

# INSTITUTE OF FOREST GENETICS AND TREE BREEDING, COIMBATORE

The Institute of Forest Genetics and Tree Breeding (IFGTB) is a national Institute formed in April 1988 under the Indian Council of Forestry Research and Education (ICFRE), an autonomous Council under the Ministry of Environment and Forest, Government of India. It was formed by upgradation of the Forest Research Centre (FRC), Coimbatore under the Forest Research Institute and Colleges, existing since 15<sup>th</sup> December 1959. Certain other organizations and schemes viz., Forest Soil-cum-Vegetation Survey (FSVS), Coimbatore, Disease and Insect Survey (DIS), Coimbatore, Indo-Danish Project on Seed Procurement and Tree Improvement (IDPSPTI), Tropical Pines Research Centre (TPRC), Kodaikanal Eucalyptus Research Centre (ERC), Ooty and Environmental Research Station (ERS), Ooty were also merged with the FRC to form the Institute.

An abstract of projects run by the Institute is as follows:

	No. of projects completed in 2007-08	No. of ongoing projects in 2007-08	No. of projects initiated in 2007-08
Plan Projects	3	23	10
Externally Aided Projects	5	14	-
<b>Total</b>	<b>8</b>	<b>37</b>	<b>10</b>

## PROJECT COMPLETED DURING THE YEAR 2007–2008

### PLAN PROJECTS

#### **Project 1: Enhancing productivity in *Casuarina* species through inter-provenance and inter-specific hybridization [IFGTB/RP-30/2003-08]**

**Findings:** Forty families of inter-provenance and inter-specific hybrids of *Casuarina equisetifolia* and *C. junghuhniana* were produced through control pollination. Three field tests were established at Veedur (Tamil Nadu), Panampalli (Kerala) and Sriharikota (Andhra Pradesh) to test the performance of F<sub>1</sub> progeny. All the tests were assessed for height and survival at 6 months age. Survival was more than 90% in Veedur and Panampalli and 85% in Sriharikota. Inter-specific hybrid families showed better height growth than local seedlings and seed orchard progenies of pure



Hybrid trial of *Casuarina* showing vigorously growing inter-specific hybrid trees and slow growing trees of parentspecies (Panampalli, Kerala)



species. The best inter-specific hybrid family showed 35 to 53% better height growth than local seedlot and 17 to 21% over orchard progenies. The average height of the best 5% of trees was 49 to 68% more than that of local seedlot and 29 to 32% over orchard progeny. The trials will be maintained upto 5 years age and periodic assessment of growth and form traits will be gathered for further ranking of families and individuals.

### **Project 2: Status and floristic diversity of sacred groves—the only remnants of natural forests in Alappuzha District, Kerala [IFGTB/RP-35/2005-08]**

**Findings:** Alappuzha is the smallest (1414 km<sup>2</sup> area) district in Kerala with a high population density (1492 persons per km<sup>2</sup>) and is the only district in the State without natural forests. The sacred groves of the district attract utmost attention as they are the only remnants of natural forests once present. Undertaken field survey in all the six taluks of the district covering 91 villages and enumerated 1128 sacred groves. The total area recorded under these groves was 83.55 ha. Nearly 40% of the groves had sacred pond associated with it. Considerable variations were observed with respect to extent of the groves and species composition. Area of these groves ranged from 0.003 to 36 acres. Most of the groves are abode of many endemic and rare plant species. A total of 687 plant species belonging to 493 genera and 127 families have been identified from these groves. Many sacred groves in the district face threat due to the dense human population and change in socio-economic status. Break up of ancestral joint family system to nuclear families is the major reason for deterioration of these valuable resources. Sanskritisation and changes in beliefs are also attribute to this denudation. Over exploitation of the resources by 'Ulladans' a tribal community and removal of litter alongwith the seeds from the floor have also led to its retrogression to a great extent. Exotic weeds namely, *Mikania micrantha*, *Lantana camera* and *Chromolaena odorata* overgrow the native species and play a major role in degradation. Sacred groves require complete protection from human interferences and is the only way to preserve these priceless treasures of nature. 'Ulladans' should be made aware of the importance of the vegetation system and the rational and sustainable exploitation of the resources. People who clear the grove after transferring the deities to the serpent worship temples for various developmental activities should also be sensitized to avoid further damage. Officials of Forest Department, Research Organizations, NGOs and Educational Institutions should take lead in imparting knowledge on the functional role and importance of sacred groves. They also should help in ecological restoration of the retrogressing sacred groves by way of selecting and planting suitable plant species. In general, each sacred grove was found to possess its own unique biological, ecological, cultural and economic dimensions. Financial supports / rewards to the individuals and trusts maintaining these groves will go a long way in preserving them intact for posterity.

### **Project 3: Studies on seed handling and storage behaviour of important NTFP species [IFGTB/RP-34/2005-08]**

**Findings:** Suitable seed handling techniques for four important NTFP species namely, *Calophyllum inophyllum*, *Decalepis hamiltonii*, *Garcinia gummigutta* and *Sapindus emarginatus* were standardized. Fruits of *C. inophyllum* have to be picked up at yellow-green stage of fruit maturity. Seeds were found to be desiccation sensitive with a Lowest Safe Moisture Content of 15%, and

studies showed that seeds can be stored for 30 days at temperature range of 10 to 20°C to prolong viability. Significant reduction in carbohydrate content and oil content could be the key factors involved in reducing viability within a period of 30 days, a tendency common in recalcitrant seeds. It is, therefore, advisable to store seeds in sealed polythene bags at a temperature range of 10 to 20°C.

*D. hamiltonii* seeds extracted from fruits collected during late March-April were found to be well matured and recorded 83% germination. Soaking in hot Water (60°C) for 24 hours was found to improve germination significantly to 98% than control. Germination on paper medium followed by transplanting to root trainers with red earth, sand and FYM (1:1:1) was found suitable for this species. Low temperature storage was not favourable and ambient storage (32±1°C) was found the best. *Decalepis* seeds can be classified as intermediate in storage behaviour with more inclination towards recalcitrance. Ambient storage of fresh seeds in sealed polybags upto 2 months is advisable. Depulping *G. gummigutta* fruits to extract seeds followed by abrasion of seeds with sand and washing with kerosene were found suitable pretreatments for cleaning seeds and rendered them suitable for germination. Shade drying seeds for 2 weeks was found suitable than sun drying and seed were desiccation tolerant. Upto 6 months, seeds withstood ambient temperature whereas upto one year storage 20°C was found favourable. The seeds did not show good storage response to different pre-storage trials such as seed dusting with protectants and moist sand storage. Seeds could be classified as intermediate in nature. Thus, storing *G. gummigutta* seeds in air tight pet jars without any storage treatments is the most suitable one.

*S. emarginatus* seeds with initial moisture content of 8.826 % showed germination of 62.5%. Pretreatments did not improve germination. Increasing trend in carbohydrate content over a period of 12 months storage could be attributed to setting of improved desiccation tolerance in the seeds. Seeds can be classified as orthodox in nature. *S. emarginatus* seeds can be safely stored in sealed polybags at room temperature or in a refrigerator upto 9 months.

