membranous outgrowth on the inner surface of the sheath. It also has ear-shaped lobes or appendages on either side called auricles. The

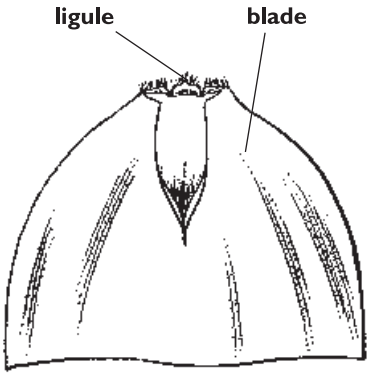
Clump

Shoot



Culm sheath





culm sheaths in most bamboo species have a pair of auricles. The blade is connected to the sheath at the ligule.

The culm sheath is the best guide to identify a bamboo plant. The shape and size of the auricles, presence of bristles on the auricles, and the shape, length and type of edge of the ligule are important identification features. Also important are the presence or absence of hair, the positioning of the hair – at the back of the sheath or around the base of the sheath blade, and whether the sheath is erect or bent backwards (reflexed).

Also significant is whether the sheath falls early (deciduous) or remains attached (persistent). It is preferable to use newer sheaths, rather than older sheaths, to identify a particular species. Newer sheaths will have all the distinguishing marks, while older sheaths may have missing or damaged parts. Typical sheaths will usually be available after the monsoon and in early winter.

Culm sheaths closer to the ground are different from those on the upper part of the culm, generally tending to be broader and to have shorter blades. As a norm, and to standardise usage, culm sheaths should be taken at eye level or from a fourth of the way up the culm. This norm is valid even for smaller bamboos.

BUDS AND BRANCHING

Each internode bears a branch bud just above the culm scar, arranged on alternate sides of the culm. The number of buds at a culm node is directly related to the number of potential branches at the node.

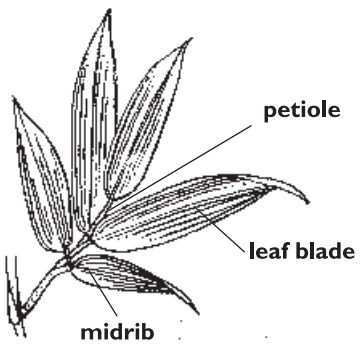
Buds at the nodes of the basal part of the main branch sometimes sprout to form secondary branches. In a three-branched condition a single dominant branch is most common. The branching pattern varies depending upon the species.

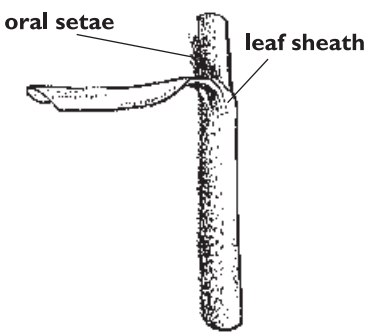
Some bamboos have thorns. These are actually sharp, pointed woody, modified branches arising from the nodes and from branches.

Branching is a useful and important characteristic in bamboos, especially for recognising or identifying genera. The number of branches in the first year as well as in older culms, whether branches are of the

Buds and branches

Leaves





same size or whether the central branch is much larger in size, and the presence of aerial roots at the branch base are important features.

LEAF

The ultimate branches or branchlets of the bamboo plant bear blades which are called leaves. The size, shape and pattern of the veins of leaves are characteristics that are useful in identifying the species.

The sheath below the leaves (called leaf sheath) is also an important identification characteristic. Leaf sheaths may bear ligules and auricles, just as culm sheaths do. Leaf sheaths differ from leaf blades in that they do not have petiole and mid-rib.

Most bamboo plants produce a profusion of leaves that fall to the ground annually, forming deep carpets of nutritious organic matter.

The pattern of leaf-fall differs amongst species. Some species are evergreen, and are never bereft of leaves. In these species, leaf-fall tends to be relatively evenly distributed through the year. In some species, there may be severe leaf-shedding at certain times of the year, leaving only a few, or no leaves at all on the plant.

FLOWERS

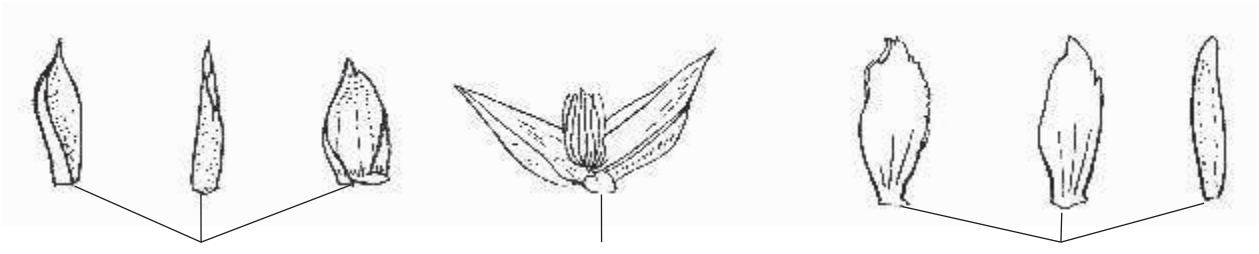
The flowering behaviour of the bamboo plant is one of its least understood aspects because it is infrequent and takes place at long intervals. Flowering cycles may vary from one year to over a hundred years. There are two types of flowering:

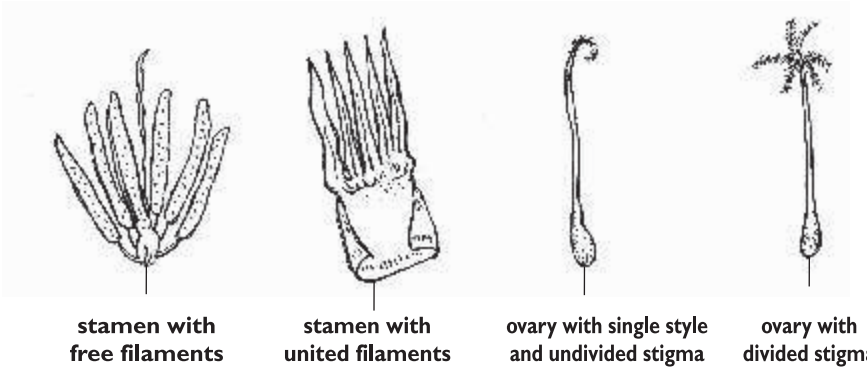
- *Gregarious*: All the culms in a bamboo clump flower together over a period of time and then die.
- *Sporadic*: Some culms in a bamboo clump flower and die thereafter.

Gregarious and sporadic flowering can occur either across a large population of bamboo clumps or in a small population. Some bamboos flower sporadically every year.

There are bamboo species that exhibit both sporadic and gregarious flowering behaviour. A small number of clumps of *Dendrocalamus hamiltonii*, for example, flower sporadically across scattered locations. This species also flowers gregariously over large tracts at long intervals of 30–40 years.

Flower and fruit





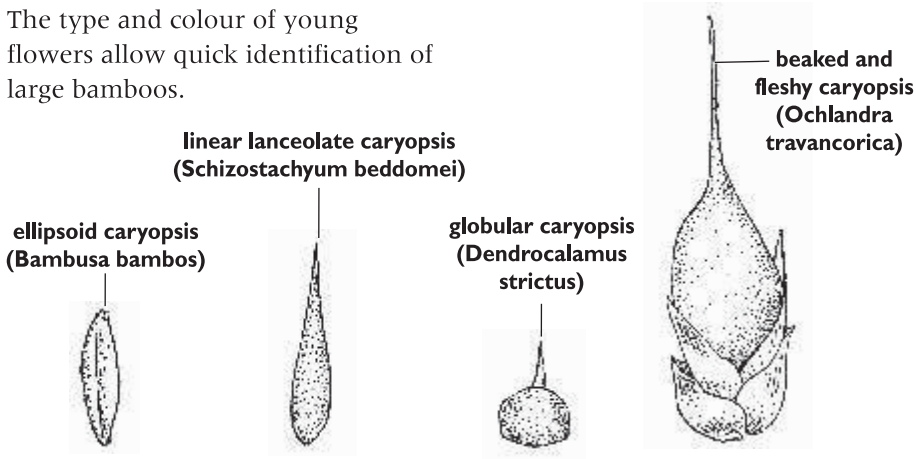
Bamboos have a compound inflorescence, usually large and consisting of many flowers. The arrangement of the inflorescence is in clusters or loosely packed. The spikelets are usually one or two-flowered, each individual flower being known as a floret. Bracts and sterile glumes support the florets.

The florets are usually very small (0.2–2.5 centimetres long). Each one comprises a lemma, a palea, lodicules (sometimes absent), generally 3–6 stamens (although in the Ochlandra species there are up to 120 stamens), and an ovary with style and stigma. The stigmatic apex is highly plumose and often divided. The type and colour of young flowers allow quick identification of large bamboos.

FRUIT

In bamboos, the fruit is an indehiscent (it does not open when ripe), one-seeded structure known as caryopsis. Depending on the species, three types of fruits (seeds) – caryopsis, glans and bacca – are found in bamboos.

In caryopsis, the pericarp (outer layer) is membranous, thin, soft and adhered to the seed coat. Glans has a hard, smooth, crustaceous pericarp separated from the seed coat. In bacca, the pericarp is fleshy, thick and separated from the seed coat.



Field Key

Each column gives you a choice of two alternatives.

- Go vertically down the field key, beginning with the first line.
- Choose the line that contains the most accurate description of the bamboo that you wish to identify.
- To get accurate results, do not immediately eliminate other options, since there may be a 'better fit' below the line that you have selected.
- Once you are satisfied that you have located the most accurate description, or the description closest to the bamboo to be identified, turn to the detailed description of the species contained later in this handbook.
- Read through the detailed description carefully, matching defining characteristics.
- If the characteristics match, the bamboo has been correctly identified.
- If the characteristics do not match, then the bamboo is not one of the 19 commercially significant and common Indian species described in this handbook. It may belong to another, less common species. Or, the identification has not been done correctly.

KEY TO GENERA

1a Clump forming bamboos: culms growing in separate clumps of more than 10 culms [*see* **2**]

1b. Spreading bamboos, culms growing separately [*see-Melocanna*]

2a Maximum culm diameter > 7cm [*see* **3**]

2b Maximum culm diameter < 7cm [*see* **4**]

3a Culm covered with dark or thick fur, central branches varied and often very large [*see Dendrocalamus*]

3b Culm with light covering of pale wax, central branches fairly uniform, usually small [*see Bambusa*]

4a Maximum internodal length > 40 cm [*see* **5**]

4b Maximum internodal length < 40 cm [*see* **6**]

5a Culms straggling (extremely divergent) 6-8 m tall [*see Teinostachyum*]

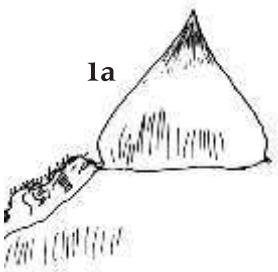
5b Culms closely packed, 6-10 m tall [*see Ochlandra*]

6a Culm sheath persistent [*see Thyrsostachys*]

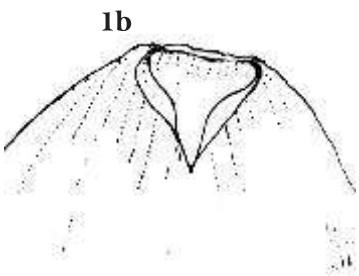
6b Culm sheath deciduous [*see Bambusa*]

KEY TO SPECIES

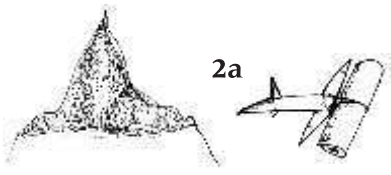
Bambusa



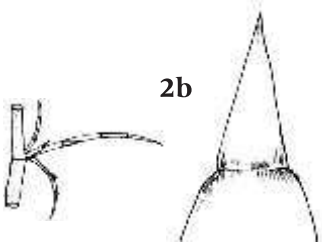
1a Culm sheath with distinct auricle [*see* **3**]



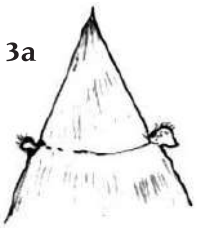
1b Culm sheath without auricle. [*see* **2**]



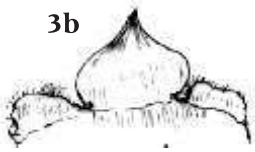
2a Culm branches with sharp spines; culm sheath blade has dark brown velvety tomentum on inner side [*see Bambusa bambos*]



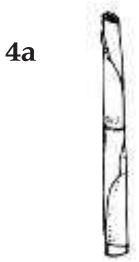
2b Culm branches without sharp spines; inner side of the culm sheath glabrous [*see Bambusa balcooa*]



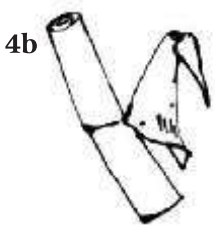
3a Culm sheath with triangular blade, auricle conspicuous. [*see Bambusa pallida*]



3b Culm sheath blade not triangular, auricle conspicuous [*see* **4**]

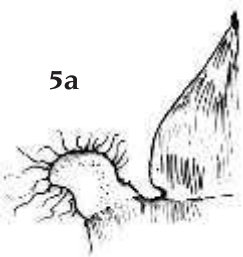


4a Tender culm fully clothed with golden yellow tomentum; culm sheath persistent [*see Bambusa polymorpha*]

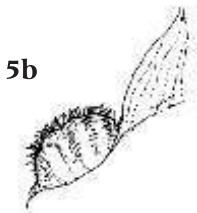


4b Tender culms glabrous; culm sheath deciduous

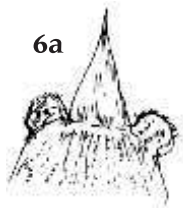
[*see* **5**]



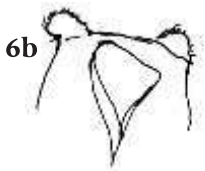
5a Culm sheath auricle falcate, slightly pointed and curved backward, surface smooth. [*see Bambusa vulgaris*]



5b Culm sheath auricle not falcate, not pointed and curved backward, surface rough [see **6**]

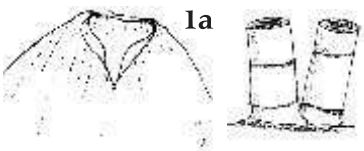


6a Basal culms green; culm sheath blade persistent, outer surface thickly clothed with jet-black hair [*see Bambusa nutans*]

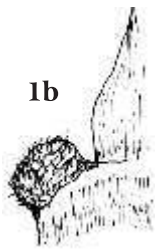


6b Basal culms with faint yellow stripes; culm sheath blade deciduous, outer surface covered with brown hairs. [*see Bambusa tulda*]

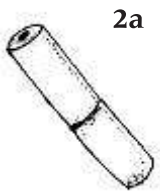
Dendrocalamus



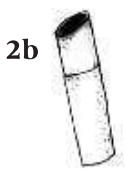
1a Culms 25-30m tall, 30-35cm in diameter; culm sheath with reflexed blade and auricles without bristles [*see Dendrocalamus giganteus*]



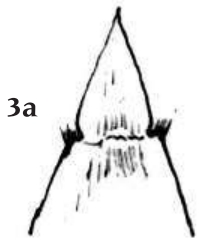
1b Culms 6-20m tall, 4-25cm in diameter; culm sheath with auricle and bristles [*see* **2**]



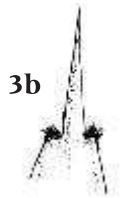
2a Culm semi solid (lumen narrow), thickly packed in a clump [*see* **3**]



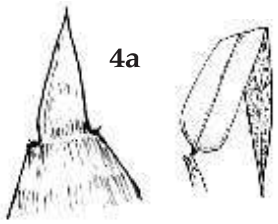
2b Culms hollow (lumen wide), not thickly packed in a clump [*see* **4**]



3a Culms glabrous with white powdery mass on the surface when young; culm sheath auricle and bristles are inconspicuous, blade short [*see Dendrocalamus strictus*]



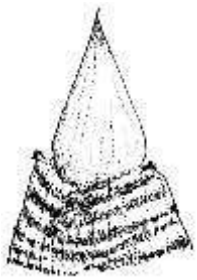
3b Culms sparsely pubescent without powdery mass on the surface when young; culm sheath with conspicuous auricle and bristles, blade long
[*see Dendrocalamus stocksii*]



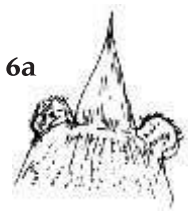
4a Culm sheath auricle small and inconspicuous; mature leaves pubescent beneath when maturity [*see Dendrocalamus hamiltonii*]

4b Culm sheath auricle large and conspicuous; mature leaves glabrous on both sides [*see* **5**]

5a Culm sheath with white striations when young.
[*see Dendrocalamus brandisii*]



5b Culm sheath without white striations when young [*see* **6**]

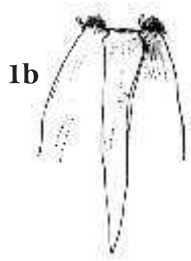


6a Culm sheath with well developed large recurved falcate auricle and long bristles, outer surface with dense upright hair in uniform pattern.
[*see Dendrocalamus sikkimensis*]

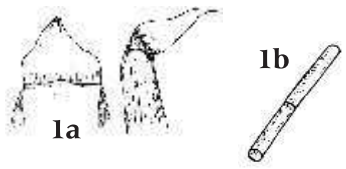
6b Culm sheath with small rounded auricle and short bristles, outer surface with dense upright hair in chevron pattern
[*see Dendrocalamus hookeri*]

Ochlandra

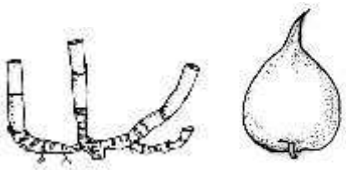
1a Culms 3-5m tall, internodes 20-60 x 1-2cm, leaves 11-30 x 1.5-2.5 cm; culm sheath with two falcate auricles, blade erect
[*see Ochlandra scriptoria*]



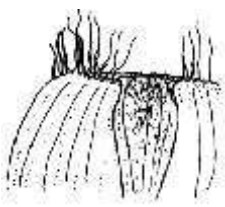
1b Culms 6-10m tall, internodes 50-120 x 4-6 cm, leaves 19-40 x 3.5-6 cm; culm sheath without falcate auricle, blade abruptly bent backward
[*see Ochlandra travancorica*]



Melocanna

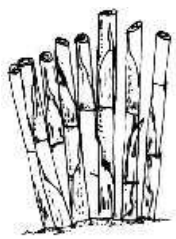


Long necked, sympodial rhizome; culms loosely arranged; culm sheath deciduous, auricles small and bristles absent; fruits large and fleshy
[*see Melocanna baccifera*]



Teinostachyum

Culm sheath smooth with flat level shoulders, ligule very short and blade with dense brown hair [*see Teinostachyum dullooa*]



Thyrsostachys

Dense clump; culm sheaths persistent and fibrous, imbricating at the base; auricles small [*see Thyrostachys oliveri*]

Bambusa balcooa

ASSAM **Bhaluka** | MEGHALAYA: GARO HILLS **Wamnah, Beru** | NAGALAND: AO **Oti/Out,** ANGAMI **Vuteya** SEMA **Awuti** LOTHA **Avuthi** | TRIPURA **Barak, Boro, Barua** | WEST BENGAL **Balku bans** | NORTH BENGAL **Boro bans**

TREE FORM | COARSE AND STOUT CULMS | RECURVED BRANCHES | PSEUDOSPINY BRANCHLETS | RARE AND ISOLATED FLOWERING

Habitat
Occurs at altitudes of up to 600 m. Prefers heavy textured soil with good drainage.

