SFRI Information Bulletin No. 15

# Field Manual for Propagation & Plantation of canes in Arunachal Pradesh

K. Haridasan, Anupam Sarmah, S.N. Hegde & L.R. Bhuyan

STATE FOREST RESEARCH INSTITUTE
Department of Environment & Forests
Government of Arunachal Pradesh
Itanagar - 791 111

This manual is produced under UNDP - DC ( H ) Cane & Bamboo Project

# Stages in Nursery technique

Fruit

Seeds after removing outer cover

Mother bed preparation

Sowing

Seedling in mother bed ready to transplant

Seedlings pricked out to poly bags

Seedlings in green house

Seedlings in nursery bed

Seedlings ready for field planting

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K. Haridasan, Anupam Sarmah, S. N. Hegde,
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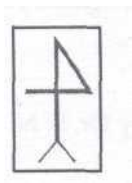
2002



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*SFRI, Information Bulletin No. 15*
Year of publication 2002

Published by the
Director
State Forest Research Institute
Van Vihar, P. B. No. 159
Itanagar - 791 111

Email: directorsfri@hotmail.com

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**COVER PHOTO**

Cane in natural habitat, (Inset - Cane fruits), In watermark - *Calamus inennis*- an unique cane of Arunachal Pradesh.

**Printed at**
**Peregrine Graphics, Bank Tinali, Itanagar - 791 111,**
**Arunachal Pradesh, Phone # 0360-2216612**

# FOREWORD

Rattans or Canes are climbing palms that have gained recognition as a valuable Non-Timber Forest Produce (NTFP). They find extensive use in furniture making, sports goods, handicraft items besides domestic use by local tribals. This group occurs in the tropical forests of the world particularly in the southeast Asian countries, China and the Indian Sub-continent. India has about 60 species belonging to 5 genera out of which the North-East region has 4 genera and 25 species. Arunachal Pradesh alone has 4 genera and 18 species distributed in its tropical and subtropical forests.

Their availability in wild from forests have become scarce due to over exploitation over the years and now there is a need to grow them in plantation to meet various demands. Government of India in association with State Government is now promoting the plantations of canes through various schemes to augment the supplies. Arunachal Pradesh has suitable agroclimatic conditions and enough land available for taking up commercial plantation of canes. There is an urgent need to disseminate information about cultivation techniques of canes so that their plantations could be raised successfully. Towards that end, the State Forest Research Institute, Itanagar has been carrying out research and field trials on cane development for over a decade and standardised the cultivation practice of Cane. The present bulletin brought out by the Institute on the subject is therefore a welcome step in this direction.

I am sure this manual will be helpful to all those interested in growing Canes.

Date : 26-12-2002,
Place : Itanagar

**S. R. Mehta**
Principal Secretary & Principal
Chief Conservator of Forests,
Department of Environment & Forests
Government of Arunachal Pradesh.

# PREFACE

Canes are important non-timber forest produce that has been the source of valuable revenue to the hilly states like Arunachal Pradesh. This state incidentally has one of the largest diversity of canes and occupies the prime position in the region. In fact this is the only state where cane still exists in desired levels of population till recently. There are 18 species belonging to 4 genera here, compared to the 5 genera and 60 species in India. With the increase in demand for cane resource there has been excessive exploitation leading to depletion in natural habitats. There has not been any serious effort to restock the forest of this precious resource. It is now increasingly felt that sustainable utilization may warrant adequate attention paid to raising plantations. This alone can meet the needs of the furniture and handicraft industry that look forward to canes from the region.

Plantation of cane is not an usual phenomenon in the forestry of this region. Thus there is not much information available to foresters to raise successful plantations. Information on nursery techniques and plantation techniques are, though available elsewhere in the country, it is not accessible to the foresters and farmers of the region in general and Arunachal Pradesh in particular. To provide the much needed information in a user friendly way to the people engaged in the propagation and farming of canes this bulletin is presented here with a hope, that it will receive good response.

The preparation of this publication is largely based on the research of the authors who have also taken the liberty to consult some of the most relevant publications in the field as cited in the reference. Those who are desirous of getting more details can refer to those publications.

We take this opportunity to thank the Development Commissioner (Handicrafts), Ministry of Textiles, Government of India, New Delhi for the fund support for the production of this manual under a UNDP supported project. Many of our field officers and their staff have extended help and shared their views which is acknowledged here. The support for production of this publication from Shri V. K. Jawal, DFO, Silviculture is specially acknowledged.

We do hope this publication would help promote cultivation and conservation of canes in this state, in addition to helping our field staff and those cane lovers in their plantation efforts. We welcome any suggestions for further improvement of the manual.

Authors

# CONTENTS


# INTRODUCTION

Rattans (the prickly palms more commonly referred to as cane) are one of the most important non-timber forest produces found in the tropical countries of South East Asia, Africa and America. India has a good representation of rattans with their concentration mainly in Western Ghats, Andaman and Northeast India. Out of 5 genera and 60 species found in India, northeastern states alone accounts for 4 genera and more than 25 species. Most of these species grow in the tropical low hills where precipitation is high and the soil reaction is slightly acidic. However some species like *Calamus acanthospathus* and *Plectocomia himalayana* have their distribution extended up to 1800 m. They generally prefer moist humid climate and are found to grow mainly as under growth in primary forests.

Apart from their traditional uses a huge quantum of rattans are also used as raw material in furniture industry. Arunachal Pradesh is a major source of supply of raw materials required for the Indian furniture industry.

