Hand Book on
BAMBOO

National Bamboo Mission
Under the Ministry of Agriculture, Government of India

Cane & Bamboo Technology Centre
Guwahati, Assam, India
Bamboo Technology Support Group for East & North-Eastern States
under The Ministry of Agriculture, Government of India
Bamboo is a natural resource available in India and particularly abundant in the North Eastern States of the Country. From time immemorial bamboo has been an integral part in life and culture of rural India in its multifarious usage besides being source of rural economy. As per the latest taxonomic descriptions, there are 18 genera and 128 species of bamboo in India. Out of these 87 species are naturally occurring and rest 41 are introduced to this country. India is the second highest bamboo producing country in the world next only to China. The National Bamboo Mission (NBM) under the Ministry of Agriculture, Government of India has recommended 13 (Thirteen) sympodial bamboo species belonging to seven genera which have immense importance in traditional as well as industrial applications. These bamboo species occur in different regions of the country with varying degree of abundance.

Identification of bamboo is a difficult task as regular flowering is few and far between. However, efforts have been made to ease out the identification process of the NBM recommended species by Cane and Bamboo Technology Center (CBTC) – the Bamboo technical Support Group (BTSG) based at Guwahati for the North Eastern States, Orissa, Bihar, Jharkhand and West Bengal after having worked on the subject to help the farmers and entrepreneurs in providing guidance based on morphological characters and also with color photographs of the species. A small booklet on the species named “Hand Book on Bamboo” for identification along with utility, Silviculture, Pest and disease control measures etc to assist in selecting suitable species for a particular region for commercial and other end use.

I acknowledge the contribution of CBTC team consisting of Shri. Kamesh Salam Shri. Zulu Pongen and Shri. S.K. Sarma in bringing out the booklet in a short period after field visits.
Bamboo is an excellent substitute for timbers. In India, particularly in backward countryside where road and communication are not developed, Bamboo plays a pivotal role in construction of houses, house hold implements, and the lots. With the non-availability of timbers from forests for various reasons and also for ban in felling trees by Honorable Supreme Court of India, the importance of bamboo in replacing timbers is gaining more and more grounds. India is the 2nd highest producer of bamboo in the world and 45% of total production of bamboo of the Country is being utilized in paper industries. The demand of paper industry and also of handicraft, bamboo mat ply, bamboo tiles, etc and lots of other items (of about 1500 documented use of bamboo) is increasing and India has vast international market potentials in the years to come. China and some South East Asian countries are now ruling the roost of the bamboo market at the moment.

Bamboo matured in 4-5 years whereas a tree of economic importance requires minimum 60 years to mature. Bamboo can be harvested annually after certain years continuously for about 30-40 years.

Bamboo is giving economic security and employment opportunity to unemployed people. Bamboo is ecologically very important plant, as it checks soil erosion and reclaims degraded lands. Bamboo shoots are also a nutrient food items in different forms and this plants have enumerable utilities in our day to day life.

The booklet named “Hand Book on Bamboos” is an endeavor to promote cultivation of suitable species of bamboo so that farmers and entrepreneurs are benefited. Identification of bamboos and there suitability to a particular locality is very important for successful cultivation. It would be an immense pleasure if the booklet serves the farmers/entrepreneurs while making use of it.

| Contents |
|--------------------------|------------------|------------------|------------------|------------------|
| Foreword | Preface | Preface |
| I | Identifying features for 13 species of bamboo recommended by NBM | 4 | Bambusa balcooa | 4 |
| | Bambusa bambos | 6 | Bambusa nutans | 8 |
| | Bambusa pallida | 10 | Bambusa tulda | 12 |
| | Melocanna baccifera | 14 | Dendrocalamus giganteus | 16 |
| | Dendrocalamus strictus | 20 | Dendrocalamus hamiltonii | 22 |
| | Oxytenanthera parvifolia | 28 | Ochlandra travancorica | 26 |
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| II | Glossary | 30 |
| III | Reference | 34 |
| IV | Annexure | I. Resource Utilization | 35 |
| | | 2. Some end uses of Bamboo | 36 |
| | | 3. Planting Scheme for different species of Bamboo under NBM Guideline | 44 |
| | | 4. Some Morphological Characters of Important Bamboo Species available in India for quick reference | - |
**Bambusa balcooa** Roxb.

**Local name**
Bhaluka (Arunachal Pradesh, Assam); Baruwa (Manipur); Wamnah/Beru (Meghalaya); Dhanu Bams/Bhalu Bans (Sikkim); Nagaland: Oti (Ao), Vuteya (Angami), Awuti (Sema), Awuhi (Lotha); Barak (Tripura).

**Habitat**
Occurs at altitude from mean sea level up to 600 m. Grows in any type of soil but prefers heavy textured soil with good drainage.

**Distribution**
It is an indigenous species of North Eastern India distributed in Nagaland, Meghalaya, Tripura, Assam, West Bengal and Bihar extending to Eastern Uttar Pradesh.

**Flowering and fruiting**
This species flower gregariously and clump dies without setting any seed. The flowering cycle is 35 to 45 years.