Distribution
Infrequently found in natural forests, and almost entirely a cultivated bamboo. A common homestead bamboo in North East India and West Bengal. Also occurs in Bihar, Jharkhand and Uttaranachal.

Culm
The culm is up to 25 m tall, dull dark green to bottle green in colour, with a not very prominent taper. It is thick-walled and has leafless thorn-like branchlets. Internodes are 20 to 45 cm long, 8 to 15 cm diameter and have wall thickness of 1.9 to 3.0 cm

Culm sheath
The culm sheath is deciduous, with a smooth inner surface, a brown, hairy outer surface, and a ciliate margin. The blade is triangular, with a smooth inner surface and hairy outer surface, and ciliate margin; auricles are absent.

Flowering
Isolated and rare. The clump/plant dies after flowering without setting any seed. The flowering cycle is 35–45 years.

The flowers are green with purple tips.

Fruit
Flowers rarely, if at all, and does not produce seeds

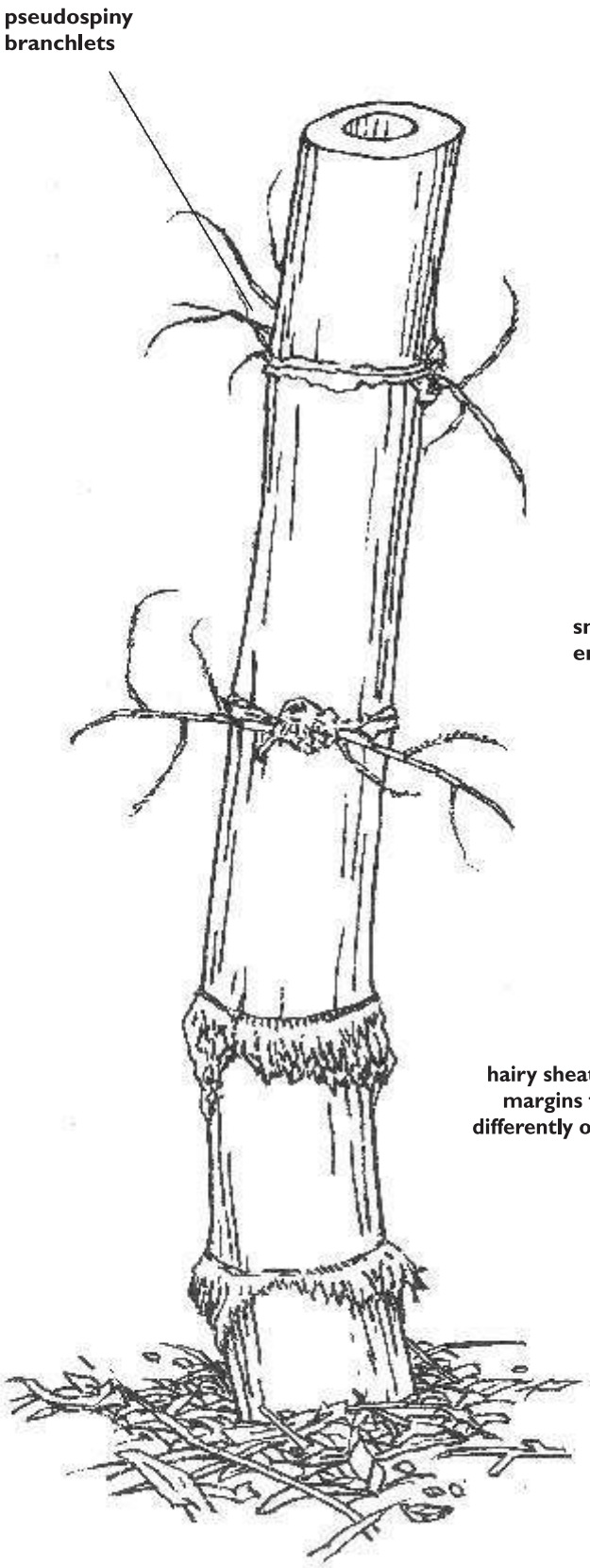
Propagation
Seeds are rarely, in fact almost never available. Propagated through offsets, and culm and branch cuttings.

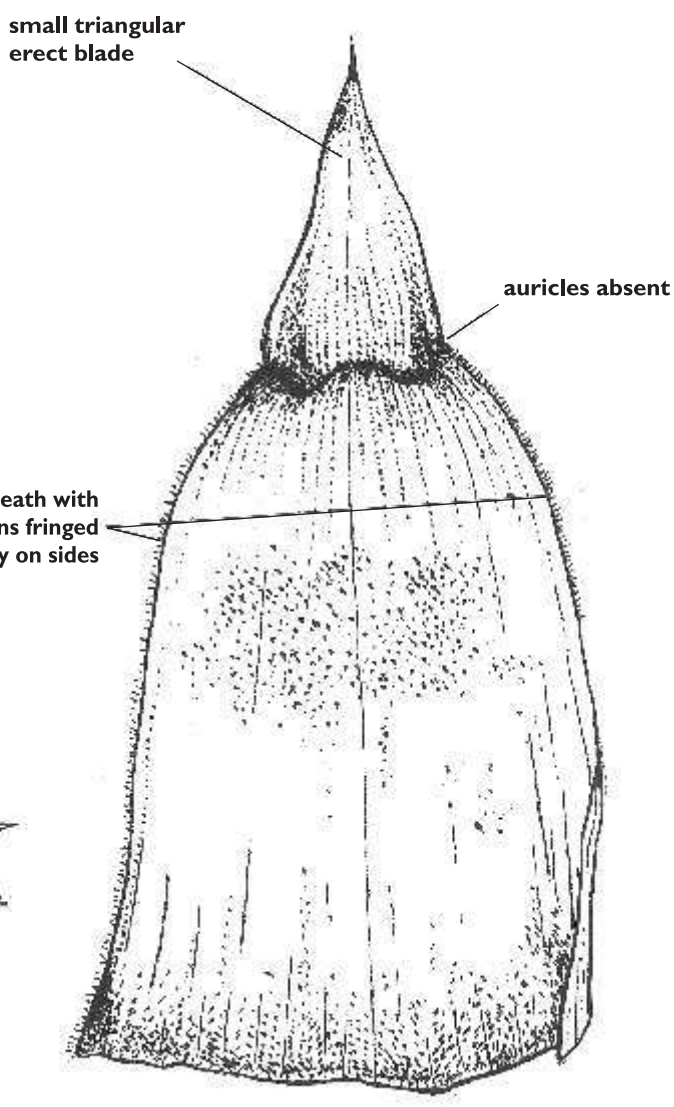
Uses
The most common use of this sturdy and strong bamboo is for structural applications. It is a preferred bamboo for house construction, scaffolding, ladders and props for small bridges. It is also used for stick-making – agarbatti sticks in particular. Large quantities find their way to pulp and paper mills. The shoots are edible, and have a sweetish taste.

Bambusa balcooa

DEFINING CHARACTERISTICS

1. Small, thin leafless, recurved, pseudospiny branchlets, especially at the lower culm nodes.
2. Culm sheath has dense hairy upper surface, and the margins fringed with hair all along one edge and only at the top on the other edge.
3. Small, triangular, erect blade with wavy edges.
4. Auricles either short or absent.





Bambusa bambos

ANDHRA PRADESH **Bongu veduru, Mulla veduru** | ASSAM **Kotoha** | KARNATAKA **Bidduru, Gatte** | KERALA **Illi, Mula, Pattill** | GUJARAT **Toncur** | MANIPUR **Saneibo** | ORISSA **Kanta bans** | PUNJAB **Nal bans** | TAMIL NADU **Mungil** | BENGAL **Kanta bans, Behor bans**

TREE FORM | DENSE CLUMP WITH CLOSELY PACKED CULMS | SPINY BRANCHES

Habitat
Attains the best growth in moist deciduous forests up to an altitude of 1000 metres. Prefers rich and moist soil, and thrives near perennial rivers and valleys. In dry tracts it prefers alluvial or other deep and fine textured soils. Grows in dense clumps of closely packed culms.

Distribution
Found almost throughout India; and common in Central and South India.

Culm
The culm is up to 25 m tall, cylindrical, dark green in colour, erect, strong and hollow.

The Nodes are slightly swollen and short aerial roots are produced in lower nodes. Internodes are 30 to 45 cm long, 15 to 18 cm in diameter and wall thickness 1.5 to 2.5 cm.

Branching is seen throughout the culms except at the lowest basal nodes. The lower branches are long and curved. Branch base and nodes have 2-3 curved thorns (branchlets). Less thorny varieties of the species are seen in Karnataka and eastern Uttar Pradesh.

Culm sheath
The culm sheath is 12–45 cm long and 10–36 cm broad at the base. It has a leathery texture, and is dark maroon or yellowish, lacking a perfect auricle.

The blade is erect, triangular and wrinkled, with a smooth outer surface and inner side covered with dark brown, velvety hair.

Flowering
Gregarious, occasionally flowers sporadically. Flowers at long intervals of 40-60 years, while, in the southern/coastal part of India flowering is reported after 30 years. Tends to flower in the winter; seeds are available during February to June.

Fruit
Wheat-like grain covered with glumes, 0.5–0.6 cm long, which is smooth, grooved on one side and short-beaked. A single clump gives about 60-100 kg of seeds. About 70,000 to 85,000 seeds weigh one kilogram.

Propagation

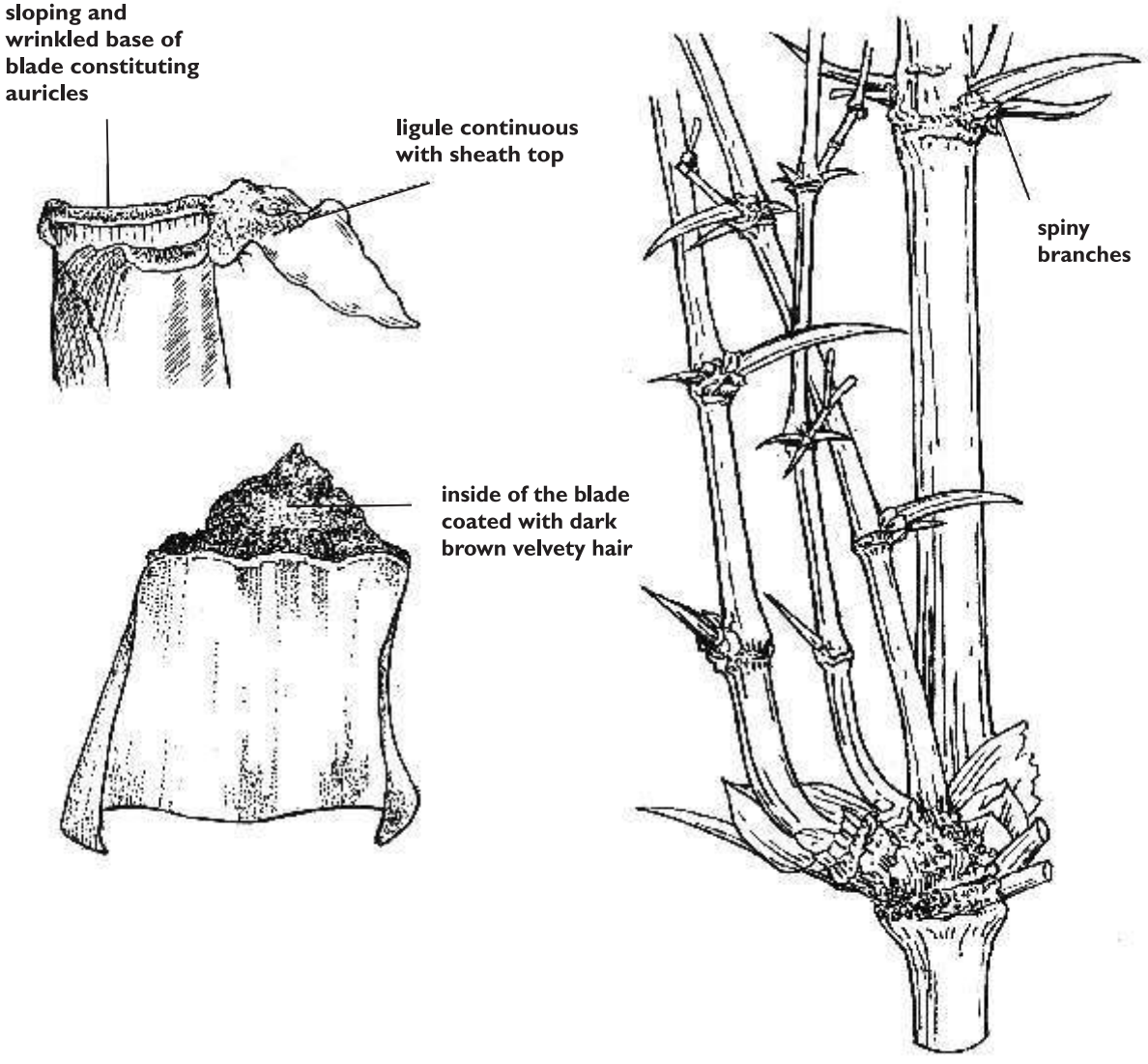
Seeds are often, if not commonly, available. Also propagated through offset, culm and branch cuttings.

Uses

Used as raw material for pulp and paper, to make panel products and handicrafts, and for thatching and roofing. The spiny branches are used for fencing. Young shoots and seeds are edible. The leaves are used as fodder and medicine. It is a good species for boundary planting, riverbank stabilization, and soil and water conservation

DEFINING CHARACTERISTICS

1. Very densely tufted bamboo with thorny branches.
2. Culm sheath has a short triangular blade, with a broad sloping and wrinkled base on either side (constituting auricles).
3. Lower surface of the sheath blade is coated with dark brown velvety hair.
4. Ligule is continuous along the top of the sheath.



Bambusa nutans

ASSAM **Makaal, Jatia** | ORISSA **Badia bansa** |
SIKKIM: LEPCHA **Mallo, Mahi bans** | TRIPURA **Makla** |
UTTAR PRADESH **Malla bans** | WEST BENGAL **Makhla, Mal, Aile**

TREE FORM | MEDIUM-SIZED | SPINES ABSENT | STRAIGHT CULMS | SMALL BRANCHES TOWARDS THE LOWER PORTION OF THE CULM

Habitat
Grows best at altitudes between 500–1500 m. Thrives on moist hill slopes and flat uplands, and well-drained sandy loam to clayey loam soils. However, being a rugged bamboo, it also tolerates dry conditions and stony soil.

Distribution
Commonly found and cultivated in the North East, Orissa and Bengal. Also occurs naturally in the sub-Himalayan tracts.

Culm
Culms are up to 25 m tall, dark to dull green in colour with a velvety whitish band below the nodes, loosely clumped, straight and smooth. Internodes are 25-45 cm long, 5-10 cm in diameter and have wall thickness from tip to base of 0.3-2.5 cm The nodes are not very prominent, and reinforce the overall straight appearance of the culm.

The culms are usually heavily branched in the upper portions.

Culm sheath
The culm sheath is 10–23 cm long and up to 30 cm broad at the base.

The blade is cupped, with black hair on the outer surface and a smooth inner surface. The auricle is well developed, large, wavy and fringed, with a recurved margin. The leaf sheath has no hair.

Flowering
Flowers gregariously at an interval of 35 years. Sporadic flowering is also observed. Some clumps are part-flowering in nature, with a cycle of 15 years.

At first glance, a clump of Bambusa nutans may look very similar to that of Bambusa tulda. There are significant differences, however. The culms of Bambusa nutans tend to be taller and straighter with less prominent nodes, and are more intensely branched in the upper portions. The culm sheath blade is strongly cupped in Bambusa nutans, and is persistent.

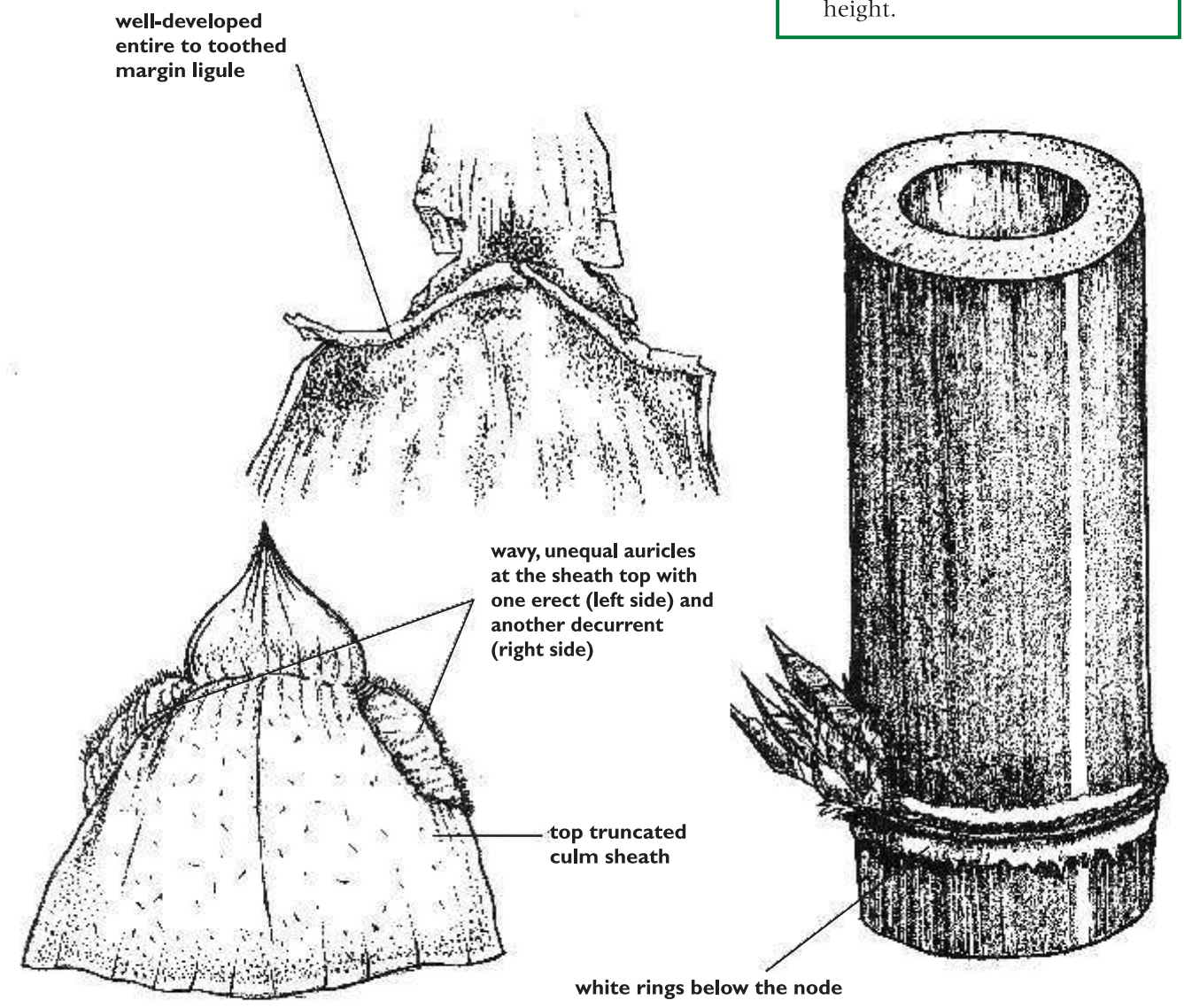
Fruit
Wheat-like grain covered with glumes, long rather than broad, blunt at the apex and hairy at the tip. The weight of 650 seeds would be about 10 grams.