The main commercially important species used in handicraft and furniture industries are : *Calamus flagellum, C. acanthospathus, C. latifolius, C. gracilis,* C. *leptospadix, C. tenuis* and *Daemonorops jenkinsiana.* Other cane species like C. *nambariensis, C. inermis, C. khasianus, Plectocomia himalayana* are also good for furniture. However, due to large scale exploitation and habitat destruction these have become comparatively scarce.

## CLASSES OF CANES:

Diameter of the stem is one of the important physical parameters for assessing the utilization potential and grading of canes. Northeast Indian canes can be divided into three classes on the basis of this character. These are:

1. **Large diameter canes** (diameter above 4 cm) : *Plectocomia assamica, P. bractealis* and *P. khasianus* come under this class. They are used in the construction of suspension bridge and for making ropes.
2. **Medium diameter canes** (diameter between 2-4 cm): Canes of this group are much used in handicraft and furniture industries for making frame and also as walking sticks. *Calamus flagellum, C. inermis, C. latifolius, C. 1. nambariensis, C. acanthospathus, C. khasianus, C. erectus, Plectocomia*

*himalayana, Daemonorops jenkinsianus, Daemonorops* sp. are included in this class.

3. **Small diameter canes** (diameter less than 2 cm) : *Calamus gracilis, C. leptospadix, C. tenuis, C. guruba,* C. *arunachalensis, C. floribundus* are grouped in this category. They are used for tying purpose and to decor handicraft produce.

**DISTRIBUTION:**

The region has nearly 25 species naturally growing in wild habitats. Each state has different number of species of Rattans, the highest being in Arunachal Pradesh followed by Assam. The distribution of rattan in different states of the region are given in **table 1.** In Arunachal Pradesh each district has different composition of canes. District wise distribution of the rattan species in Arunachal Pradesh is given in **table 2** below.

**Table 1: The distribution of Canes in North east India.**

| S/N | Name of species | Assam | Arunachal Pradesh | Nagaland | Manipur | Meghalaya | Mizoram | Tripura | Sikkim |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Calamus leptospadix | + | + | + | + | + | + | + | + |
| 2. | C. tenuis | + | + | + | + | + | + | + | + |
| 3. | C. inermis | | + | | | | | | + |
| 4. | C. latifolius | + | + | + | | + | | + | + |
| 5. | C. latifolius var. mormoratus | | | | | | | | + |
| 6. | C. nambariensis | + | + | | | | | | |
| 7. | C. khasianus | + | + | + | + | + | + | | |
| 8. | C. gracilis | + | + | | | + | | | |
| 9. | C. flagellum | + | + | + | + | + | + | + | + |
| 10. | C. erectus | + | + | + | + | + | + | | |
| 11. | C. floribundus | + | + | + | + | + | | | |
| 12. | C. floribunds var. depauperatus | | | | | + + | | | |
| 13. | C. acanthospathus | + | + | | + | + | + | | + |
| 14. | C. guruba | + | | | | + | + | | |
| 15. | C.kingianus | + | | | | + | | | |
| 16. | C. mastersianus | + | | | | | | | |
| 17. | C.viminalis | | | | | | | | + |
| 18. | C. arunachalensis | + | + | | | | | | |
| 19. | Daemonorops - jenkinsianus | | + | + | | | | | |
| 20. | Plectocoma himalayana | + | + | | | | | | |
| 21. | P. assamica | + | + | | | | | | |
| 22. | P. bractealis | + | + | | | | | | |
| 23. | P. khasianus | | | | | + | | | |
| 24. | Zalacca secunda | + | + | | | | | | |

**Table 2: District wise distribution of canes in Arunachal Pradesh.**

| Sl. No. | Name of the species | Tirap | Changlang | Lohit | D Valley | U Siang | E Siang | W Siang | L Subansiri | L Subansiri | U Subansiri | Papum Pare | W Kameng | E Kameng |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | C. acanthospathus | - | + | - | - | + | + | P | + | - | - | - | - | - |
| 2 | C. arunachalensis | + | | | | | + | | | | | | | |
| 3 | C. leptospadix | + | + | + | + | - | - | - | + | - | + | - | + | |
| 4 | C. tenuis | - | - | - | - | - | + | - | - | - | - | - | - | |
| 5 | C. floribundus | + | + | - | - | - | - | - | + | - | + | - | - | |
| 6 | C. flagellum | - | - | + | + | + | + | + | + | - | + | + | + | |
| 7 | C. erectus | - | - | - | - | - | - | - | + | - | + | + | + | |
| 8 | C. gracilis | - | - | - | - | - | - | - | + | - | + | + | + | |
| 9 | C. inermis | - | + | - | - | + | + | + | - | + | - | - | - | |
| 10 | C. nambariensis | + | + | + | - | - | - | - | - | - | + | - | - | |
| 11 | C. latifolius | - | - | - | - | + | + | + | + | + | - | - | - | |
| 12 | C. khasianus | - | - | - | - | - | - | - | + | + | - | - | - | |
| 13 | C. sps | - | + | - | - | + | + | + | - | - | - | - | - | |
| 14 | Damonorops jenkinsianus | - | - | - | - | - | - | - | - | - | - | - | + | |
| 15 | Plectocomia assamica | - | - | - | P | - | + | + | + | + | + | + | + | |
| 16 | P. bractealis | - | + | - | - | - | - | - | - | - | - | + | - | |
| 17 | P. himalayana | - | - | - | - | + | + | + | + | - | - | + | - | |
| 18 | Zalacca secunda | | + | + | + | - | - | + | - | - | - | - | - | - |