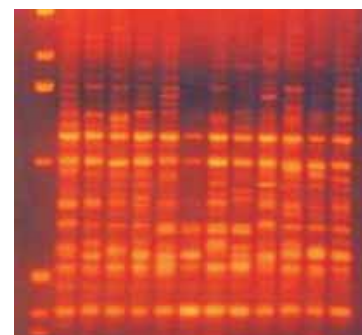


Flowering, fruiting, seeds and seedlings of *Sapindus emarginatus*

## EXTERNALLY AIDED PROJECTS

### Project 1: Genome evaluation and characterization in Casuarinas and Eucalyptus for improving productivity and conservation

**Findings:** The project aimed at assessing the genetic diversity in different population levels in *Casuarina* and *Eucalyptus*, specifically targeting those which are currently utilized under the breeding program developed by the Institute. The second major focus of the project was on developing end use markers for diagnosing species identity and specific traits. The genetic diversity existing between and within six eucalypts and five *Casuarina* species were assessed



ISSR-PCR profile of the species *Eucalyptus tereticornis* for genetic diversity estimation



using ISSR marker system. Subsequently, nine species-diagnostic markers were identified for *Casuarina* and *Allocasuarina* species and twenty one diagnostic markers were identified for five species (*E. camaldulensis*, *E. citriodora*, *E. grandis*, *E. tereticornis* and *E. urophylla*).

These markers were converted into SCAR markers in *C. equisetifolia* and *C. junghuhniana*. At the sub specific taxa level, genetic diversity was estimated within and between fifteen provenances of *E. tereticornis*, six progenies of seed orchards of *E. camaldulensis* and *E. tereticornis*, forty superior performing clones of *E. tereticornis* and *E. camaldulensis*, four SSOs of *C. equisetifolia* and two SSOs of *C. junghuhniana* using ISSR marker system. Further, three putative markers were identified using RAPD and four markers using SSRs for non-rooting clones of *E. tereticornis* and the SSR markers were validated at the family level. The project also provided leads for developing early selection markers for pulping trait in *E. tereticornis*, where in allelic diversity in the CCR and CesA genes were correlated with the holocellulose, lignin and pentosan content of the wood.

### **Project 2: Identification of Broad Spectrum Antifungal Proteins from Elite Medicinal Plants for Control of Plant Pathogens**

**Findings:** The project aimed at identification and characterization of broad spectrum antifungal proteins from medicinal plants including *Acorus calamus*, *Withania somnifera*, *Piper longum* and *Rauwolfia tetraphylla*. Initially the above mentioned species were screened for antifungal proteins and *A. calamus* and *W. somnifera* were short listed for protein purification. Further, optimized the source tissue, developmental stage and buffer composition for extraction of total proteins with antifungal activity from these two species. Subsequently, purified a 32 KDa antifungal protein from leaves of *A. calamus* with pI value of 7.93, pH optima at 5.6 and temperature optima at 36°C. The protein was localized in the epidermal layers and xylem lumen of the leaf tissues. The peptide sequence showed similarity to peroxidase from *Oryza sativa*. It inhibited the hyphal extension of major pathogens including *Trichosporium vesiculosum*, *Macrophomina phaseolina* and *Fusarium moniliforme*. In *W. somnifera*, an acidic lectin with 30 KDa size and pI value of 4.0 was purified. It showed a similarity with concanavalin; A like lectin from *Canavalia maritima* and inhibited the hyphal extension of *T. vesiculosum*, *M. phaseolina*, *F. moniliforme* and *Rhizoctonia solani*.

### **Project 3: Refinement of *in vitro* multiplication protocol for *Bambusa nutans* and *Dendrocalamus giganteus***

**Findings:** Developed *in vitro* axillary bud proliferation protocol for the multiplication of mature plants of *Bambusa nutans* and *Dendrocalamus giganteus*. Pruning of actively growing culms was effective in *D. giganteus* for the emergence of axillary shoots, where more explants with suitable size can be extracted for inoculation. Modification in supply of Nitrogen and Magnesium was found to be favorable for culture establishment and shoot multiplication in *D. giganteus*. Addition of low levels IBA was effective in controlling shoot necrosis of *D. giganteus* rooted plants. Glucose as a carbon source was identified as the major regulator for root induction in multishoots derived from mature plants like *B. nutans* and *D. giganteus*. Field demonstration trial was established with 500 plants of *B. nutans* in the ongoing field trial project for tissue culture plants.

#### **Project 4: Selection and clonal propagation of commercially important medicinal plants [IFGTB/GO/TN-11/2005/Ext/2005-08]**

**Findings:** 60% to 90% rooting of different genotypes was observed in the combination of 100 ppm IBA concentration and composted coirpith in *Tinospora cordifolia*. Cuttings from young trees of *Aegle marmelos* responded to the combination of 2000 ppm IBA concentration and vermiculite. 60% rooting was observed. In the case of *Terminalia bellerica*, woody branch cuttings were tried with different concentrations of IBA and potting media. Initially, 3% of rooting was observed in the combination of 2000 ppm IBA and vermiculite. Further, using serial propagation technique, rooting of cuttings from the rejuvenated plants was enhanced to 30% using the combination of IBA and NAA with a concentration of 1500 ppm each and soilrite. Eleven genotypes of *Tinospora cordifolia* were subjected to biochemical analysis for alkaloid content. High alkaloid content was observed in the roots of the genotype from Anaikatti with a value of 50.8 genotypes of *Aegle marmelos* were studied for alkaloid content. High alkaloid content was observed in the leaves (64) and fruits (80) from the genotype in IFGTB campus. Four genotypes of *Saraca asoca* were studied to find the tannin content. High tannin content was observed in the leaves (3.22) of the genotype from Peechi, Kerala and in the bark (22.03) of the genotype from Courtrallam. Twenty four genotypes of *Terminalia chebula* were studied to find the tannin content. High tannin content was observed in the bark (8.69) of the genotype from Bargur and in the fruits (7.36) of the genotype from Thalaimalai.

#### **Project 5: Development of yield assessment methods for *Eucalyptus* species and *Anacardium occidentale* using image analyzer (Funding agency: Tamil Nadu Forest Plantation Corporation-TAFCORN) [IFGTB/EF-RP-22/2005-07]**

**Findings:** Methods were developed for single tree height, diameter and volume estimation. Pictures taken from 10 to 30 metres ground distance with a reference scale at breast height can be measured using Image analyser. Correction factors were worked out for the above measurements to estimate actual height, diameter and volume. Height and diameter of single tree can be estimated in high precision and accuracy with an error of  $\pm 1.0\%$ . A formula was developed and validated for estimation of single tree volume from trunk surface area and height. This method of volume estimation showed an error of  $\pm 3.02\%$ .

