



CHAPTER II 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 of the Ministry of Environment and Forests, Government of India. It was formed by up-gradation of the Forest Research Centre (FRC), Coimbatore under the Forest Research Institute and College, existing since 15.12.1959. Few 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.

PROJECTS COMPLETED DURING THE YEAR 2003-2004

Project 1: Standardization of containerized nursery practices for selected forest tree species [IFGTB/RP11/1999-2003]

Principal Investigator – M. Maria Dominic Savio

Findings: Study on different shade levels, container type and sizes on the growth of *Tamarindus indica* seedlings was carried out to see the effect of different potting media, application of biofertilizers. Potting media containing sand and spent mushroom in the ratios of 2:1 and 1:1 and sand, soil and farmyard manure in the ratio 1:2:1 was found to be best suited for raising quality seedlings of

Tamarindus. Shade nets with 25 percent shade level and 300 cc containers individual cell root trainers are found to be most suitable for raising *Tamarindus indica* seedlings for nursery period up to 180 days period.

Nursery trials were carried out to study the effect of different potting media combinations containing different levels of amendments and components on the nursery growth of *Acacia nilotica*, *Acacia leucophloea*, *Acacia auriculiformis*, *Azadirachta indica*, *Albizia amara*, *Pongamia glabra*, *Dalbergia latifolia* and *Eucalyptus camaldulensis*. The potting media containing sand and spent mushroom beds in the ratio 1:4 along with the following amendments (De-oiled neem cake 10 kg/m³; Single Super Phosphate 4.5 kg/m³; Thimmet 250 g/m³; Indofil 250 g/m³ and Muriate of Potash 250 g/m³) was found to produce the best quality seedlings of *Azadirachta indica* and *Albizia amara*.

Project 2: Standardization of seed handling procedures for commercially important medicinal plants of forest ecosystems [IFGTB/RP13/1999-2004]

Principal Investigator - Ms Rekha R. Warriar

Findings: Fruit collection, seed extraction procedures, dormancy treatments to enhance germination, storage conditions to improve longevity were studied in *Aegle marmelos*, *Feronia elephantum*, *Embllica officinalis*, *Syzigium cuminii*, *Strychnos nux-vomica*, *Oroxylum indicum*, *Pterocarpus marsupium* and *Terminalia bellerica* and it was observed that



seeds with hard seed coats required pre treatments mainly water soaking. All the species stored for over a year under controlled conditions of temperature and moisture maintained good seed vigour.

Project 3: Standardization of seed handling techniques for tropical recalcitrant seeds [IFGTB/RP14/1999-2003]

Principal Investigator - Shri V. Sivakumar

Findings: Seed maturity, initial viability, collection method, moisture content, storage temperature and mycoflora affects the storability of *Hopea parviflora* seeds. In case of *Vateria indica*, initial viability, moisture content, storage temperature and mycoflora were the major factors affecting the storability of seeds. The EC, rehydration ability, free amino acid content, total carbohydrate, reducing sugar content and free fatty acid content were changed during seed deterioration in both *H. parviflora* and *V. indica*.

Controlled moisture content and temperature, treating the seeds with ascorbic acid, citric acid, ABA and Coumarin and storage with wet vermiculite were found to improve the storability of both *H. parviflora* and *V. indica*. Storage of seeds in earthen pots with 100 percent field capacity of soil at 10 and 15 °C was suitable for *H. parviflora* and *V. indica*, respectively. Storage of *H. parviflora* and *V. indica* seeds in 150 and 100 gauge thick polythene bags, respectively found to improve the storability.

The germination of fresh seeds with 32 percent moisture content was found to be 79 percent. Stored seeds of *Madhuca longifolia* collected from Vedapatti (Coimbatore) and Cuddalore (at 20°C temperature with 32 percent

moisture content) survived better (52 percent) than other combination of treatments studies.

Project 4: Productivity and nutrient dynamics in agroforestry system [IFGTB/RP18/ 1999-2004]

Principal Investigator - Dr M. George

Findings: Casuarina trees harvested in short rotation (3-4 years) under alley cropping yielded 8-9 t/ha of fuel wood. The economic productivity of Casuarina was 3-4 times more than that under block plantation. Casuarina is a highly efficient species in recycling of various (N, P, K, Ca and Mg). Productivity of teak has also shown that trees can be harvested in short rotations (15-20 years) under agroforestry systems.

