

Technical Bulletin

ICAR-CENTRAL ISLAND AGRICULTURAL RESEARCH INSTITUTE

Port Blair- 744105, Andaman & Nicobar Islands, India

**SEED PROPAGATION TECHNIQUES  
FOR SELECTED UNDERUTILIZED  
SPECIES OF ANDAMAN AND  
NICOBAR ISLANDS**

**Ajit Arun Waman**

**Pooja Bohra**

**DIVISION OF HORTICULTURE AND FORESTRY**

**2019**

## CONTENT

Sl. No.	Section	Page no.
1	Introduction	3
2	<i>Haematocarpus validus</i> (Miers.) Bakh. f. ex Forman, Menispermaceae	4
3	<i>Myristica andamanica</i> Hook. f., Myristicaceae	6
4	<i>Horsfieldia glabra</i> Warb., Myristicaceae	8
5	<i>Garcinia kydia</i> Roxb., Clusiaceae	10
6	<i>Garcinia andamanica</i> King, Clusiaceae	12
7	<i>Semecarpus kurzii</i> Engl., Anacardiaceae	14
8	<i>Semecarpus prainii</i> King, Anacardiaceae	16
9	<i>Musa indandamanensis</i> L.J. Singh, Musaceae	18
10	<i>Musa paramjitiana</i> L.J. Singh, Musaceae	20
11	<i>Aegle marmelos</i> (L.) Correa, Rutaceae	22
12	References	24

## 1. INTRODUCTION

Plant diversity has been supporting life of human beings and numerous creatures of varied kinds since time immemorial. The Andaman and Nicobar islands harbor a great variety of unique diversity including taxa endemic to these islands. More than 2,426 species of flowering plants have been reported from these islands, of which about 12% (*ca.* 300 species) are known to be endemic. Some of these taxa have been utilized extensively by the native tribal communities of these islands for food, shelter, medicine *etc.*, while other local and introduced species are being cultivated by the settler communities of these islands. A large number of potentially useful species are known to occur in the forest, semi-forest and cultivated areas of these islands. However, most of these species have remained neglected and systematic studies for utilizing them are limited.

Regeneration is the foremost step for ensuring survival and perpetuation of any species. Under ideal environmental conditions, natural regeneration would operate in the ecosystem; however, the ideal conditions have largely been disturbed due to manmade and natural disasters. Artificial or assisted regeneration could not only help in improving the natural stand of a species but also provide opportunities for conducting further studies in these species. Seed germination is known to get affected by a number of internal and external factors. Though various techniques and methods have been developed to improve the seed germination percentage with enhanced seedling vigour attributes in a number of species, such studies on the native species of these islands are limited.

In the present technical bulletin, studies conducted at ICAR-CIARI, Port Blair on standardization of seed germination techniques in ten underutilized species of direct and indirect importance to the island ecosystem have been presented. This could serve as a ready reckoner for raising seedlings of these species in large number for further use in habitat enrichment activities, conducting grafting studies in some of these species and promotion of multipurpose species in backyards. Suitable descriptions have been provided to support the studies and relevant photographs have been included to improve the understanding.

## 2. *Haematocarpus validus*, Menispermaceae

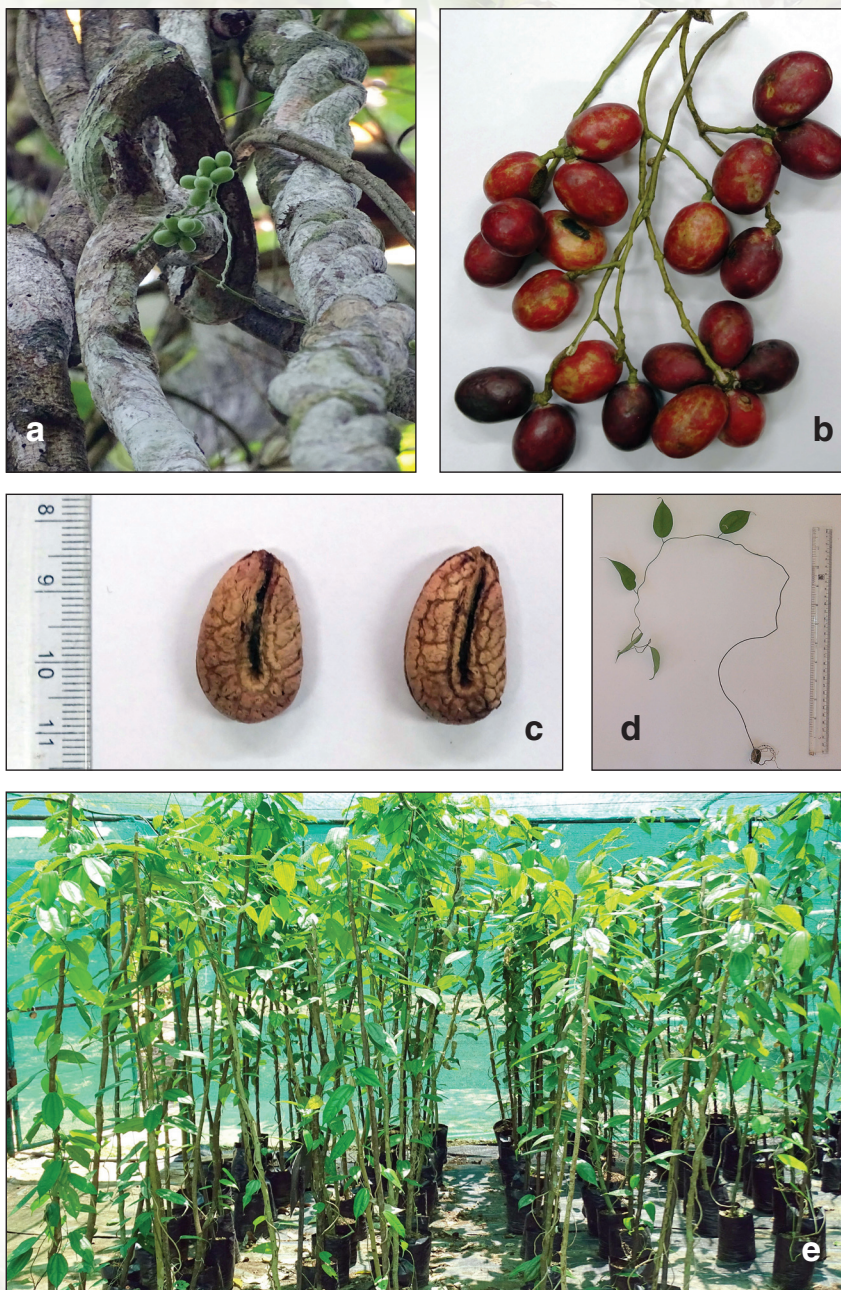
Blood fruit or *khoon phal* is an antioxidant rich fruit species found distributed in the North and Middle Andaman and North Nicobar islands. Besides, this species is also found grown in the forests of Tripura, Meghalaya, Assam, Arunachal Pradesh, Sikkim and West Bengal. Edible fruits of this species are borne in clusters directly on the lianas. Flowering is generally noticed during December to January, while fruits attain harvestable maturity during April to June. Each seed weighs about 2.02 to 4.03 g with 2.1 to 2.8 cm length, 1.1 to 1.6 cm width and 0.9 to 1.2 cm thickness. Population of blood fruit is dwindling in wild in almost all the areas of occurrence mainly due to destructive harvesting.