## **PROJECTS ONGOING DURING THE YEAR 2007–2008**

### **PLAN PROJECTS**

#### **Project 1: Genetic Improvement of *Eucalyptus tereticornis* Smith through controlled pollination and molecular characterization [IFGTB/RP-3/2002-08]**

**Status:** Control pollinated hybrids in combination of *E. tereticornis*  $\times$  *E. grandis*, *E. tereticornis*  $\times$  *E. alba* and *E. tereticornis*  $\times$  *E. pellita* were developed. Three trials were developed in Kerala and Tamil Nadu. The Tamil Nadu Forest Department has raised a full-sib trial consisting 6 full-sib families in the State Forest Research Institute at Kolapakkam. Growth parameters at 60 months



indicate *E. tereticornis* x *E. grandis* as a viable combination. Thirty hybrid selections have been made in Panampally, Kerala and Sadiwayal, Tamil Nadu for clonal testing during 2008-09 for field transfer.

### **Project 2: Genetic improvement of *Acacia auriculiformis* through half-sib progeny selection [IFGTB/RP-39/2005-10]**

**Status:** Two progeny trials of 1 ha each consisting 132 half-sib families of selected superior trees were established at Palode (Trivandrum) and Vadakkancherry (Thrissur) in Kerala. Maintenance activities like weeding and fire tracing were undertaken in all four progeny trials established at Pondicherry, Vadakkancherry, Panampally and Palode. The trial at Panampally has been evaluated for growth parameters as well as stem form. Profound variations were observed for these characters among families.



Progeny trial (one and half year old) of *A. auriculiformis* at Panampally, Kerala

### **Project 3: Phenotypic selection, reproduction and propagation in *Ailanthus excelsa*: Perspectives for Safety Matches Industry and Farmers in Tamil Nadu [IFGTB/RP- 40/2005-09]**

**Status:** Seeds were collected from different agroclimatic zones of Tamil Nadu, Rajasthan, Madhya Pradesh, Andhra Pradesh and Uttarakhand and seedlings were raised for establishing germplasm banks. One germplasm bank has been established in Tirupati, Andhra Pradesh. Two locations in different agroclimatic zones have been identified in Tamil Nadu for establishing two more germplasm banks.



Germplasm bank of *Ailanthus excelsa* at Tirupati, Andhra Pradesh

### **Project 4: Genetic transformation of *Eucalyptus tereticornis* and *Casuarina equisetifolia* to enhance salinity tolerance [IFGTB/RP-6/2002-05]**

**Status:** A standard protocol for regeneration and transformation of *Eucalyptus tereticornis* was developed. Both direct and indirect transformation experiments were carried out by using different strains of *Agrobacterium* like GV2260 and EHA 105 with pCAMBIA 1305.2 and pCAMBIA 1305.1, GV2260 harboring the Osmotin gene and also LBA 4404 harboring the gene construct AtNH. Various pre-incubation treatments including *Agrobacterium* concentrations, cocultivation durations, sonication treatments (0 and 50 A), and calcium chloride treatments (0 and 20  $\mu$ M) on the explants were optimized. Particle gun mediated transformation was attempted and the results indicated very good positive transient expression in *Eucalyptus tereticornis*. In *Casuarina equisetifolia* experiments were carried out in Epicotyls of the provenances 00254 (Karunya), 00249 (Pondichery), and also from other 17 provenances for dedifferentiation in media containing 5  $\mu$ M BAP and 10 $\mu$ M BAP with 0.005  $\mu$ M of NAA. Callus response was observed in all the provenances.

**Project 5: Studies on the population structure and reproduction of *Pterocarpus marsupium* in Tamil Nadu and Kerala [IFGTB/RP-37/2005–08]**

**Status:** Surveys were carried out in 13 distinct populations of *Pterocarpus marsupium* in Western Ghats of Tamil Nadu. In total, 283 representative trees were marked and studied for morphological parameters and phenology.

**Project 6: Evolving silvicultural practices for *Casuarina junghuhniana* ssp. *timorensis* [IFGTB/RP-33/2005–09]**

**Status:** A total of eight field trials have been established both in coastal and inland areas covering five agroclimatic zones in Tamil Nadu, using seedlings raised from 59 different seed sources. In all these field trials growth performance of *C. junghuhniana* at different spacing levels (0.5 x 0.5 m to 2 x 1.5 m- 7 levels) will also be evaluated.

**Project 7: Identification of conserved motifs in genes conferring salt tolerance to develop strategies for gene isolation from salt tolerant tree species [IFGTB/RP-28/2005–08]**

**Status:** More than 4500 sequences of the genes conferring salt tolerance were downloaded. A number of Bioinformatics software Tools such as Clustalw, CLC free workbench; Geneious, primer software etc. were used for analysis. Conserved motifs are identified for the different genes under the main classification such as Transcription factors Cellular signaling components, Ion transporters, Proton transporters, Water transporters, Molecular chaperones-protein stabilization, ROS scavenging, Membrane fluidity, Osmo protection etc. Primers are obtained from conserved motifs wherever exists for most of the genes using tools.

**Project 8: Natural regeneration studies on important trees in Silent Valley National Park, Kerala [IFGTB/RP-32/2004-09]**

**Status:** Enumeration of trees and their regeneration status in different ecosystems in Silent Valley National Park has been studied. A total of 96 tree species have been enumerated from the sample plots and recorded the girth, number of seedlings and saplings for preparation their population structure. Soil samples were collected for assessment of soil seed banks of trees in different ecosystems.

**Project 9: Studies on the diversity of bee fauna of the Nilgiris [IFGTB/RP-36/2005–08]**

**Status:** In total, 35 species of bees have been collected and data gathered on vegetation in 32 sampling locations covering 9 forest types and 4 plantations. The floral associations of these bees species were studied. Threat factors on bees were also assessed.

**Project 10: Assessment on carbon pool potential of important tree species at different sites, ages and management regimes [IFGTB/RP-41/2006-11]**

**Status:** To assess carbon pool potential in *Casuarina* plantations, 183 trees were felled from 63 plantations in four agroclimatic zones of Tamil Nadu under different soil types and under irrigated and rainfed conditions. Soil samples were also collected and analyzed for carbon.


**Project 11: Assessment of insect pest problems of selected fast growing indigenous tree species in Tamil Nadu and Kerala [IFGTB/RP-42/2006-09]**

**Status:** Insect pest surveys carried out in nurseries, plantations and natural population of *Gmelina arborea*, *Dalbergia sissoo*, *Ailanthus excelsa*, *Melia dubia*, *Thespesia populnea*, *Bombax ceiba* and *Morus alba* at Amaravathi, Arimalam, Melakadu, Bhavanisagar, Sathiyamangalam, Theni, Mayiladumparai, Thangachimadam, Kodumudi, Vangal and Mahadhanapuram in Tamil Nadu and Kulathupuza, Sanjivanivanam Poothotam, Kalluvarambu, Tuillivellam (Nilambur), Attapaddy, Walayar, Karvoor and Chalakudy in Kerala revealed the following important insect pests.