Propagation
Through offsets, culm and branch cuttings.

Uses
Occasionally used in house construction, it is preferred for basketry and craft. Also used as an ornamental plant.

DEFINING CHARACTERISTICS

1. Top-truncated culm sheath with jet black hair on the back and culm sheath blade prominently cupped.
2. Wavy, unequal auricles at the top of the sheath, wider than their height. One auricle is normally erect and another decurrent (occurring below the point of insertion).
3. Culms with white rings below the node.
4. Entire to tooth-margined, well-developed ligule of 1-2 mm tall height.



Bambusa pallida

ARUNACHAL PRADESH: NYISHI **Hojae** | ASSAM: BARAK VALLEY **Bakhal, Burwal** BRAHMAPUTRA VALLEY **Bijuli** | KARBI-ANGLONG **Loto** | MEGHALAYA: KHASI HILLS **Seskien, Skhen, Tneng, Usken** | NAGALAND **Tero, Watoi** | SIKKIM: LEPCHA **Pashipo, Pushee** | NEPALI **Kalinga** | TRIPURA **Makal**

TREE FORM | DENSE CLUMP | SLENDER CULMS

Habitat
Occurs on gentle slopes at altitudes up to 2000 m, and in the plains.

It grows best in high rainfall and humidity areas with moderately high temperature, but can tolerate temperature as low as 6° C during winter. It has a preference for loamy soils and can be grown in shady locations.

In natural tropical forests in the hills, it often forms the understorey.

Distribution
Both naturally found and cultivated in the North East, Sikkim and North Bengal.

Culm
The culm is up to 20 m tall, olive green in colour and smooth. Young culms are covered with appressed white hair.

The nodes are rooted at the base, and not prominent.

Internodes are 45 to 70 cm long and 5 to 8 cm diameter. New shoots are greenish brown and hairy.

Culm are closely spaced and grow in thick clumps.

Culm sheath
The culm sheath is 18–30 cm long and 25 cm broad at the base. It is triangular, and smooth or covered with hair when young.

The blade is very long, longer than the sheath, and covered with hair when young; the lower part of the margin is bristled.

The leaf sheath is smooth and striate; the auricle is small, erect, rounded, fringed with stiff bristles, smooth or sometimes hairy; the ligule is short and narrow.

Flowering
Sporadic. The flowering cycle is 40 years.

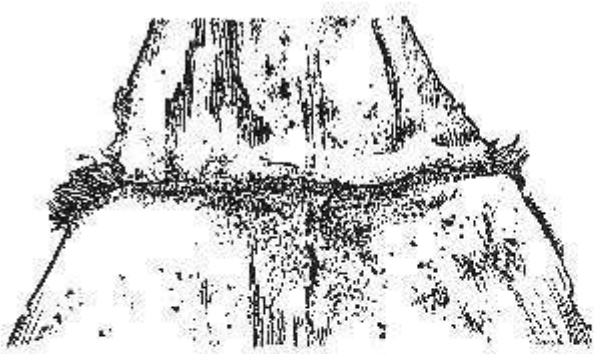
Fruit
Unusually large-sized and pear shaped.

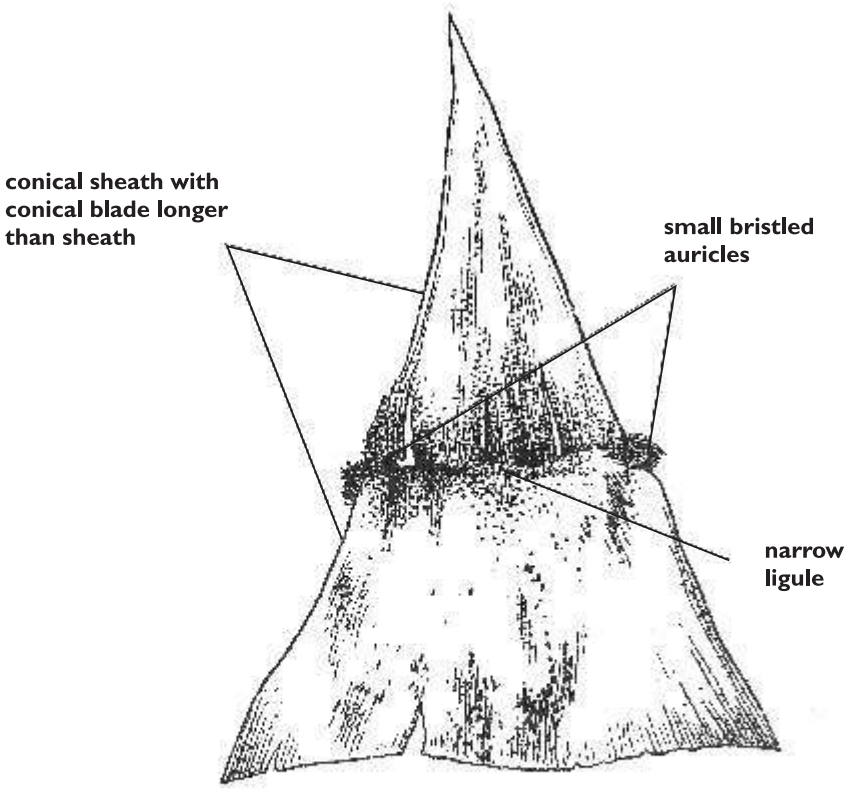
Propagation
On homesteads, the preference is for propagation with offsets. It also propagates through culm cuttings.

Uses
Mainly used in house building and for making baskets, mats, toys, wall plates, screens and wall hangers.

DEFINING CHARACTERISTICS

1. Nodes are not prominent.
2. Conical culm sheath with conical blade longer than the sheath.
3. Small bristled auricles and narrow ligule.





Bambusa polymorpha

ASSAM **Jama betwa, Betwa** | MADHYA PRADESH **Narangi bans** | TRIPURA **Paura** | WEST BENGAL **Jama betwa, Betwa**

TREE FORM | DENSE CLUMP | DECIDUOUS | PERSISTANT CULM SHEATH

Habitat

Prefers deep, fertile, well-drained loam and riverine alluvial soil. Grows well on low hill slopes along valleys. Grows also in non-calcarious and slightly acidic, moderately alkaline soils, and in regions with a mean annual rainfall ranging from 600 to 1200 mm.

Distribution

Commonly found in Arunachal Pradesh, Assam, Manipur, Meghalaya, Tripura and West Bengal. Cultivated on homesteads in North Bengal.

Has been introduced in forests in Tamil Nadu (Coimbatore), Kerala (Palghat, Nilambur, Wayanad) and in Karnataka (Coorg).

Culm

The culm is up to 25 m tall, and light green or white grey to greyish-green in colour.

Internodes are 40 to 60 cm long, 8 to 15 cm in diameter and have wall thickness of 2 to 2.5 cm.

Within the genera Bambusa, this species tends to have relatively small-sized leaves.

Culm sheath

The culm sheath is thick, 15-25 cm long and 25–35 cm broad at the base, and persistent, being broader at the base and narrow towards the tip. It is covered on the back with firmly appressed, dense whitish brown to dark brown hair. The imperfect blade is cup shaped, short and reflexed, with dark brown hair.

Cum sheaths are green when young, then they turn yellow and ultimately brown.

The ligule is narrow, entire to irregularly dentate (toothed with pointed teeth directed outwards) and fringed with fine hair. Auricles are unequal, often one upwards and the other downwards, sickle-shaped and fringed with fine hair.

Flowering

Gregarious as well as sporadic. Flowering cycle is 55–60 years.

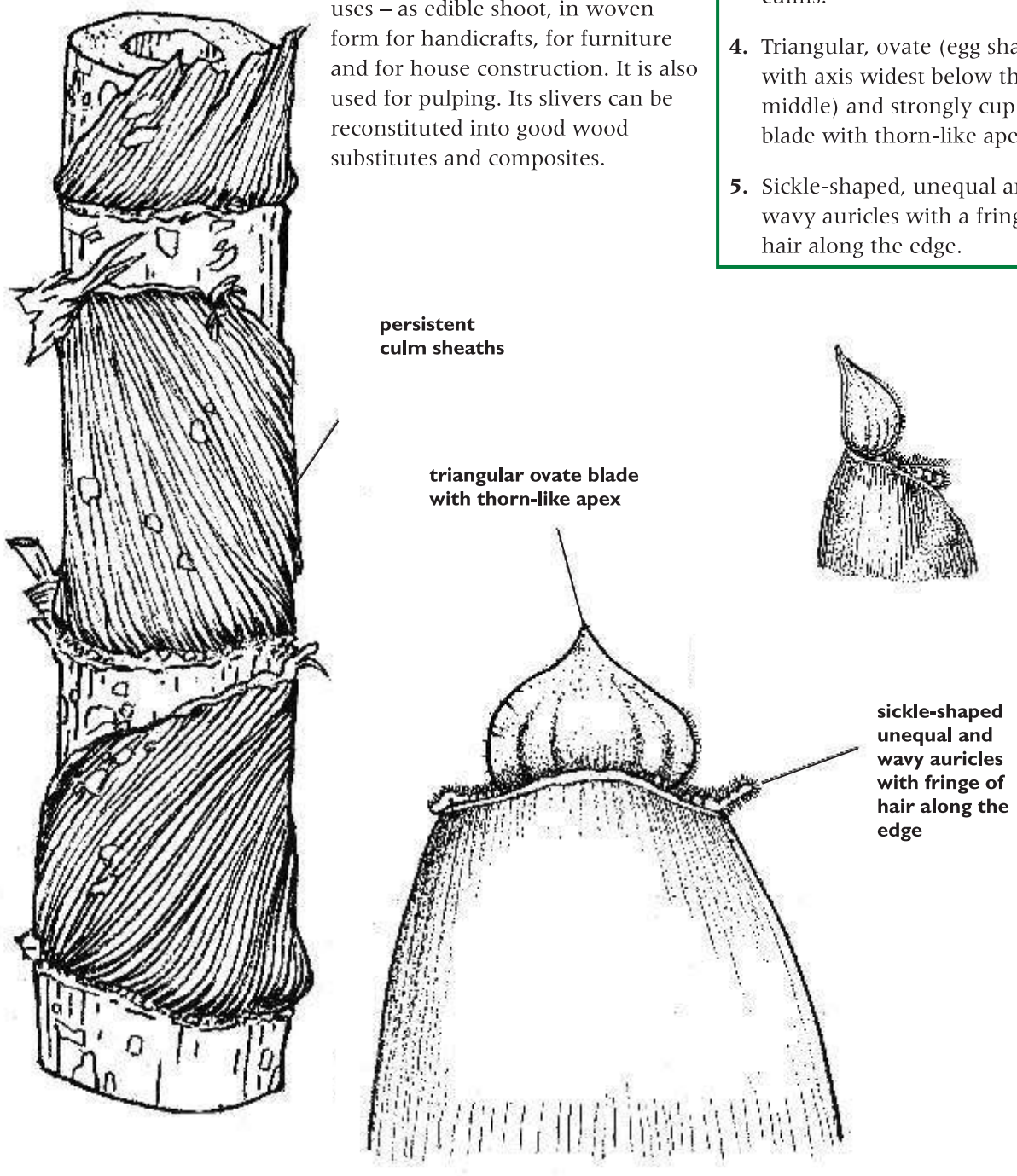
Fruit
Like small wheat grain, it is covered with glumes and is 0.3–0.6 cm long. It is depressed, flattened on one side and hairy, ending in a short point. Seeds per kilogram vary from 27,000 – 40,000 in number.

Propagation
Through offsets and culm cuttings.

Uses
It is a bamboo with many traditional uses – as edible shoot, in woven form for handicrafts, for furniture and for house construction. It is also used for pulping. Its slivers can be reconstituted into good wood substitutes and composites.

DEFINING CHARACTERISTICS

1. Closely packed to slightly loosely oriented culms, grey to greyish-green in colour.
2. Leaves smaller in size than other Indian Bambusa species.
3. Culm sheaths with appressed white hair on the back and persistent at the base of the culms.
4. Triangular, ovate (egg shaped with axis widest below the middle) and strongly cup shaped blade with thorn-like apex.
5. Sickle-shaped, unequal and wavy auricles with a fringe of hair along the edge.



Bambusa tulda

ARUNACHAL PRADESH: ADI **Dibang** NUISHI **Hotae** | ASSAM **Jati** | BIHAR **Deobans** | MEGHALAYA: GARO HILLS **Wati** | MIZORAM **Rawthing** | NAGALAND: AO **Longami** ANGAMI **Khoprei** SEMA **Api** LOTHA **Tsuntsan** KONYAK **Ngetmei** RENG **Gunyon** | SIKKIM: LEPCHA **Paoshiding, Ying** | TRIPURA **Mirtinga, Mitinga** | WEST BENGAL **Jati** DOOARS **Kiranti**

TREE FORM | CLOSELY CLUMPED | HAIRY CULM SHEATH WITH UNEQUAL AURICLES |

Habitat

Occurs at altitudes of 1500 m and thrives along water courses.

Prefers good rainfall areas with moist alluvial soil rich in organic matter, nitrogen, calcium, potassium and phosphorous. The pH preference is 4.5 to 6.5. Also grows in fine-textured soils in semi-evergreen forests, in relatively low rainfall areas.

Distribution

Found extensively in the North East and West Bengal. Cultivated in Arunachal Pradesh up to an altitude of 1000 m, and in the Brahmaputra valley. Also cultivated in Uttar Pradesh, Uttaranchal, Karnataka and West Bengal.

Culm

The culm is up to 25 m tall, thick-walled, strong, upright and smooth. The young culm is dark green in colour with a slight wheatish bloom on the internode that comes off easily. It is greyish-green when older and sometimes the 2-4 basal nodes have wheatish yellow stripes.

Internodes are 40 to 70 cm long, 5 to 10 cm diameter and have wall thickness of 0.8 to 1.5 cm The lower nodes have fibrous roots.

Branches emerge from the lower part, and are closely packed. At each culm node there are usually three larger branches, and many small branches.

Culm sheath

The culm sheath is 15–25 cm long and gradually tapering with an abruptly ending upper portion. It is deciduous, with an outer surface that is covered by brown hair and a smooth inner surface. The sheaths are covered with white powder and black hair when young.

The blade is broadly triangular and heart-shaped. Its apex is somewhat abruptly constricted into an elongated, sharp-pointed tip. The inner surface is hairy and the outer surface smooth.

Flowering

Gregarious. The flowering cycle is 30–60 years. Flowers are green.

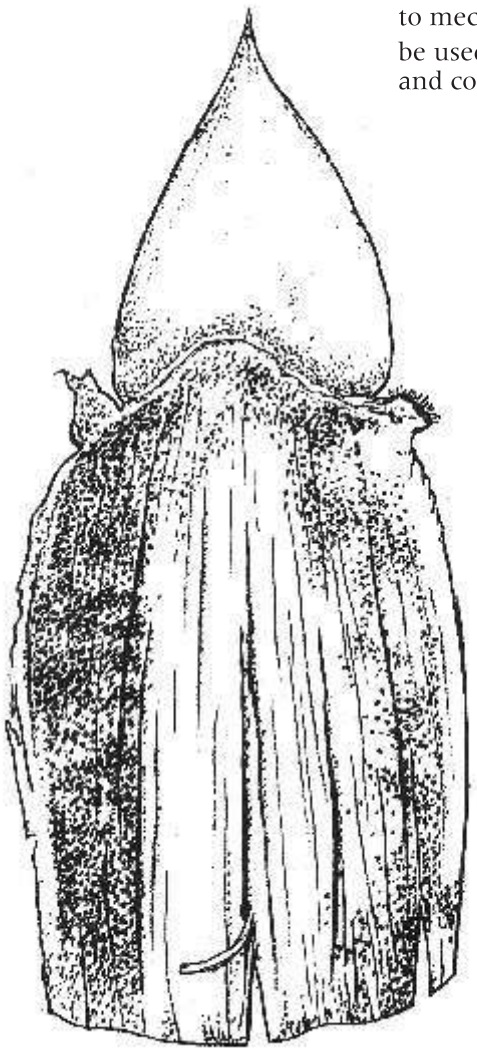
Fruit
Like wheat grain, covered with glumes. One kilogram contains about 14,000 seeds. Seed viability is about 35 days.

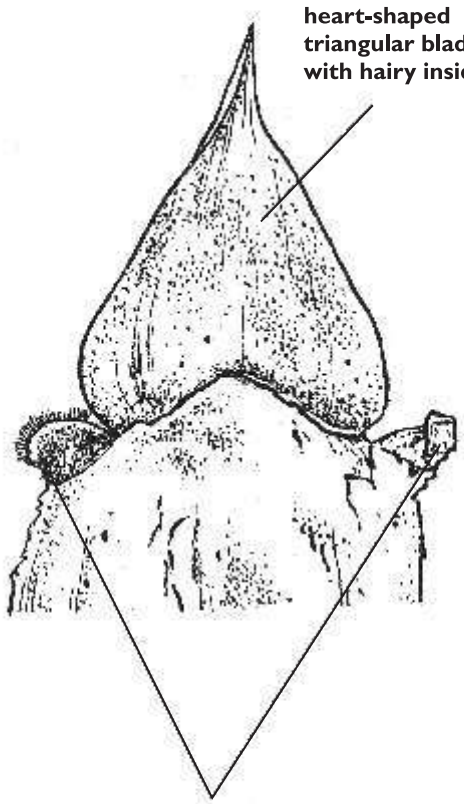
Propagation
Commonly propagated through offset planting. An alternative method is through culm cuttings, using 2 or 3 node cuttings. It can also be propagated through stump sprouting, and seedling macro-proliferation. Branch cuttings have a low ratio of rooting and survival.

