KFRI Research Report No.

Certification of Planting Material of Bamboo

Report of Project No. KFRI RP 647.7/2012

E.M.Muralidharan
R.C. Pandalai

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Kerala Forest Research Institute,
(An Institution of Kerala State Council for Science, Techno logy and Environment)
Peechi, Thrissur, 680653, Kerala

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Summary of Project

1. Title of the Project	:	Certification of Planting Material of Bamboo
2. Principal Investigators	:	Dr. E.M.Muralidharan Dr. R.C. Pandalai
3. Date of commencement	:	May 2012
4. Date of completion	:	June 2015
5. Funding agency	:	National Bamboo Mission

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Abstract

Certification of planting material of bamboo was envisaged by the National Bamboo Mission as a measure to improve the productivity of bamboo plantations in the country through use of superior planting stock. Bamboo plants being unique in their biology, growth and mode of propagation, presents hurdles in identification of species, genetic improvement and quality control in the nurseries. An attempt to streamline the quality control procedures and set standards for quality planting stock has been made. The framework for an institutional mechanism to ensure production of genuine , quality planting of the priority bamboo species was developed, which consists of procedures to validate the identity of mother plants used for multiplication by experts in taxonomy, selection of superior Clumps, maintenance of Rhizome /Clone bank of the superior mother plants, maintenance of quality of plants produced through the different modes of multiplication viz. seeds, vegetative propagation, rhizome transplanting or tissue culture. Proformae for collecting the essential information about the source of multiplied plants, documentation at every stage of the plant production to ensure traceablity of each propagule to the mother plant and details of the labeling are aspects covered in this study.

The objective of certification is to ensure that the bamboo planting material coming under purview carries an assurance on the correct identity of species and clone and that it meets the prescribed standards of quality in propagation and nursery procedures and also provides with a means of verification of the claims through proper documentation and on-site inspections. To this end the recommendation is to set up a committee under the auspices of NBM that will approve Bamboo Nursery Certifying Agencies having the required expertise, who will then assess the nurseries and issue certificates if the requirements are complied with. Bamboo propagules carrying the label of "Certified Bamboo Planting Material" sold from a Certified Bamboo Nursery will therefore be an assurance of plant quality and health and the correct species and clone.

The norms for certification of bamboo planting material has been approved by NBM and the documents uploaded on their website.

Introduction

India is a country with a rich diversity of bamboo species and the plants has been used by people over the centuries in traditional manner for their household, agricultural and food uses (Sharma and Nirmala, 2015; Seethalashmi and Muktesh Kumar, 1998) . Bamboo was available in plenty in and around communities where they found traditional applications and was always collected form the wild. It was only when the paper/pulp industry began using bamboo as an industrial raw material that the natural bamboo resources in the wild began to be exploited on a bigger scale without any effort at regeneration. Degradation of the wild bamboo resources in the forests resulted when the extraction was done in an unsustainable manner. Planting of bamboo in mixed forests to supplement the resources was undertaken in many states by the forest departments using seed collected during the flowering events but plantations established on scientific lines were not usually carried out. In many parts of the country, notably the North Eastern States, bamboo was grown in the homesteads to cater to the local requirements. Here too planting was done using traditional knowledge of propagation methods and cultivation practices no scientific interventions have been known to be applied.

Bamboo is today increasingly becoming a species for increasing industrial uses and an alternative to timber (Lobovikov, 2007) . A wide range of modern industrial produces and processes now use bamboo as raw material. This includes bamboo for paper/pulp, bioenergy, bamboo ply, laminates and composites as well as for construction and for edible shoots. With the diversity of bamboo species available in the country which includes the native species as well as some exotic species that have naturalized in the country, it is also important that the correct species are used for specific end uses especially for those uses where the culm characteristics like culm diameter, wall thickness and internode length are relevant. To meet the increased demand for bamboo it is essential that plantations of the appropriate species be raised on a large scale in forest as well as homesteads and farmlands. The low productivity of bamboo plantations established in the past across the different agro climatic zones of the country is a concern that has been recognized by the National Bamboo Mission. The productivity estimates for bamboo range 3 -10 metric tonnes/ hectare/ year in forest areas to 24 in intensively managed bamboo

plantations (BTSG-ICFRE, 2014) which is unsatisfactory when compared to figure from other parts of the world. Accordingly it has been recognized that improvements in productivity will have to be taken up as a challenge. Besides choice of the correct species for each agroclimatic zone, the genetic quality of the planting stock in terms of the important parameters for higher productivity will have to be given importance when future plantations are envisaged.