S. No.	Tree species	Pests recorded	Major pests	Natural enemies recorded
1.	<i>Gmelina arborea</i>	2 Sap suckers ( <i>Clovia</i> sp. and <i>Tingis beelsoni</i> ), 2 defoliators ( <i>Myllocerus discolor</i> and <i>Eupterote geminata</i> ), 2 stem borer ( <i>Sahydrassus malabaricus</i> and <i>Indarbela quadrinotata</i> )	<i>E. geminata</i> , <i>S. malabaricus</i> , <i>I. quadrinotata</i> and <i>T. beelsoni</i>	One Entomopathogenic fungus on <i>S. malabaricus</i>
2.	<i>Dalbergia sissoo</i>	1 Sap sucker (Coccids), 3 defoliators ( <i>Myllocerus discolor</i> , <i>M. viridanus</i> and <i>Dasychira mendosa</i> ) and 1 unidentified defoliator	<i>M. discolor</i>	—
3.	<i>Ailanthus excelsa</i>	2 Lepidopteran defoliators ( <i>Atteva fabriciella</i> and <i>Eligma narcissus</i> ), 1 stem borer ( <i>I. quadrinotata</i> ), 1 sap sucking mealy bug ( <i>Maconellicoccus hirsutus</i> ) and the leaf minor	<i>A. fabriciella</i> , <i>E. narcissus</i> and <i>M. hirsutus</i>	One Coccinellid beetle (predator) on the mealy bug <i>M. hirsutus</i> , 2 different spiders on the larvae of <i>A. fabriciella</i>
4.	<i>Melia dubia</i>	<i>Boarmia virigata</i> , 1 scale insect (Coccids) and 1 grass hopper <i>Orthacris</i> sp.	<i>Orthacris</i> sp.	—
5.	<i>Thespesia populnea</i>	2 Defoliators ( <i>Orthacris</i> sp. and a lepidopteran pest)	<i>Orthacris</i> sp.	
6.	<i>Bombax ceiba</i>	1 Scale insect, stem borer <i>Batocera</i> sp., and the bark feeding borer <i>I quadrinotata</i> .	<i>I. quadrinotata</i> and <i>Batocera</i> sp.	—
7.	<i>Morus alba</i>	1 Defoliator - <i>Spodoptera litura</i> , 1 mealy bug <i>M. hirsutus</i> (Pink mealy bug) and white flies	<i>S. litura</i> and <i>M. hirsutus</i>	Two Coccinellid beetles on the mealy bug <i>M. hirsutus</i>



Data on the percentage/intensity of attack of the pest, nature of damage caused and the climatic conditions such as temperature and humidity were also recorded. The insect specimens collected from the field were reared in lab condition and preserved for further studies and also for identification purposes. Out of 13 insect species identified so far, 3 were new record on the host plants (*Gmelina arborea*, *Bombax ceiba* and *Thespesia populnea*) studied.

### Project 12: Origin, distribution and genetic diversity of *Jatropha curcas* in India [IFGTB/RP-43/2006-08]

**Status:** Fifteen enzyme systems have been evaluated for their efficacy in distinguishing the accessions. While three (formate dehydrogenase, malate dehydrogenase and peroxidase) were found useful, twelve did not exhibit any variation and had fixed monomorphic alleles. Each polymorphic enzyme system produced one well resolved polymorphic region except peroxidase which had three. On an average, 4 loci (26.67%) were found to be polymorphic (P) and mean observed number of alleles per locus (A) was 1.533. Average observed heterozygosity ( $H_o$ ) was 0.1082 and expected value ( $H_e$ ) was 0.0993 with and gene flow  $Nm=0.2177$  showing low level of genetic variation among different accessions suggesting poor segregation of genes over generations. The isozyme variation was measured by standard gene diversity measures using POPGENE v. 1.32. Dendrograms constructed for the above 55 accessions using the zymograms reveal that all the land races have very low heterozygosity.

DNA extraction procedures were standardized to avoid latex contamination. PCR protocols were optimized by carrying out variations in  $MgCl_2$  concentration, primer concentration, DNA and buffer volume.

## EXTERNALLY AIDED PROJECTS

### Project 1: Germplasm collection and production of improved planting stocks of *Terminalia chebula* Retz. and *Terminalia bellerica* [IFGTB/EF-RP/2005-08]

**Status:** Vegetative propagation in *Terminalia chebula* and *T. bellerica* have been standardized. Among the rooting of branch cuttings, aird layering, budding and grafting the wedge grafting method was found to be relatively successful. Grafting of selected trees in Kallar, Talwadi, Bargur and Kalrayan hills areas of Tamil Nadu were attempted. Selection criteria for plus tree selection based on fruit yields and quality have been standardized. Eighty five superior trees of *T. chebula* and 17 superior trees of *T. bellerica* have been selected in various places in Tamil Nadu based on fruit yield. Fruit samples have been collected from these identified trees for biochemical analysis. Four distinct populations *T. chebula* and five populations of *T. bellerica* were screened for medicinally important biochemical compounds like total phenols, tannins, gallotannin, free gallic acid and ellagitannins to investigate



*Terminalia chebula* trees in farmland at Kalrayan Hills, Tamil Nadu



the relationship between geographic location and the biochemical content. Though variations were being observed between populations for all these compounds, the tree- tree variation within populations were higher.

### **Project 2: Population structure and reproduction in *Bruguiera* and *Ceriops* : implication on conservation [IFGTB/EF-RP-26/2005-08]**

**Status:** Based on three years of observation in Pitchavaram, it is understood that flowering is strongly seasonal. Studies in 5 different taxa of Rhizophoraceae reveal unique reproductive phenology and pollination syndromes. Inflorescences are borne sub-terminally only on the second and third nodes immediate to the meristamatic tips of vegetative branches. Flowers are strongly protandrous and dichogamous. Spatially anthers are placed well above the gynoecium. After complete anther dehiscence and dispersal, the stigma projects out of the dried anther mass. On a temporal scale, male and female phases are separated 1-2 days. *Bruguiera* and *Ceriops* are entomophilous. *Bruguiera cylindrica* is pollinated by thrips (intra floral pollination) while *Ceriops decandra* is pollinated by diverse taxa of insect visitors. Pollen fertility in *Bruguiera* and *Ceriops* is comparatively lower to the values reported in other out breeding woody perennials Despite having multiple ovule system (4-6), only one ovule succeeds in developing into a propagule. In *B. cylindrica*, propagules develop within 3-4 months and in *C. decandra* and *C. tagal*, it is 6-8 months. Diverse floral features, high pollen output, very high pollen to ovule ratio and low reproductive success noticed in *Bruguiera* and *Ceriops* places them amongst highly out crossing woody perennials.

### **Project 3: Field performance of micro and macro-propagated planting stock of selected five commercially important Bamboo species [IFGTB/EF-RP-17/2004-07]**

**Status:** It is a networking project among IFGTB, IWST and KFRI for raising demonstration trial of tissue culture (TC) plants for five species. IFGTB has established trials for three species namely *Dendrocalamus strictus*, *Pseudoxytenanthera stocksii* and *Bambusa bambos* in an area of 25.0 ha. Growth performance of the tissue culture raised plants has been assessed with the cuttings and seedling raised plants. Preliminary results showed that the cutting propagated plants of *P. stocksii* showed 4.2 shoots per clump whereas the micro-propagated plants of the same clone produced 5.7 shoots. In *D. strictus*, cutting propagated plants produced more number of shoots (8.5) than the micro-propagated plants.