Uses
Traditionally favoured for basketry and woven applications, it is also used for structural purposes. A strong bamboo, it lends itself easily to mechanised processing, and can be used for making bamboo and composites.

DEFINING CHARACTERISTICS

1. Closely packed clump with smooth, greyish-green culms; sometimes, faint stripes present on the lower internodes.
2. Dark brown hair on outer side of culm sheath, with heart-shaped triangular blade (hairy inner surface), which is found to be not strongly cupped as in case of *Bambusa nutans*.
3. Unequal auricles, the larger one continuous with the blade (or sine-shaped, separated) and rounded with a hairy margin.
4. Numerous branches from all nodes, usually three larger ones at each node.





unequal auricles: larger one continuous or sine-shaped, separated, with blade and rounded with hairy margin

Bambusa vulgaris

MANIPUR **Bakal** | MIZORAM **Vairua** | ORISSA **Sundrogai, Sunderkania bansa** | TRIPURA **Bari, Jai** | WEST BENGAL **Basini bans, Bakal**

TREE FORM | LOOSELY CLUMPED | RARE AND ISOLATED FLOWERING

Habitat
Prefers moist soil; thrives at the periphery of cultivated lands, creeks and foot-hills.

Distribution
Widely cultivated in tropics, from sea level to 1200m. The yellow variety is commonly grown as an ornamental plant in gardens.

Culm
The culm is up to 20 m tall, erect, bright green or yellowish in colour, green or yellow striped, smooth and glossy. Branches emerge from the middle of the culm. Internodes are 30 to 45 cm long, 5 to 10 cm in diameter with wall thickness of 0.7 to 1.5 cm.

A sulcation (grooved, longitudinal furrow) on the internode can be felt with the finger just above the bud or branch complement, especially in the common green variety.

Culm sheath
The culm sheath is 15-25 cm long and 25-35 cm broad at the base, striate, with an outer surface that is densely covered with brown-black hair. It has a ciliate margin.

Culm sheath auricles are slightly pointed and curve backwards. The blade is triangular, yellowish, and covered with black hair on the outer surface. It has a ciliate margin. The ligule is somewhat tall and dentate. The auricle is subequal and ciliate, with curved margins.

Flowering
Sporadic. Clumps flower rarely, if at all after a long time (80 years) and then die.

As the name suggests, Bambusa vulgaris is the most widespread bamboo species in the world. Many of its varieties are popular and are common ornamental plants.

Bambusa vulgaris var. vittata and Bambusa vulgaris var. striata have combinations of yellow and green stripes on the culm, and are popularly known as 'Tiger bamboo', a common ornamental.

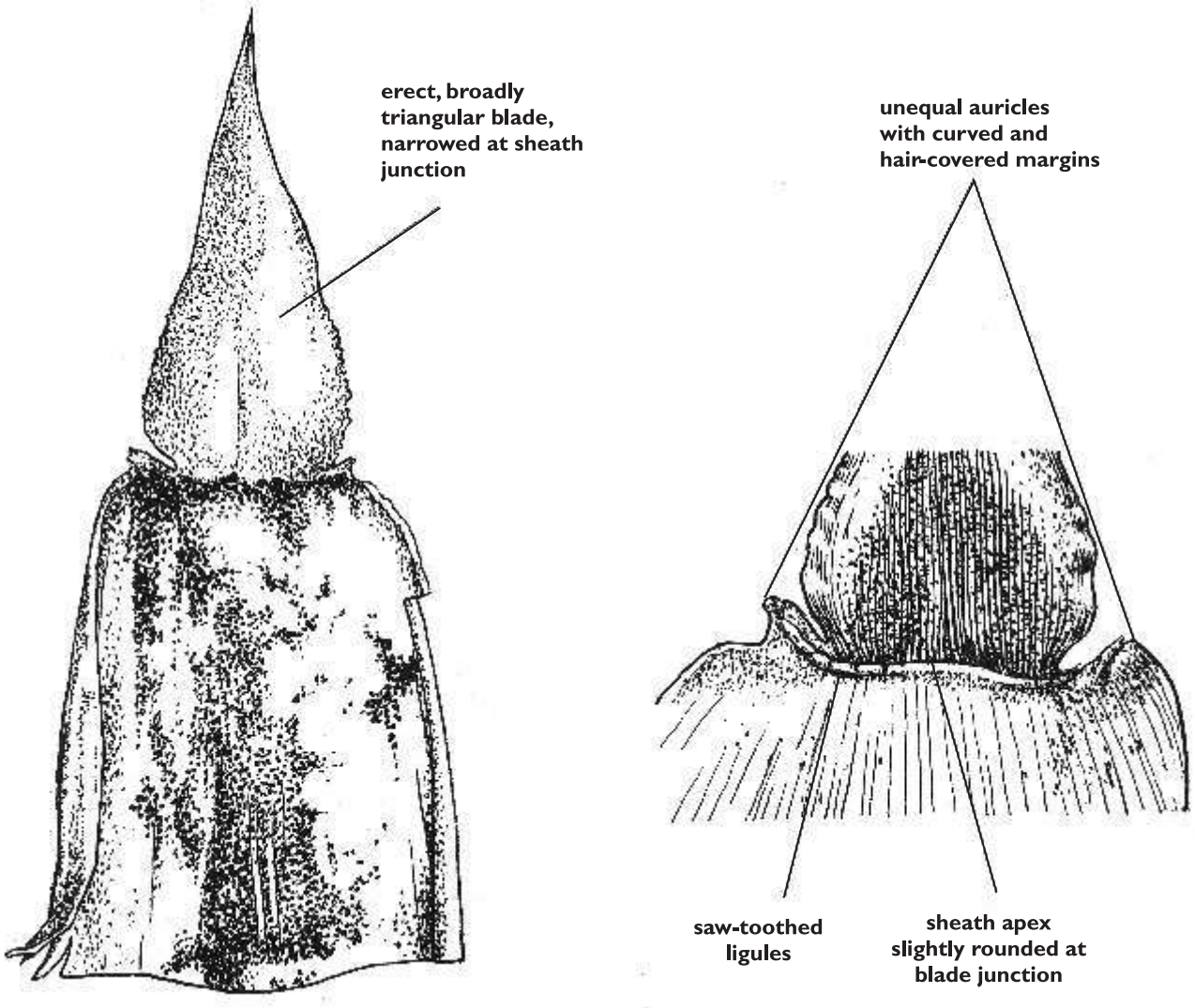
Fruit
Flowers rarely produce seeds.

Propagation
Propagating with seed is not a practical option. Easy to propagate through offsets, branch cutting and culm cuttings.

Uses
Used for making paper, decorative items and handicrafts. Also used for scaffolding and ladders. A starchy bamboo, it needs to be well-treated before use in structural applications. Because of its heavy spreading rhizomes, it is a good species for riverbank and soil stabilisation.

DEFINING CHARACTERISTICS

1. Culm is dark shiny green, sometimes yellow or with yellow stripes.
2. Sheath apex is slightly rounded at the blade junction.
3. Erect and broadly triangular blade, slightly narrowed at the sheath junction, and with bristles at the lower edge.
4. Saw-toothed ligules.
5. Unequal auricles with curved and hair-covered margins.



Dendrocalamus brandisii

BENGAL **Bulka** | MANIPUR **Wanan**

TREE FORM | TUFTED | TALL

Habitat
Primarily found in tropical forests, chiefly on calcareous rocks, at altitudes of up to 1300 m.

Distribution
A native of Burma, it is found in the Jiribam area of Manipur and in the Andamans, and to a lesser extent in Assam, Nagaland, Kerala and West Bengal. It was introduced into Coorg (Karnataka) around 1915, and has since thrived there.

Culm
The culm is up to 25 m tall with a diameter of 13 to 20 cm and a wall thickness of 1.7 to 3 cm. It is smooth and ashy grey to greenish-grey in color. Branches emerge from the middle of the culm. Internodes are 30 to 60 cm long.

Culm sheath
The culm sheath is up to 60 cm long and up to 35 cm broad. It is thick, leathery and smooth.

The blade is small compared to the main part of the culm sheath; recurved and hairy. The ligule is 1–2 cm high and deeply cut. Auricles are small, plaited and hairy.

Flowering
Gregarious and sporadic. Flowering cycle is 40-45 years.

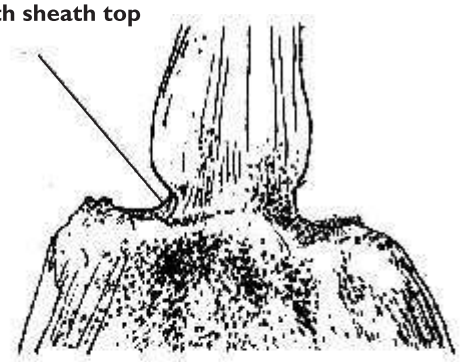
Fruit
2.5-4 mm size.

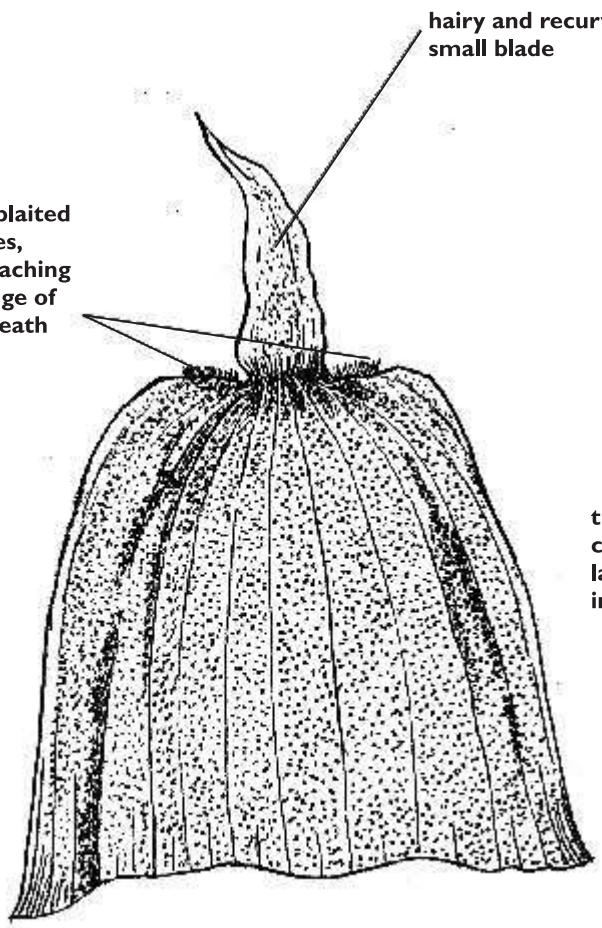
Propagation
Through offset planting, culm cuttings and branch cuttings.

Uses
It is a preferred bamboo for use as edible shoot. Its other traditional uses are for house construction and basketry, and to make handicrafts.

DEFINING CHARACTERISTICS

1. Thick leathery culm sheath larger than internodes.
2. Hairy, recurved, small blade.
3. Hairy, plaited auricle not reaching the edge of the sheath.
4. Ligule is continuous with the sheath top and has deep cuts.





Dendrocalamus giganteus

ARUNACHAL PRADESH: KHAMTI **Maipo** | ASSAM **Worra** | MANIPUR **Maroobob** | SIKKIM **Bhalo bans**

TREE FORM | TALLEST OF BAMBOOS | THICK AND COMPACT CLUMPS | SLENDER BRANCHES

Habitat
Grows well in humid tropical and sub-tropical regions. Adapted to pH range of 5.5 -6.5. Can tolerate winter temperatures of 6° -7° C. Occurs at altitudes of up to 1200 m. Prefers moist hill slopes and flat lands with rich loamy soil.

Distribution
The North East, West Bengal, North West Himalayas and Bihar, in natural forests. Also cultivated in these areas.

Culm
In this tallest of the bamboos, the culm is large and up to 35 m tall (the tallest culm measured, from Arunachal Pradesh, stood at over 42 m). It is grey –green in colour, and is covered with white, waxy scurf when young. It has hairy nodes and the branches are usually slender, largely in the upper part of the culm.

Internodes vary in length from 20 to 60 cm. The longest internodal sections tend to be in the middle of the culm.

The culm diameter ranges from 20-30 cm. Wall thickness at the bottom of the culm 2.5-3.5 cm in the middle portion 0.7-0.8 cm and 0.1- 0.2 cm at the top.

A deep longitudinal groove is present just above the nodal bud/ branch in the upper part of a well-developed culm.

Culm sheath
The culm sheath is large, 30–50 cm long and very broad, hard, smooth and shining within, with dark brown hair at the back.

The blade is small and recurved with wavy and rolled edges. Auricles are wavy, smooth, stiff, and narrow upwards to end in a sharp point; Stiff, black, serrate ligule.

Flowering
Sporadic. The flowering cycle is 80-90 years.

Fruit
Grain-like covered with glumes; about 200 seeds per 10 gram.

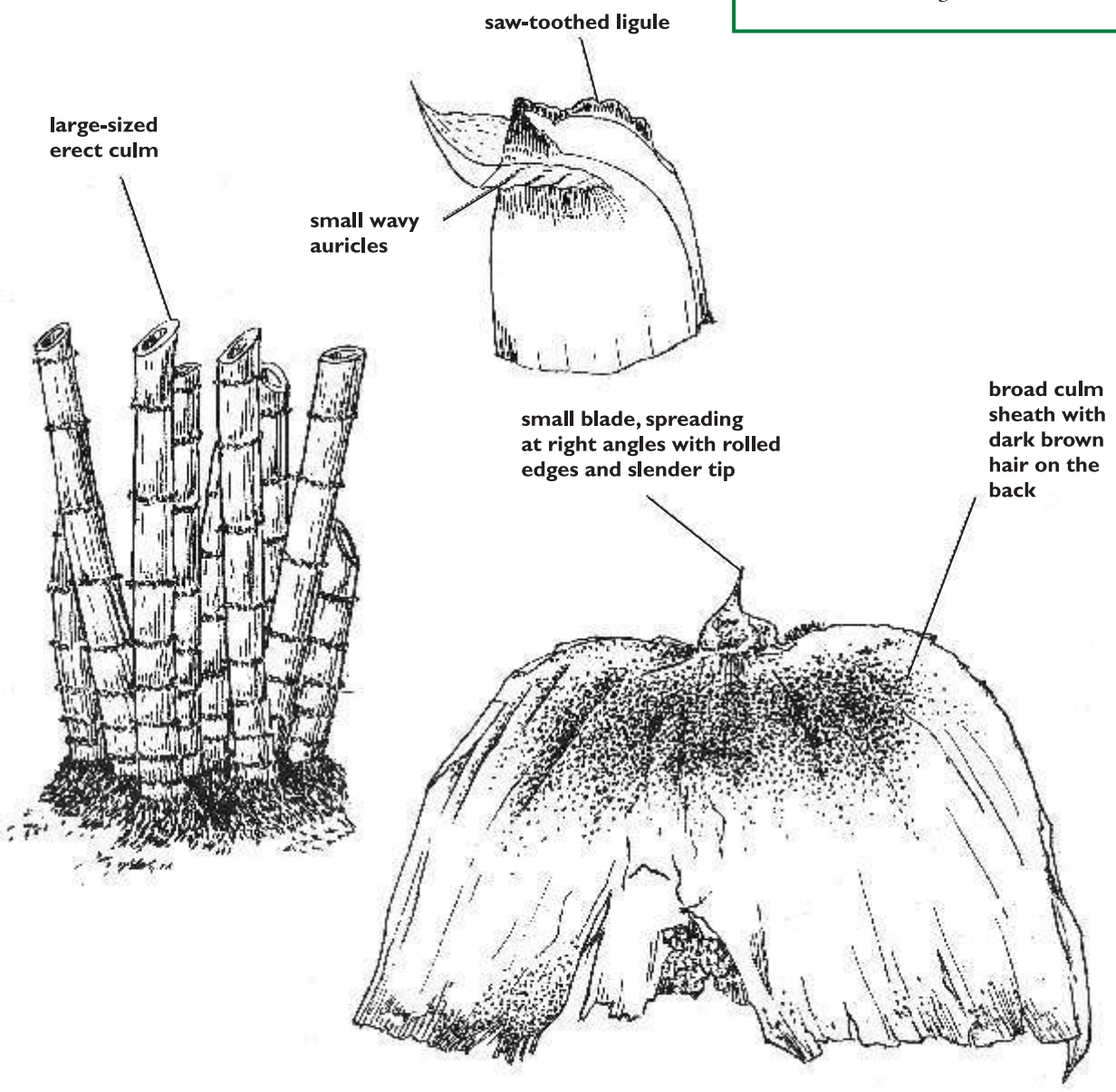
Dendrocalamus giganteus

Propagation
Conventionally propagated through offsets. Can also be propagated through branch and culm cuttings, ground layering and marcotting.

Uses
Used for construction purposes and to make boat masts. Also used to make vases, buckets, and water pitchers. It is pulped for paper. The shoots are edible.

DEFINING CHARACTERISTICS

1. Large-sized (up to 35 m), erect culms.
2. Very broad (up to 30-50 cm) culm sheath with few brown hair at the back and flattened against the sheath.
3. Small blade, spreading at right angles, and with rolled edges and slender tip.
4. Small wavy auricles (not bristled).
5. Saw-toothed ligule.



Dendrocalamus hamiltonii

ARUNACHAL PRADESH: NYUISHI **Eo** | ASSAM **Kako** KARBI-ANGLONG **Fonay** | HIMACHAL PRADESH **Maggar** | MANIPUR **Unep** | MEGHALAYA: GARO HILLS **Wanoke** | MIZORAM **Phulrua** | NAGALAND:AO **Auo** ANGAMI **Vuprie** SEMA **Tughakhau** LOTHA **Vepvu** KONYAK **Yo** RENGMA **Apuchye** | SIKKIM: LEPCHA **Pao** NEPALI **Choya bans** | TRIPURA **Pecha** | WEST BENGAL **Pecha** DARJEELING **Tama**

TREE FORM | LARGE CULMS | DENSE CLUMP

Habitat
Occurs in fine-textured soil in semi-evergreen forests, in areas with good but not excessive rainfall.

Distribution
Grows abundantly and well in the North East. A favoured homestead bamboo in North Bengal. Cultivated in many other parts of India too.

Culm
The culm is large, up to 25 m tall, and often with overhanging and long, drooping tips; greyish-white wax-like pubescence when young and dull green when old. The lower nodes have root scars.

Straw-creamy coloured big branch buds are found on the culm nodes. Culms are usually unbranched in lower portion and highly branched in upper portions.

Internodes are 30 to 50 cm long with diameter of 10 to 19 cm and wall thickness of 1.0 to 1.5 cm. Internodes in the middle portion of the culm tend to be longer.

Culm sheath
The culm sheath is long, stiff, up to 45 cm long and 30 cm broad at the base. It is smooth and shining within; the outer surface is covered with stiff, greyish brown hair.

The blade is short, about three-fourths the length of the sheath, with rolled margin, smooth outer surface and hairy inner surface at the base. Auricle is absent or rudimentary. Broad, smooth and entire ligule.