### Present and potential uses

Leaf decoction of blood fruit is used by the Nicobarese tribe to treat body ache. When cut opened, the fully ripe fruits reveal dark red sour-sweet pulp which is rich in anthocyanins; hence, the fruits have potential to be used as natural colourant for both food and non-food products. Systematic studies are in progress at ICAR-CIARI to standardize the extraction procedure and stability of the dye. Unripe fruits are also used for making pickles in some places. The species is being promoted as a backyard crop in the islands.

### Standardized technique

Seeds should be extracted from fully ripe fruits and adhering pulp should be washed off using water. Seeds should be soaked in solution of thiourea (0.1%) or  $GA_3$  (1000 mg/l) for 24 h and sown in coirpith as substrate in protrays. Nursery should be ideally raised in the polyhouse to protect the germinating seedlings from direct sun and rains. Judicious irrigation should be provided to avoid drying of substrate. Germination generally starts after 50 days of sowing and about 85% germination is obtained after 115 days of sowing. Seedlings should be transplanted to polybags filled with soil: FYM (1:1, v/v) and supported with wooden stake until field planting. Phenomenon of polyembryony has also been observed during the studies.



**Fig. 1. *Haematocarpus validus*: Woody climber with unripe fruits (a), ripe fruits (b), seeds (c), germinated seedling (d) and seedlings ready for planting (e)**

### 3. *Myristica andamanica*, Myristicaceae

*Myristica andamanica* is an endemic species reported from South Andaman, Middle and North Andaman and North Nicobar islands. It is a component of the evergreen hill forests, rainforests and mixed forests in these areas. Flowering is noticed during July-August and fruits ripe by March. Fruits are largest among all the wild nutmeg species found in the islands. Upon ripening, pericarp breaks open at natural suture, revealing attractive crimson red arils (mace) and ripened fruits fall down naturally. Each seed weighs to about 11.18 to 16.50 g, with 37.4 to 49.4 mm length and 21.5 to 25.0 mm width. This species has been categorized as Vulnerable in the IUCN Red List and the population trend is declining.

#### Present and potential uses

Nuts of *M. andamanica* are used by Nicobarese tribe for preparing decoction to cure fever. Further, nuts are also used by settler communities for creating body heat and curing cough and cold. Leaves are known to possess wound healing activities. Studies have also shown the utility of this species as a rootstock for cultivated nutmeg. Recent studies at ICAR-CIARI revealed that nuts are rich in fatty acids which could be of commercial importance.

#### Standardized technique

Freshly fallen seeds should be collected and washed to remove the adhering aril. Only non-rattling seed should be used for the nursery raising. Nursery should be raised in polyhouse to protect the germinating seedlings and judicious watering should be provided to avoid drying/ rotting of seedlings. Seeds should be then soaked in water for 24 h and the sinking ones should be selected for sowing. Without damaging the seed hull, seeds should be soaked in water for 24 h and sown in coir pith as substrate. Such seeds start germinating after 16 days and final germination of about 76% could be obtained. Seedlings have leaves covered with whitish/ ash coloured coating, which decreases as the seedling grows. One year old seedlings could be used for planting in the field.