(Kurung Kumey district is treated under L. Subansiri district. Tawang district excluded)

**Areas of cane concentration** :

Extended over all the districts, there are important areas of cane concentration in the state. Some of these pockets from West Arunachal Pradesh to East Arunachal Pradesh are: Doimara (Foothill) and Tippi-Sessa in West Kameng, Seijusa-Khari in East Kameng, Chessa-Hollongi-Itanagar, Doimukh & Sagalee in Papum Pare, Ziro-Raga (30 km) in Lower Subansiri, Mori-Mugli, Taliha in Upper Subansiri, Tirbin-Basar in West Siang, Migging, Yingkiong-Ramsing in Upper Siang, Likabali, Gensi, Sibe, Kaying-Tato in West Siang, Dambuk in East Siang, Namsai, Wakro in Lohit district, Namdapha in Changlang district, etc. These areas are known not only for abundance but also for species diversity.

Out of the 18 species, about l0 species are widely used in Industry. Their proper identification is essential to decide the choice of species to be planted. To facilitate their recognition brief description of some selected species is provided below giving their salient characters, their flowering and fruiting time and uses.

**Description**:

1. *Calamus acanthospathus* Griff. Vern. Name Jati, Tassar, Esong (Adi).

A cluster forming robust climber of varying thickness of 3-5 cm with sheath and 1.5 - 2 cm without sheath. Knee quite prominent. Leaves are without cirrus 1-1.5 m long. Leaflets regular alternate, 6-8 nerved. Terminal leaflets often fused at base. Inflorescence flagelliform. **Fruits ovoid 2.5 - 1.5** cm, **Orange in colour.**

**Flowering and fruiting** : May - November.

**Use** : This is very useful cane for furniture. It is also good for making baskets etc.

*Calamusjiagellum* Griff. Vern. Raidang (Assam), Ramang (Adi), Thou (Nishi)

A thicket forming cane. Stem thick. Thickness of cane with leaf sheath 3-5 cm and without 2-3 cm diameter. Densely sharp black

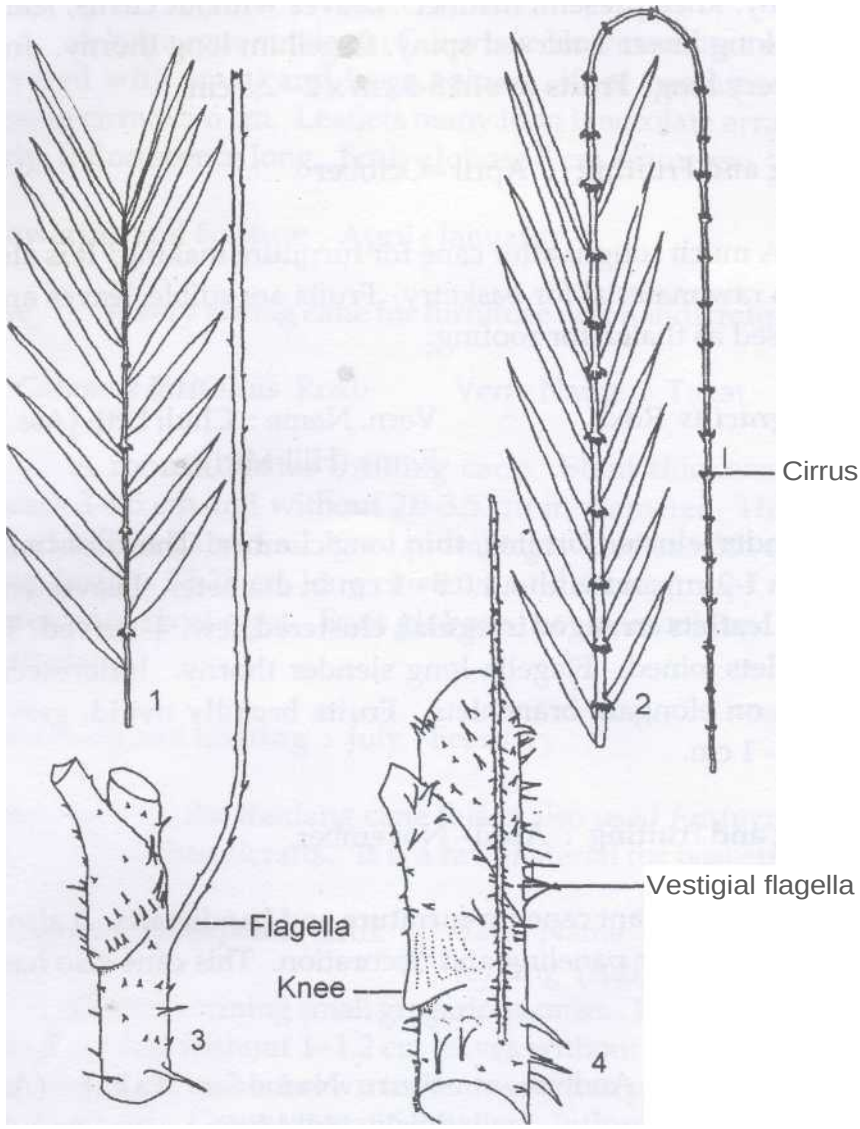


Fig 1. Stages of canes

(1) Ecirrate leaf (2) A leaf with cirrus (3) A portion of steamwith flageiia
(4) A portion of stem with vestigial flageiia and Knee

. spiny, knee present, distinct. Leaves without cirrus, leaflets alternate, long linear 1 nerved spiny, flagellum long thorny. Inflorescence very long. **Fruits ovoid 3-5 cm x 2 - 2.5 cm.**

**Flowering and Fruiting** : April - October

**Use** : A much sought after cane for furniture making. It is also a raw material for basketry. Fruits are edible, leaves are used as thatch for roofing.