Three months old tissue culture raised plants of *Bambusa bambos* in the field

### **Project 4: Germplasm conservation and establishment of seed stands for production of quality seeds and seedlings [IFGTB/EF-RP-9/2003-06]**

**Status:** Standardized seed handling techniques including storage, testing and germination for *Saraca asoca*, *Tinospora cordifolia*, *Oroxylum indicum*, *Gymnema sylvestre*, *Strychnos potatorum*, *Aegle marmelos*, *Embllica officinalis*, *Embelia ribes* and *Asparagus racemosus*.

**Project 5: Evaluation of superior planting stock of *Acacia mangium* in agroforestry systems at different eco-climatic zones of Kerala and Tamil Nadu [IFGTB/EF-RP-11/2003-06]**

**Status:** Eight experimental plots (in 2.8 ha) with superior planting stocks of *Acacia mangium* under agroforestry systems have been established and intercropping activities carried out in Tamil Nadu and Kerala. Six representative trees in three girth classes were felled for biomass estimation in two plots.

**Project 6: Ecorestoration for Tsunami devastated coastline of Andaman Group of Islands [IFGTB/EF-RP-20/2004-07]**

**Status:** The project envisages planting of 60 ha areas, over a period of three years. Out of the total target, an area of 41.2 ha has been completed so far in Sippighat, Chouldari, Kadakachang, Adajig, Rangat, Long Island and Casuarina Bay. Some of the plants are affected by Mealy Bug and the staff were advised to spray the pesticide Confidor. Insect samples along with twig have been collected for identification. About 300 Forest Department staff of Andaman have been trained in the establishment and management of nurseries and plantations.

**Project 7: Establishment of Bamboo model plantations in different agroclimatic zones of Tamil Nadu using quality planting stock [IFGTB/EF-RP-21/2005-08]**

**Status:** Model plantations of bamboo have been established in 60 ha with six different species of both tissue culture and macro-propagated planting stocks in five agro-climatic zones of Tamil Nadu.

**Project 8: Bamboo Location Trial (BLT) – Funded by NMBA, TIFAC, DST [IFGTB/EF-RP-23/2005-07]**

**Status:** Multi-location trials were established using 8 different bamboo species under 9 different nutrient management as well as under organic and inorganic farming methods.

**Project 9: Development of post harvest techniques for seed production in *Jatropha curcas* (DBT Funded project) [IFGTB/EF-RP-24/2005-07]**

**Status:** Flowering and fruiting phenology studies indicated that *Jatropha curcas* has high reproductive efficiency with reference to the selected locality, Anaikatti. Fruits at yellow stage gave 95% germination indicating the attainment of physiological maturity. Studies on effect of fruit colour (maturity) on oil content and quality showed that the colour/ maturity stage of the fruits processed for oil extraction had considerable effect on oil characteristics like Acid value, Iodine No., Peroxide Value and Viscosity. The results indicate that fruits need to be harvested at late yellow stage or black pulpy stage and is safer to avoid collecting fruits at dry stage. Effect of drying method on *Jatropha* oil was studied in seeds extracted from fruits at black pulpy stage. Considering the oil yield, shade drying for 10 days and oven drying at 40°C for 1 day were found suitable methods. However, desirable values for most of the oil characteristics in the oven drying treatment at 40°C for 1 day renders it superior to 10 days of shade drying treatment. Comparing the oil yield during the two seasons, it is found that during the second season (October-December), the oil yield in *Jatropha* is more than the first one (July-September). Also the oil physical and chemical



characteristics are favourable during the second season. It is essential to separate the shell or seed coat from seed in order to restrain loss of oil through absorption by seed coat and thereby maximize oil recovery. The experiment revealed that soaking *Jatropha* seeds for 24 hours in water followed by 2 hours drying helps in recovery of good seeds. The infection in the seeds was confirmed through the X-ray images. The quality characteristics of oil were low in 5% moisture content seeds compared to 6%. Hence it can be concluded that 6% moisture content is the Lowest Safe Moisture Content to which *Jatropha* seeds need to be dried. Effect of storage container on seed oil parameters and viability, was tested on seeds stored in different containers such as polybag, jute bag, cloth bag, paper bag and black polybag. The most apt material to store *Jatropha* seeds as revealed by the study would be cotton cloth bag or jute bag. Effect of different temperatures on storability of *Jatropha* showed interim results which suggest that seeds could be stored at 10-15 °C (normal refrigerated conditions) to obtain maximum oil content with desirable characteristics. Viability of seeds was observed to drop after nine months of storage. Studies are still in progress. Storage studies on effect of atmosphere, pre-storage treatments and mid-storage correction are in progress.

**Project 10: Differential analysis of transcript expression in *Casuarina trichosporium* interaction to isolate defense-Related Genes [IFGTB/EF-RP/2006-09]**

**Status:** The project aimed at cloning Initially, the conditions for elicitation of optimal disease response were standardized. Subsequently, transcript profiling in untreated and elicitor treated *C. equisetifolia* was performed using 9 arbitrary primers, 81 anchored DD-PCR primers and five gene-specific primers. Further, 183 amplicons were re-amplified and 75 selected fragments were cloned in pDRIVE vector and sequenced. The differentially expressed transcripts during elicitation included R gene, arabinogalactan, *hsp*, LEA-dehydrin, ARF, defensin, endochitinase, nodulin, extension and CRR transcripts and SCARFACE. Further, designed and synthesized 8 gene specific primer pairs and 7 nested primers for the above mentioned transcripts for RACE. Also constructed an expression library in lTriplEx2 vector with pfu / ml of  $4 \times 10^6$  independent plaques and 75% recombinants.

**Project 11: Infrastructure development of the Botanical Garden of the Institute of Forest Genetics and Tree Breeding and *ex-situ* conservation of selected rare and threatened species (Funding Agency: MoEF 2007) [IFGTB/EF-RP/2007-08]**

**Status:** Ten RET species and 140 other plant species have been collected from Thanderai, Ulundurpet, Yercaud, Anaikatty and adjoining areas (Tamil Nadu), Anandagiri, Venkatagiri, Thirupati hills (Andhra Pradesh), Pondicherry, Trivandrum, Trissur, Kanjikkode, Pokkunnu, Calicut University, Kasargod (Kerala) and are being maintained in the Botanical garden. Infrastructure development works like repair of green house and labelling of plants in the garden have been completed.