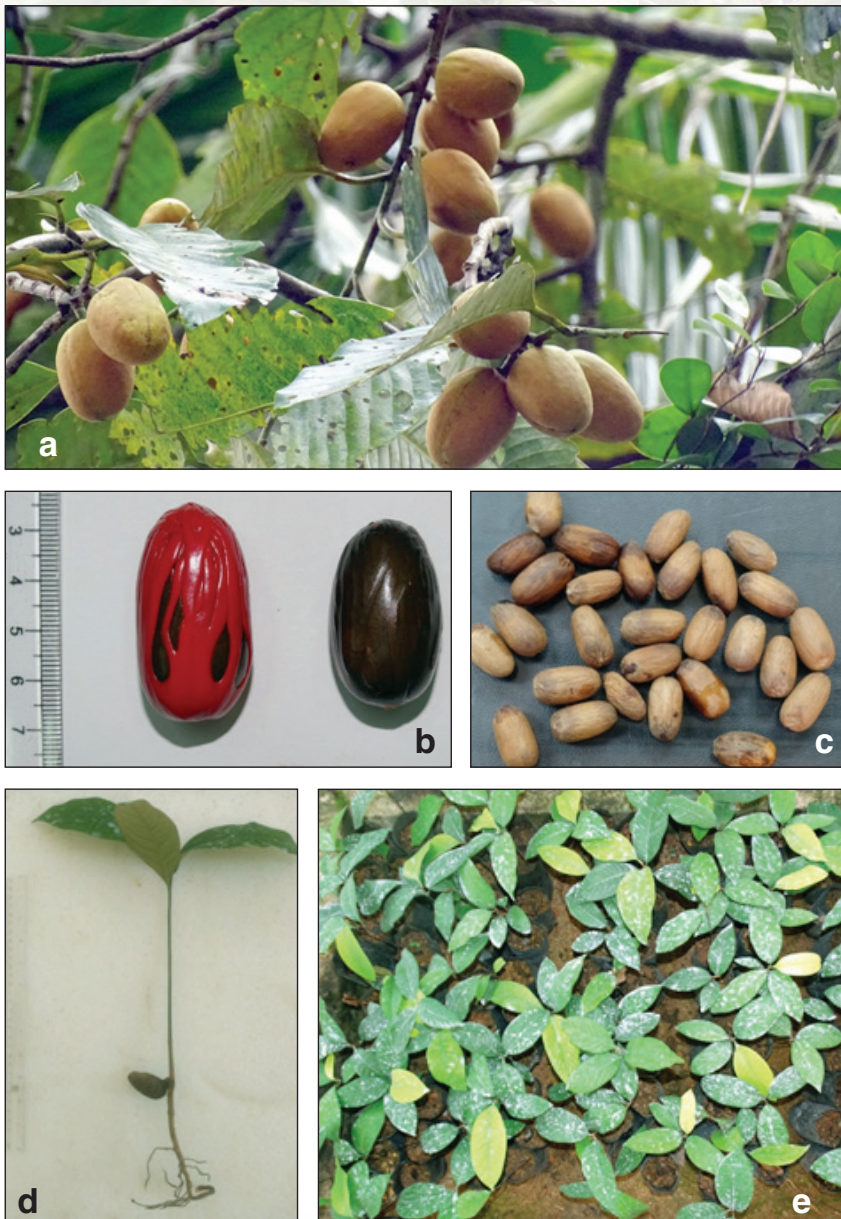


Fig. 2 *Myristica andamanica*: developing fruits borne in clusters (a), seed with and without mace (b), seeds without shell (c), germinated seedling (d) and seedlings being hardened in polyhouse (e)

#### 4. *Horsfieldia glabra*, Myristicaceae

*Horsfieldia glabra* is a wild nutmeg species found distributed in India (Little Andaman, Middle Andaman, South Andaman and Nicobar Islands), Java, peninsular Malaysia, Thailand, Cambodia, Laos, Sumatra, Bali and Myanmar. Fruits turn yellow from green upon ripening. Ripened fruits split open at the natural suture exposing the attractively coloured aril. Such fruits drop down on ground during June-July and germinate, when the conditions are favorable. Each fruit contains single seed of about 3.2 to 4.3 g weight, 2.6 to 2.9 cm length and 1.5 to 1.7 cm width.