**Identification features**
- **Culm** 12-20m height and 8-15cm diameter, grayish green, thick walled, the diameter of the cavity about one-third of that of culm; node thicken with a whitish ring above, hairy brown; internodes 20-40cm long; branch from the lower nodes leafless and hard, mostly spreading, sometimes thorn-like; young shoots blackish green, green with yellow; brown or orange tinged culm sheath, clothed sparsely with dark brown hairs.
- **Culm sheaths** green when young, deciduous, tapering above and rounded at tip, adaxial surface with densely appressed dark brown hairs, margin ciliate; lower one much shorter and broader than the upper ones; blade 6-8 cm long, 5-7 cm broad, triangular, acute to acuminate, adaxial surface with dark brown pubescence, margin ciliate; ligules 5-8mm high, denticulate, membranous; auricle absent or very small, ciliate.
- **Leaves** 15-30cm long, 2.5-5cm broad, oblong lanceolate, glabrous above, pale and puberulous beneath, margins rough, apex pointed, sub cordate, or round at base with short petiole.

**Silvicultural management techniques**
The species is propagated vegetatively by branch cutting and culm cutting pretreated with growth promoting substance such as IBA or NAA or mixture of both. Cutting from 2-3 years old culms and basal part of the culm gave maximum rooting response (Seethalakshmi et al., 1983).

**Pest and diseases and their control**
This species is affected by bamboo blight caused by Sarocladium oryzae. Blight affect the culm in August, the disease progresses by November. The disease can be controlled by cultural practices such as removal of blighted culm, burning debris in situ, adding new soil around clumps before the onset of monsoon in April and application of fungicides, Indofil M-45 as a soil drench (Rahman, 1990).

**Uses**
The most common use for this bamboo is for structural applications. It is a highly preferred bamboo species for house construction, scaffolding, making ladders and props for small bridges. The shoots are edible in nature with sweet taste. It is also used for Aparbatti sticks and in bamboo wood chip industry. Large quantity of this bamboo species is also consumed in pulp and paper industries.
**Bambusa bambos** Voss

**Local name**
Katabah (Arunachal Pradesh); Kotoha/Kotabanh (Assam); Saneiba (Manipur); Kanday bans (Sikkim); Thorny bamboo (English)

**Habitat**
This species prefer sandy loam and fertile soil with tropical to sub tropical climatic condition up to 1200m altitude.

**Distribution**
This species is found throughout India up to 1200m altitude.

**Flowering and fruiting**
This species flower gregariously and clump dies after flowering. The flowering cycle is 30 – to 45 years.

**Identification features**
A very dense tufted bamboo, producing large dense clump of closely packed culms.

- **Culms** strong, cylindrical, erect, hollow, dark green-colored up to 30m tall, 15-18 cm diameter, the wall very thick with a lumen; branching at all node, those form the lower nodes recurved and bend downward towards the ground with the upper branches arching and producing a fan like plume, the upper leafy branches bearing small spines. Nodes slightly swollen and few lower nodes produce short aerial roots. Nodes contain a single branch bud at the ridged nodal line. Central dominant branch is produced first, with one or two lateral from the lower nodes, usually the primary and one secondary branch produced at the lower nodes of the culm often spine-like, usually three branches produce at the upper nodes, leafy, with some branches.

- **Culm sheaths** coriaceous, glabrous to pubescent with dark brown velvety hairs

- **Leaves** diffuse in complements, 15-30 cm long and 8-15 mm broad, with about 10 leaves in each complement. Leaf blades linear and variable in size, lanceolate, narrowed to an acuminate tip, with mid-vein inconspicuous on the abaxial side and prominent on adaxial side

**Silvicultural management techniques**

**Natural regeneration:** Natural regeneration occurs from seeds after gregarious flowering. Seeds have no dormancy and help to utilize the favorable condition after seed fall. Protection from grazing and fire is very much essential during the seedling stage for proper establishment.

**Artificial regeneration:** Seeds are collected by sweeping the ground under flowered clumps and cleaned by winnowing. Cleaning process can be minimized by spreading cloth or sheets under the flowered clump and collect the falling seeds directly. Seeds can be sown directly on nursery beds during March-May in patches and cover lightly with soil. If fresh seeds are sown 90 to 100 percent germination can be achieved. Partial shade is necessary for initial establishment of seedlings. The seedlings can be poly-potted after 45 days. There is a considerable increase in biomass when large sized containers are used (Chacko and Jayaraman, 1990).

Large scale production can be achieved through macro proliferation. Offset planting can be done during the onset of monsoon but this method is expensive for transportation and rhizome extraction as it is difficult. This species is also propagated through culm cutting and branch cuttings after treated with growth regulating hormone.

**Pest and diseases and their control**
Leaf blight, leaf spot, stem infection, damping off, rhizome bud rot, rhizome decay, culm rot, basal culm decay, leaf rust, sooty mould by differed pathogen have been reported in this species. These can be controlled by adopting appropriate silvicultural management practices such as thinning out diseased, infected and matured culm from the stand. Proper sanitation measures should also be adopted to control fungal attack.

Animals like Porcupines, rats, pigs, elephants, Squeals, hares, deer, goats etc also cause considerable damages in bamboo plantation. Therefore proper fencing and protection should be provided around the plantation site especially during the seedling stage.

**Uses**
This bamboo is utilized as raw material for paper, house construction, panel production and fencing. It is also used for scaffolding, handy craft, furniture, cooking utensils, etc. shoots is used as vegetable and leaves as fodder and medicine.
**Bambusa nutans Wall ex Munro**

**Local name**
Mokal/Mallo/Kali (Arunachal Pradesh); Deoban/Jatie makal (Assam); Utang (Manipur); Mal Bans (Sikkim); Rungazumi (Nagaland).

**Habitat**
This species is found between 600 to 1500 m altitudes. It requires well drained sandy loam to clay loam soil with tropical to sub tropical climate.