3. *Calamus gracilis* Roxb. Vern. Name : Chuli beth (Ass.), Reme (Hill Miri).

Slender, cluster forming, **thin** long climber. Thickness with leaf sheath 1-2 cm and without 0.5-1 cm in diameter. Leaves without cirrus, **leaflets arranged irregular, clustered,** few. 4- nerved. Terminal leaflets joined. Flagella long slender thorny. Inflorescence distichous on elongate branchlets. **Fruits broadly ovoid,** greyish brown 1.5-1 cm.

**Flowering and fruiting** : April - November.

**Use** : A very important cane for furniture and handicrafts. It also employed for paneling and decoration. This cane also has edible fruits.

4. *Calamus inermis* T. Anders. Vern. Name : Takat (Adi, Nishi, Hill Miri).

Apparently non-clump forming (few stemmed) robust climbing canes. Stem large 4-6 cm with sheath and 2.5-4.5 cm without sheath. In stem there are no thorns**.** Knee with very prominent wrinkles at base. Leaves cirrate leaf with cirrus 5-6 m. leaflets arranged in pairs margins and rachis thorny. Inflorescence very long. Fruits 2-4 x 1.5 cm **ellipsoid.**

**Flowering and fruiting** - January - October

**Use** : Like other Raidang used for furniture.

5. *Calamus khasianus* Becc. Vern. Name : Takat.

A large cane similar to C. *inermis.* However stem **sparingly covered** with **small and large spines.** Knee prominent, smooth. Leaves cirrate 5-6 cm. Leaflets many long lanceolate arranged regularly. Inflorescence long. **Fruit globose** 3 cm diameter.

**Flowering and** fruiting: April - January.

**Use** : A very strong cane for furniture and handicrafts.

6. *Calamus latifolius* Roxb. Vern. Name : Takat

A robust cluster forming cane. Stem thickness with leaf sheath 3-4.5 cm and without 2.5-3.5 cm in diameter. Thick swollen based **reflexed thorns.** Knee prominent. Leaves with cirrus 2-4 m long, leaflets 55-75 cm long clustered at distant groups. Female inflorescence short erect. Fruit **globose** brown in colour 1-1.5 cm in diameter.

**Flowering and fruiting** : July - February.

**Use** : Like Raidang cane this is also used for furniture and handicrafts. It is a raw material for basketry etc.

*7.* *Calamus leptospadix* Griff. Vern. Name : Lejai (Ass.), Jeyying (Adi).

Cluster forming small gregarious canes. Thickness with sheath 1.2-2 cm and without 1-1.2 cm leaves without cirrus, flagella slender long. **Leaf rachis brown tomentose when young.** Leaflets regular 25-40 cm. Comparatively smaller. Inflorescence slender long drooping. Fruits small **globose** 1.5-2 cm x 2 cm in diameter. Greyish brown.

**Flowering and fruiting** : March - October.

**Use** : Much used in furniture. Also for other handicrafts and baskets.

8. *Calamus nambariensis* Becc. Vern. Name : Houka.

Medium sized small clump forming canes. Stem with sheath 2-4 cm and without sheath 1-1.5 cm. **thorns sparse flat deflexed.**

Knee very prominent. Leaves 50-70 with cirrus. Leaflets regular alternate. Inflorescence long decompound. Fruits **ovoid** 2.5 cm diameter, **reddish brown.**

**Flowering and fruiting** : **July** - February.

**Use** : Very good quality cane. Used in furniture and handi craft industry.

9. *Calamus tenuis* Roxb. Vern. Name : Jati (Ass.)

Gregarious, cluster forming canes. Stem thickness with leaf sheath 1-2 cm and without 0.8 -1 cm. leaves without cirrus upto 1 m long. Leaflets regular linear shining green. 20-40 cm long. Flagella slender very long prickly. Inflorescence long flagella like branched drooping. Fruits small **globose** 1-2 cm pale yellow to yellowish brown in colour.

**Flowering and fruiting** : June - April.

**Use** : A useful raw material for furniture and handicrafts, used for weaving works.

10. *Daemonorops jenkinsianus* Griff. Vern. Name : Raidang (Ass.)

A robust cluster forming cane. Stem thick reddish brown with straight long spines. Thickness 2-4 cm with sheath and 1.5-2 cm without. Leaves with long cirrus. Leaflets regular, linear, pale green. Inflorescence comparatively short with boat shaped bract. Fruits medium **globose** 1.5-2 cm reddish brown.

**Flowering and fruiting** : October - June.

**Use** : Used in furniture, for making rough baskets, chair frames, etc. Also for cane bridges, rope, etc.

## Plantation prospects:

Due to the global phenomenon of decreasing forest cover and consequent habitat destruction coupled with over exploitation, there is reduction in the availability of this important non-timber forest produce.Therefore, many industries, which depend on wild resource,are now finding it extremely difficult to obtain their required raw materials. This warrants some urgent measures to be taken up for developing commercial Plantations and farming of rattans. Northeastern states with their favourable agroclimatic condition and habitat, offer immense scope for raising plantation of rattans in commercial scale.