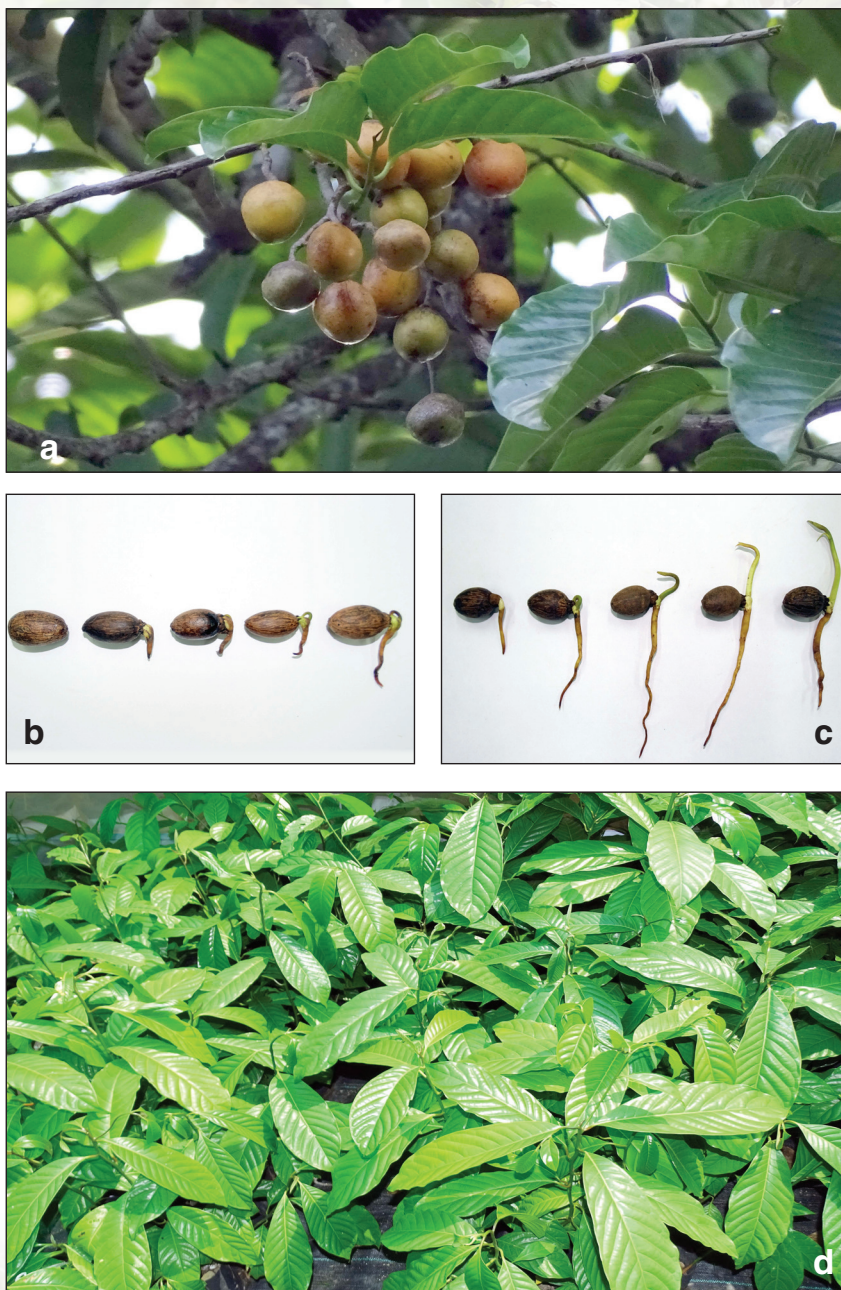
#### Present and potential uses

Though the species is found widely in the islands, its potential is yet to be explored. Studies at ICAR-CIARI suggested it contains high amount of fat with fatty acid composition of industrial applications. Being a wild relative of cultivated nutmeg, this could be a potential rootstock species. A report from Thailand suggested that seeds of this species are rich in energy and industrially exploited compound - resorcinol. Antibacterial and antioxidant properties have also been reported.

#### Standardized technique

Freshly fallen seeds of the species should be washed with water to remove the adhering aril and dirt. Soaking of seeds in 100 mg/L solution of  $GA_3$  for 24 h and subsequent sowing in containers filled with coir pith is recommended. Nursery should be raised in polyhouse and judicious irrigation should be provided. This treatment could improve the germination upto 79%, along with reduction in time taken for initiation of germination (18 days) and time taken for 50% germination (27 days). Post-transplanting survival was found to be 100%.





**Fig. 3** *Horsfieldia glabra*: developing fruits (a), germinating seeds showing radicle emergence (b), emergence of plumule (c) and seedlings ready for field planting (d)

## 5. *Garcinia kydia*, Clusiaceae

*Garcinia kydia* is an edible underutilized fruit species with rare distribution in the Andaman and Nicobar Islands. It has been reported from South Andaman and Middle Andaman islands. Trees grow large with straight trunk and exhibit prolific bearing habit. Fully ripe orange coloured fruits are clearly visible in the green canopy. Fruiting is generally observed during April to July and lot of fallen fruits are noticed during the season. Each fruit has 1 to 8 seeds and individual seed weighs about 0.64 to 1.07 g with 1.7 to 2.4 cm length, 0.9 to 1.3 cm width and 0.6 to 0.9 cm thickness. Population of this species is reducing in different parts of the islands.

### Present and potential uses

Like most of the other *Garcinia* species, this species is known to have straight and durable stem, due to which it is utilized for construction of huts and buildings. Sour-sweet fruits have refreshing aroma and are consumed by local inhabitants in fresh form. Fruits are source of vitamin A and C. Rind could be dehydrated and stored for long time. Value added products could be prepared which could be easily marketed in the island markets. This species could be planted on the boundaries and also as a backyard crop in the islands.

### Standardized technique

Fully ripe fallen fruits should be collected and seeds should be extracted. Seeds should be washed with water to remove the adhering pulp. For raising nursery, naturally ventilated polyhouse could be used. Seeds should be soaked in solution of potassium nitrate (0.1%) and sown in protrays filled with soil: FYM: coir pith (1:1:1, v/v) as substrate. Regular watering should be done to avoid drying of substrate. Seeds start germinating after three weeks of sowing and about 77% germination is obtained after seven weeks of sowing. At this stage seedlings will be of 14- 18 cm length with 6-8 leaves and after hardening for about 9 to 10 months, the seedlings could be planted under field condition.



Fig. 4. *Garcinia kydia*: fully developed tree (a), branch showing unripe and ripe fruits (b), seeds (c) and seedling (d)