**Distribution**
This species is cultivated in North East, Orissa and West Bengal. Naturally occurs in Himalayan tracts west of Yamuna River.

**Flowering and fruiting**
Flowering type is both gregarious and sporadic in this species. Flowering cycle is reportedly gregariously after an interval of 35 years.

**Identification features**
Medium sized elegant bamboo.

**Culms** 6-15m tall, 5-10cm diameter, loosely clumped, much branched above, usually un branched below, straight, green, smooth, not shining, white ring below the node; node slightly thickened, often hairy, lower one bearing rootlets; inter nodes usually 25-45 cm long, thick walled.

**Culm-sheaths** 10-23 cm long, up to 30cm wide at base, with appressed scattered black hairs on the back, base with soft deciduous hairs, top truncate; auricles 2 at the top of the sheath, large wavy, unequal in size, with long bristle. Young shoot yellowish green at apex. Sheathes covered sparsely with dark-brown yellow hairs.

**Leaves** 15-25 cm long and 2-3.5 cm broad, linear-lanceolate, acuminate at apex, round and usually oblique at base, upper surface dull green, lower surface glaucous; petiole 3-5mm long, leaf-sheath hairy when young, striate; auricle falcate with few long hairs.

**Silvicultural management techniques**
Mass propagation can be done through culm cuttings, branch cuttings after treated with growth regulating hormone. Offset planting is also practices for small cultivation.

**Pest and diseases and their control**
Rhizome rot, culm rot, blight and leaf spot caused by *Ganoderma lucidum*, *Botryodiplodia theobromae*, *Sarocladium oryzae* and *Hendersonula toruloidea* respectively have been reported. High temperature and humidity are found favorable for infection. Bevastin (0.15%) combined with Dithane M-45 (0.3%) or Fytolan (0.3%) are found effective for controlling the blight. Attack by insect borer *Dinoderus sp.* and *Chlorothorax annularis* is reported.

**Uses**
It is use for house construction, paper mat and poles.
**Bambusa pallida Munro**

**Local name**
Bijil/Jowa (Arunachal Pradesh); Bijuli/Jowa/Makal (Assam); Tenang/Ushken (Meghalaya); Tenang (Sikkim); Teero/Watoi (Nagaland); Mizoram; Makal (Tripura).

**Habitat**
This species occurs in hills mainly between 700-2000 m altitudes. It requires well drained sandy loam with tropical climatic condition and even cultivated at temperate regions.

**Distribution**
It is distributed over North East India, Bhutan and Myanmar.

**Flowering and fruiting**
Sporadic flower is occurred in this species.

**Identification features**
A caespitose bamboo, growing in thick clumps

- **Culms**: 13-20m high, 5-8 cm diameter, smooth, olive green, covered with white powder; inter nodes 45-70cm long, wall thin.
- **Culm-sheath**: 18-30 cm long and 25 cm broad, slightly attenuate upwards and truncate at top. When young, blade often 35 cm long, triangular-acuminate from a broad base covered with appressed white hairs. Young shoots spear-shaped, smooth, sheath green with dark tinge.

**Propagation**
This species can be propagated by Rhizome, culm cuttings and seeds.

**Pest and diseases and their control**
Negligible damage by pest and disease

**Uses**
This species is used for house building, baskets, mats, toys, wall plates, screen and wall hangers.
**Bambusa tulda** Roxb

### Local name
Jati/Mirtinga/Wati (Arunachal Pradesh); Jati (Assam); Owati (Meghalaya); Koraincho bans (Sikkim); Longneii (Ao – Nagaland); Rawthing (Mizoram); Mirtinga (Tripura).

### Habitat
This species occurs at an altitude of 1500 m. It prefers moist alluvial soil in good rainfall areas and fine textured soil in semi evergreen forest, in relatively low rainfall areas with subtropical to temperate climatic conditions.

### Distribution
Distributed widely in North Eastern India and West Bengal

### Flowering and fruiting
This species flower gregariously. The flowering cycle is 30 – to 60 years

### Identification features
A large tufted bamboo

**Culm** up to 20 m high and 8 cm in diameter, smooth; internodes 40-70cm long

**Culm sheath** 20-25 cm long and broad, nearly glabrous, rounded at tip, black inside; blade 10-15 cm long, triangular, cuspidate, appressed hairy beneath, rounded at base; ligule 2 mm high, white hairy outside

**Leaves** 20-35 cm long and 3-4 cm broad, oblong-lanceolate, base oblique, petiole short; leaf-sheath glabrous or sparsely hairy, ligule short.

### Silvicultural management techniques
The seeds exhibit orthodox behavior and can be stored by proper control of moisture content and temperature. Studies on seed viability shows that under natural condition the seed are viable not more than two months but this can be extended by storing over anhydrous silica gel in desiccators up to 18 months.

Vegetative propagation like rhizome and culm cutting are successfully practiced for propagation of this species apart from seeds. The seedlings raised from culm cuttings can be successfully multiplied by shoot proliferation. As per felling rules, felling cycle four years is suggested. Culm less than one year should be retained and cuttings should be made 30 cm above the ground. A minimum of six culms should be left in a clump. This species is one of the high yielding bamboos suggested for large scale plantation.

### Pest and diseases and their control
The sap sucker Orega bumbusae which causes the wilting and death of young shoots have been reported. Bavistin, BHC powder or dieldrin or aldrin (0.5 percent solution or powder) are affective control. Fungal infection also affects the yield and quality of pulp. The species also affected by blight caused by Sarocladium oryzae. This can be controlled by cultural practice and application of Dithane M45 as soil drench.