Exploitation of cane so far for commercial purpose has been from wild resources - the forests. As natural regeneration of cane is poor and if current rate of depletion continues, some of the important cane species might become extinct with in few years from the region. Therefore cultivation of some high value cane species is an urgent need to reduce the pressure on wild cane flora as well as to meet the growing demand for raw materials.

Technologies for raising nurseries and plantation are available for application (Lakshmana, 1993). They generally prefer shady localities and grow as undergrowth in tropical moist and humid forests. Canes can be grown as inter-crop with valuable timber species which provides shade and support for climbing. Such cultivation will not only add to the productivity but also provide a sustainable source of income in a perennial manner to the farmer. They can also be cultivated in marshy areas, marginal land,*jhum* fallows and waste land. Canes are regenerated from seeds, though, their viability is comparatively short. Collection of seeds at the right time and giving right treatment can ensure higher germination rate and seedling production. The growth rate of cane is very slow in first three years and requires 8-13 years (depending upon the species) to attain harvestable maturity. The people of this region are mainly agriculture oriented and are experts in cultivation of plants in hilly terrain. The shifting cultivation practiced by the people also leave large areas as fallows, which could be profitably used for cultivation of canes.

## Nursery technique

Successful plantation and afforestation require sound nursery technique for raising required seedlings. The most successful and easy method for propagation of rattan is through seeds. However they can also be propagated through suckers in certain species.

## Propagation through seeds:

The seeds are generally collected when the fruits become straw brown in colour. Freshly collected seeds are pretreated in fresh water for 48 hours and then outer scaly cover and fleshy pulpy layer is removed by rubbing with hands. The seeds so extracted are then washed in water, shade dried for few hours and stored in moist place for a short period or sown in the mother bed. Fruits of most of the cane species remain viable for a month or so but some of the species can be kept for even up to 6 months if maintained under proper moisture level. Loss of moisture results in poor germination percentage, which could be 60-80% if pre-treatment, and preparations of seedbed are proper.

Table 3 highlights some of the important facts and figures related to creation of nursery for rattans.

| Species | Local name | Fruit types | Fruiting time (Month) | Seeds/kg (nos.) | Viability | Pre-Treatment (Days) | Germination period | Germination% | Sowing Season |
|---|---|---|---|---|---|---|---|---|---|
| *Calamus acanthospathus* | Tasar | Drupe | 10-11 | 400 | 2 | FW* | . | - | 10-11 |
| *C. erectus* | Jeng | Drupe | 4-6 | 250 | 2 | FW | 40-75 | 60 | 6 |
| *C.flagellum* | Drupe | 9-10 | 220 | 6 | FW | 50-100 | 53 | 1-2 | |
| *C. floribundus* | Lejai | Drupe | 6-7 | 2400 | 2 | FW | 70-120 | 40 | 7-9 |
| C. *gracilis* | Chuli | Drupe | 10-11 | 2400 | 2 | FW | - | - | 1-2 |
| *C. inermis* | Takit | Drupe | 9-10 | 200 | 2 | FW | | | 10-11 |
| *C. latifolius* | Hauka | Drupe | 1 | 210 | 2 | FW | 120-180 | 15 | 2-3 |
| *C. leptospadix* | Lejai | Drupe | 10-11 | 1800 | 6 | FW | 75-180 | 50 | 10-11 |
| *C. tenuis* | Jati | Drupe | 5-6 | 5100 | 4 | FW | 70-120 | 30 | 6 |
| *Daemonorops jenkinsianus* | Raidang | Drupe | 4-6 | 300 | 3 | FW | 35-60 | 5 | 5-6 |
| *Plectocomia assamica* | Hathibet | Drupe | 6-7 | 135 | 2 | FW | 30-70 | 15 | 7-8 |

• Fresh water

## Seed collection:

Seeds are collected from the mother plants when fruits are ripe which can be found out by the change in colour of the fruits from green to straw brown or orange brown depending on the species. It can also be tested by pressing fruits between thumb and index finger and if a space felt between the seed and outer scaly cover, then it can be presumed to be ripe. Alternatively seeds from bunches start falling which is also an indication of seed ripeness.

Seed treatment:

The collected seeds need to be sown in nursery without much delay as they lose viability. Cane seeds are known to be viable only upto six months of collection if properly stored keeping them moist. Other wise they may lose viability even in 15 to 30 days time. The seeds after collection are to be removed of the scaly fruit wall and sarcotesta or the fleshy portion over the seeds. The scaly portion can be removed by hand or rubbing with foot. The sarcotesta can easily be removed by mixing the water soaked seeds with coarse sand and rubbing with hand or leg. The process can also be done under running tap water. The cleaned seeds are shade dried and kept stored in poly bags. They can best be sown in mother beds. There are reports that seeds can be sown after pretreatment by soaking in boiled water for 5 minutes and taken out and soaked in water for 12 hours. This process reduces the germination period.

Sowing:

The cleaned seeds are sown in mother/ germination beds in lines of 5 cm apart (see photo plate) by making shallow furrows (3-5 cm deep) and placing seeds 2-5 cm apart in these channels. They are then covered with soil and watered. The beds are to be provided with overhead shade and direct sunlight should be avoided. Alternatively seeds can also be directly sown in poly bags filled with usual nursery mix and kept in shaded beds. Regular watering twice a day is essential.