**Project 12: Bioproduction of secondary metabolites from *Aegle marmelos* [IFGTB/EF-RP/2006-09]**

**Status:** Phytochemical screening of the leaves and roots of the species reveals, in general the secondary metabolites distributed in both the leaves and roots of the species. It was observed that steroids, carbohydrates, amino acids, reducing sugars, Triterpenoids, Catechin, Flavanoids were present in both the plant parts. Alkaloids and tannins were not detected in the leaves. Phenolic compounds were not detected in the roots. Anthroquinones and saponins were not detected in the species.

Different growth regulator concentrations were tested for the initiation of callus from different explants. It was observed that shoot and root explants responded well to the growth regulators while leaf explants showed slow and poor response. Response was good in explants inoculated in 6.0 mg / L 2, 4-D. Response was good with root and hypocotyl explants in eight different media compositions with the initiation period ranging from one to three weeks. Calli produced had a weight ranging from 85-100 mg on fresh weight basis.

### **Project 13: Establishment of seed production systems for NTFPs of Attapady hills [IFGTB/EF-RP/2006-08]**

**Status:** The species under study were recommended by AHADS as they are important NTFP species utilized by the tribals. These species needed to be reintroduced into the area. Seed biology of *Aegle marmelos*, *Terminalia bellirica*, *Oroxylum indicum*, *Acacia concina*, *Saraca asoca*, *Asparagus racemosus* and *Caesalpinia sappan* were studied.

Seedlings of the above mentioned species were raised and planted as 100 plants plot in an area of 1.5 ha as a model seed production system for NTFPs at Vattaluki in Agali, Kerala, a tribal village. All the plants are surviving well.

### **Project 14: Developing strategies for describing, testing and registering varieties of forest tree species in India [IFGTB/EF-RP-23/2006-08]**

**Status:** Selected trial plots of *Eucalyptus camaldulensis*, *E. tereticornis*, *Casuarina equisetifolia* and *C. junghuhniana* were visited in the State of Tamil Nadu. Probable characters which can be used as descriptors for these species were identified. These characters include both vegetative and reproductive characters.

## **NEW PROJECTS INITIATED DURING THE YEAR 2007–2008**

### **PLAN PROJECTS**

#### **Project 1: Evaluation and characterization of clones of Casuarina with reference to yield, tree form, biomass, pulping characteristics and key nursery pests [IFGTB/RP/2007-12]**

**Status:** Eighty seven clones of *C. equisetifolia* were short listed for field testing, prepared planting stock and established a field trial at Mayiladumparai, Karur District, Tamil Nadu during March 2008. Considerable variation was observed with reference to the rooting percentage in the clones. Planting stock is getting ready for two more trials. Raised an experiment to screen 124 selected clones for the key nursery pests and observations were recorded at 15 days interval. Low incidence of a new unidentified sap sucking insect pest was noticed in 6 clones initially. The pest had spread to 59 clones. Incidence of *Icerya purchasi* was observed in 64 clones. The percentage of incidence and intensity of attack was found to be 0.1 to 1.5% only.

#### **Project 2: Improvement of Teak through selection, quality seed production, hybridization and clonal evaluation**

**Status:** The potential plantations and SPAs short listed in the States of Kerala and Tamil Nadu for selection of plus trees. Seeds were collected from 70 selected trees from Pambikulam and Nilambur.



Trees were identified for carrying out controlled pollination. Forty selected clones were multiplied vegetatively for establishing a clonal trial of teak. The rooting performance of different clones has been studied.

**Project 3: Demonstration of agroforestry technologies for enhancing the livelihood opportunities in different agroclimatic zones of Tamil Nadu (IFGTB/RP-46/2007-10)**

**Status:** Established 5 ha of demonstration plots of agroforestry models developed by IFGTB as well as National Research Centre for Agroforestry, Jhansi under three agroclimatic zones of Tamil Nadu. Tree species used for these models are Teak, Ailanthus, Melia and Casuarina.

**Project 4: Evaluation of improved germplasm of *Eucalyptus camaldulensis* and *E. tereticornis* for productivity, wood traits, tolerance to insect pests and diseases and management for higher seed production**

**Status:** Evaluation of Eucalyptus clonal trials for growth traits at three locations (Karunya, Kulathupuzha and Sathyavedu) has been completed.

Wood samples of 42 clones of *Eucalyptus* were collected from Karunya and Sathyavedu trials and submitted to the Institute of Wood Science and Technology (IWST), Bangalore for wood traits analysis.

Screenings have so far been carried out at these clonal trials at periodical intervals for the incidence of pests and diseases revealed the occurrence of the pests such as gall insect, thrips, aphids and bark feeding borer and diseases such as leaf spot, leaf blight and pink disease on coppices and grown up trees. The per cent incidence and intensity of attack of these pests and disease on individual clone were assessed and the identity of the pests and pathogens was established.

Collection of growth data and selection of trees for imposing different treatments for enhancing seed yield at 4 Seed Production Areas (SPAs) of *E. camaldulensis* and *E. tereticornis* at Panampally and Pudukottai have been completed.

Application of Panchakavya and Dasakavya in the nursery trial of *Eucalyptus* was done and recording of data on the incidence of insect pests and diseases on treated plants is in progress.

**Project 5: Performance of selected clones of *Casuarina equisetifolia* for insect pest and disease tolerance and their response to bio-farming practices**

**Status:** Casuarina cuttings collected from identified resistant clones were raised in nursery. Trees in the clonal trial of Casuarina in Coimbatore and in International provenance trial at Puducherry were screened for incidence of bark feeder and blister bark disease. Analysis for Phenol and Tannin content were completed for of 3 provenances. Pathogenicity test conducted with the pathogen *Trichosporium vesiculosum* on *C. equisetifolia* seedlings showed wilting symptoms with white lesion on stem and needles under glass house conditions. Further symptoms and assessments of progression of blister bark disease is in progress. Panchakavya and Dasakavya preparations were made and analysed for their chemical properties such as macro, micro nutrients and growth regulators. Microbial population present in the Panchagavya and Dasagavya were also assessed.

### **Project 6: Selection and conservation of red and sweet tamarind in southern India [IFGTB-49/GTB/2007-10]**

**Status:** Extensive surveys were conducted in various parts of Tamil Nadu and Karnataka to identify red and sweet Tamarind trees. A total of 40 red and 30 sweet Tamarind trees were identified in different locations of the two States. Quantification of Anthocyanin and its stability was investigated in red Tamarind. Control pollination experiments were conducted between Natham red and Natham sweet clones and obtained viable fruit set indicating compatibility between the two clones. Vegetative multiplication of different red Tamarind was carried out through cleft grafting. The biochemical screening of sweet Tamarind is in progress.

### **Project 7: Studies on efficacy of secondary plant derivatives of *Aegle marmelos* on important insect pests of teak [P-21/2007-09]**

**Status:** Completed the extraction work of different tissues of *Aegle marmelos* and *Acharas sapota* with aqueous, methanol, hexane and ethyl acetate. Tested those extracts of different tissues at the concentrations ranging from 1 to 10% against the teak insects *Hyblaea puera* and *Spodoptera litura* as per the standard bioassay procedure. During the feeding regime, it is observed that *A. marmelos* unripen - EtOAc and seed of 1% hexane brought about 80% larval mortality on *H. puera*. *A. sapota* seed hexane 1% brings about 60% larval mortality on *S. litura*. Results were compared with the control, Neem product and synthetic pesticide. Variation of chemical analysis of both the plant species were analysed for tannins, phenols, saponins, alkaloids and flavonoids, and these could be the causative factors of exhibiting bioactivity against insect pests. Individual secondary metabolites analysis is under progress.