### Uses
It is favored for handicraft, paper and structural purpose. It is a strong bamboo; it lends itself easily to mechanized processing, and is being used for making bamboo boards and composites.
**Bambusa vulgaris Var. Vulgaris Schrad ex Wendle**

**Local name**
Tela banh/Tantri banh (Assam); Lam-Saneibi/ Babal / Basni (Manipur); Bheriu (Meghalaya); Bakal (Beng.); Vairui (Mizoram); Jai (Tripura).

**Habitat**
Prefers moist soil and thrives at the periphery of cultivated land, creeks and foot-hills and requires tropical climate. It grows up to 1200 m and is frost tolerant.

**Distribution**
It is distributed in North East India and natural forest in central India. This is commonly grown in homesteads and garden as ornamental plant.

**Flowering**
It flowers sporadically.

**Identification features**
A moderate sized bamboo not densely tufted.

**Culms**
8-20 m high, 5-10 cm in diameter, bright green, glossy, erect, matured culm yellowish, walls 7-15 mm thick, branching usually form mid-culm to top; nodes prominent, lower ones often with a narrow ring of roots, usually covered with brown hairs; inter nodes up to 15 cm long. Young shoots dark brown to yellowish green.

**Culms-sheaths**
15-25 cm long and 25-35 cm broad, rounded and truncate at top, often beautifully streaked when young with green and yellow, straite, adaxial surface densely covered with thick appressed brown black hairs, edges ciliate; ligule 5-8 mm tall, continuous with the top of the sheath, dentate or sometimes entire, margin ciliate; auricle 2, sub equal, continuous with the blade; blade somewhat triangular, bright yellow, acute, 5-15 cm long and up to 10 cm broad, appressed-hairy with black hair on the adaxial surface, margins bristly.

**Leaves**
narrow or broadly lanceolate, 15-25 cm long and 2-4 cm broad rounded or attenuate at the base into a 5 mm long petiole, glabrous on surfaces, occasionally sparsely hairy when young; margin scabrous.

**Silvicultural management techniques**
This species is one of the fast growing bamboo species preferred for raising plantation in India.

**Pest and diseases and their control**
Blight by Sarocladium oryzae, basal culm rot by Fusarium sp, culm sheath rot by Glomerella cingulata, leaf rust by Dasturella divina, and leaf spot by Dactylaria sp. These can be controlled by removal of affected culm and application of fungicides.

**Uses**
This species is commonly used for pulp and paper industries, constructions, scaffoldings, fencing, handicrafts, shoots as vegetable etc.
**Dendrocalamus asper** Backer ex Heyne

**Local name**
Sweat Bamboo (English), Thaitama Bans (Sikkim).

**Habitat**
Prefers loamy to black soil and requires subtropical to tropical climate.

**Distribution**
It’s an exotic species cultivated in most of the north eastern states of India.

**Flowering and fruiting**
This species flower gregariously. The flowering cycle is 30-40 years.

**Identification features**
- **Culm** very tall, hollow, 20-30 m high, diameter up to 20 cm, young culm densely pubescent, matured culm very large and very strong and durable, thick walled, swollen nodes, upper internodes longer than the lower, internodes at culm base very short, lower nodes with many aerial roots.
- **Culm sheaths** caduceus in old, sheaths ligules narrow and wavy, sheath blade ovate-lanceolate.
- Leaves 5-9 on each twig, pseudo spikelets often in spherical dense clusters at the nodes of leafless branches.

**Silvicultural management techniques**
This species is propagated by cuttings and widely cultivated in tropical regions.

**Uses**
This species is mainly cultivated for edible shoot apart from this it is used for construction, paper and pulp, pole etc.
**Dendrocalamus giganteus** Munro

### Local name
Worra (Arunachal Pradesh); Bor Kako (Assam); Maribob (Manipur); Bhalu Bans (Sikkim); Warok (Ao-Nagaland); Rawnal (Mizoram).

### Habitat
This is a species of tropical and sub tropical climate and grown in loamy soil.

### Distribution
This species is native to Malaya and Myanmar, cultivated in India and frequently cultivated in North eastern state and west Bengal.

### Flowering and fruiting
So far gregarious flowering of this species have not been reported. Flowering cycle is 40 years (Seethalakshi and kumar 1988)

### Identification features
The largest of the bamboo, densely ceaspitose
- **Culm** over 30m tall, 15-25 cm in diameter, often naked at the base, branchy above, nodes hairy; internodes 37-40cm long, covered with white waxy scurf when young.
- **Culm Sheaths** As broad at the base as at the summit, 25-50 cm long, glabrous within, clothed with golden or brown hairs, 15-35cm long, often recurved, wavy auricles.
- **Leaves** large, broadly lanceolate, rounded at the base, 30-50cm x 1-1.1cm, cuspidate-accumulate, at first hairy, afterwards glabrous, sheaths striate, ligule long.

### Silvicultural management techniques
This species is propagated by rhizome/offsets planting, cuttings and also by seeds.

### Pest and diseases and their control
Damage caused by pest and disease pest has not been reported so far and it appears to be negligible.

### Uses
In north eastern India, the culms are widely used for house building, fencing, as container and various decorative items. In Arunachal Pradesh Mishmi tribe use this bamboo mainly as water container. It is also better raw material for paper and pulp. In Manipur several vegetable products are prepared from tender shoots.
Dendrocalamus hamiltonii Ness and Arn ex Munro

Local name
Kako/Hate (Arunachal Pradesh); Kako banh (Assam); Unap (Manipur); Aotsü (Ao-Nagaland); Choya Bans/Ban Bans/ Dhungray bans (Sikkim); Phulrua (Mizoram); Pecha (Tripura).