## 6. *Garcinia andamanica*, Clusiaceae

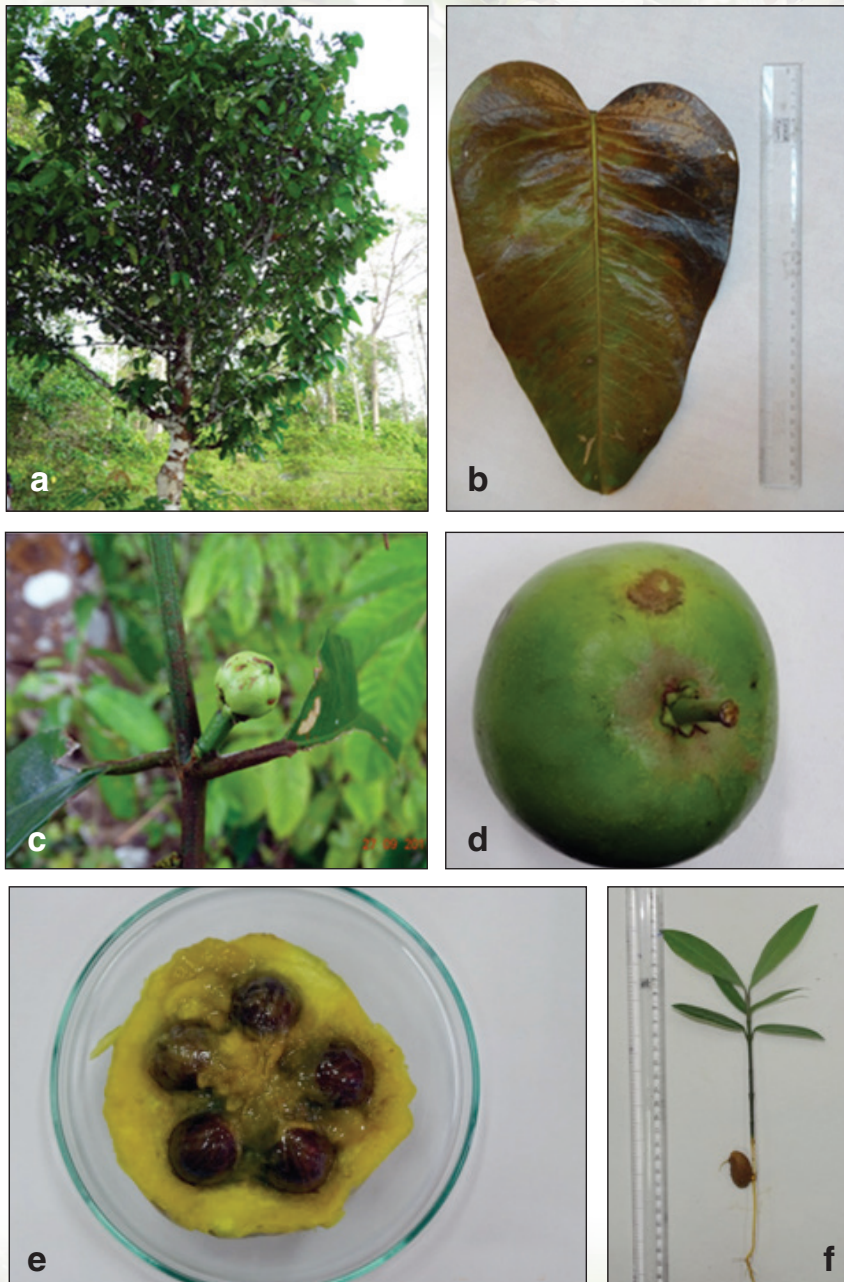
It is an endemic species found distributed mainly in the South Andaman island including Little Andaman, Rutland, Peel island, Havelock, Baratang and Middle Andaman. Trees are of 7 to 8 m high and leaves are large of about 30 cm long. The flowering is observed during January to March and fruits are generally harvested during April. At the time of ripening, fruits turn yellow from dark green. Fruits are large in size and each fruit contains upto five seeds embedded in yellow pulp. Each seed weighs about 4.02 to 6.45 g with dimension of 2.8 to 3.3 cm length, 1.7 to 2.1 cm width and 1.4 to 1.7 cm thickness. Due to the anthropogenic activities, the population of this species has seen declining trend and hence, needs immediate conservation.

### Present and potential uses

Fruits are edible and sour in taste. The local communities commonly consume them during the season. Onge tribe is known to use trunk of this species as poles and pillars for construction of huts. Studies conducted at ICAR-CIARI revealed that the fruits contain Vitamins A and C. Fatty acid composition of seeds was also carried out which suggested that it could be exploited for industrial purposes. However, further studies are required in this species.

### Standardized technique

Freshly fallen ripe fruits when cut opened, exhibit bold seeds arranged in circular fashion around the axis. As seeds are completely embedded in the pulp, they should be separated and washed with water. Seeds should be then soaked in potassium nitrate (0.1%) for 24 h before sowing. As the seeds are bold in size, root trainers filled with coir pith should be used instead of regular protrays. Regular watering should be done to facilitate quicker seedling emergence. Under ideal conditions, seedlings start emerging after two months of sowing and 46% germination could be obtained after five to six months of sowing. Seedlings at this age would be about 15 cm long with 4 to 5 leaves. Interestingly, seedlings continue to emerge after 6 months also and more than 80% germination could be obtained. About 12 months old seedlings could be used for field planting.



**Fig. 5** *Garcinia andamanica*: Grown up tree (a), leaf (b), developing fruit (c), fully mature fruit (d), ripe fruit showing seed arrangement (e) and seedling (f)

## 7. *Semecarpus kurzii*, Anacardiaceae

*Semecarpus kurzii* is commonly known as wild cashew (English) and *Bhallataka* or *Bada bhilwa* (Sanskrit). It is native to India and is found distributed in Andaman and Nicobar Islands and Myanmar. Inflorescence is a terminal panicle bearing numerous flowers during September- October. Fruits take about six months to develop and ripening is usually observed during April-May. The natural populations of this species have been damaged during Tsunami and due to anthropogenic activities.

### Present and potential uses

Fruits of this species, though edible, are not generally eaten due to allergenic action in some people. However, Onge tribe consumes them as food and Shompen tribe values it for its wound healing activity. The species is referred to as *Arbudahara* in Ayurveda due to its antitumor properties. It is an important constituent of formulations such as *Bhallataka taila* and *Bhallataka ghrita*. Conventionally, leaves are employed for curing inflammation, fever and pain. *S. kurzii* is also a source of iso-ricinoleic acid which is a renewable raw material for the oleochemical industry and a precursor for synthesis of antimicrobial compounds.