Flowering
Gregarious, with flowering cycle of 30-40 years. Sporadic flowering is not uncommon. Flowers are a distinctive reddish purple.

Fruit
Grain-like seed covered with glumes; 260-280 seeds per 10 grams.

Propagation
Seed is occasionally available, because of its extensive range and sporadic flowering habit. It is largely propagated through offsets and culm

and branch cuttings. It can also be propagated through layering and seedling macroproliferation.

Uses

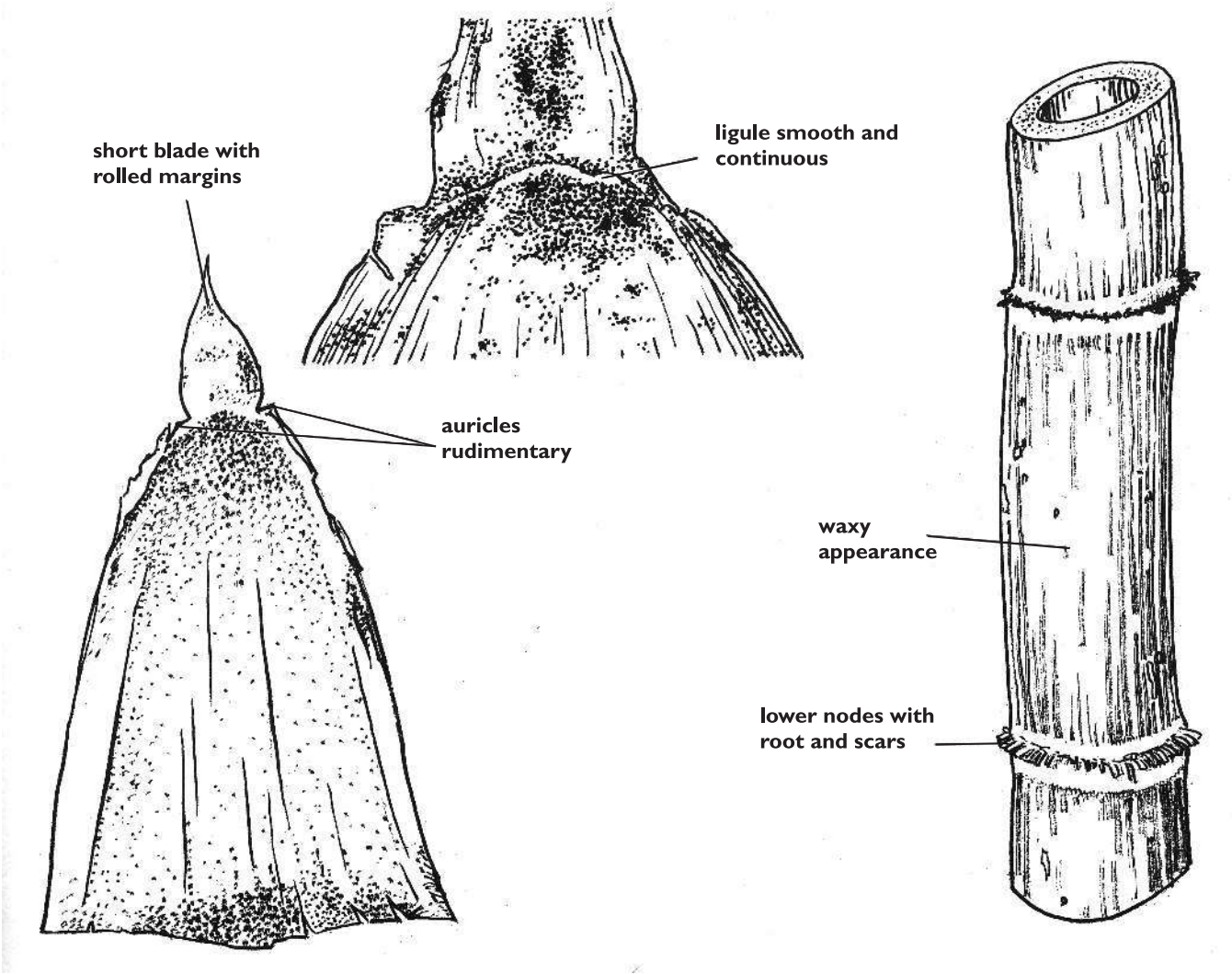
Used as edible shoot, for roofing and construction purposes, as well as for making rafts and handicrafts. The skin is used for binding furniture and craft items.

Because of its root system which spreads vertically as well as horizontally, it is an excellent species for watershed management and soil conservation even in dry areas.

The leaves are an important source of fodder in the hilly Himalayan regions, especially in winter.

DEFINING CHARACTERISTICS

1. Culm has a dull green and waxy appearance, with the lower nodes marked with root scars and white rings on either side of the node.
2. Curving branchlets and distinctly visible straw-creamy coloured big branch buds at the culm nodes.
3. Short culm sheath blade with rolled margin
4. Rudimentary auricles with no bristles.
5. Smooth, continuous ligule rising steeply in the centre.



Dendrocalamus hookeri

ARUNACHAL PRADESH: ADI, NYISHI **Aepo** | MANIPUR **Ooei** | MEGHALAYA: KHASI **Seiat, Sejsai, Sijong, Ukotang, Ussey** | SIKKIM:NEPAL **Tili bans**

TREE FORM | DARK GREEN | LOOSE CLUMP | TALL | MARKED NODAL LINE

Habitat
This species is found on hill slopes of eastern Himalayan region at altitudes of 300 to 1800 m.

Distribution
It is distributed in the hills of Arunachal Pradesh, Nagaland, Mizoram, Meghalaya, North Bengal, Sikkim and Manipur.

Culms
The culm is up to 25m high with long curving branches, 10-15 cm in diameter, dark green in colour, and usually naked below. Internodes are 40-50 cm long, rough and hairy, with walls about 2.5 cm thick.

Culm sheath
The culm sheath is 20-30 cm long, and 40 cm broad at the base. Sheaths of upper nodes are narrower, densely covered with black or brown hair outside and glabrous inside. Ligules are toothed; auricles are small and rounded, with long stiff hair; the blade is 8-18 cm long, triangular, hairy above.

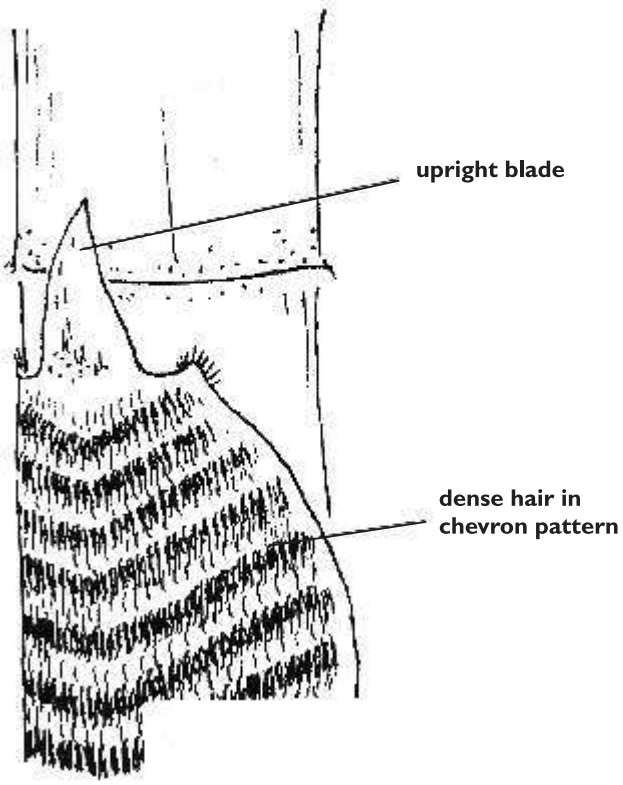
Flowering
Sporadic. The flowering cycle is 55-60 years.

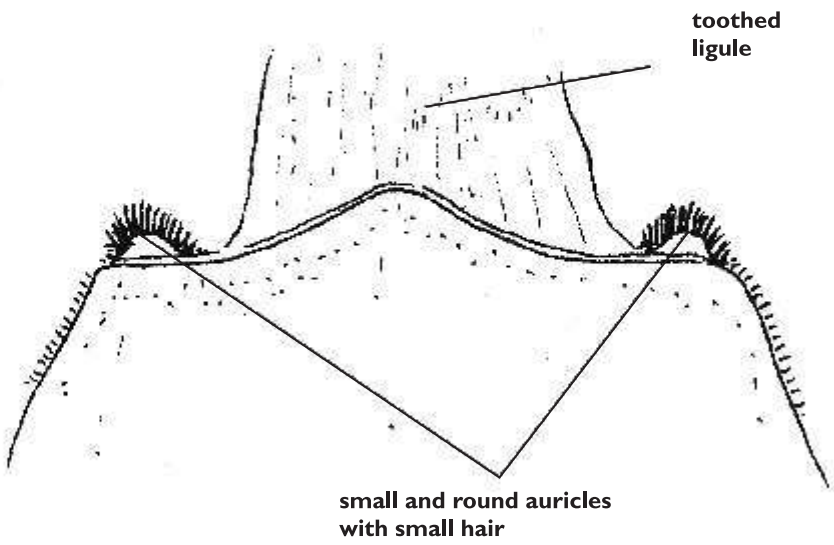
Propagation
Through offsets, culm cuttings and branch cuttings.

Uses
The culm is used for construction and fencing purposes, and for making baskets and buckets.

DEFINING CHARACTERISTICS

1. Tall culms, reaching up to 25 m height; culm sheath blade upright.
2. Culm with brown shiny fur.
3. Culm sheath with round auricles and bristles.
4. Dense hair on outer part of culm sheath in chevron pattern.





Dendrocalamus sikkimensis

MEGHALAYA :GARO **Wadah** | MIZORAM **Rawami, Sangaur** |
SIKKIM : NEPALI **Bhalu bans**

TREE FORM | DENSE CLUMP | CONSPICUOUS CULM SHEATH

Habitat
Grows at higher elevations of Himalayan forests and in the hills of North East India up to an altitude of 2100 m.

Distribution
The North East, West Bengal, Sikkim.

Culm
The culm is large, up to 25 m high, bare at the base, 12-20 cm in diameter, and dark green in colour. Internodes are up to 45 cm long and rough.

Culm sheath
The culm sheath is 36 cm long and 30 cm broad, densely covered with golden-brown hair; imperfect blade that is lanceolate and recurved; two auricles covered with pale bristles; ligule up to 5 mm wide, sharply toothed.

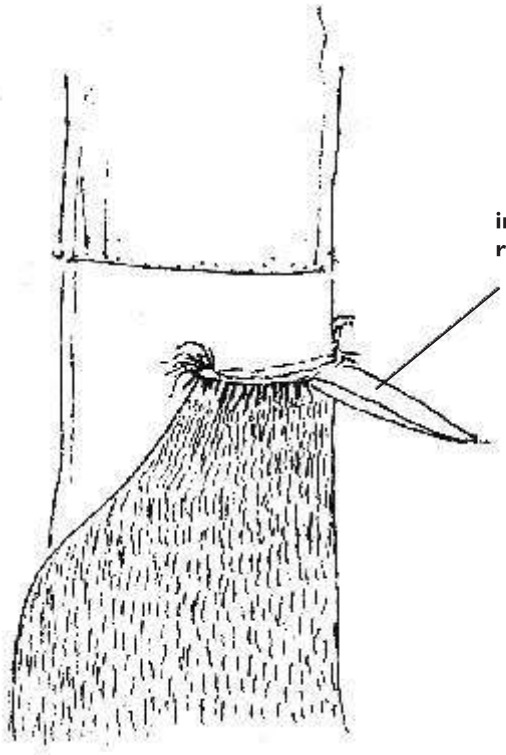
Flowering
Sporadic, with a 50-year cycle.

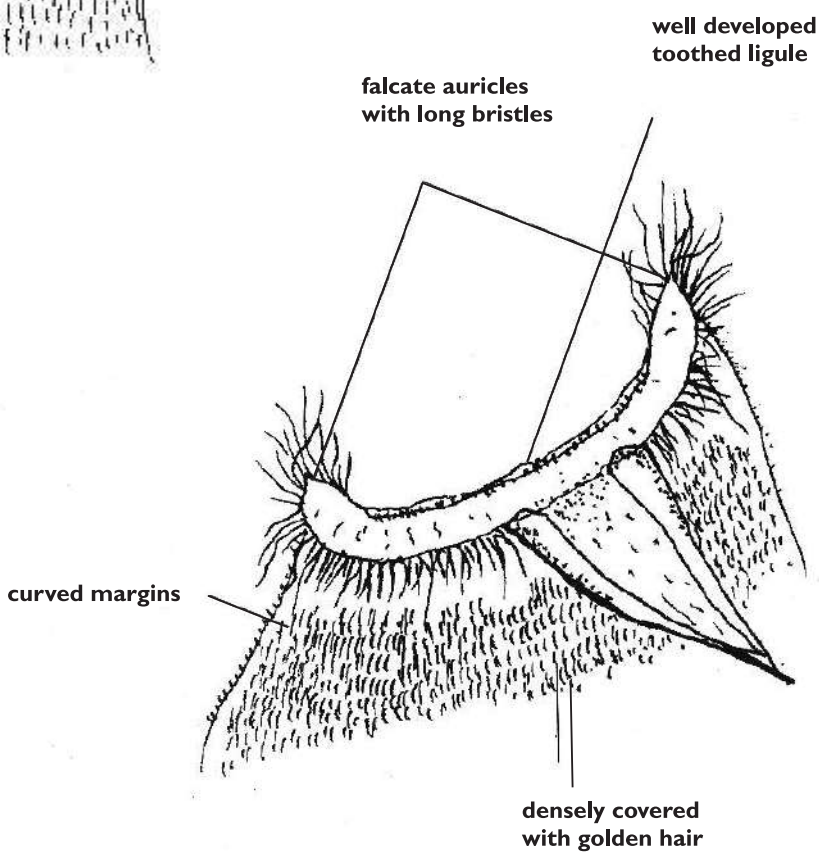
Propagation
Through offsets and culm cuttings.

Uses
Used for fencing, posts, huts, ropes, boxes, water containers and water pipes, and as animal fodder. It is also used for pulp and paper.

DEFINING CHARACTERISTICS

1. Tall culms reaching up to 25 m height and with dense brown furry wax.
2. Culm sheath with dense upright hair and horizontal blades.
3. Auricles large and falcate, with long, spreading bristles.
4. Well developed culm sheath ligule with curled and feathered margins.





Dendrocalamus stocksii

KARNATAKA **Konda, Oor-shema** | KERALA **Uyi, Mula** |
MAHARASHTRA **Chivari, Mes**

TREE FORM | LOOSELY PACKED CLUMP | NEARLY SOLID CULMS

Habitat
Typically grows from sea level up to altitudes of 800 m.

Thrives on the banks of streams and in valleys. Prefers well drained and deep, loamy soil.

Distribution
Confined and endemic to southern peninsular India. Common in Northern Kerala, in Karnataka along the Konkan coast and in Southern Maharashtra.

Culm
The culm is up to 15 m tall, straight at the top, yellowish green in colour, erect, strong and semi-solid (narrow lumen). Internodes are 15 to 30 cm long, and 2.5 to 4 cm in diameter.

Culm sheath
The culm sheath is 12–25 cm long and 10–15 cm broad at the base, covered with rough and brown hair. The auricle is 2–3 mm long, and clothed with numerous erect, stiff bristles. The inner ligule is conspicuous, 8–10 mm high, and deeply fringed at the margin. The blade is erect, awl-shaped, striate, with margins rolled or turned in, and a smooth, slender tip with a sharp point.

Flowering
Sporadic. The flowering cycle is 7-15 years.

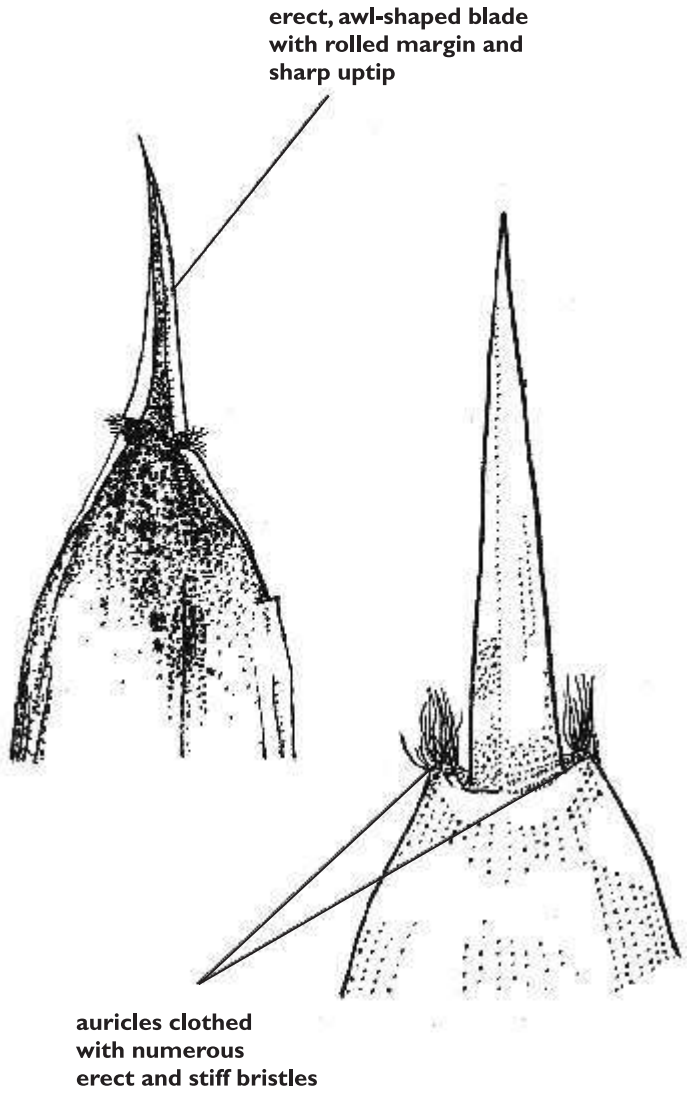
Fruit
Much longer than broad, with nearly parallel sides.

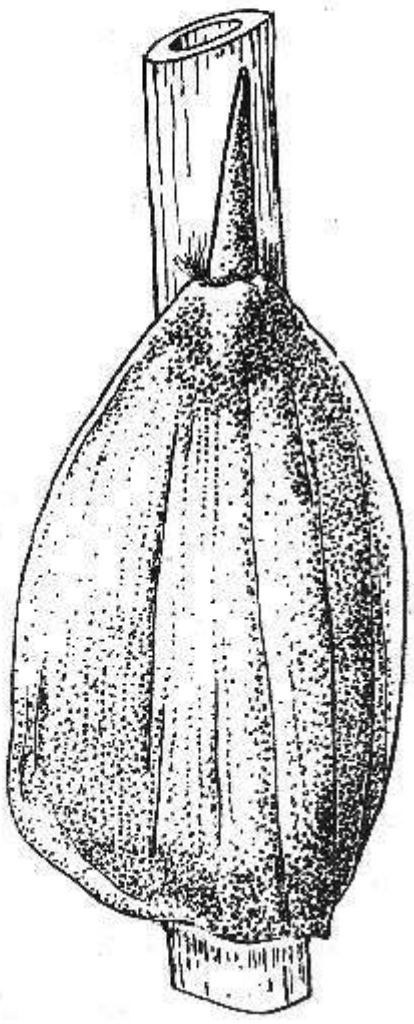
Propagation
Through rooting culm cuttings and branch cuttings.