Bamboo, because of its unique growth habit and reproductive behavior is not easily amenable to accurate identification and easy propagation. The long and often unpredictable flowering cycles and short period of annual culm production limited to a few weeks results in a dearth of taxonomic feature for most of the time in the life cycle and leading to misidentification of species and mixing up of planting stock. Consequently, research efforts have focused on overcoming the problems of taxonomy and propagation so that misidentification and production of planting material of dubious quality is avoided. The development of molecular methods for identification at species and clonal level is to be developed since there is a remarkable absence of discriminative vegetative characters in the juvenile state or vegetative multiplication phase..

Planting stock in bamboo is produced through a variety of propagation methods and the propagules produced show differences in size and vegetative characters. Thus planting material which comes in a variety of forms viz. seedlings, rooted culm or branch cuttings, rhizome transplants and micropropagated plantlets and belonging to various age classes, are difficult to identify because of the absence of clearly distinguishable and consistent characteristics. A reliable means is therefore required for ensuring that the plants being produced in the nurseries and used to establish plantations are properly identified at the species level and are from a genetically superior source.

In bamboo, the conventional genetic improvement strategies are not applicable due to the long and unpredictable flowering cycles and the reduced possibility of synchronous flowering of species. Hence only selected clones demonstrated through field trials to be superior in performance can currently be considered as genetically superior stock. Bamboo planting stock currently available for bamboo farmers are in most cases seedlings and vegetatively propagated

plants originating from bamboo clumps that have not undergone any selection process. A serious limitation of vegetatively propagated bamboo is often the lack of information on the flowering cycle of the mother clumps and carrying a risk of flowering at any point of time. Any genetic improvement programme should ensure that properly identified and selected mother clumps alone are propagated.

It was envisaged that through use of state -of- the art methods it will be possible to achieve the above objectives of species and clone identification, selection of genetically superior clumps and mass propagation. These methods are expected to also help in nursery-level discrimination to overcome inadvertent mixing up of species. The proposed certification system aims at the traceability of each certified bamboo plant back to correctly identified mother clump. Planting stock can thus be certified for its genetic antecedents and quality by a competent authority to be established for the purpose. Such a certification procedure does not address issues of sustainability of the bamboo plantations, environmental or social impacts nor does it cover bamboo product certification.

The certification process developed for this purpose is for the present intended for the various programmes implemented by the NBM through the network of Certified Bamboo Nurseries where mass propagation and production of bamboo planting material is practiced for supply to farmers and other agencies.

Scope of the work:

The work undertaken in the present study aims to:

i. Establish a framework under the National Bamboo Mission (NBM) for developing the institutional mechanism to ensure availability of genuine, quality planting stock of different bamboo species for plantation and other ancillary activities of NBM;.

ii. Lay down a proforma for obtaining the details of the planting stock of bamboo species to validate identification of species, assess the quality including availability of superior genetic antecedents of mother clumps and to assist in the certification process so that the multiplied planting stock is compliant with the prescribed standards relating to nursery and labeling;

iii. Validate, verify and certify the origin of planting material with documentation at all stages of production and supply of planting material to consumers;

iv. Issue guidelines under NBM for certification process to ensure that quality planting stock of bamboo conforming to prescribed certification standards is made available to cultivators raising bamboo plantations under NBM; and

v. Streamline the certification procedures and standards of bamboo planting material produced and utilized under NBM funded activities.

Objectives

The objective of certification is to ensure that the bamboo planting material coming under purview carries an assurance on the correct identity of species and clone and that it meets the prescribed standards of quality in propagation and nursery procedures and also provides with a means of verification of the claims through proper documentation and on-site inspections.

Outline of the certification process

To achieve the objectives, the certification process was developed by addressing the following aspects (for full details see Supplement 1) .

i. Accurate identification of source of planting material: ✓

This involves accurate identification of bamboo using identification keys developed by acknowledged experts in the field of taxonomy. A proforma for collecting the essential information and with supporting documentation maintained by the nursery for each lot of bamboo seeds or vegetative material helps the expert identified by NBM in the identification. This forms the origin of all certified planting material propagated and sold in Certified Bamboo Nurseries.

ii. Mass production of planting material:

Correctly identified seeds and genetically superior clones of bamboo obtained with the necessary certificates of origin will be mass propagated and the planting material conforming to the guidelines drawn up for determining quality standards (see Section 6 Guidelines in

Appendix 1) will be labeled as Certified Bamboo Planting Material by Certified Bamboo Nurseries following guidelines issued by NBM.

iii. Maintaining traceability :

The chain- of- custody of the vegetative material used for producing planting stock through any of the mass vegetative propagation systems will be documented by the Certified Nursery to the point of sale of the planting stock

NBM will oversee the certification process through a Committee constituted for the purpose. The first step would be to approve the formation of Bamboo Nursery Certifying Agencies. Such agencies with expertise in bamboo taxonomy, propagation techniques and nursery technology and having the research infrastructure etc. are chosen and entrusted with the task of certifying bamboo nurseries.