Habitat
Tropical and sub tropical climatic zone and prefers hill terrains.

Distribution
a) India, Bhutan, Nepal, Myanmar and Thialand.
b) West, Central and Eastern India in the lower hills from Simla eastward extending to the upper Myanmar up to 900 m msl.
c) Wild in lower hill of Assam and also occasionally cultivated in the plains.

Flowering and fruiting
This species usually flowers sporadically every year, some times gregariously and the flowering cycle is reported to be 30-40 years. This species flower gregariously in Assam in 1905, 1912, 1956, 1967-1969 and also 1981-1982 in different localities.

Identification features
A large bamboo, evergreen or deciduous, ceasptiose, densely clumped, some times growing tall and erect, but more often sending out its stems at an angle or curved downwards.

Culm: Large, 12-20m or up to 25m tall, 10-18.5cm diameter, usually naked below, much branched above. Internodes 30-50 cm long, wall 1.25cm thick, nodes marked with root scars.

Culm sheaths: Long and stiff, variable in size, those of lower part of large culm 35-45 cm long, about 20cm broad. Imperfect blade about ¾ the top of the sheath.

Leaves: Variable, small on side branches but on new shoots reaching 37.5cm broad rounded at the base into a short thick petiole; leaf sheath covered with white, appressed stiff hairs.

Silvicultural management techniques
This species can be propagated by rhizome/offset planting, cuttings and also from seeds.

Pest and diseases and their control
Serious incidences of damages by pest and diseases have not been observed.

Uses
This bamboo is one of the commonly used species in Assam and Nagaland. It is used in house building, construction, making of basket, mats, ropes, as container for water, milk and other eatable items. It is also used in paper and pulp industries in large quantity. Some people in North East prepare vegetable, some drinks, and sour pickle from tender shoots.
**Dendrocalamus strictus Ness**

**Local name**
Shal bann (Assam); Latthi bans (Sikkim); Tursing (Mizoram); Lath bans (Tripura); Karail (Bang.); Salia (Oriya); Male bamboo (English).

**Habitat**
It grows in dry and semi-dry zones along plains and hilly tracks.

**Distribution**
a) China, India, Indonesia, Java, Malaya, Myanmar, Nepal, Singapore and Thailand.
b) Widely distributed in arid and semi-arid zones of plains and central and south India and commonly cultivated throughout India in the plains and foot hills.
c) Occasionally cultivated in Assam and the culm become hollow.

**Flowering and fruiting**
Sporadic flowering have been reported in almost every year from different parts of India. Blatter (1930) recorded flowering years of this species from various parts of India and adjoining regions from the period 1865-1914. According to Troup (1921) flowering cycle for Garhwal outer Himalayan track is 20-30 years. Gregarious flowering cycle varies from 25-45 years.

**Identification features**
A deciduous, sub-arborescent, densely tufted bamboo
- **Culm** hollow in wet, solid in dry climates, 6-20m tall 2.5-7.5cm in diameter; nodes somewhat swollen, internodes 30-45cm long.
- **Culm sheaths**: Variable; 7.5-30cm long, covered on glabrous, striate, rounded at the top; imperfect blade, triangular hairs on both sides; ligules narrow.
- **Leaves**: Linear-lanceolate 2.5-25 X 0.5-3 cm, rounded at the base into a short petiole; sharply acuminate; twisted point, rough and hairy above, softly hair below; leaf-sheaths striate, hairy.

**Silvicultural management techniques**
This species can be propagated by seeds, cuttings, and also rhizome/offset planting.

**Pest and diseases and their control**
Disease like damping off, wilt, seedling stem infection, leaf blight, leaf rust are seen to attack this species. Application of Bavistin in combination with Fytolan is effective in controlling disease. Defoliator cause some damages but they are considered minor pest.

**Uses**
This is one of the most important bamboo species in India. It is found suitable for reclamation of ravine lands. In India it is extensively used for paper pulping and also for constructional purposes. It is used for Agricultural implementations musicals instruments, furniture etc. tender shoots are commonly used as food items. Decoction of leaves and nodes and siliceous matters is used in traditional medicines in India.
**Melocanna baccifera Kurz**

**Local name**
Muli/Tador dorp (Arunachal Pradesh); Tarai banh/Muli (Assam); Maubiwa (Manipur); Turiah (Nagaland); Mautak (Mizoram); Muli (Tripura).

**Habitat**
Well trained soil of lower hills and also plains of North East India.

**Distribution**
a) India, Myanmar, Bangladesh, cultivated in many Asian country.
b) Assam, Manipur, Meghalaya, Mizoram, Tripura, Sikkim, West Bengal.

**Flowering and fruiting**
It was reported to be flowering gregariously during the following years: 1863-1866, 1892-1893, 1900-1902, 1910-1912, 1933, and 1960. Sporadic flowering was reported in Cachar (Assam) and Manipur in 1967. Gregarious flowering in Mizoram was reported in 1960. Recent flowering in this state is seen in 2005. the flowering cycle period is according to Gamble Ca 30 years, according to Kurz 30-35 years and according to Troup 45 years. Culm and rhizome dies after flowering.

**Identification features**
Evergreen bamboo, arborescent, culm diffuse

*Culm* 10-20m high; 3-7 cm diameter; green when young and straw color when old; internodes 20-50cm long; wall thin 2-4mm; nodes slightly larger; branches arise from top 1/3rd of the culm; all equal and slender.