Germination:

60 to 80% germination can easily be obtained in properly treated and appropriately sown seeds. Seed germination takes place in about 30 to 60 days time. Some times the pretreated seeds are known to germinate in 15 to 20 days depending upon species. Some seeds may take as much as 8 to 12 months for germination, which is rather rare.

Pricking out:

Once the seedlings attain 1-2 leaf stage, they can be pricked out and transplanted to poly bags kept in shade. Our experience at SFRI is that seedlings with 3-5 cm long plumule even without open leaves can be transplanted. These seedlings in poly bags are to be kept in shade beds and regularly watered. A green house which is covered all around with agroshade net of 50% shade meshes are very ideal to store such seedlings to get good growth.

Field planting :

One year old seedlings when they are 40 to 80cm height can be used for raising plantations. We have been able to use even two-year-old seedlings successfully. The seedlings can be planted at 5m X 5m spacing. This spacing can be modified as per requirement. For this, pits of $45cm^3$ can be dug and used. Planting is best done with the onset of monsoon. (Lakshmana 1993). In the subsequent year there is a need for vacancy filling due to expected mortality of about 25%. The selected site should be in shady place with over head shade trees and sufficient moisture in the soil. They can also be planted in tunnels as done in Aided Natural Regeneration (ANR) in sparsely wooded jungles.

Tending:

In the first two to three years, it is necessary to carry out regular weeding and ensure protection from cattle grazing. During winter mulching could also be provided to retain moisture and better survival. After the initial three years, canes develop shoots and climb on its own to the supporting trees. In the earlier years occasional loosening of soil will have beneficial effect on growth.

Growth:

During winter months growth retarded. During warm months growth is needs enhanced. The plants will grow at a rate of 2 - 5 m per year once the shoots emerge. It may take about 8 to 13 years for the canes to reach harvestable age. Canes of the northeast region are by and large clump forming. Depending upon the species there could be 20 to 30 culms. However, in *Calamus khasianus, C. inermis* and *Plectocomia assamica,* the plants are more or less single and clump formation is not much evident. The observations at SFRI suggest that the growth is better in partially shaded areas than in dense shade.

Propagation through suckers/rhizomes:

The canes start producing rhizomes as can be seen in the case of *Calamus tennis* or C. *leptospadix*. 10 - 20 rhizomes can be observed, a few centimeters away from the mother plant which will grow into plantlets. Few of these can be carefully removed with roots intact. Without drying the separated plantlets can be transported to nearby nursery and planted in polybags of sufficiently large size. Rooting in suckers and establishment can be enhanced by using growth regulating substance like IBA or NAA at appropriate concentration of 1000 ppm or 2000 ppm. (Seethalakshmi 1992). After storing in shaded beds for three to six months they can be used for raising plantation as in the case of seed raised seedlings. Other sources of planting materials are wildings or stolons.

Wildings:

Wherever too many seedlings come up near cane plants resulting in congestion some of these seedlings can be uprooted and used for raising nursery stock or planting at site.

Stolones:

Some species like *Calamus leptospadix* produce stolons in the ground and aerial suckers. These can also be separated and used as propagation material.

Tissue culture:

Propagation with tissue culture is attempted in some institutes including SFRI. There is possibility of producing large number of seedlings through this method. But this method is yet to gain popularity due to the cost and sophistication required.

References:

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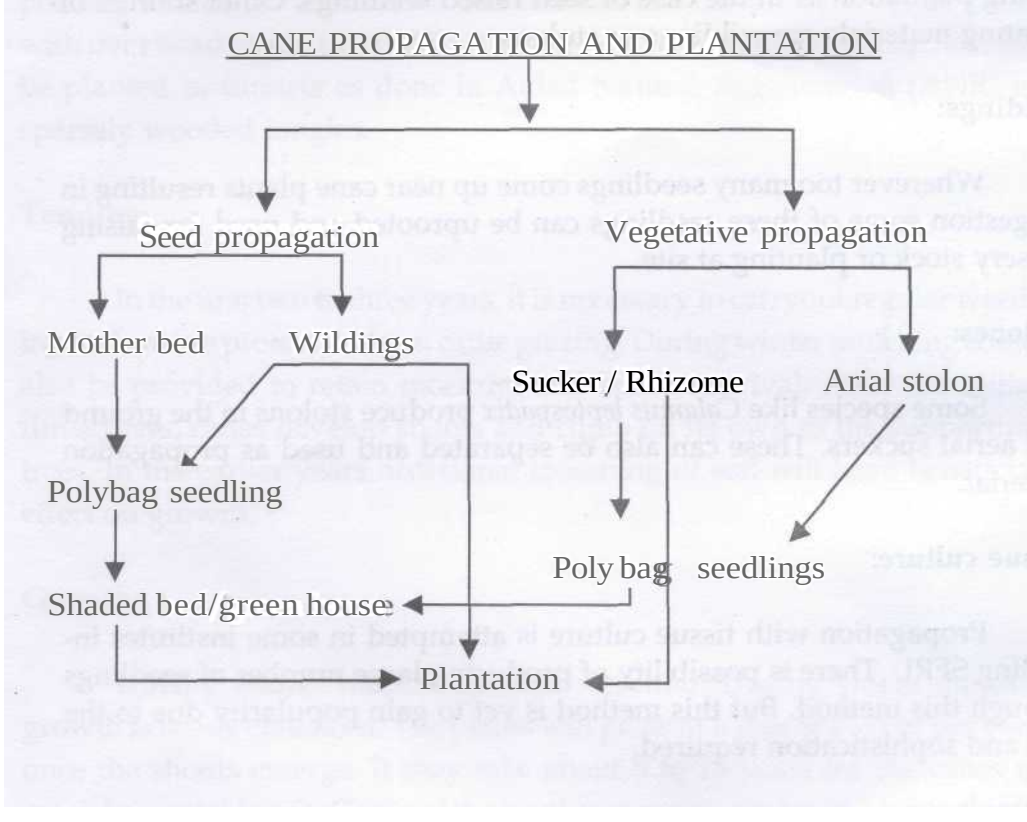