Bamboo propagules carrying the label of "Certified Bamboo Planting Material" sold from a Certified Bamboo Nursery will therefore be an assurance of plant quality and health and the correct species and clone.

Documents submitted to NBM

A comprehensive document "Certification of Bamboo Planting Material for Area Expansion Programme under National Bamboo Mission" that delineates the concept and the procedure to be followed has been submitted and approved by NBM (Supplement 1). The document is also available in the public domain on NBM website :(http://nbm.nic.in/PDF/CertificationNBM15.05.2014.pdf)

Related documents

The following documents that complement the certification process have been submitted to National Bamboo Mission and have been uploaded into their website (www.nbm.nic.in)

1. Guidelines for Establishment and Management of Certified Bamboo Nurseries http://nbm.nic.in/PDF/Guidelines13.05.2014.pdf
2. . Manual for Establishment and Management of High-Tech Bamboo Nursery http://nbm.nic.in/PDF/Manual19.5.14.pdf

Conclusion:

A certification procedure that utilizes the state- of- the- art technology to ensure quality of bamboo planting stock with respect to correct identity of species and origin from mother plant of known superior characteristics and meeting the standards set for each mode of propagation and maintaining chain of custody through precise documentation is developed. A national certification system where accredited certifying agencies with expertise will certify nurseries which comply with the requirements. The process will ensure that bamboo planting stock carrying the label of "Certified Bamboo Planting Material" sold from a Certified Bamboo Nursery will be an assurance of plant quality and health and the correct species and clone.

References

BTSG-ICFRE (2014) Proceeding of National Seminar "Bamboo Productivity in Forest and Non – Forest Areas" 30th to 31st January, 2014 Forest Research Institute, P. O. New Forest, Dehradun

Lobovikov M, Paudel S, Piazza M, Ren H, Wu J (2007) World Bamboo Resources. A Thematic Study Prepared in the Framework of the Global Forest Resources Assessment, 2005, Food and Agriculture Organization of the United Nations, Rome, Italy

Seethalakshmi KK and Kumar M (1998) Bamboos of India (A Compendium). KFRI, Peechi (India) and INBAR (China). Tech. Report No. 17:1–342

Sharma ML and Nirmala C (2015) Bamboo diversity of India: An update. 10th World Bamboo Congress Korea. pp 12. http://www.worldbamboo.net

Supplement 1: Certification of Bamboo Planting Material for Area Expansion Programme under National Bamboo Mission

Certification of Bamboo Planting Material for Area Expansion Programme under National Bamboo Mission

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Certification of Planting Material of Bamboo

1. Background

Improved productivity of bamboo plantations across the country will necessarily become a priority when the initial mandate of identifying the suitable species and matching it with the diverse end uses and assessing their suitability for different agro climatic zones, is achieved. Due to the unique biological features of bamboo that impose hurdles in its accurate identification and easy propagation, special efforts are required in overcoming the problems of misidentification and use of planting material of dubious quality. Planting stock is produced through a variety of modes of propagation and the resulting propagules show differences at different phases of growth. A reliable means is therefore required for ensuring that the plants being produced in the nurseries and used to establish plantations are properly identified at the species level and are from a genetically superior source. The only scientifically documented and dependable means available currently for identification of bamboo species is based on morphological features of mature clumps and is best done when new culms emerge so that the sheath morphology is available for comparison. Several publications are available to guide the expert in proper identification of bamboo. At the field level however, there is the need to have a less technical means of distinguishing bamboo species particularly where planting material is concerned. Thus planting material which comes in a variety of forms viz. seedlings, rooted culm or branch cuttings, rhizome transplants and micropropagated plantlets and belonging to various age classes, are difficult to identify because of the absence of clearly distinguishable and consistent characteristics.

Conventional genetic improvement strategies are largely not feasible in bamboo due to the long and unpredictable flowering cycles and therefore only selected clones demonstrated through field trials to be superior in performance can currently be considered as genetically superior stock. While superior clonal propagules should be the ideal planting stock for plantations under the NBM scheme, the bulk of planting stock currently used are seedlings and vegetatively propagated plants originating from mother plants that have not undergone any selection process. Even with such material there are problems of misidentification of species and lack of information about varieties/landraces and the very serious issue of lack of information of the age *vis- a- vis* the flowering cycle of the mother clumps. Any programme aimed at improving the productivity should look at ways

and means of ensuring that properly identified and selected mother clumps alone are propagated.

A certification framework is proposed here as the means of achieving the above objectives through state -of- the art procedures. This will continually be updated and strengthened based on the experience gained and through the integration of newer techniques and procedures that may be developed and standardized in future for species and clonal identification, selection of genetically superior clones, genetic improvement and mass propagation. Revisions to the document are therefore to be expected from time to time. Some of these methods are expected to also help in nursery-level discrimination to overcome inadvertent mixing up of species. The backbone of the proposed certification system is the maintenance of traceability of each certified bamboo plant back to the mother clump identified at species level and certified for its genetic antecedents and quality by a competent authority.