*Culm sheaths*: 10-15 cm long; 12-25 cm broad at the base, undulated above, yellowish green when young, yellowish brown when matured.

*Leaves*: 15-30 X 2.5-5cm long, lancelolate to oblong lanceolate, the apex acuminate with long scabrous, penicillate hairs, base rounded, often oblique.

**Silvicultural management techniques**
This species can be propagated by seeds which can be collected aplenty during gregarious flowering and also sporadic flowering. Propagation can be also done by rhizome planting.

**Pest and diseases and their control**
Pest and diseases have not been found very damaging. If there is some, it is negligible.

**Uses**
It is one of the principal species used in house buildings, weaving of baskets and other articles and superior pulp. Fruits are edible. Tabasin an ancient elixir can be isolated from the culm and branches. Prefabricated wall called ‘Tarja’ or ‘Chatai’ made from the split culms are used for roofing and walls of huts and temporary barricade etc.
**Ochlandra travancorica** Benth

**Local name**
Kar-etta (Mal.); Eeral/Eera-Kalli (Tamil); Elaphant grass English.

**Habitat**
It occurs widely as undergrowth in the low level evergreen and semi evergreen forests. This species prefers diffused light, requires a rainfall of more than 1500 mm and good drainage for proper growth. The soil under this species is generally dark brown, acidic, sandy loam with granular structure, high porosity, good aggregate stability and with high water holding capacity.

**Distribution**
Throughout Western Ghats and is more abundant in South Kerala. Flowering cycle reported by Gamble is 7 years, but field observations do not agree with this reported flowering dates are 1868, 1875, 1882 and 1907. Gregarious flowering is reported in Kerala during 1976. Recent flowering are during 1988, 1992, 1993 from southern parts and Western Ghats. Fruits is large in size, about 45-57 fruits weigh one kilogram and weight of individual fruit varied from 17.5-22.2 gm.

**Identification features**
Erect, shrubby or arborescent, reed like gregarious bamboo

**Culm:** 2-6m high, grayish-green, rough, 2.5-5cm diameter, nodes some what swollen and marked with base of fallen sheath; internodes usually 45-50 cm long, sometimes even 1.5 m long, wall very thin 2.5mm.

**Culm sheaths:** 15-20 cm long, thin, longitudinally wrinkled, striate.

**Leaves:** Broadly oblong-lanceolate 9-3 cm long and 5-12 cm broad, often obliquely rounded at the base into a thick, broad, some what concave, 0.7-1.0 cm long petiole.

**Silvicultural management techniques**
Natural regeneration occurs from seeds and rhizomes. Soon after seeds fall, they germinate and within a period of 5-8 years, develop into full clumps which last for a period of 25 years. The sprouting season is usually after pre monsoon shower and during rainy season.

**Pest and diseases and their control**
Witches brooms disease has been reported widespread in the natural reeds growing areas. The fungus *Balansia linearis* has been associated with this disease. Leaf spots have been recorded; Sooty mould disease has also been reported. Main insect associated with damage of stored culms and products are termites and some beetles.

**Uses**
An ideal raw material for paper manufacture, Culms are also used for mat and basket making, umbrella handles, fishing rods, handicraft and making walls of huts. The mates made from reeds are used for making bamboo ply.
Oxytenanthera parvifolia Brandis ex Gambel

Local name
Hill Jati (Assam).

Habitat
Large sized, evergreen, caespitose bamboo growing in hill areas.

Distribution
a) India, Myanmar  
b) Assam, Mizoram  
c) Cachar and north Cachar hill district of Assam

Flowering and fruiting

Identification features
Culms up to 20 m high and 8 cm in diameter, dark green, nodes slightly prominent, internodes 20-45 cm long, walls up to 1.2 cm thick.
Culms sheaths 20-23 cm long, 20-25 cm broad at base truncate, striate rounded at top, outer surface with appressed brown hairs, inner surface glabrous, base rounded, ligule broad dentate, imperfect blade 5-7.6 cm long, 2.5 cm broad.
Leaves 7-23 cm X 1.5-2 cm, linear lanceolate, base rounded, leaf sheath hairy when young, glabrous on maturity.

Silvicultural management techniques
So far cultivated from rhizome only

Pest and diseases and their control
Negligible damage by pest and disease

Uses
Local Dimasa, Kuki and other Hill tribes use this bamboo for construction their huts and also for making baskets, mats etc.
## Glossary

### A
- **abaxial**: the side facing away from the axis of the plant; syn. dorsal, opp. ventral
- **abjoint**: to separate at a joint
- **acuminate**: having a long, slender, sharp point with concave sides; margins straight to convex
- **acute**: sharp-pointed, margins straight to convex; adaxial; adaxial surface: the sides towards the axis; the surface of a leaf that faces the stem during development, eg. the upper side of the leaf; apical
- **aggregate**: clustered together to form a dense mass or head, usually applied to an inflorescence
- **alluvial soil**: a type of azonal soil which is highly variable and is classified by texture from fine clay/silt soils through gravel and boulder deposits
- **apex, apices**: the tip, the terminal end
- **appressed**: closely and flatly pressed against the entire length of an organ or part
- **arborescent**: of tree-like habit; resembling a tree in growth or appearance
- **attenuate**: with a long, slender taper, more gradual than acuminate; applied to base or apices of parts; gradually tapering
- **auricle**: an ear-like lobe
- **axial**: of or pertaining to an axis, especially main axis
- **axis, pl. axes**: the main stem of a plant; the main or central line of development of any plant or organ
- **BHC**: benzene hexachloride
- **blight**: a plant disease where there is a sudden wilting or death of plant parts
- **bristle**: a stiff strong trichome (hairs)