### Standardized technique

Naturally fallen fully ripe fruits should be collected and seeds should be separated from the fruits. Seeds should be washed with water to remove dirt and pulp, if any. Nuts are then soaked in water for overnight and the sinking seeds are used for sowing. Selected seeds should be soaked in potassium nitrate solution (0.1%) or gibberellic acid (2.9 mM) for 24 hours and then sown in nursery containers filled with coir pith as substrate. Seedlings start emerging after about 11-13 days and 94% germination is obtained after 26-29 days of sowing. Seedlings attain a height of 25-28 cm after a month of sowing. About six month old seedlings could be used for field planting.



**Fig. 6 *Semecarpus kurzii*: Profuse flowering (a), mature and ripe fruits (b), regenerated seedling (c) and seedlings ready for transplanting (d)**

## 8. *Semecarpus prainii*, Anacardiaceae

*Semecarpus prainii* is a wild cashew species naturally distributed in the Andaman group of Islands, North East India, peninsular Malaysia, Bangladesh and Myanmar. In the islands, it is generally found in the undisturbed semi-evergreen and littoral forests. Flowering is generally noticed during August to September in panicles and fruits ripe during February to March. Fruits turn their colour from green to dark orange as they advance in ripening. Fruits of this species are smaller than that of previous species.

### Present and potential uses

Information available about this species is meager. The species is a wild relative of cashew (*Anacardium occidentale*) and marking nut (*Semecarpus anacardium*) and hence, studies could be done to identify similar exploitable features in this species. Breeding and rootstock potential should also be studied. Pharmacological studies could help in determining the medicinal potential of this species.

### Standardized technique

Freshly fallen seeds should be collected and soaked in water for 24 hours. After this, sinking seeds should be separated and used for sowing. Such seeds should be soaked in water for 2 hours and sown in coir pith as substrate. More than two weeks are required for initiation of germination and after ten weeks, about 35% germination is obtained. At this stage, seedlings attain a height of about 25 cm with 7-8 leaves. Seedlings of one year age could be used for planting under field conditions.





Fig. 7 *Semecarpus prainii*: Fruit bearing branch (a), unripe and ripe fruits (b), seedlings (c) and seedlings ready for transplanting (d)

## 9. *Musa indandamanensis*, Musaceae

It is an endemic wild banana species reported from the forests of Little Andaman islands. The species is characterized by presence of green coloured floral bracts, a rather uncommon trait in the genus *Musa*. Seeds are black coloured and irregular in shape. A single fruit may contain 211 to 262 seeds. Seed length varies from 0.70 to 0.82 cm, while weight of 100 seeds ranges between 11.1 and 11.4g. Though the conservation status of this species has not been assessed by IUCN, it has been categorized as threatened and hence, needs to be conserved urgently.

### Present and potential uses

Being seed fertile in nature, it could serve as a potential source of genes for conventional breeding of banana. However, systematic characterization studies could be taken up only if sufficient plant population is available. Hence, a field gene bank of the species has been established at ICAR-CIARI and characterization is being carried out to identify the potential uses.

### Standardized technique

Seeds should be extracted from fully ripe fruits and washed to remove the adhering pulp as it may attract ants, if retained. Seeds could be air dried and stored in air tight containers at ambient temperature for further use. However, germination and seedling vigour reduce considerably over storage period of seven months. Only about half of the seeds germinate after three months of storage and hence, use of fresh seeds gives better results. Seeds should be soaked in 0.1% potassium nitrate solution for 24 h before sowing. Soil should be avoided as a component of germination substrate as it may result in incidence of seedling rot. Treated seeds should be sown in protrays filed with vermicompost which can give germination of about 92%. Seedlings are transplanted in polybags containing soil and farmyard manure (1:1) and should be transferred to the field at eight leaf stage.