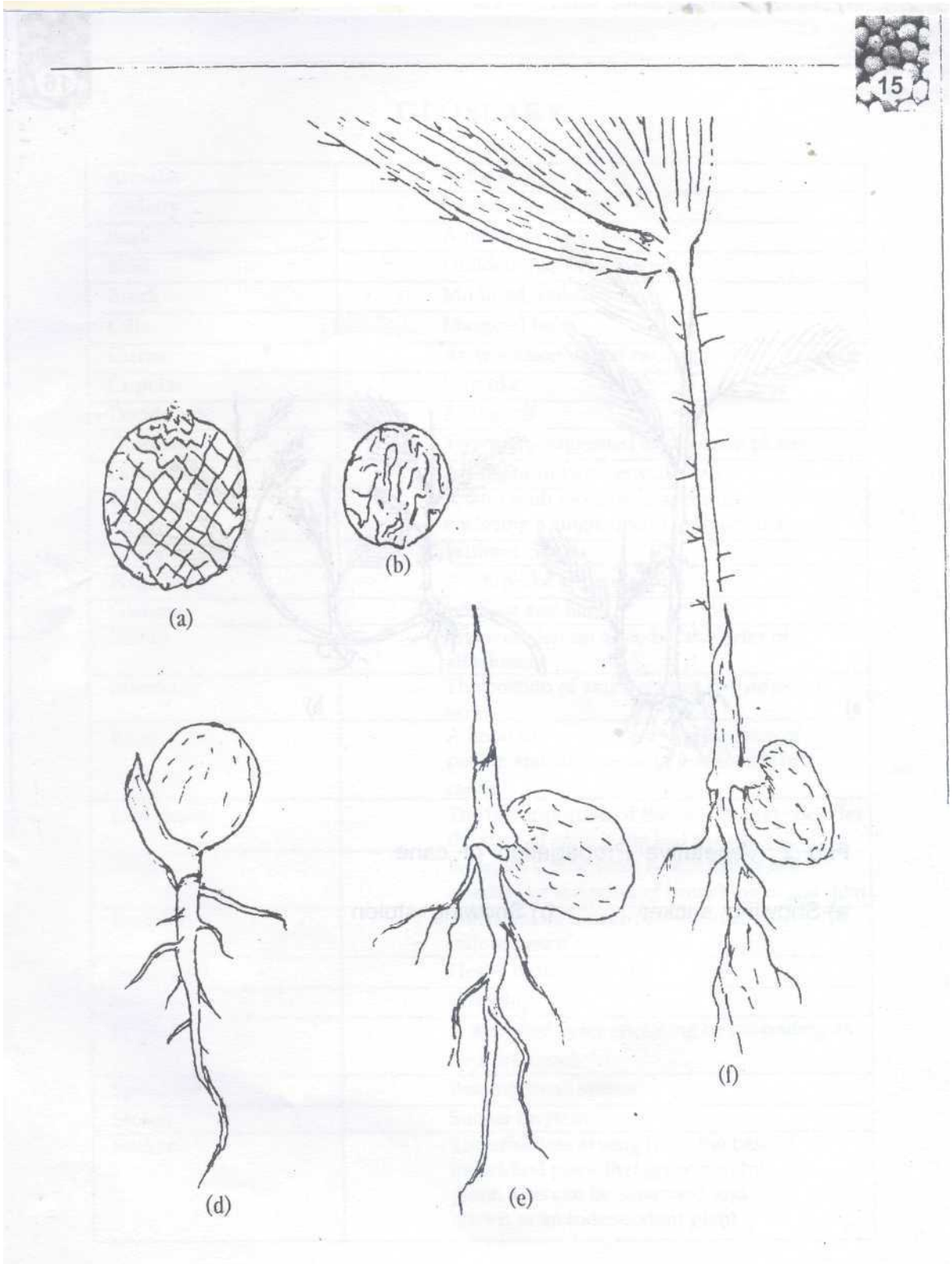
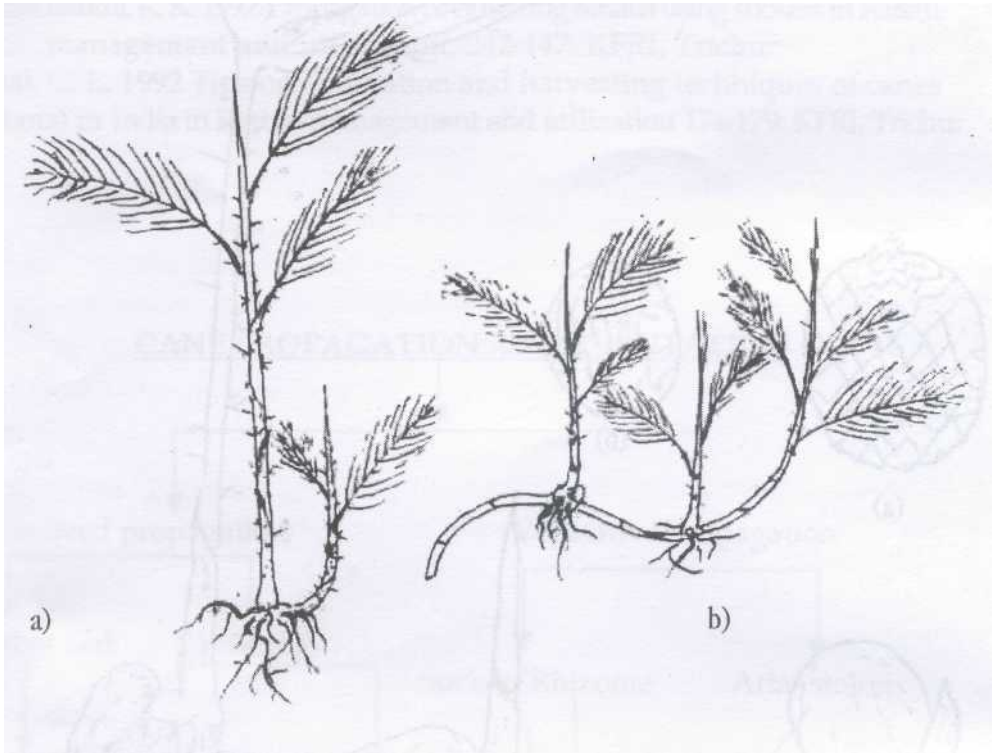