### B
- **caespitose**: see caespitose; caespitose: matted, growing in tufts or small dense clumps; plants forming a cushion
- **ciliate**: fringed with conspicuous hairs along the margins
- **cordate**: heart-shaped, having notched end at the base and the pointed end at the apex
- **coriaceous**: thick, tough and leathery
- **cusp**: the stem of a grass or sedge
- **culm**: the sheath of the culm leaf; borne singly at each node of the culm proper, below the level at which the sheath of foliage leaves originate
- **culm sheath**: with an apex somewhat abruptly and sharply constricted into an elongated, sharp-pointed tip or cusp
- **cutting**: a vegetative portion removed (cut) from a plant for the purpose of propagation

### C
- **damping off**: a fungal disease of seedlings which causes them to rot and shrivel at soil level, or to die before they emerge from the soil
- **deciduous**: the falling of parts at the end of a growing period
- **dentate**: with toothed margin
- **denticulate**: minutely toothed, finely dentate
- **determinate**: growth of limited duration
- **dieback**: a progressive death of plant shoots beginning at the tip
- **diffuse**: the loosely branching or spreading; widely spread
- **dorsal**: the lower or undersurface of a leaf; abaxial

### D
- **entire**: without indentations or incisions on the margins; smooth
- **erect**: directed towards summit, not decumbent

### E
- **falcate**: sickle-shaped

### F
- **glaucous**: covered with a removable waxy coating which gives the surface a whitish or bluish green cast
- **gregarious**: growing in groups or colonies; in bamboos, gregarious flowering is used to indicate that a whole population flowers over a period of time

### G
- **habit**: the general appearance or characteristic form of a plant, or other organisational erect, prostrate, climbing etc
- **habitat**: the natural environment of an organism; the place where it is usually found

### I
- **IBA**: indole butyric acid
- **internode**: the portion of the stem between two successive nodes
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>lanceolate</td>
<td>much longer than broad; widened above the base and tapering towards the apex</td>
</tr>
<tr>
<td>leaf sheath</td>
<td>the basal portion of a leaf blade or petiole that more or less completely surrounds the stem</td>
</tr>
<tr>
<td>ligule</td>
<td>a membranous outgrowth on the upper surface of a grass leaf at the junction of the sheath and the blade. It may be presented by a ridge or by a line of hairs; an elongated flattened strap shaped structure</td>
</tr>
<tr>
<td>linear</td>
<td>long and narrow with sides parallel</td>
</tr>
<tr>
<td>NAA</td>
<td>naphthalene acetic acid</td>
</tr>
<tr>
<td>oblique</td>
<td>slanted; with unequal sides</td>
</tr>
<tr>
<td>oblong</td>
<td>much longer than broad with nearly parallel sides</td>
</tr>
<tr>
<td>offset</td>
<td>a short, lateral shoot or branch which develops from the main stem producing a means of vegetative propagation</td>
</tr>
<tr>
<td>ovate</td>
<td>egg-shaped in outline, with the axis widest below the middle</td>
</tr>
<tr>
<td>penicillate</td>
<td>ending in a tuft of fine hairs or branches</td>
</tr>
<tr>
<td>petiole</td>
<td>the stock of a leaf</td>
</tr>
<tr>
<td>pruinose</td>
<td>having a heavy waxy bloom on the surface</td>
</tr>
<tr>
<td>pubescence</td>
<td>covered with short, soft trichomes</td>
</tr>
<tr>
<td>pubescent</td>
<td>the soft fleshy part of the fruit; mechanically ground or chemically digested wood used in manufacturing paper and allied products</td>
</tr>
<tr>
<td>recurved</td>
<td>bent or curved downward or backward</td>
</tr>
<tr>
<td>rhizome</td>
<td>an underground stem which is distinguished from a root by the presence of nodes, buds and leaves or scales</td>
</tr>
<tr>
<td>scabrous</td>
<td>having a surface that is rough to touch, because of the presence of short stiff hairs</td>
</tr>
<tr>
<td>scale</td>
<td>any thin, usually small and dry, scarious to coriaceous bract</td>
</tr>
<tr>
<td>sparsely</td>
<td>scattered</td>
</tr>
<tr>
<td>sporadic</td>
<td>widely dispersed or scattered; irregular in time, flowering at irregular intervals</td>
</tr>
<tr>
<td>striate</td>
<td>marked with fine longitudinal parallel lines, as grooves or ridges</td>
</tr>
<tr>
<td>terminal</td>
<td>found at the tip, apex or distal end</td>
</tr>
<tr>
<td>tomentose</td>
<td>covered with dense, matted, woolly hairs</td>
</tr>
<tr>
<td>truncate</td>
<td>a base or apex which ends abruptly almost right angles to the main axis</td>
</tr>
<tr>
<td>tufted</td>
<td>in clumps; clustered, cespitose</td>
</tr>
<tr>
<td>undulate</td>
<td>a margin wavy (up and down) in the vertical plane</td>
</tr>
<tr>
<td>vein</td>
<td>a strand of vascular tissue in the organs like leaf or petals</td>
</tr>
<tr>
<td>velvety</td>
<td>with a matting of the soft hairs; the same as tomentose but dense so that the surface feels very smooth</td>
</tr>
<tr>
<td>ventral</td>
<td>facing central axis</td>
</tr>
</tbody>
</table>
Reference