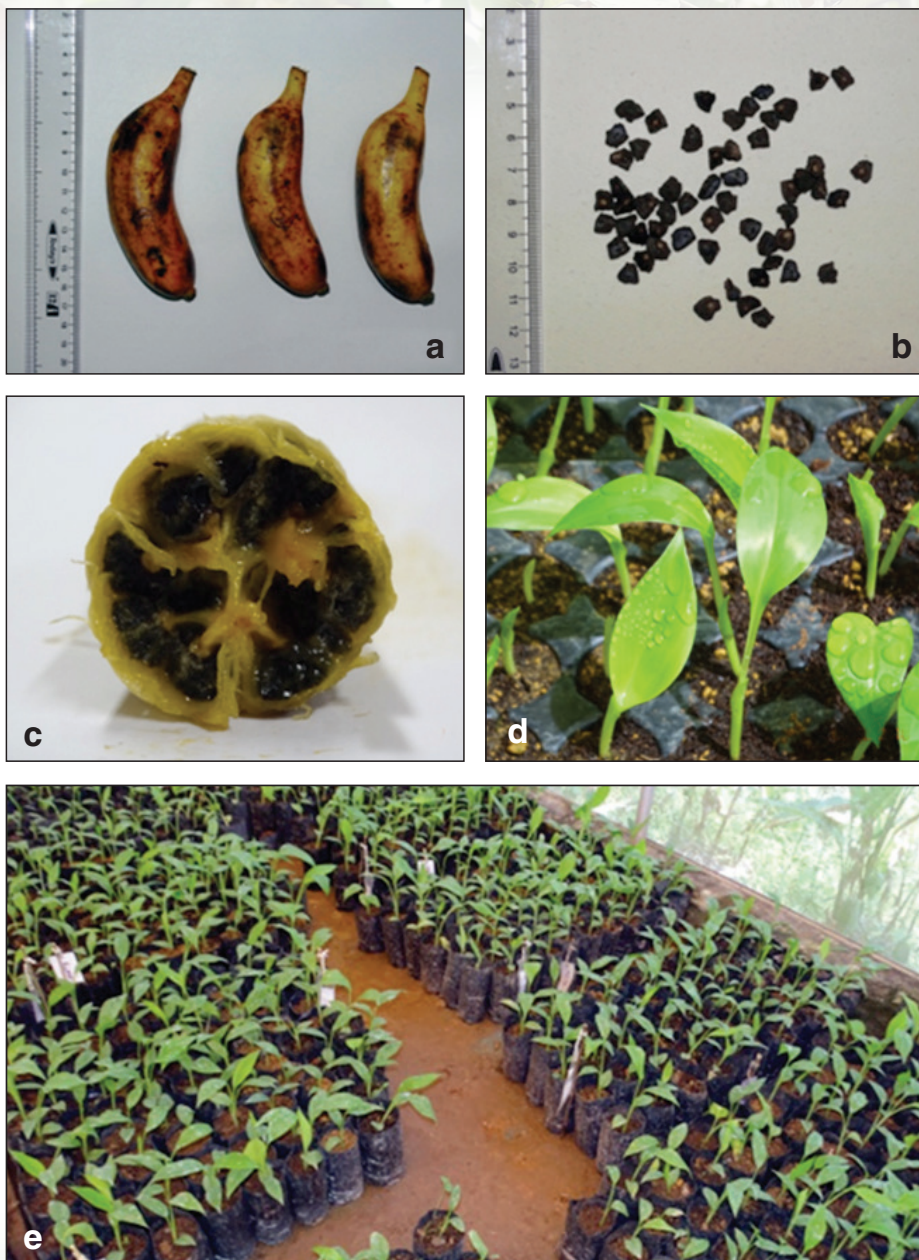


Fig. 8 *Musa indandamanensis*: fruits (a), seeds (b), cross section of a ripe fruit (c), regenerated seedlings (d) and seedlings being hardened in polyhouse (e)

## 10. *Musa paramjitiana*, Musaceae

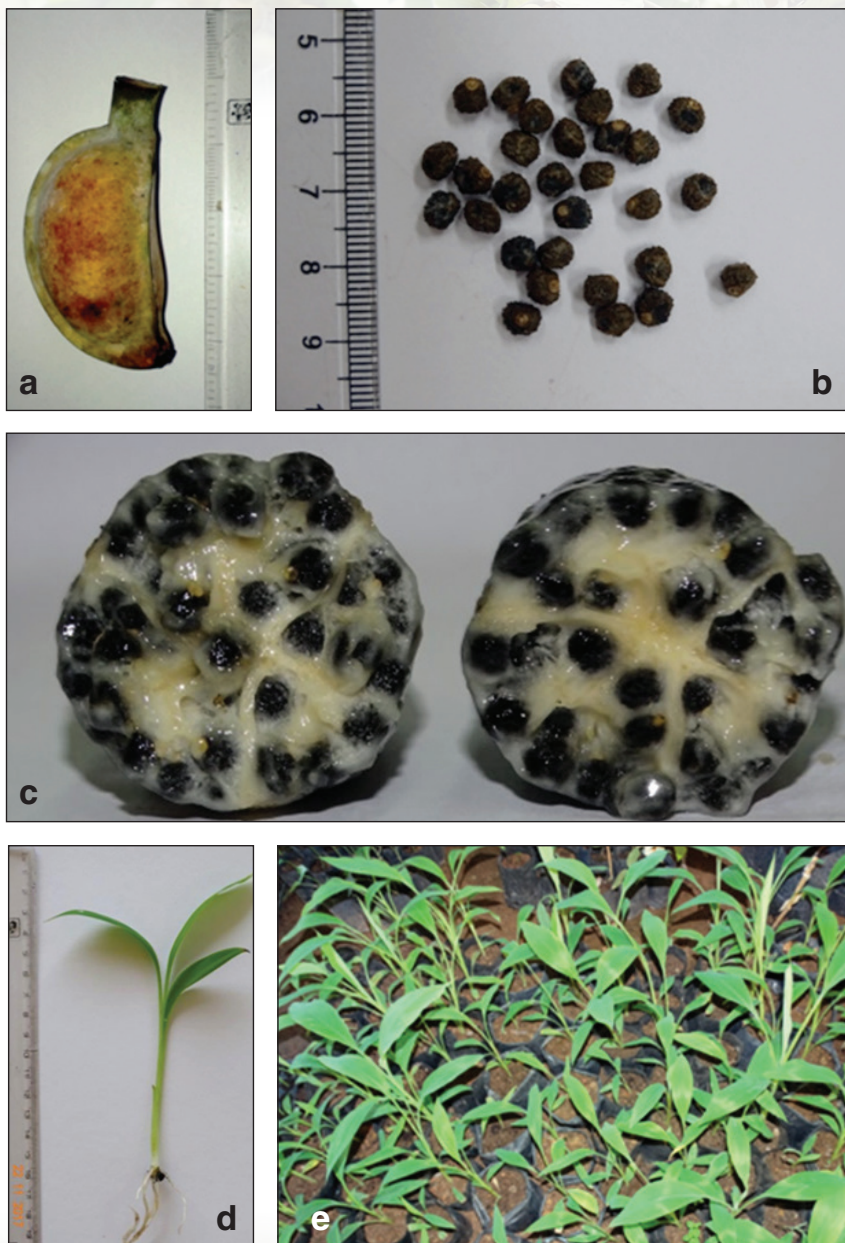
*Musa paramjitiana* is an endemic species of wild banana reported from the Andaman and Nicobar Islands. It bears small, attractive fruits filled with numerous seeds embedded in creamy white, edible pulp. Seeds are almost round in shape. Intraspecific variations have been observed for various traits including number of seeds per fruit, which varied between 79 and 526 depending upon fruit size.