Since the term certification is more commonly used in the context of international trade of timber, it should be emphasized here that the certification of planting material does not address issues of sustainability of the bamboo plantations, environmental or social impacts nor does it cover bamboo product certification.

The certification process is for the present intended solely for the various programmes implemented by the NBM through the Certified Bamboo Nurseries where mass propagation and production of bamboo planting material is practiced. Moreover certification of bamboo planting stock will be optional for the nurseries and only mandatory for use in NBM sponsored activities.

2. **Scope**:

i. To establish a framework under the National Bamboo Mission (NBM) for developing the institutional mechanism to ensure availability of genuine, quality planting stock of different bamboo species for plantation and other ancillary activities of NBM;.

ii. To lay down a proforma for obtaining the details of the planting stock of bamboo species to validate identification of species, assess the quality including availability of superior genetic antecedents of mother clumps and to assist in the certification process so that the multiplied planting stock is compliant with the prescribed standards relating to nursery and labeling;

iii. To validate, verify and certify the origin of planting material with documentation at all stages of production and supply of planting material to consumers;

iv. To issue guidelines under NBM for certification process to ensure that quality planting stock of bamboo conforming to prescribed certification standards is made available to cultivators raising bamboo plantations under NBM; and

v. To streamline the certification procedures and standards of bamboo planting material produced and utilized under NBM funded activities.

3. Objective

The objective of certification is to ensure that the bamboo planting material coming under purview carries an assurance on the correct identity of species and clone and that it meets the prescribed standards of quality in propagation and nursery procedures and also provides with a means of verification of the claims through proper documentation and on-site inspections.

4. Outline of the certification process:

i. **Identification of source of planting material:** Identification of bamboo at the species level is done by an acknowledged expert in bamboo taxonomy. Identification keys for most of the major bamboo species including the NBM priority species are available in literature and these will form the basis for accurate identification.

Based on the proforma and supporting documentation (see Appendix 2) accompanying each lot of bamboo seeds or vegetative material of known origin, the identity of the species and clonal identity, wherever relevant, will be established by an expert identified by NBM (see Section 5. below) and approved for use in mass propagation and production of certified bamboo planting material in the nurseries. The proforma thus forms the basis on which the expert correctly identifies the bamboo species and also as the documentation maintained by the nursery for material used for propagation and production of certified bamboo planting material.

Genetically superior bamboo clumps at the mature stage of growth or seeds are precisely identified and the flowering cycle is documented with certainty. This forms the origin of all certified planting material propagated and sold in Certified Bamboo Nurseries. Establishment of Clonal Gardens and Rhizome Banks at the bamboo nurseries or research institutes, will ensure that tested clones are available for mass propagation.
When seeds are used for raising planting material, the identity of the species is either established from the mother clumps or from the seed morphology by experts.

ii. **Mass production of planting material:** Correctly identified seeds and genetically superior clones of bamboo obtained with the necessary certificates of

origin will be mass propagated and the planting material conforming to the quality standards (see Section 6 Guidelines in Appendix 1) will be labeled as Certified Bamboo Planting Material by Certified Bamboo Nurseries following guidelines issued by NBM.

iii. **Maintaining traceability :** Documentation of the chain- of- custody of vegetative material used for producing planting stock will be maintained by the Certified Bamboo Nursery at all stages leading from the certified mother clump through any of the mass propagation systems to the point of sale from where the farmers procure the planting stock.

5. Certification procedure:

i. NBM will oversee the certification process through a Committee constituted to approve the formation of Bamboo Nursery Certifying Agencies. The Agencies are identified based on the availability of expertise in bamboo taxonomy, research infrastructure etc. (for criteria see Appendix 6). The list of Bamboo Nursery Certifying Agencies will be posted on the NBM web site.

After a due process of appraisal of the scientific competence, infrastructure and availability of expertise in the relevant disciplines, the Committee will entrust the Bamboo Nursery Certifying Agencies with the task of certifying bamboo nurseries established with the financial support from NBM. The same Committee will also recommend on the formation of a Panel of Experts in bamboo taxonomy who are competent to carry out bamboo identification and the remuneration for the experts for their services. The composition of the Committee will be as follows:

a. Deputy Director General (Research) - Chairman
ICFRE, Dehradun

b. Chief Consultant, NBM, - Member
New Delhi

c. Coordinator, BTSG, KFRI, - Member Secretary
Peechi, Kerala

ii. The Bamboo Nursery Certifying Agencies on receiving an application from bamboo nurseries established under NBM, will send a team of experts for inspection and when found to comply with prescribed standards (see "Guidelines for Bamboo Nurseries" issued separately by NBM) will issue certification.