Uses
A very strong bamboo with tall culms, well suited for construction purposes. Also used for making furniture, ladders and supports.

DEFINING CHARACTERISTICS

1. Nearly solid, bamboo in loosely packed clumps.
2. Erect, awl-shaped (narrow and gradually tapering to a sharp point) blade with rolled margin and a sharp tip.
3. 2-3 mm long auricles, clothed with numerous erect and stiff bristles.





Dendrocalamus strictus

ANDHRA PRADESH **Kanka kara, Sandapa veduru** | BENGAL **Karal** | KERALA **Kallanmula, Kurathimula, Korna** | GUJARAT **Nakur bans, Kiri bidiru** | MAHARASHTRA **Narvel** | NORTH AND CENTRAL INDIA **Lathi bans** | ORISSA **Salia** | TAMIL NADU **Kalmungil**

TREE FORM | DENSE CLUMP

Habitat
Found normally at altitudes up to 1000 m, in dry, open deciduous forests on hill slopes, ravines and alluvial plains. Occurs naturally in tracts receiving as little as 700 mm of rainfall.

Distribution
Hardy, adapts well in dry areas. Widely distributed in semi-dry and dry zones and all over the country, except in North Bengal and Assam.

Culm
The culm is up to 15 m tall, erect but slightly arched at the top. It is waxy green when young, and dull green or yellowish when old. Internodes are 30 to 45 cm long, 6 to 10 cm in diameter and have wall thickness of 2 to 3 cm.

Culms are hollow in humid conditions, but tend to be semi-solid and even solid in dry conditions. At the lower nodes aerial roots may be present. Branches arise almost throughout the length of the culm.

Culm sheath
The culm sheath 12–22 cm long and 4-6 cm broad at the base, striate, papery, smooth (covered with golden brown hair when young) and yellowish. The blade is erect, triangular and smooth. The auricle is short; aural setae are represented by short hair.

Flowering
Gregarious. Reported flowering cycle in South India is 24-28 years, in the North East and Central India 40-45 years, and in Western India 65 years. Sporadic flowering occurs almost every year somewhere in India.

Fruit
Small (5-7 cm long), like wheat grains covered with glumes, slightly reddish-brown, shining, beaked with persistent style. About 225-260 seeds weigh 10 grams. Seed viability is about 30-35 days.

Propagation
Seed is relatively commonly and periodically available. Also propagated through culm cuttings, branch cuttings and seedling macroproliferation.

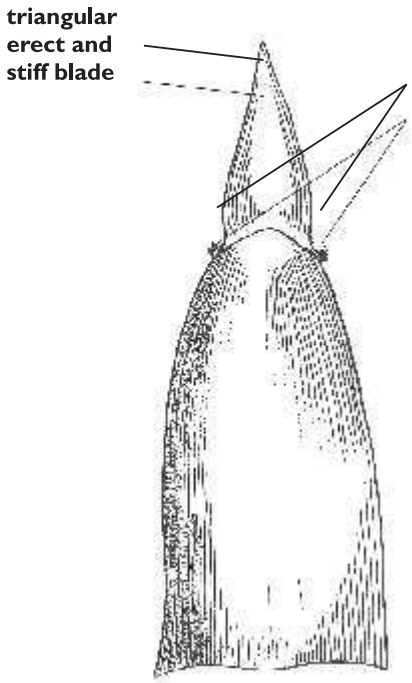
Uses

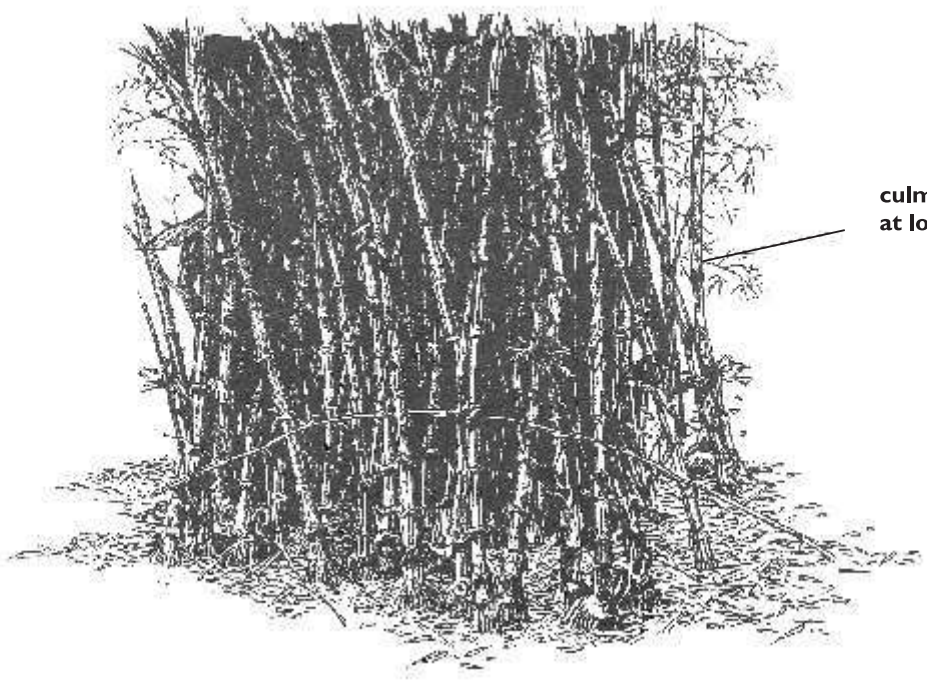
The culms are used as building material, for making furniture, mats, basketry and implements – either in round form or woven. This is the most commonly used bamboo in India by the pulp and paper industry. The shoots are edible.

DEFINING CHARACTERISTICS

1. Clumps big to medium in size, congested to slightly open.
2. Culms thick-walled and veering to solid in dry conditions. Branches throughout the culm including at the lower nodes, but thorn-like branchlets are absent.
3. Culm sheath covered with golden brown stiff hair on the back; and blade is triangular, erect, and stiff.

4 . None or small auricles, covered with short hair (not bristles).





Melocanna baccifera

ASSAM: BRAHMAPUTRA VALLEY **Tarai** BARAK VALLEY **Muli**
KARBI-ANGLONG **Arten** | BENGAL **Muli** | MANIPUR **Moubi, Reang** |
MEGHALAYA: GARO **Watrai** | MIZORAM **Mautak** | NAGALAND **Turiah** |
TRIPURA **Muli**

DIFFUSED CLUMP | THIN-WALLED | SMALL DIAMETER | EVERGREEN

Habitat

Found chiefly in the north – eastern region of the country. It grows best on low hills on aspects that are less exposed to the sun.

It requires well-drained soils that are sandy-loams or deep loams. The soil should be slightly acidic. It does not tolerate water logging.

Distribution

Found in large concentrations in Manipur, Mizoram, Tripura and in Southern Assam. Also grows in Nagaland, Meghalaya, Nagaland and North Bengal. It is cultivated in Eastern Arunachal Pradesh.

Culm

The culm originates singly from the rhizome at a distance, and the nature of the clump is therefore diffused.

Culms are smooth, and up to 15 m tall and 3-7 cm in diameter. They are green when young, and turn straw coloured as they become older.

The internodal length is 20 to 50 cm. The nodes are thick with a circular band of wide powdery residue a little below the node.

Culm sheath

The culm sheath is 10–15 cm long, yellowish brown or yellowish green when young, brittle, striate, smooth, and without hair or with sparse white hair on the back. There is a ridge on the outside of the sheath where the blade is attached.

The blade is long, narrow and sword-shaped (longer than the sheath proper). The auricle is small, sub-equal and thin, fringed with silvery bristles. The ligule is very short with an undulated or toothed margin.

Flowering

Gregarious, proceeding like a 'wave' from one area to another and covering large tracts of land. The flowering wave may continue for 10-15 years; isolated clumps may also flower rarely.

The species has more than one flowering genotype in the population: some exhibit a flowering cycle of 30 ± 5 years, others 45-48 years and few others still 60-65 years.

Fruit

The fruit is smooth, very fleshy, large, green, and pear-shaped with a curved beak. Mature seeds germinate well (60-80 per cent) under partial shade, usually within 3-7 days, viability period is 30-35 days.

Propagation

Can be propagated by part-clump planting and stump-sprouting.

Uses

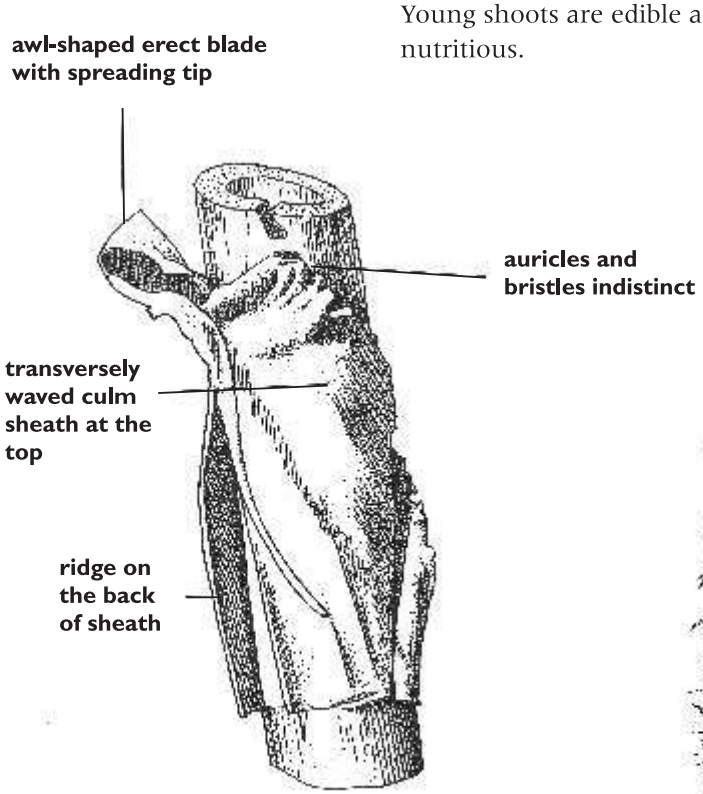
Used in the construction of houses in roofing, thatching, matting and for making woven products. In Tripura it is widely used for making agarbatti sticks. It is also an important source for paper pulp.

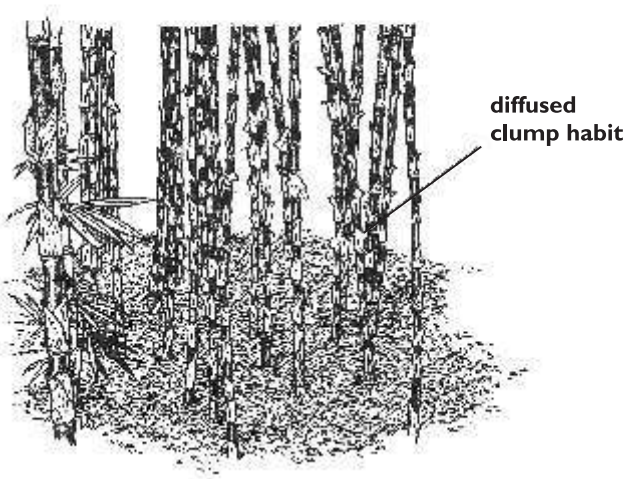
It is an efficient bamboo species for soil conservation and preventing landslide.

Young shoots are edible and nutritious.

DEFINING CHARACTERISTICS

1. Diffused clump habit, as it has a long-necked (1.0-2.0 m) sympodial rhizome.
2. Young culms (less than one year old) are completely unbranched with persistent straw -coloured culm sheaths on the nodes, and apical thin part drooping with 4-6 leaves which is visible even from a distance during October to April.
3. The culm sheath is straight for about two-thirds of the way up and transversely waved at the top
4. Ridge on the back of the sheath, where the narrow sword-shaped blade (longer than the sheath proper) is attached.
5. Awl-shaped (narrow and gradually tapering to a sharp point) erect blade with spreading tip.





Ochlandra scriptoria

KERALA **Ama, Pal oda, Ottal**

REED BAMBOO | SMALL THIN CULMS

Habitat
A shrubby reed bamboo, found mainly along banks of streams at lower elevations.

Distribution:
Endemic to the Western Ghats. Also found in Karnataka, Tamil Nadu and Kerala.

Culm
The culm is erect, sometimes straggling, hollow, 6-9 m tall, with the tip arched or drooping. The nodes are swollen. Internodes are 20-60 cm long, 1-3 cm in diameter, pale green in colour and smooth.

Culm Sheath
The culm sheath is 15-20 cm long and 6-8 cm broad at base. It is sparsely hairy when young, and the hair are restricted to the base and margins when old. The sheath is striate, papery, the tip rounded and truncate, inner side smooth and shining. The blade is erect, glabrous and narrow. Auricles are falcate with stiff bristles. The ligule is very short.

Flowering
Flowering is reported to be sporadic. The flowering cycle is 4-10 years.

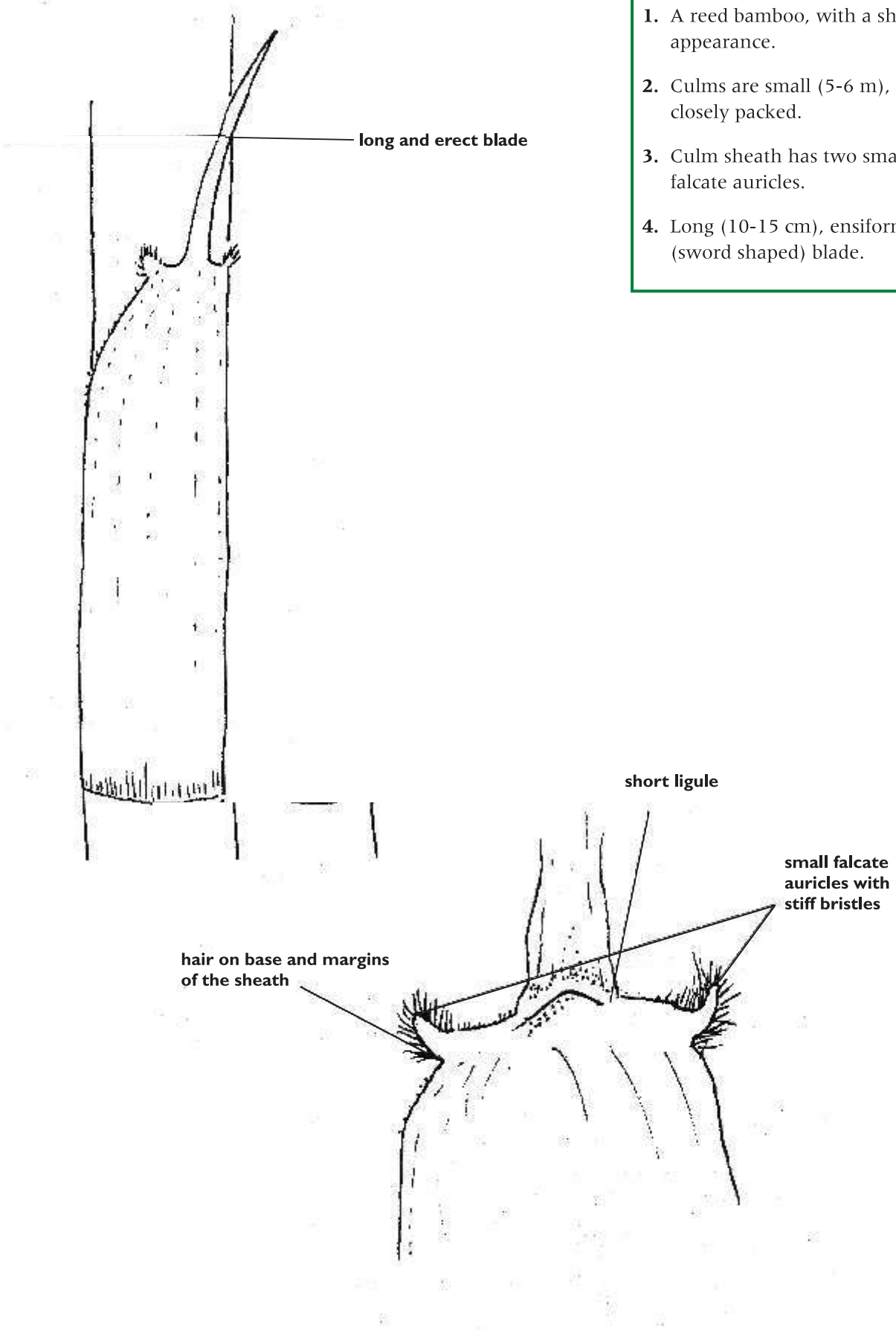
Fruit
A caryopsis, fleshy, oblong, 6-6.5 cm long and 0.7-1 cm wide, supported by persistent glumes. About 625-640 fruits make one kilogram.

Propagation
Through culm cuttings and branch cuttings.

Uses
It is used as raw material for the paper industry, and for making mats, baskets, floats and rafts. Bamboo boards are made from mats. Small culms are used for making handicrafts.

DEFINING CHARACTERISTICS

1. A reed bamboo, with a shrubby appearance.
2. Culms are small (5-6 m), and closely packed.
3. Culm sheath has two small falcate auricles.
4. Long (10-15 cm), ensiform (sword shaped) blade.



Ochlandra travancorica

KERALA **Eera, Eatta, Earakalli, Kreetta, Oda** | TAMIL NADU **Odai**

REED BAMBOO | TUFTED | DENSE CLUMP

Habitat
Thrives in moist deciduous and semi-evergreen forests, where it occurs widely as undergrowth. It also grows in extensive reed brakes, especially along banks of rivers and stream.

Prefers diffused light, and thrives in areas of rainfall of over 1500 mm annually.

Distribution
Confined to the Southern Western Ghats. Found in Kerala, South Karnataka and Tamil Nadu, from sea level to an elevation of 1000 m.

Culm
The culm is up to 9 m tall, erect, hollow, with the tip slightly arched, dark green in colour and smooth (rough towards the tip). Branches, which arise from the fifth or sixth node, are thin and numerous.

Nodes are slightly swollen and marked with the base of fallen sheaths. Internodes are 45 to 100 cm long, 2.5 to 5 cm diameter, with wall thickness of 0.4 to 0.6 cm.

Leaf
The leaf is large - 20–45 cm long and 2–10 cm broad and smooth on both sides, with rough margins.

The leaf sheath is closely attached, smooth, striate, with a short auricle and oral setae at the tip.