### Present and potential uses

Being endemic, the species has important role in its native ecosystem. As the fruit pulp is edible, identification of genotypes with higher pulp recovery could be useful. It may have potential economic traits which could be used in breeding of edible banana and plantains. Hence, systematic characterization work has been initiated at ICAR-CIARI. The species could be evaluated for its secondary products viz. leaves, flower, pseudostem *etc.* for their utility in comparison with the traditional banana cultivars.

### Standardized technique

Seeds should be extracted from fully ripe fruits and washed to remove the adhering pulp as it may attract ants, if retained. Seeds could be air dried and stored in air tight containers at ambient temperature for further use. However, fresh seeds give better results in terms of germination percentage and seedling vigour. Seeds should be soaked in 0.1% potassium nitrate solution for 24 h before sowing. Soil should be avoided as a component of germination substrate as it may result in incidence of seedling rot. Treated seeds should be sown in pro trays filed with vermicompost which can give germination of about 90%. About days are required for completion of germination process. Seedlings are transplanted in polybags containing soil and farmyard manure (1:1) and are transferred to the field after three months of hardening.



**Fig. 9** *Musa paramjitiana*: ripe fruit (a), seeds (b), cut section of ripe fruit (c), regenerated seedling (d) and seedlings ready for field planting (e)

## 11. *Aegle marmelos* (L.) Corr., Rutaceae

Bael is one of the most important fruit species bearing medicinal value originated in India. Though, the species is known to thrive well in the drier regions of the country, the species grows luxuriantly and exhibit prolific bearing under humid tropical conditions of Bay islands. Being highly heterozygous, considerable variability is observed for tree and fruit morphological and physicochemical parameters. Flowering and fruiting season vary greatly and hence, harvesting is also variable in different regions. Numerous seeds are arranged in the pulp in either scattered or centric pattern.

### Present and potential uses

Bael fruits are commonly relished either fresh or in processed from viz. juice, milk shake, preserve etc. It has been traditionally used in the treatment of stomach related disorders. Recently, anti-venom potential of its leaves has also been reported. As the species is very hardy in nature and can thrive well under adverse soil and climatic conditions, it could serve as a good livelihood option for farmers or farm women as a cottage scale enterprise.

### Standardized technique

Seeds should be collected from fully ripe fruits for raising nursery. Adhering pulp should be washed off and then seeds should be soaked in 1,000 mg/l  $GA_3$  for 24 hours. Treated seeds should be sown in portrays filled with coirpith as substrate. No dormancy is generally observed and the seedlings start emerging within a week of sowing. About 78% germination success could be obtained within four weeks of sowing. At this stage, seedlings would be about 11 cm long with 3-4 leaves. Such seedlings should be transplanted into polybags filled with soil: farmyard manure (1:1, v/v). Seedlings of one year age could be used for field planting.



**Fig. 10 *Aegle marmelos*: Prolific bearing of fruits in North Andaman (a), ripe fruit showing arrangement of seeds in the pulp (b) and regenerated seedlings (c)**

## 12. References

- Ajit Arun Waman and Pooja Bohra (2016) Sustainable development of medicinal and aromatic plants sector in India: an overview. *Science and Culture* **82**(7-8):245-250.
- Ajit Arun Waman, Pooja Bohra and Avinash Norman (2018) Chemical pre-treatments improve seed germination and seedling growth in *Semecarpus kurzii* Engl.: an ethnomedicinally important plant. *Journal of Forestry Research*, **29**(5): 1283-1289 DOI: 10.1007/s11676-017-0562-9.
- Ajit Arun Waman, Pooja Bohra and Debabrata Basantia (2018) Effect of chemical pretreatments on germination and seedling growth in *Horsfieldia glabra* Warb. and *Semecarpus prainii* King. *Indian Forester*, **144**(1): 24-29.
- Annual Reports of ICAR-Central Inland Agricultural Research Institute, Port Blair for the years 2016-17 and 2017-18.
- Bhargava N. (1983) Ethnobotanical studies of the tribes of Andaman and Nicobar islands, India. I. Onge. *Economic Botany* **37**(1): 110-119.
- Kumar, K., Kumar, B., Selvan, T., Sajibala, B., Jairaj, R. S. C., Mehrotra, S. and Pushpangadan, P. (2006), Ethnobotanical heritage of Nicobarese tribe. *Journal of Economic and Taxonomic Botany* **30**:331–348.
- Murugan, C., Prabhu, S., Sathiyaseelan, R. and Pandey, R.P. (2016). A checklist of plants of Andaman and Nicobar islands (Eds. Paramjit Singh and Arisdason, W.). ENVIS Centre on Floral Diversity, Botanical Survey of India, Kolkata, India
- Pooja Bohra and Ajit Arun Waman (2017) Effect of pre-treatments on seed germination in bael (*Aegle marmelos* (L.) Corr.) for facilitating rootstock production. *International Journal of Forest Usufructs Management*, **18**(2): 25-31.
- Pooja Bohra and Ajit Arun Waman (2018) Observations on occurrence of polyembryony in four species from Bay Islands, India. *Indian Forester*, **144**(3): 311-312.
- Pooja Bohra, Ajit Arun Waman, Debabrata Basantia, Hidangmayum Lembisana Devi and Ezekiel Reang (2018) Domestication and conservation efforts in *Haematocarpus validus* (Miers.) Bakh. F. ex Forman: an underutilized fruit species and natural colourant. *Current Science*, **115**(6):1098-1105.
- Singh S., Waman A.A., Pooja Bohra, Gautam R.K. and Dam Roy S. (2016) Conservation and sustainable utilization of horticultural biodiversity in tropical Andaman and Nicobar Islands, India. *Genetic Resources and Crop Evolution* **63**: 1431-1445.