All bamboo nurseries established and certified under NBM scheme will be eligible for production and supply of certified planting material to be used under NBM's area expansion program. All tissue culture units which are certified bamboo tissue culture propagule production facilities under the DBT-NCS-TCP are eligible for producing certified bamboo TC propagules.

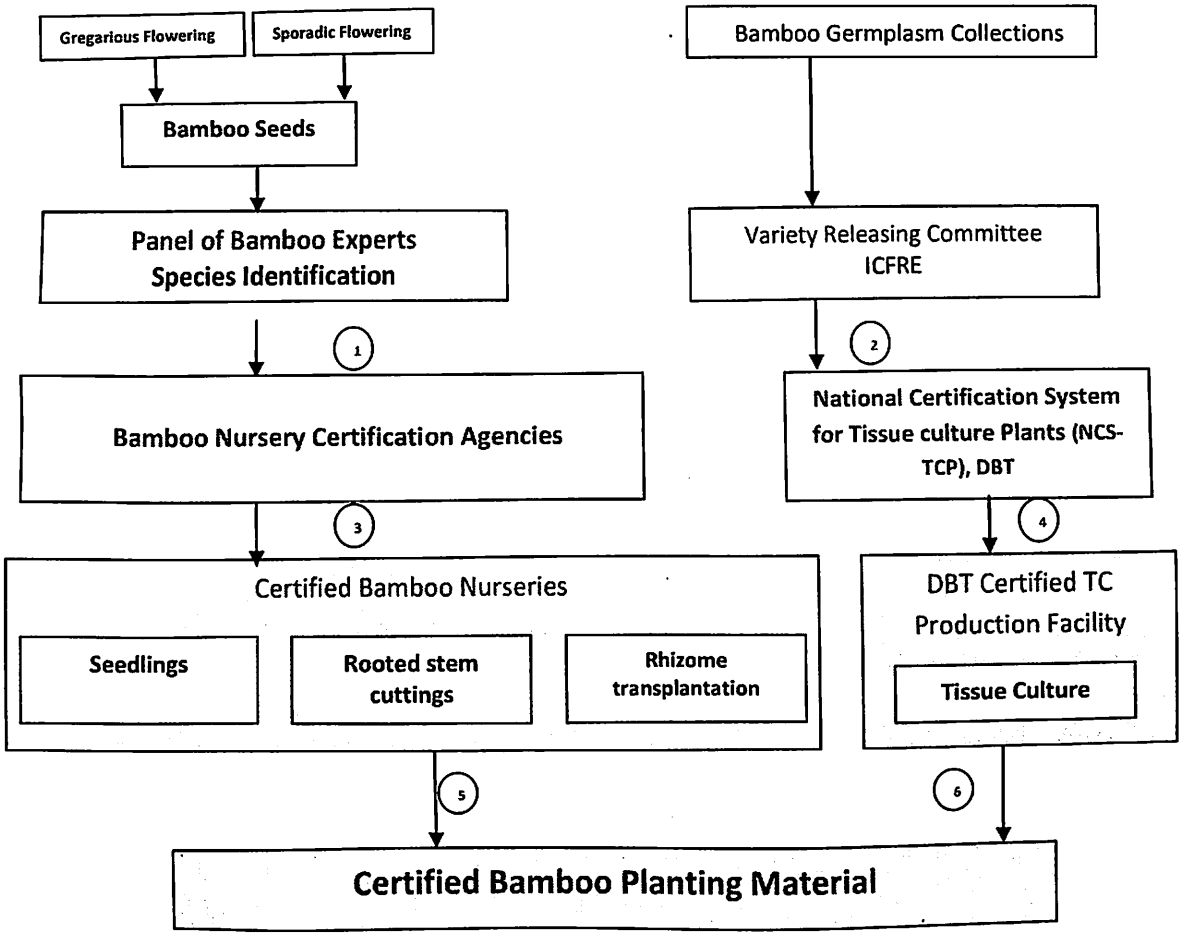
iii. Bamboo seeds or clumps correctly identified by experts based on information provided in the "Proforma for documentation of diagnostic features of seeds and bamboo planting material" (given in Appendix 2) or if necessary after visit to location, will be used for mass propagation and production of planting material. Certified Bamboo Nurseries will issue certificates (see format in Appendix 3) for bamboo planting material they produce through any of the mass propagation methods available. Such planting material will carry labels (see format in Appendix 4) that declare the essential information that give an assurance to the bamboo grower of the quality. Guidelines have also been prepared (see Appendix 1, particularly Section 6 "Overall quality") for help in complying with certification criteria relating to species identity, origin of the planting material and quality of plants.

iv. A bamboo propagule carrying the label of "Certified Bamboo Planting Material" sold from a Certified Bamboo Nursery will therefore be supported by:

a.. Certificate of plant quality and health from the nursery itself,
b. Certificate issued by the Bamboo Nursery Certifying Agency attesting to its status as a "Certified Bamboo Nursery" and/or from DBT NCS- TCP certified nursery – on demand by the customer.
c. Certificates to attest to the species and clonal identity of mother plants.

v. Certified bamboo planting material will be mandatory for NBM plantations, but bamboo nurseries will issue the certificate voluntarily on the demand of the buyer.