Culm sheath
The culm sheath is 15–26 cm long and 8–12 cm broad at the base, leathery, smooth or slightly hairy (covered with bulbous-based golden brown hair when young), with a smooth and shining inner side.

The sheath is wrinkled, with the wrinkles running from top to bottom.

The blade is abruptly bent backwards, without hair and awl-shaped. The auricle is short and inconspicuous, ornamented with numerous stiff bristles.

Flowering
Gregarious. The flowering interval is 7–15 years.

Fruit

One-seeded, large, fleshy, egg-shaped, 8 – 9.5 cm long and 2.8–3 cm in diameter, long rather than broad.

In one kilogram, the number of seeds varies from 45 – 57. The seed germinates promptly with 75 per cent viability and longevity up to 120 days.

Propagation

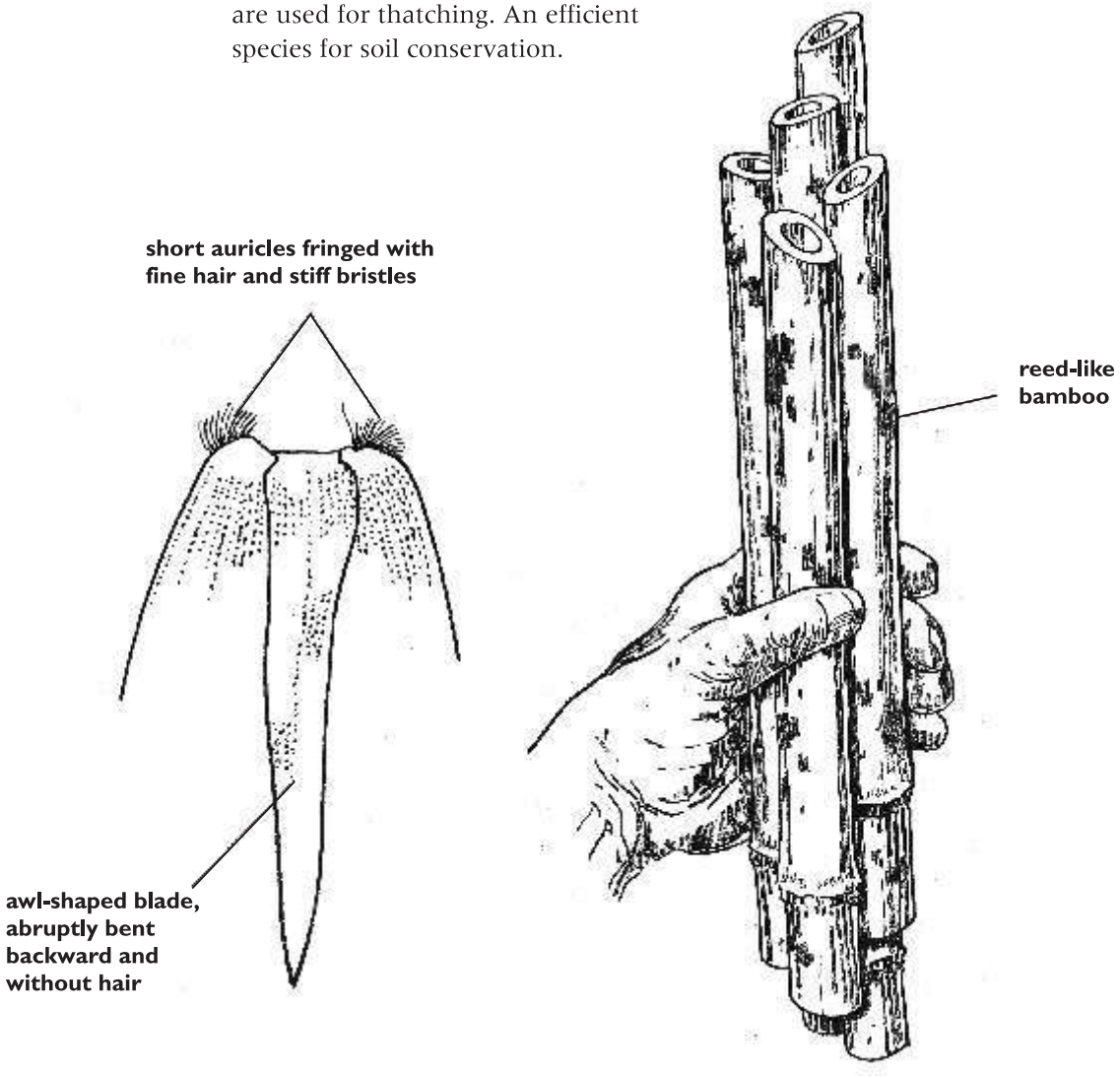
Through culm cuttings, branch cuttings and tissue culture.

Uses

Used for basketry, mat-making and handicrafts. Also used as raw material in pulping. Mature culms are used for roofs and walls; leaves are used for thatching. An efficient species for soil conservation.

DEFINING CHARACTERISTICS

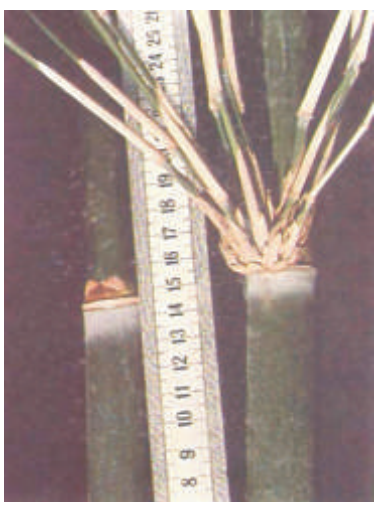
1. Broad-leafed reed-like bamboo with long internodes.
2. Short auricles fringed with fine hair and stiff bristles.
3. Awl-shaped (narrow and gradually tapering to a sharp point) blade without hair and abruptly bent backwards.



Teinostachyum dullooa

ASSAM **Dolo** | MANIPUR **Guh** | MEGHALAYA: GARO HILLS **Wadroo** | SIKKIM **Tokri bans** | TRIPURA **Dalu**

LOOSELY CLUMPED | MEDIUM SIZED



Habitat
This bamboo grows at lower elevations, up to an altitude of 1200 m, in the north-eastern region of India. It prefers shade and generally occurs in moist, well-drained and fertile valleys as an understorey in semi-deciduous forests. It is rarely found on drier, open and scrubby hills.

Distribution
It is found in Assam, Tripura, North Bengal, Manipur, Sikkim, and Khasi and Jaintia Hills in Meghalaya.

Culm
Variable in size, the culm is generally 10-15 m tall and 2.5-7.0 cm in diameter, very thin- walled (2-5 mm thickness), dark green in colour with a few white hair. It is whitish below the nodes and glossy when dry.

Internodes are 40-75 cm, and sometimes up to 1 m long. Branching usually occurs from the middle of the culm to the top. A dense tuft of 3-35 slender, sub-equal branches develop in a complement from each node.

The culm nodes are almost level, not swollen. They have flat appressed buds with wing-like appendages.

Culm sheath
Variable in size, the culm sheath is 12-30 cm long and 10-25 cm broad. It is striate with white appressed hair, rounded at the tip somewhat concavely truncate and loosely fringed with bristles.

The imperfect blade is narrow, subulate, recurved, hairy within, with a convolute edge, 7.5-15 cm long and 0.8-1.8 cm broad. The sheath is not auricled. The ligule is prominent, long, fimbricate (margins are fringed with long and course hair).

Flowering
Gregarious and sporadic. Reported flowering cycles are 15, 35, 45 years.

Fruit
Small, elongated grain-like, with a broad, flat base and cylindrical top terminating in a long beak formed by the persistent base of the style.

It is covered with glabrous glumes.

The length of the glumed seed (grain part) is 1.0-1.9 cm and that of the persistent style is 1.1-1.7 cm. The ripe seeds (deglumed) are blackish brown. The weight of a hundred glumed seeds and deglumed seeds are 3.03 grams and 2.51 grams respectively. Seeds are short- lived.

Propagation

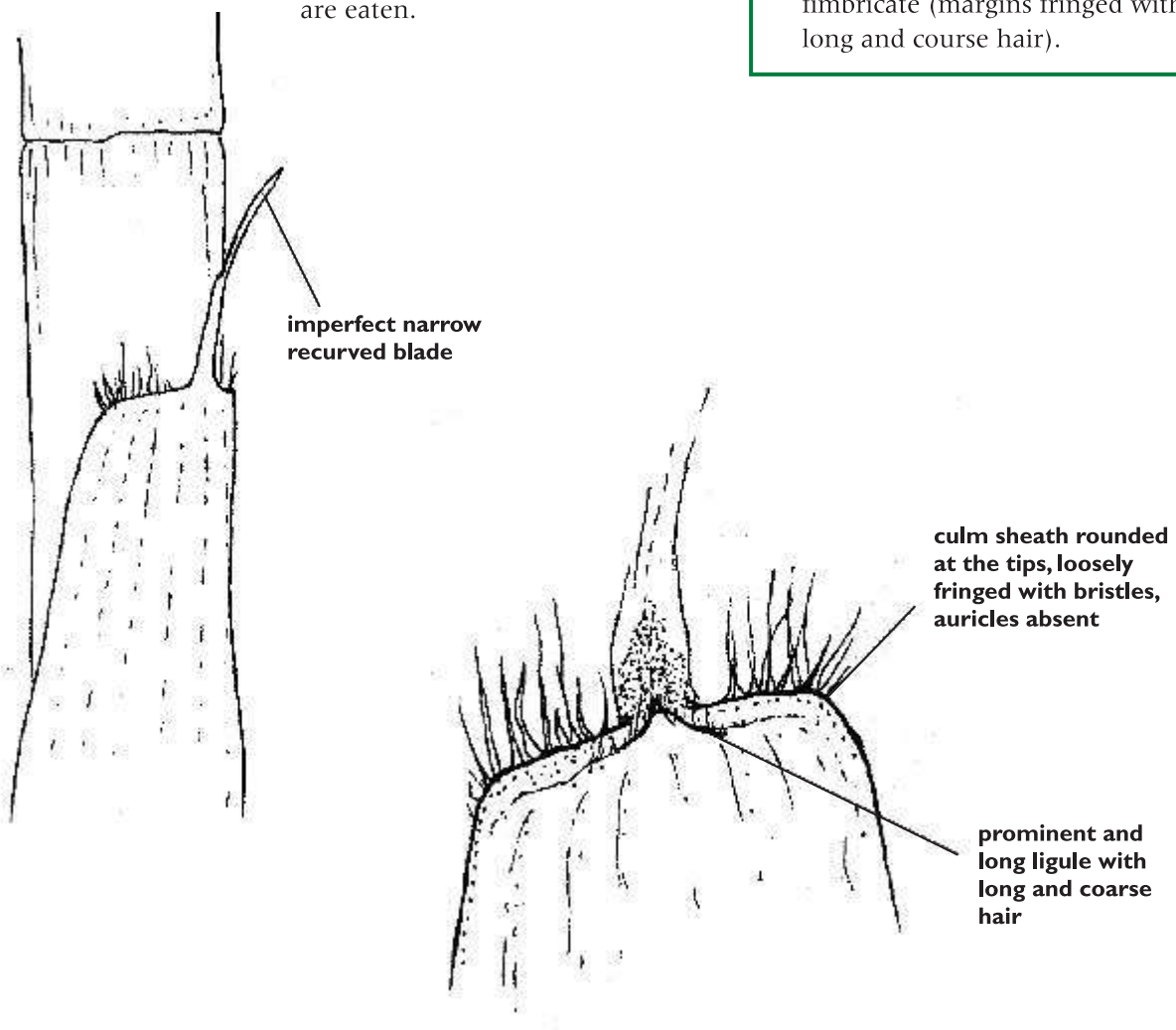
Through part-clump planting and culm cuttings. Also by seeds and seedling macroproliferation.

Uses

This bamboo is used for carrying water and for making umbrellas. It is also used for making baskets, small boxes and bamboo mats. The shoots are eaten.

DEFINING CHARACTERISTICS

1. The pendulous culm tip with 4-6 leaves at the apex, visible in more or less densely caespitose clump (small dense clump, growing in tufts).
2. Very thin-walled culms, dark green with silvery white hair, glossy when dry.
3. A whitish band, 7-12 mm wide, just below the node.
4. Smooth culm sheath with flat level shoulders; sheath blade has brown dense hair auricles absent.
5. Ligule prominent, long and fimbricate (margins fringed with long and course hair).



Thyrsostachys oliveri

KERALA **Thottimula, Lathimula** | TRIPURA **Kanakkaich**

TREE FORM | CULMS CLOSELY PACKED

Habitat
Occurs in moist forests, mixed or teak forests, at moderate elevations (650 m). Prefers deep soil and high relative humidity.

Distribution
This bamboo species is a native of Myanmar. It has been introduced and is commercially cultivated in the Kathlamara and Mohanpur areas of Tripura.

Culm
The culm is straight, 15-20 m high, 5 cm diameter, bright green with a whitish silky surface when young, and dull green or yellowish on maturity.

The nodes are hardly thickened. The internodes are 40-60 cm long and thin-walled (wall thickness is 1-1.2cm); in drier and exposed areas the culm becomes thick-walled.

Branches are always in the upper part of culm, fascicled (bundled) at the nodes with small light green leaves, the lower ones ascending and upper ones horizontal.

Culm Sheath
The culm sheath is fibrous, imbricating at the base, green when young, turning orange and finally brown, persistent, clothed on the back with thick, white, stiff, pubescence, rounded at the top. Margins are thin and ciliate.

The ligule is up to 4 mm high and dentate. There are two auricles. The blade is very small, triangular, up to 23 cm long and 2-3 cm broad, recurved, awl-shaped, and hairy on both surfaces.

Flowering
Gregarious. The flowering cycle is reported to be 48-50 years.

Fruit
About 1 cm long, glabrous, cylindrical, with a somewhat broader top and spongy below, ending in a long beak formed by the persistent base of the style.

Thyrsostachys oliveri

Propagation

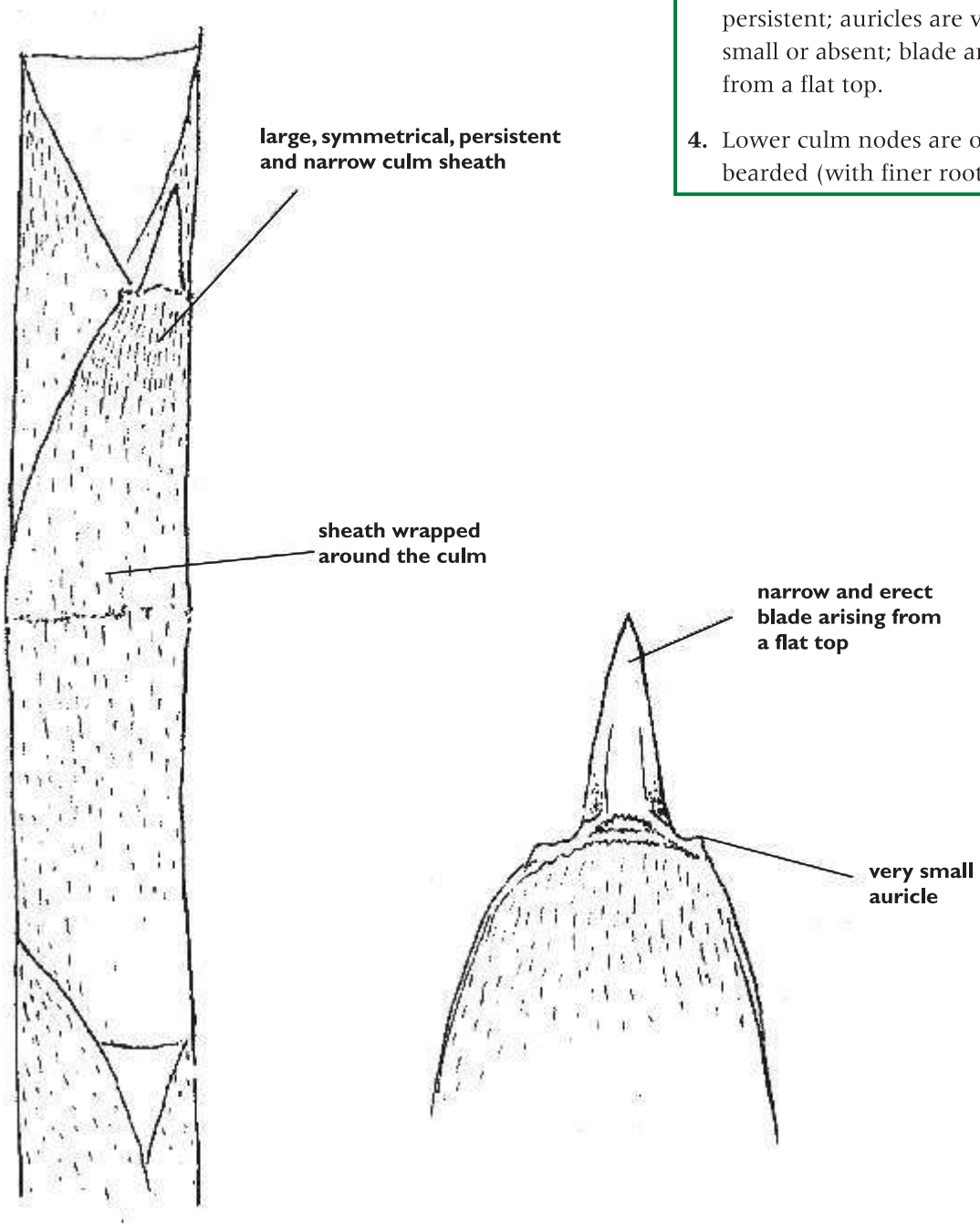
Through offsets and culm cuttings.

Uses

The culms of this bamboo are in great demand for construction purposes, as reinforcement for concrete slabs, as javelin poles, fishing rods, and for making baskets, furniture and handicrafts.

DEFINING CHARACTERISTICS

1. Grows in dense clumps, with branching near the top and with small leaves, making it distinct and attractive.
2. Culms are straight, closely packed and wrapped with sheaths.
3. Culm sheath is fairly large, felted; symmetrical, narrow and persistent; auricles are very small or absent; blade arises from a flat top.
4. Lower culm nodes are often bearded (with finer roots).



Guadua angustifolia

KERALA **Guadua** | KARNATAKA **Guadua**

THORNY OPEN CLUMPS | SHORT INTERNODES AT BASE LONGER AT MID SECTION

Habitat

Occurs in well-watered, fertile regions at elevation below 1500m. Grows best in high rainfall humid tropics. Prefers loamy rich soil. Can tolerate waterlogging to a great extent.

Distribution

This species is a native of South America. It has been experimentally introduced in tropical humid zones of Kerala and Karnataka and has shown great potential.

Culm

The culm is erect, up to 25 m tall, dark green with white band at nodal region, loosely clumped and tapers towards top.

Nodes have prominent sheath scar. The lower ones are marked by dense band of cream-buff colored hair. Internodes are 18 to 20 cm in diameter.