Fig. 1 : Stages of Seed germination of canes

a) Fruit, b) Cleaned seed, c) d) e) Different stages of germination, f) transplantable Seedling




Fi.g .2 : Vegetative Propagation of cane

a) Showing sucker, b) Showing stolon

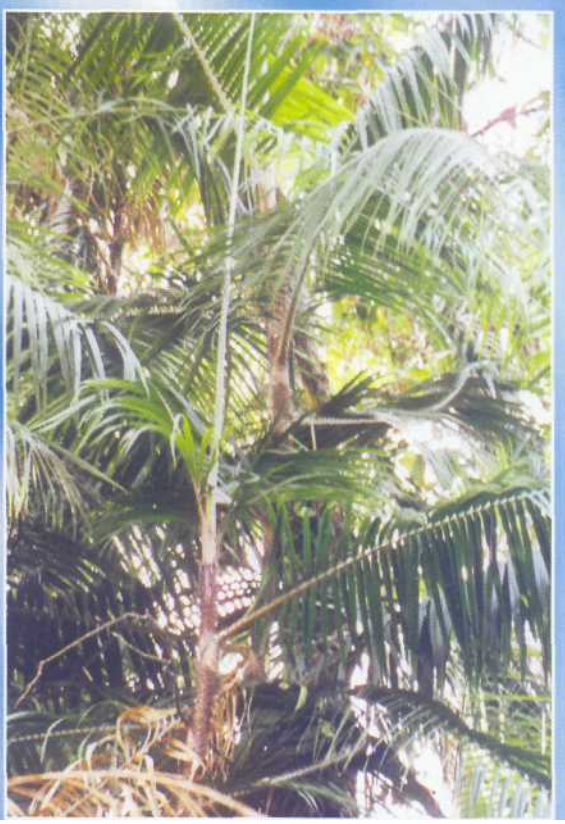

# GLOSSARY

| | |
|---|---|
| Annular | In the form of a ring |
| Axillary | Situated in the axil |
| Beak | A narrow pointed tip |
| Bifid | Divided into two/forked |
| Brack | Modified, reduced leaf |
| Cilia | Marginal hairs |
| Cirrus | An extension of leaf rachis or a sort of tendril |
| Cupular | Cup like |
| Deciduous | Falling off |
| Dioecious | Two sexes suggested as different plants |
| Distichous | Arranged in two vertical rows |
| Drupe | A fruit with more or less succulent flesh enclosing a single one to many celled stone |
| Ecirrate | Without cirrus |
| Flagellum | A whip-like appendage |
| Glabrous | Without any hairs |
| Hilum | The scare left on a seed at the print of attachment |
| lnternode | The portion of axis between two adjacent nodes |
| Knee | A knob like structure in the junction of petiole and stem seen on leaf sheath in canes |
| Leaf sheath | The lower portion of the petiole that encircles the stem of cane is the leaf sheath. |
| Node | A region on the stem where leaves are attached or the point of branching of the stem |
| Rachillae | The ultimate flower bearing axis of an inflorescence |
| Sarco testa | Fleshy outer seed coat |
| Scandent | Climbing |
| Spathe | A modified bract enclosing or subtrading as in- florescence |
| Spinulose | Bearing small spines |
| Stolon | Sucker on stem |
| Sucker | The offshoots arising from the base of individual plant that grow into full plant. This can be separated and grown as an independent plant |

# Stages in Plantation technique

Seedling stock

Transplanted in 45 cm $^3$ pits



Cane in six year old plantation

Cane in two year old plantation

Cane in two year old plantation

A community plantation-*Calamus flagellum*

Harvestable cane

Harvested cane

Cane basket, one of the many cane products

*Designed and Printed at : Peregrine Graphics, Bank Tinali, Itanagar( A.P )*