Framework of the process for certification of bamboo planting material



Steps marked requires Certificate for ensuring chain- of- custody documentation

6. References

i. DBT (2006) National Certification System for Tissue Culture Raised Plants Department of Biotechnology, Ministry of Science & Technology, Government of India October 2006
ii. Bamboo Tissue Culture– (BaTC)- Standards http://dbtncstcp.nic.in/downloads/Bamboo.pdf
iii. Approved Guidelines for Testing and Releasing of Tree Varieties and Clones, ICFRE (http://www.icfre.org/UserFiles/File/GUIDELINES_181108.pdf)
iv. Mohanan, C. (1997) Diseases of Bamboos of Asia: An Illustrated Manual, INBAR. 228p
v. Muktesh Kumar (2012) Bamboo Diversity and Taxonomic keys. KFRI Handbook No. 28. 99 p
vi. Muktesh Kumar (2002) Commercial Bamboos of Kerala. KFRI Handbook No. 12.KFRI.20 p

Appendix 1

Guidelines

for compliance with certification criteria

1. Identification of bamboo species

Identification of bamboo requires the involvement of an expert with adequate experience in the area. Since this activity will be carried out under the auspices of a research organization with adequate support of a library and herbarium, only a brief account of the identification procedure is given here.

All the species in the priority list can be identified clearly based on morphological features. The practical problems that are encountered in identification are many. Vegetative characteristics especially sheath morphology is of paramount significance in identification of bamboo from the adult clump in the field. The morphology of newly emerging culms is in particular very important and therefore the preservation of the sheath after the season is required. Photographing the emerging culm will capture the colour differences. Another aspect that assumes significance in the context of cultivation is the intra-specific variation that can be the equivalent of landraces, varieties or subspecies or even an accession deserving the status of a new species. Clonal differences in morphology also require attention since it facilitates the registration of clones.

Voucher specimens consisting of plant material particularly those parts with diagnostic value viz. the leaf sheath, inflorescence and seeds supplemented with photographs of the emerging culms, branching pattern etc. are required to be collected. The procedure for selection of clones would by itself ensure that the identification of the species is done by an expert. When seeds are collected for propagation the above procedure should be given attention. The voucher specimens are best deposited at a recognized herbarium or research organization and a Catalogue No. obtained for future reference.

The location of the clumps should be documented particularly with respect to the geo coordinates as ascertained by a GPS instrument and also marked on a map along with important landmarks.

Several publications in conjunction with the type herbarium specimens serve the experts in the identification of bamboo:

i. Negi, S S and Naithani, H. B (1994) Handbook of Indian bamboos, Oriental Enterprises
ii. Muktesh Kumar, MS (2002) Field Identification Key to Native Bamboos of Kerala, KFRI . 38p.
iii. http://www.eeob.iastate.edu/research/bamboo/index.html
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vii. Tewari, D.N. (1992) A monograph on bamboo . International Book Distributors, Dehra Dun 498
viii. Muktesh Kumar (2012) Bamboo Diversity and Taxonomic keys. KFRI Handbook No. 28. 99 p
ix. Muktesh Kumar (2002) Commercial Bamboos of Kerala. KFRI Handbook No. 12.KFRI.20 p

2. Seeds

When seeds are used as starting material, the species identity and origin should be ascertained by an expert. Seeds are valuable with respect to maintaining genetic variability as well as to ensure that the plantation will survive until the full flowering cycle but their genetic quality cannot be ascertained until the clumps mature after 3-6 years of planting the seedlings. The nature of the flowering viz. sporadic or gregarious flowering should be documented.

Photographs of the inflorescence, seeds in close –up with the bracts and bracts removed, should be included in the documentation accompanying the voucher samples. A scale may be included in the frame for reference. Appendix 2 gives the proforma for collecting the information essential for identification.

3. Juvenile morphology of seedlings, clonal planting material

The species identity of planting material in the nursery can often be confused and inadvertent mixing of lots is not uncommon. To enable identification by nursery men and non experts, documenting of the juvenile morphology of the various planting material is important. The diagnostic features considered to be most promising for this purpose are the leaf sheath and culm sheaths particularly the ligules, auricle and the setae and the leaf shape and ratio of the length to breadth of the leaves. The proforma (see Appendix 2) provides a means of collecting the essential diagnostic characteristics of the planting material like the morphology of the leaf and

culm sheaths, branching pattern, leaf length/breadth ratio along with digital photographs so that an expert is able to confirm the identity.