Bhuyan L K, R K Taju, G N Sinha, G Murtem and J Dopum, Commercially Important Bamboo Species of Arunachal Pradesh, SFRI Information Bulletin No. 20, State Forest Research Institute, Department of Environment and Forest, Government of Arunachal Pradesh, Itanagar - 791111


Hand book on Bamboo

Competitiveness: Resource Utilisation of Bamboo
Some End use of bamboo

Annexure - II

Bamboo Handicraft Items

Hand book on Bamboo

Hand book on Bamboo
Bamboo Housing

Hand book on Bamboo

Engineered Bamboo Products

Hand book on Bamboo

Bamboo Housing
Bamboo Charcoal

Bamboo raw charcoal
Bamboo briquette charcoal
Bamboo round charcoal
Bamboo powder charcoal
Bamboo particle charcoal
Bamboo powder charcoal

Bamboo Rhizome artefacts
### Annexure - IV

**Some Morphological Characters of Important Bamboo Species available in India for quick reference**

<table>
<thead>
<tr>
<th>Species</th>
<th>Canopy Formation</th>
<th>Height of Canopy (m)</th>
<th>Number of Canes</th>
<th>Nodes</th>
<th>Nodes/unit length</th>
<th>Length of Internodes (cm)</th>
<th>Bending Angle (°)</th>
<th>Color of Canes</th>
<th>Color of Internodes</th>
<th>Hardness Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bambusa balcooa</td>
<td>Tall branching, forked</td>
<td>9-12</td>
<td>7-8</td>
<td>6</td>
<td>6</td>
<td>20-40</td>
<td>45</td>
<td>Green</td>
<td>Green</td>
<td>Hard</td>
</tr>
<tr>
<td>Bambusa bambos</td>
<td>Tall branching, forked</td>
<td>9-12</td>
<td>7-8</td>
<td>6</td>
<td>6</td>
<td>20-40</td>
<td>45</td>
<td>Green</td>
<td>Green</td>
<td>Hard</td>
</tr>
<tr>
<td>Bambusa nutans</td>
<td>Tall branching, forked</td>
<td>9-12</td>
<td>7-8</td>
<td>6</td>
<td>6</td>
<td>20-40</td>
<td>45</td>
<td>Green</td>
<td>Green</td>
<td>Hard</td>
</tr>
<tr>
<td>Bambusa pallida</td>
<td>Tall branching, forked</td>
<td>9-12</td>
<td>7-8</td>
<td>6</td>
<td>6</td>
<td>20-40</td>
<td>45</td>
<td>Green</td>
<td>Green</td>
<td>Hard</td>
</tr>
<tr>
<td>Bambusa tulda</td>
<td>Tall branching, forked</td>
<td>9-12</td>
<td>7-8</td>
<td>6</td>
<td>6</td>
<td>20-40</td>
<td>45</td>
<td>Green</td>
<td>Green</td>
<td>Hard</td>
</tr>
<tr>
<td>Bambusa vulgaris</td>
<td>Tall branching, forked</td>
<td>9-12</td>
<td>7-8</td>
<td>6</td>
<td>6</td>
<td>20-40</td>
<td>45</td>
<td>Green</td>
<td>Green</td>
<td>Hard</td>
</tr>
<tr>
<td>Dendrocalamus asper</td>
<td>Tall branching, forked</td>
<td>9-12</td>
<td>7-8</td>
<td>6</td>
<td>6</td>
<td>20-40</td>
<td>45</td>
<td>Green</td>
<td>Green</td>
<td>Hard</td>
</tr>
<tr>
<td>Dendrocalamus giganteus</td>
<td>Tall branching, forked</td>
<td>9-12</td>
<td>7-8</td>
<td>6</td>
<td>6</td>
<td>20-40</td>
<td>45</td>
<td>Green</td>
<td>Green</td>
<td>Hard</td>
</tr>
<tr>
<td>Dendrocalamus hamiltonii</td>
<td>Tall branching, forked</td>
<td>9-12</td>
<td>7-8</td>
<td>6</td>
<td>6</td>
<td>20-40</td>
<td>45</td>
<td>Green</td>
<td>Green</td>
<td>Hard</td>
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<tr>
<td>Dendrocalamus strictus</td>
<td>Tall branching, forked</td>
<td>9-12</td>
<td>7-8</td>
<td>6</td>
<td>6</td>
<td>20-40</td>
<td>45</td>
<td>Green</td>
<td>Green</td>
<td>Hard</td>
</tr>
<tr>
<td>Melocanna baccifera</td>
<td>Tall branching, forked</td>
<td>9-12</td>
<td>7-8</td>
<td>6</td>
<td>6</td>
<td>20-40</td>
<td>45</td>
<td>Green</td>
<td>Green</td>
<td>Hard</td>
</tr>
<tr>
<td>Ochlandra travancorica</td>
<td>Tall branching, forked</td>
<td>9-12</td>
<td>7-8</td>
<td>6</td>
<td>6</td>
<td>20-40</td>
<td>45</td>
<td>Green</td>
<td>Green</td>
<td>Hard</td>
</tr>
<tr>
<td>Oxytenanthera parvifolia</td>
<td>Tall branching, forked</td>
<td>9-12</td>
<td>7-8</td>
<td>6</td>
<td>6</td>
<td>20-40</td>
<td>45</td>
<td>Green</td>
<td>Green</td>
<td>Hard</td>
</tr>
</tbody>
</table>

**Handbook on Bamboo**