### **Project 8: Screening and identification of potential isolates of Ectomycorrhizal fungi for increased productivity of *Acacia*, *Casuarina* and *Eucalyptus* tree species in nursery**

**Status:** Pure cultures of different isolates of two different ECM fungi viz., *Laccaria fraterna* and *Pisolithus albus* were made from fresh basidiomata of these fungi collected from various plantations in Tamil Nadu, Kerala and Puducherry. Mass production of these cultures by selecting suitable culture medium was standardized.

Different types of inocula (basidiospores inoculum, vermiculite based mycelial inoculum and mycelium entrapped alginate bead inoculum) of different isolates of two ECM fungi were developed and methods standardized for long term storage and utilization.

Efficacy of different types of inocula of these ECM fungi on growth improvement of 3 different *Eucalyptus* species (*E. camaldulensis*, *E. tereticornis* and *E. grandis*) was tested in nursery and it was observed that the inoculated seedlings (90 days old) had better growth over uninoculated (control) seedlings. The study also indicated that among different inocula tested, the basidiospore and vegetative mycelial inocula of all the isolates of *P. albus* were superior in promoting the growth of the seedlings than other inoculum type during the period of observation. Further study is in progress.



### **Project 9: Assessment of population structure using SSRs and molecular characterization using RAPD in *Casuarina* species**

**Status:** For assessment of population structure using SSR marker in *Casuarina* species, genomic DNA was extracted and amplified with GA and CA rich ISSR primers. Sixty amplicons were obtained from ISSR primers in search of SSRs. DNA profiling was done for 85 clones of *Casuarina equisetifolia* using RAPD technique.

### **Project 10: Association analysis of adventitious rooting traits using STS markers in *Eucalyptus tereticornis* and DNA profiling of eucalypts clones**

**Status:** Contrasting phenotypes for rooting frequency was identified from the culled individuals of provenance trial cum seedling seed orchard available at Karunya field station. Sequence Tagged Site (STS) primers for vegetative propagation traits and gene specific (ARRO-adventitious rooting related oxygenase) primer pairs were synthesized and used for PCR amplification of poor and best rooters. Fingerprinting of 93 clones of *E. tereticornis* and *E. camaldulensis* assembled by IFGTB has been completed using RAPD-PCR.

### **Project 11: Evaluation of Teak CSO at Walayar using DNA profiling**

**Status:** In evaluation of the genetic makeup of stock and scion of bud-grafted standing trees in the teak Clonal Seed Orchard at Walayar, Kerala, DNA profiling was done for 440 rametes of 20 clones using RAPD technique. Data analysis is in progress.

## **TECHNOLOGY ASSESSED AND TRANSFERRED**

A technology has been developed for estimation of mean diameter of trees in plantations using Image analyzer by taking digital photographs. Using this technology, mean diameter of *Eucalyptus* plantations can be estimated with an error of  $\pm 6\%$ . This technology is applicable for species with bark, reflecting the flash light after sun set.

Single tree volume, height and diameter estimation technique from digital photographs has been developed using image analyzer. Using this technology, volume of trees can be estimated with  $\pm 3.9\%$  error. Height and diameter of trees can be estimated with  $\pm 2\%$  error. This technology is applicable for a wide range of species which has clear visibility of entire tree trunk. Day time photographs can also be processed for estimation of volume, height and diameter. Both these technologies have been transferred to TAF CORN.

Potential isolates of Entomopathogenic fungi for management of Teak and Casuarina stem borers, *Sahyadrassus malabaricus* and *Indarbela quadrinotata* were identified from natural habitats of the pests, mass produced *in vitro* on agro-products and waste and standardized the method of application for control of these pests species under ICFRE funded project. Isolation, identification, evaluation and mass production of native entomopathogenic fungi for management of teak and Casuarina stem borers and the same has been advocated to the field staff of the Forest departments through various training programmes.



## EDUCATION AND TRAINING

**Students Development Programme:** IFGTB hosted 77 PG Science and UG Engineering students to carry out their 2-6 month dissertations for their universities during the year 2007-08 in two sessions [summer (May-July) and winter (December–May)] under the ongoing research programmes of the Institute. The various fields under which the projects were carried out include DNA isolation, purification and amplification using PCR tools, DNA fingerprinting and marker systems, Genetic transformation of tree species, Database development and sequence analysis of genes conferring desirable traits, Tissue culture of trees, Vegetative and macro-propagation techniques, Cell culture, Reproductive and pollination ecology, Detection of hybrids using molecular markers, Instrumentation methods for analysis of primary metabolites, Bioassay directed identification, isolation and purification of secondary metabolites, Root and soil colonization of micro-flora, Mass multiplication techniques for pure culture production of biofertilizers, Insect-Host Plant interaction studies, Microscopic techniques and Image analysis and Carbon sequestration studies.

## LINKAGES AND COLLABORATION

### National

The Institute has collaborated with National Research Centre for agroforestry, Jhansi for demonstration of agroforestry systems in different agroclimatic zones of Tamil Nadu.

### International

A project on “New biocontrol opportunities for Acacia exploration in India” formulated in collaboration with Alan Fletcher Research Station, Australia was approved by the State of Queensland acting through the Department of Primary Industries and Fisheries, Australia.

## PUBLICATIONS

### Brochures

Brochure on following species has been prepared.

*Artocarpus heterophyllus*, *Terminalia bellerica*, *Ailanthus excelsa*, *Terminalia chebula*, *Acacia nilotica*, *Phyllanthus emblica*, *Tectona grandis*, *Tamarindus indica*, *Syzygium cumini* and *Azadirachta indica*.

## CONSULTANCIES

1. The Institute has carried out mid term evaluation of the National Afforestation Programme (NAP) undertaken by Forest Development Agencies (FDA) of Kerala and Tamil Nadu.
2. Dr. A. Nicodemus, Scientist-D offered consultancy to the Andhra Pradesh Paper Mills, Rajahmundry on genetic improvement of Casuarina through seed orchards.