4. Genetically superior clones of bamboo

The ICFRE Guidelines for testing and release of tree varieties and clones are applicable for bamboo also. ICFRE has an ongoing programme for testing of bamboo clones previously assembled in an earlier programme. To supplement this other priority species can be added and the best clones made available for Bamboo Clonal Gardens and Rhizome Banks which will form the point from which the bamboo nurseries will source their material for mass multiplication. Any such material collected for propagation will carry the certificates attesting to their species identity and pedigree.

5. Plant health

The quality of the planting stock in the phyto-sanitary perspective has to be ensured in the certification process since it has a great influence on the performance in the plantation.

Symptoms of fungal and bacterial diseases of bamboo are well documented in the illustrated manual by Mohanan (1997). Inspection of the planting material for signs of diseases and prophylactic measures as part of the nursery management should be ensured. The Nursery Log book should record the treatment schedules and monitor the progress.

The Guidelines of the DBT recommend virus indexing and elimination of virus is desirable in bamboo. Virus free plantlets may be optional for certification of bamboo planting material except in the case of TC plants. The facilities for virus diagnosis are available at IARI, New Delhi

6. Overall quality

The quality of the bamboo planting material will also be determined by the cultural practices followed in the nursery. The vigor of the planting material is determined by the number of culms and the rhizome formation. To be sampled, the plants are removed from the container and washed in water for examining the status of the root and rhizome system. The criteria for the quality of the shoot, rhizome and root system to be followed by the Nursery for certification are as follows:

i. **Shoot system**:

a: Good quality: 4 sturdy shoots of 50 cm or more in length with healthy leaves.

b. Acceptable: At least 3 sturdy shoots which are 50 cm or longer with healthy leaves.

c. Rejected: Only 1-2 shoots or leafless/ poorly developed shoots.

ii. Rhizome system:

a. Well Developed: Number of well developed rhizomes are the same as the shoots or more.
b. Acceptable: Number of rhizomes at least the same as shoots.
c. Rejected: Without any well developed rhizomes/with damaged rhizomes.

iii. Root system:

a. Well Developed: Each shoot with profuse roots having root hairs.
b. Acceptable: Planting material with at least two functional roots per shoot.
c. Rejected: Lacking well developed root system.

7. Micropropagation

The Department of Biotechnology has done pioneering work towards developing a certification system for micropropagated plants for the first time in the world. The National Certification System for Tissue culture Plants (NCP-TCP) also includes specific standards for certification of bamboo which can be adopted for our purpose

Genetic Fidelity testing is also mandatory in the case of tissue cultured plantlets. The CDFD, Hyderabad is the designated agency for the testing.

Appendix 2

Proforma

for documenting the diagnostic features of seeds and planting material of bamboo

To be submitted to one of the experts in bamboo identification on the panel given in the NBM website (www.nbm.nic.in) to obtain approval as plant material used for propagation by Certified Bamboo Nurseries.

(The Proforma also serves as the documentation maintained by the Nursery for plant material used for propagation)

<table>
<tr><td colspan="4">A. Seeds</td></tr>
<tr><td colspan="4">Species :</td></tr>
<tr><td>1</td><td>(Include digital photo of seeds of at least 1:1 magnification here) Add scale in the frame</td><td></td><td>Scale : 1 mm markings</td></tr>
<tr><td>2</td><td colspan="3">Seed Weight: ----- gm/100 seeds (...../Kg)</td></tr>
<tr><td>3</td><td colspan="2"><u>Seed collection</u>

Date:
Location of flowering clump:
State : District: Taluk:
Forest Range:
Address, if any:

GPS coordinates:
Landmarks, if any:</td><td>4</td><td><u>Collected By:</u>
Name :
Affiliation/Designation:
Address:</td></tr>
<tr><td>5</td><td colspan="2"><u>Voucher specimen</u>
Serial No.:
Deposited at:
a. Name of repository:
b. Address:</td><td>6.</td><td>Storage Conditions:
a. Temperature
b. Container

Germination test results:</td></tr>
<tr><td></td><td colspan="2"><u>Identification done by:</u>
Name of expert:
Affiliation:</td><td></td><td><u>Annexure if any:</u>
Photographs of clump,
Sheath morphology, inflorescence</td></tr>
</table>

B. Planting material derived through mass propagation techniques

Species:

Age: 6 months/12 months /older (Specify)