Thorny and few branches above the middle of culm and becomes fascicled (bundled) as move above the culm.

Culm Sheath

The culm sheath is deciduous in upper part but persistent in lower part of the culm. It is densely tomentose towards the base, with small, brown, persistent hair and densely fringed on the margins with cilia.

With the objective of assessing the performance of Guadua angustifolia under different management conditions, a project was taken up by NMBA with Institute of Wood Science & Technology, Bangalore under of aegis of Dr. Syam Viswanath. The initial plants were brought from Colombia by Bamboo Society of India in 2000 and some plants were given to IWST to develop macro and micropropagation techniques of this species. In 2006, under project on assessing the productivity of G.angustifolia, species was introduced in Kodagu (Karnataka) and Alwaye & Palakkad (Kerala). The best performance of plants is observed in Kodagu (Karnataka). One could see the good growth of Guadua at Alwaye and Wyanad in Kerala and at Coorg and Chickmanglur in Karnataka.

The ligule is convex, with light-brown hair, vertical bands separated by glabrous bands of similar width on the outer surface. Margins are ciliate and fringed.

Flowering

Not much information is available on flowering cycle. In its native habitat it is described as a non gregarious flowering species like *D.stocksii* in India.

Fruit

Globular caryopsis.

Propagation

Through culm cuttings, seeds, Chesquines (rhizome with new stalk from basal region) and apical shoots.

Uses

This bamboo is used for scaffolding, building material, as pulp for paper industry and making furniture. For architectural purposes, *Guadua* is the favorite among all the world's bamboo species.

DEFINING CHARACTERISTICS

1. Large thorny open clumps with thick rhizomes tapering at neck.
2. Dark green new culms with white bands at nodal region.
3. Culm sheath blades are roughly triangular, persistent at base and less so towards the top.
4. Ligule very variable, convex sometimes truncated or humped with ciliate margin.
5. Lower internodes are very short (7-10cm) while mid culms internodes are much longer (upto 35 cm)

Annexures

ANNEXURE I : VEGETATIVE PROPAGATION CENTERS (VPCS) – A SOURCE OF QUALITY PLANTING MATERIAL OF BAMBOO

The easiest way, even cheapest, method of propagation is through seeds but they are not commonly available since most species have long flowering cycles and some others do not seed at all. Even when seeds are available, they have short viability and have low germination percentage. Traditionally bamboo has been propagated through vegetative means for millenniums. However for large scale production such efforts require minimal infrastructure and facilities in standardized vegetative propagation centres (VPCs). NMBA with its in-house expertise has designed, and field tested, model VPC's in different parts of Country for decentralized production of quality seedlings.

S.No.	Location	Agency	Contact info	Species Available
1	Basishtha, Guwahati, Assam	State Silviculturist	Shri. D.Jaman, IFS Basishtha Forest complex, Beltola, Guwahati -781 029, Assam	*Bambusa balcooa, Bambusa nutans, Bambusa tulda, Bambusa vulgaris, Dendrocalamus giganteus, Dendrocalamus hamiltonii, Bambusa pallida, Bambusa multiplex*
2	Kokrajhar (Haltugaon & Karigaon), Assam	DFO Bodoland Territotal Council, Kokrajhar	Sri Rajen Choudhury, Divisional Forest Officer, Haltugaon Division, BTC, Kokrajhar, Assam Tel: 03661 270863	*Bambusa balcooa, Bambusa tulda, Bambusa vulgaris, Bambusa pallida, Bambusa garuchuka*
3	BCKV, Kalyani	Bidhan Chandra Krishi Viswa Vidyalaya	Dr. S.K. Samanta, Joint Director of Research, B.C.Krishi Viswavidyalaya (BCKV)Kalyani 741235, Nadia, W.B. Email: drsamanta@gmail.com	*Bambusa balcooa, Bambusa tulda*
4	Bangalore, Karnataka	Institute of Wood Science & Technology	Dr. Geeta Joshi, Tree Improvement & Propagation Division, Institute of Wood Science and Technology, 18th Cross, Malleswaram, Bangalore, Karnataka - 560003 Tel: 080 23346811, Fax: 080 23340529	*Dendrocalamus brandisii, Dendrocalamus stocksii, Guadua angustifolia*
5	Pantnagar, Uttaranchal	Govind Ballabh Pant University of Agriculture & Technology	Dr. Rajesh Kaushal, G.B. Pant University of Agriculture & Technology, Pantnagar - 263145, Uttaranchal Tel: 05844 233632, 234631 Fax: 233257, 233423 Email: bamboocentr@yahoo.com	*Bambusa balcooa, Dendrocalamus hamiltonii, Bambusa nutans, Bambusa tulda, Bambusa vulgaris, Bambusa bambos*
6	Palampur, Himachal Pradesh	Institute of Himalayan Bio-resource Technology	Institute of Himalayan, Dr. Anil Sood, Scientist & Head, Biotechnology Division, IHBT, CSIR, Post box no.6 Palampur, Himachal Pradesh 176061 Tel 01894- 230742-43, Fax 230433, 230428 Email: kukisood@yahoo.co.in	*Dendrocalamus hamiltonii, Bambusa nutans*
7	Zunheboto, Nagaland	Nagaland Bamboo Development Agency	Dr. K.Vikato Sumi, Nagaland Bamboo Development Agency, Redcross Building, P.R.Hill, Kohima, Nagaland Tel 0370-2229416 Email: nagaland_bda@yahoo.com	*Bambusa balcooa, Bambusa tulda, Dendrocalamus brandisii*
8	Chessa, Itanagar, Arunachal Pradesh	State Forest Research Institute	Sril. L. R. Bhuyan, Systematic Botanist, State Forest Research Institute, Van Vihar, P. B. No. 159, Itanagar 791111, Arunachal Pradesh Tel: 0360 2203523, Telefax 0360 2203566, Mobile: 09862091717 Email: l_bhuyan@indiatimes.com	*Bambusa tulda, Bambusa balcooa, Bambusa nutans, Dendrocalamus hamiltonii*
9	Sindhudurg, Maharashtra	Jt. Director, Social Forestry Circle,	Sri B.R. Khaire, Jt. Director, Konkan Social Forestry Circle, Kopri Village Road, Near Police Line, Kopri, Thane (East) Maharashtra- 400603 Tel: 25320899, Email:konkanjd@gmail.com	*Pseudoxytenanthera stocksii, Dendrocalamus stocksii*
10	Kolhapur	Shailesh Nursery	Mr. Ashwnini Bhingarde Shailesh, Nursery Yelur, Post- Malkapur, Tal. Shahuwadi, Distt. Kolhapur Maharashtra- 415101 Tel: 02329-224263	*Dendrocalamus stocksii*

Apart from VPC's supported by NMBA, bamboo tissue cultured plants are available at following Agencies

S.No.	Location	Agency	Contact info	Species Available
1	Gurgaon, Haryana	The Energy and Resources Institute (TERI)	Dr Sanjay Saxena, Senior Fellow & Area Convener Micropropagation Technology Park Gual Pahari - 122 001, India Tel: 0124-2579320-23; Extn. 255	*Bambusa balcooa, Bambusa tulda Bambusa vulgaris*
2	Hosur, Tamilnadu	Growmore Bio-Tech. Ltd.	Dr. N. Bharathi, #41-B, SIPCOT Phase-II, Hosur - 635 109. Tamilnadu State, India. Phone : +91 04344 260564, 260565, Fax : +91 04344 260560, Email : info@growmorebiotech.com	*Bambusa balcooa, Bambusa tulda, Bambusa vulgaris(green), Bambusa pallida, Dendrocalamus asper, Dendrocalamus hamiltonii, Dendrocalamus stocksii, Bambusa bambos, Thyrostachys oliveri*

ANNEXURE II: BAMBOO SPECIES UTILITY

Species	Construction/ boards	Shoots	Flooring	Sticks	Slivers/ mat	Charcoal/ gasifier	Fencing	Furniture	Paper industry
Bambusa bambos	✓	✓	-	✓	-	-	✓	-	✓
Bambusa nutans	✓	✓	-	-	-	-	-	-	-
Dendrocalamus hamiltonii	✓	✓	-	-	-	✓	-	✓	✓
Dendrocalamus giganteus	✓	✓	-	-	-	-	-	-	-
Dendrocalamus strictus	✓	✓	-	-	✓	-	-	✓	✓
Dendrocalamus asper	✓	✓	-	-	-	-	-	-	-
Bambusa tulda	✓	✓	✓	-	✓	-	-	-	-
Bambusa balcooa	✓	✓	-	✓	-	-	-	-	✓
Dendrocalamus brandisii	✓	✓	-	-	-	-	-	-	-
Melocanna baccifera	-	✓	-	✓	✓	-	-	-	✓
Phylostachys pubescens	✓	-	-	-	-	-	-	-	-
Bambusa polymorpha	✓	✓	-	-	✓	-	-	✓	-
Bambusa pallida	-	✓	-	-	✓	-	-	-	-
Bambusa vulgaris	✓	-	-	-	-	-	-	-	✓
Dendrocalamus giganteus	✓	✓	-	-	-	-	-	-	✓
Dendrocalamus hookeri	✓	-	-	-	-	-	✓	-	-
Dendrocalamus sikkimensis	-	-	-	-	-	-	✓	-	✓
Dendrocalamus stocksii	✓	-	-	-	-	-	-	✓	-
Ochlandra scriptoria	-	-	-	-	✓	-	-	-	✓
Ochlandra travancorica	-	-	-	-	✓	-	-	-	✓
Teinostachyum dullooa	-	✓	-	-	✓	-	-	-	-
Throstachys oliveri	✓	-	-	-	-	-	-	✓	-

GLOSSARY

a

acuminate having a long, slender, sharp point with concave sides
acute sharp-pointed
adventitious occurring in an abnormal position
alluvial soil usually rich in minerals that are deposited by water, as in flood plains
amphipodial a system of rhizome axes in which both sympodial and monopodial branching occur
appressed closely or flatly pressed against the entire length of an organ part
arborescent tree-like growth or form
attenuate with a long slender taper
auricle ear-shaped lobe or extension at the base of the blade on each side of the blade proper; this extension can be enlarged towards the outer end. A pair of auricles is found on each culm sheath or leaf
awl-shaped narrow and gradually tapering to a sharp point
axes an imaginary central line of development of any plant or organ

b

bifid forked; two-cleft
blade lamina; a thin, expanded, chlorophyll-bearing, stalked or unstalked, apical appendage of a culm sheath or leaf
bract modified leaf associated with a flower or inflorescence
branch limb arising from the culm; sub-branches are branches arising from branches
branch complement set of branches that develop at any one culm node
bristle a stiff strong trichome (hair)
bud undeveloped shoot containing the embryonic meristems which develop into flowers, stems or leaves; enclosed in protective specialized leaves called bud scales

c

caesipitose tufted, growing in a clump
caryopsis fruit of a grass, in which the outer layer (testa) of the seed proper is fused to the ovary wall; one-seeded, dry, indehiscent fruit; grain of the fruit of grasses
chevron pattern a v-shaped pattern
ciliate fringed with fine hair
clump individual unit of a bamboo having a pachymorph rhizome which consists of several culms
conjugate joined together
coriaceous of leathery texture
cortex outer part of a culm or rhizome, between the epidermis and the ground tissue
culm the aerial axis of the bamboo plant, divided into nodes and internodes
cuttings plant sections that can be placed in soil or water to root

d

deciduous falling off of parts at a particular stage of growth (opposite of persistent); usually applied to structures that fall off rather quickly, densely, compactly, thickly elliptic oval in outline, wide about the middle

decurrent having the leaf base extending down the stem below the insertion
diffuse even spaced culms rather distant from each other

e

elliptic in the shape of an ellipse
empty when used in relation to bracts or glumes, it means that it does not subtend a flower
endemic occurring in only a specific habitat, or restricted to a given geographic or political region
entire continuous and smooth in outline; usually describes the margin or edge of a relatively flat structure such as the leaf blade, ligule or auricle
erect standing upright
evergreen never entirely without green foliage, leaves persisting until a new set has appeared

f

falcate sickle-shaped
fascicled a close cluster of flowers/ leaves in groups (bundles)
filament slender stalk that supports the anther
fimbricate margins fringed, with long and coarse hair
floret unit of spikelet that consists of a single flower
foliage leaves leaves of woody bamboos with well-developed green blades and small sheaths produced in complements on culm branches
genus (genera) taxanomic category; smallest natural group (groups) containing different species

g

genus the smallest natural group containing distinct species
girdle the often swollen and persistent band of tissue inserted circumaxially at the node of some bamboos
glabrous smooth and without hair, like the 'skin' of the tomato or apple
glaucous covered with a removable white or blue, waxy coating on the surface as in dark purple plums or grapes
glume modified leaf or bract of the bamboo subtending a grass spikelet or pseudospikelet
ground tissue the tissue that forms the culm, consisting of parenchyma cells and vascular bundles

h

habit characteristic appearance or pattern of growth of a plant
habitat natural environment of a plant or organism; the place where it is usually found

i

imbricate with regularly arranged, overlapping edges, as fish scales
immature culm a young culm in which the process of lignification is not yet complete
indehiscent remaining closed at maturity, used in the context of fruits
indigenous native to a specified area or region; not introduced
inflorescence an aggregation of flowers
internode portion of a stem between two successive nodes

k

keel sharp crease or ridge

l

lacerate irregularly cut or divided
laciniate cut into lobes separated by deep, narrow, irregular incisions
lanceolate lance-shaped, wide at the base and tapering towards the apex
layering a technique of vegetative propagation by which the part of plant, without separating it from the plant, is brought in contact with rooting media

leaf modified leaf in a bamboo culm, which generally consists of a blade, a large sheath, ligule and two auricles
lemma bract-like sheath that subtends a grass flower
leptomorph one of two general types of rhizomes; characterized by a slender stem, long internode and indeterminate growth
lignification formation of polymer wall that gives strength to the culm
ligule membranous outgrowth on upper surface of culm sheath or leaf, at the junction of the sheath and blade; may be represented by a ridge or by a line of hair; elongated, flat, strap-shaped
linear long and narrow, with the sides nearly parallel
loam a soil composed of sand, slit and clay in such proportions that properties of the soil are not dominated by any one of them
lobe rounded protection form; example: the blade of a culm sheath or foliage leaf
lodicule one of two or three minute hyaline scales of the base of stamens of most grasses; perianth segment (tepal) with a scale-like structure

m

marcotting a method of vegetative propagation, also known as air layering which involves bending a one year old culm and applying rooting medium at nodes for development of new shoots from the buds
monocarpic plants that flower (and fruit) once in their life time and then die
monopodial form of branching in which lateral branches usually originate at some distance from the apex of the main axis. In bamboos, a primary axis which continues its original line of growth from the same apical meristem to produce successive lateral branches

n

native naturally occurring (not cultivated or introduced)
nodal line a prominent line below the nodal region
nodal region region that bears roots, buds and branches, between the nodal line and supernodal ridge
node the place on the stem where a leafy branch or bud arises, marked by prominent line

o

oblique slanted; with unequal sides
oblong much longer than broad, with nearly parallel sides
obovoid somewhat egg-shaped (the reverse of ovoid)
offset the rhizome along with the culm, used for vegetative propagation
orbicular more or less circular in outline or shape
ovoid oval in outline

p

pachymorph rhizome system characterized by a shortened, thick and fleshy stem, and many-branched clumps with closely packed culms
palea upper or inner of a pair of bracts that subtends the floret
panicle type of indeterminate branched inflorescence in which all the flowers are pedicellate (stalked) or borne by the secondary axis
parallel venation numerous veins (bundles of vascular tissue) run through the blade of the leaf, serving to bring water and to collect the products of photosynthesis; in some plants, the larger veins all run he length of the blade with smaller veins branching off and interconnecting them and is called parallel venation
perennial a plant that lives for a number of years

pericarp wall of fertilized ovary; sometimes differentiated into distinct layers such as exocarp, mesocarp and endocarp (outer, middle and inner carps)
persistent remaining attached even after the attainment of maturity, like the culm sheath in certain species of bamboos
pH a measure of the amount of lime (calcium) contained in the soil; pH value of 0 o 6.5 indicates acidic conditions, a pH value of 7.0 indicates neutral conditions and pH values greater than 7.0 indicate alkaline conditions
plumose covered with a fine, feather-like pubescence
powdery mass silicaceous material with powder-like appearance, for the protection of young culms
prophyll first leaf of a branch; a kind of sheath found at the first node of a branch or scale-like appendage
prophyllate bud a bud with a prophyll
pseudospikelet spikelet-like inflorescence; unlike a true a true spikelet, it has bracts at its base each of which bears a prophyllate bud
pubescent covered with hair
rachilla secondary axis, like the stalk of grass spikelets

r

rachis axis of a compound leaf upon which the leaflets are attached; central axis of an inflorescence
recurved bent or curved downward or backwards
reed medium sized plants with thin walled culms
reflexed abruptly bent backwards
reniform shaped like a kidney
rhizome neck constricted portion of the rhizome which links the thick portions
rhizome underground stem or the portion of a stem with nodes and internodes, bearing scales or leaves and usually rooting at the nodes

s

scabrous having surface that is rough to touch because of the presence of short stiff hair
scale leaf leaf-like sheathing organ for the protection of the rhizome
scandent climbing
serrate with a saw toothed edge or margin notched with tooth like projections
shoot young culm at any stage of its development
shrubby erect short forms, bushy in nature, are very thin and grow up to a limited height
sinous with a strongly wavy margin
species basic unit of classification of living things; consists of all individuals that are closely related such that they appear very similar and often interbreed to produce offspring
spike a simple indeterminate inflorescence with stalkless flowers along a young axis; the youngest are at its tip while the older ones are towards the base
spikelet a secondary spike
spinous having spines
stamen male pollen-bearing part of a flower, consisting of a filament and anther
sitgma terminal part of the gynnoecium which receives the pollen
straggling extremely divergent, spreading, very far apart
striate marked with long longitudinal parallel lines as grooves or ridges
style narrow prolongation of the ovary which terminates in a branched or unbranched stigma
subentire very slightly toothed or lobed, almost entire
suborbicular not very orbicular
subscandent semi-climbing
subtend extending under
subulate awl-shaped, tapering from the base to the apex
swollen enlarged, bloated
sympodial a clump- forming rhizome in which

each axis (rhizome) is dominant, and secondary axes (culms) develop from it

t

terminal at or produced from the tip of an axis
thorn sharp, hardened, modified branch arising from the nodes and branches of some woody bamboos
tomentose covered with dense, matted, wolly hair
toothed with notched projections along the margins
truncate a base or apex which ends abruptly, as though cut off

u

unarmed without thorns, spines or prickles
understorey an underlying layer of vegetation, especially the plants that grow beneath the canopy of a forest

v

velvety with a matt of soft hair, smooth
verticillate arrangement in whorls, arising at the same node

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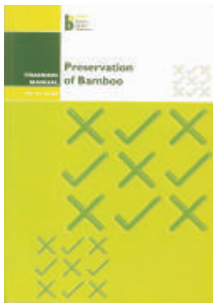

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