3. B. Gurudev Singh, as a member of the team under the Consultancy by ICFRE carried out “Environmental Impact Assessment studies in the Bauxite mine areas of Arakku Valley”.
4. Dr. V. Mohan acted as a Technical Member to undertake Environment Impact Assessment (EIA) and Environment Management Plan (EMP) for Ankua Iron Ore Deposits in Jharkhand (ICFRE consultancy project).
5. Dr. V. Mohan, acted as a Technical Member to undertake Environment Impact Assessment (EIA) and Environment Management Plan (EMP) for bauxite mining in Jarrela Block III, Visakhapatnam, Andhra Pradesh State (under ICFRE consultancy project).
6. Dr. A. Balu, Scientist–E, extended Technical and Advisory services in respect of Eucalyptus gall insect pest management to (i) Tamil Nadu Forest Plantation Corporation (TAFORN), (ii) Andhra Pradesh Forest Development Corporation (APFDC), (iii) Karnataka Forest Development Corporation (KFDC) and (iv) Tamil Nadu Paper and Newsprint Ltd., (TNPL).
7. Dr. A. Balu, Scientist–E, extended Technical and Advisory services on Casuarinas needle borer problem and its management to Sriharikota High Altitude Range (SHAR).
8. Dr. C. Kunhikannan, Scientist-D has rendered his services as a team member for following consultancies.

Preparation of Catchment Area Treatment (CAT) Plan for proposed Bauxite mines in Araku Valley (Chittamgondi, Galikonda and Rekthakonda), Vishakhapatnam District, Andhra Pradesh by APMDC, Hyderabad through ICFRE, Dehradun.

Environmental Impact Assessment (EIA) studies at proposed Bauxite mines in Araku Valley Chittamgondi, Galikonda and Rekthakonda, Vishakhapatnam District, Andhra Pradesh, by APMDC, Hyderabad through ICFRE, Dehradun.

Mid-term evaluation of National Afforestation Programme (NAP) in the State of Kerala.

Preparation of Catchment Area Treatment (CAT) Plan proposed Bauxite mines in Jarrela blocks Vishakhapatnam District, Andhra Pradesh by APMDC, Hyderabad through ICFRE, Dehradun.

Environmental Impact Assessment (EIA) studies at proposed Bauxite mining areas in Jarrela blocks Vishakhapatnam District, AP by APMDC, Hyderabad through ICFRE, Dehradun.

Preparation of Catchment Area Treatment (CAT) Plan and proposed Iron Ore Mines in Ankua, Manoharpur, Jharkhand.

Environmental Impact Assessment (EIA) studies at proposed Iron Ore Mines in Ankua, Manoharpur, Jharkhand.

## **CONFERENCE/MEETINGS/WORKSHOPS/SYMPOSIA/EXHIBITIONS**

1. Organized the Institutional Bio-Safety Committee (IBSC) meeting on 31<sup>st</sup> December 2007 to obtain clearance from Dept. of Biotechnology, Govt. of India for the projects involving DNA activities.



2. Conducted a national level network meeting on “*Eucalyptus* improvement” sponsored by the Department of Biotechnology, New Delhi on 20<sup>th</sup> and 21<sup>st</sup> April 2007.
3. A field visit cum meeting with experts from research institutes, Wood based industries, Forest departments and Forest development corporations was arranged on 17<sup>th</sup> April 2007 in Chennai to discuss the strategy to be adopted to prevent and contain the insect gall problem in *Eucalyptus*.
4. A technical meeting to formulate an All India Coordinated project on *Eucalyptus* gall insect pest management was organized at the Institute from 28<sup>th</sup> to 30<sup>th</sup> June 2007.
5. A National seminar on “Implications of the Protection of Plant Varieties and Farmer’s Right Act, 2001 in Forestry Sector” was organized at the Institute on 4<sup>th</sup> and 5<sup>th</sup> July 2007.
6. A National Workshop to “Identify Stakeholders and Capacity Building Needs in Forest Genetic Resource Conservation” under APFORGEN programme was organized at the Institute on 11<sup>th</sup> July 2007.

## **DISTINGUISHED VISITORS**

1. Dr. R.B. Singh and Dr. A. Rabbani, Head, C and LD, Satish Dhawan Space Centre, Sriharikota /Engr ‘SF’, C & LD, SDSC, SHAR, Sriharikota on 15<sup>th</sup> May 2007.
2. Dr. Aravind Boaz, Director General (SACEP) South Asia Co-operative Environment Program, Colombo, Srilanka on 22<sup>nd</sup> September 2007.
3. Dr. Kyu Kyu Thinn , Staff Officer, Forest Department, Myanmar, on 22<sup>nd</sup> January 2008.
4. Dr. D.N. Tewari, Former Director General, ICFRE, on 22<sup>nd</sup> February 2008
5. Shri Namo Narayan Meena, Hon’ble Minister of State for Environment and Forests, Govt. of India.
6. Dr. V.L. Chopra, Hon’ble Member, planning Commission, Govt. of India.
7. Dr. B.N. Yogandar, Hon’ble Member, Planning Commission, Govt. of India.
8. Dr. D.N. Tiwari, Vice Chairman, State Planning Commission, Chhattisgarh.
9. Ms. Meena Gupta, IAS, Secretary, MoEF, Govt. of India.
10. Shri G.K. Prasad, IFS, Director General of Forests and Special Secretary, MoEF, Govt. of India.
11. Dr. S. Nagarajan, Chairman, Protection of Plant varieties and Farmers Rights Authority, Govt. of India.
12. Shri Jagadish Kiswan, Director General, ICFRE.
13. Mr. C.K. Sreedharan, IFS, Principal Chief Conservator of Forests, Tamil Nadu.
14. Dr. P.J. Dilip Kumar, IFS, Managing Director, Karnataka State Forest Development Corporation.
15. Prof. C. Ramasamy, Vice Chancellor, Tamil Nadu Agricultural University.
16. Dr. Ramani Jamunadas, ICRAF, Nairobi.
17. Dr. C.K. Gandhi Rajan, IPS, Inspector General cum Commissioner of Police, Coimbatore.
18. Dr. M. Sanjappa, Director, Botanical Survey of India.



19. Dr. Ganesan, Director, Tropical Botanical Garden and Research Institute.
20. Mr. Homg-Lay-Thong and Mr. Leesoon-Leong, Biodiversity International, Malaysia.
21. Shri R.K. Goel, IFS, Joint Secretary, MoEF, Govt. of India.
22. R.K. Ojha, Chief Conservator of Forests, Tamil Nadu.
23. Shri P.N. Unnikrishnan, Chief Conservator of Forests, Kerala.
24. Shri Bhagawan Singh, IFS, Chief Conservator of Forests and Director, Tamil Nadu Forest Academy, Coimbatore.
25. Shri M.L. Mal, Director, Indian Paper Mills Association.
26. Shri Narayan Moorthy, General Secretary, Indian Paper Mills Association.
27. Shri Saradha, Vice President, J.K. Paper Mills, Rayagad, Orissa.
28. Shri N.S. Atkoli, Chairman, Bamboo Society of India.
29. Dr. D.C. Uprety, National Fellow and Principal Scientist, ICAR.

## MISCELLANEOUS

1. Quality seeds of *Eucalyptus camaldulensis*, *E. tereticornis*, *Casuarina equisetifolia* and *C. junghuhniiana* were collected from orchards and supplied about 52 kg of seeds to farmers and other user agencies.
2. A reconnaissance survey was undertaken to the major eucalyptus growing areas of Tamil Nadu and Karnataka to assess the status and the incidence of stem and leaf gall in *Eucalyptus* caused by *Leptocybe invasa*.