1	Culm Sheath: Lower nodes (No.1-3) *(Include digital photos of 1: 1 magnification)*	2	Culm sheath: Upper (upper most 2 nodes) *(Include digital photos of 1: 1 magnification)*
3	Leaf sheath: Lower *(Include digital photos of 1: 1 magnification)*	4	Leaf sheath: Upper *(Include digital photos of 1: 1 magnification)*
5	Other morphological features: Trichomes on sheath: Length: Colour: Trichomes on leaf lamina Dorsal : Ventral: Length Colour *(Include digital photographs)*	6	Length /breadth ratio of leaf lamina Mean leaf length of 5 leaves : Mean leaf breadth of 5 leaves:
7	Branching pattern at the lowest available node *(Include digital photos of 1: 1 magnification)*	8	Culm diameter: a. Previous year's shoot b. Current year's shoot Internode length: a. Previous year's shoot b. Current year's shoot

C.	Observations of the Expert		
1	Identification of species	:	Identity of species in case of seeds:
		:	Identity of species based on juvenile morphology of planting material:
		:	Insufficient information/Additional plant material /information required
		:	Visit to location required
		:	Other remarks:
2	Recommendations and report of the experts	:	a) Species b) Variety c) Provenance d) Clone (Please also enclose a brief report)
3	Signature , Date Name and Address of Expert	:	

Appendix 3

Format of certificate to be issued by Certified Bamboo Nursery

(LOGO)	Name of Certified Bamboo Nursery		
	Certification no. Validity period:		
	Certificate of bamboo planting stock		
	(To accompany each Batch of Planting Material produced in a Certified Nursery)		
A	Full address and contact details of Certified Bamboo Nursery)	:	
	Details of certificate issued by Bamboo Nursery Certifying Agency	:	
B	**Name of Species**		
I	Scientific name	:	
Ii	Variety name/Local name (if any)	:	
C	**Origin of planting material**		
I	Accession No./Clone No.	:	
Ii	Batch No.	:	
Iii	Batch size	:	
Iv	Details of Certification from competent Authority	:	
v.	Expected year of flowering	:	
D.	**Propagation**		
i.	Mode of Propagation	:	*(Seedlings/Rooted culm cuttings/ rhizome offsets,/micropropagation. Indicate if macroproliferation was adopted and if so number of cycles)*
Ii	Details of certification from NCS-TCP, DBT for TC plants	:	

E	**Silvicultural quality**		
I	Age of planting material	:	
Ii	Number of healthy(leafy) tillers	:	Above 50 cm:
			Emerging :
Iii	Quality of rhizomes	:	*(Well developed/Acceptable/Poor)*
Iv	Quality of root system	:	*(Well developed/Acceptable/Poor)*
F	**Plant Health**		
i.	Prophylactic treatments given	:	
ii.	Incidence of diseases	:	
Iii	Incidence of pest	:	
Iv	Whether certified virus free	:	
V	Symptoms of nutritional deficiencies, if any	:	
G	**Approved Commercial end use**		
I	Biomass for timber/energy	:	
Ii	Ecorestoration	:	
Iii	Others (Specify)	:	
H	**Labeling**		
I	Attach sample of label accompanying planting material	:	
Ii	Bar code	:	
Signature , Name, designation and Seal of Certified Bamboo Nursery			Signature, Name, Designation and Seal of designated Official from Bamboo Certifying Agency
Date:			Date :

Entries in Italics are for instruction only and not to be printed

Appendix 4

Format of label for certified bamboo planting material

Logo here *Name of Certified Bamboo Nursery here*

Certification no. Validity period:

Address and contact numbers etc

CERTIFIED BAMBOO PLANTING MATERIAL

1 Name of Species :

2 Common name (in local language) :

3 Clone No. and name (If any) * :

Declaration

The bamboo material meets the specifications and standards set by National Bamboo Mission for certified bamboo planting material.

In case of complaints, write/call :

Telephone: Email :

4 Expected date (year) of next Flowering :

5 Age of planting material :

6 Price: *Print Bar code here* *

(Signature of supplier with seal)

Entries in Italics are for instruction only and not to be printed on label.

* *Optional and only if available*

Appendix 5

Criteria for qualifying as Bamboo Nursery Certification Agency

An organization which has the following infrastructures/ expertise/ programmes may be identified as Bamboo Nursery certification Agency.

1. An active research programme and at least 10 years of standing as an organization in research on bamboo taxonomy/ propagation/ genetic improvement.
2. An expert specializing in bamboo taxonomy on its rolls and empanelled with NBM for the purpose of certification
3. A recognized herbarium with bamboo collections.
4. Library with a good collection of bamboo literature
5. Bambusetum, clonal bank of important bamboo species and bamboo germplasm collections or easy access to such collections.

Appendix 6

Indicative list of organizations with competence to certify bamboo nurseries

1. ICFRE Institutes with an active bamboo research programme (taxonomy in particular)
2. Kerala Forest Research Institute, Peechi
3. Bose Institute, Kolkata
4. Institute of Himalayan Bioresource Technology (IHBT), Palampur, HP
5. National Botanical Research Institute, Lucknow
6. Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI), Palode, Kerala
7. SFRI, Itanagar
8. University Departments with an active bamboo research programme.