Project 5: Investigation on wood properties of teak in relation to variation in age and site factors [IFGTB/RP15/1998-2003]

Principal Investigator - Shri C. Buvaneshwaran

Findings: Analysis of data from southern and western zones of Tamil Nadu, collected from teak plantation in Tirunelveli and Coimbatore Forest Division revealed that there is a proportionate increase in heartwood content as the d.b.h. increases. It is inferred that intensive silvicultural management practices (like irrigation and fertilizer applications) will increase the heartwood content concurrent with increase in d,b,h and productivity. On an average, the heartwood produced was in greater proportion in trees in southern zone (80 percent of total disc area) than in western zone (74 percent of total disc area). Marginal difference in wood density was observed between the two zones. The results further revealed that there was no definite trend for wood traits with increase in age and the traits varied with respect to site conditions.



Correlation analysis revealed that electrical conductivity, bulk density, nitrogen, potassium and calcium were found to have significant correlation with wood traits.

Project 6: Management of *Casuarina equisetifolia* in agroforestry systems for sustainable economic returns [IFGTB/RP17/1999-2003]

Principal Investigator - Dr Syam Viswanath

Findings: The study was conducted in two on-farm sites in farmers fields in Coimbatore district. The field experiment was laid out in a Randomized Block Design with six treatments and four replications. The treatments envisaged were a set of canopy management, root management and combination of canopy and root management. The control envisaged tree rows without any canopy and root manipulations. The results have shown that pruning of lower branches up to $\frac{1}{4}$ to $\frac{1}{2}$ the size of full canopy can be done to get a better bole without adversely affecting stem height and has to be done at the end of first year and also in the second year. Further, in wide row inter cropping pruning of lateral roots in initial year has been found to minimize competition for resources especially under rainfed conditions. The overall enhancement in soil chemical properties is an additional incentive to practice wide row intercropping systems with casuarinas.

Project 7: Selection of pest resistant trees from wild population, provenances and exotic trials and progeny tests [IFGTB/RP23/1999-2004]

Principal Investigator - Shri K.R. Sasidharan

Findings: Survey conducted in the International Provenance Trial of *Casuarina equisetifolia* was established at Pondicherry. Out of 35 seed sources available in the trial, all the three seed

sources from China and provenances from Egypt, Solomon Island and local seed sources had infestation of the bark caterpillar, *Indarbela quadrinotata*. However in general infestation reduced with increase in age of the trees. Growth performance of the less susceptible seed sources was fair in terms of height and diameter as compared to susceptible seed sources such as 'Sarawak' from Malaysia.

Biochemical profiles of various less susceptible and susceptible seed sources revealed that, the nutritional substances did not have direct impact on the infestation of the bark caterpillar. The less susceptible seed sources like QL-Australia, NT-Australia and Kenya were found to have higher levels of phenol and tannin contents in the bark, as compared to the susceptible seed sources like Hama-China, TN-India and Sarawak-Malaysia. Hence it is inferred that, the amount of these compounds in the bark could be the major factor restricting attack.

The stem borer *Sinoxylon* sp., the scale insect *Anomalococcus indicus* and the defoliator *Selepa celtis* have been serious detriment to Babul (*Acacia nilotica* sp. *indica*), in the early stage of establishment. Field studies carried out have resulted in preliminary identification of a few seed sources having low susceptibility to these insects. The susceptible seed sources were found to have higher amount of proteins and nitrogen as compared to the less susceptible seed sources.

The bunching of shoot and stunting of growth of *Albizia lebbek*, caused by sap sucking pests like Psyllids (*Psylla hyalina* and *Acizia indica*) and Aphids (*Aphis* sp.) have been a serious problem in nursery as well as in young



plantations. The field studies carried out on six seed sources of *A. lebbek* have revealed that, a few were less susceptible to the sap sucking pests. Studies on biochemical parameters have shown that, the sap sucking pests have preference for seed sources having higher levels of protein as well as nitrogen.

Project 8: Development of package of practices for management of nursery pests and diseases [IFGTB/RP20/2000-2003]

Principal Investigator - Dr J.P. Jacob

Findings: Moderate to severe defoliation by *Myllocerus* sp. beetles on *Dalbergia latifolia*, *Albizia lebbek* and *Pongamia pinnata* and on Neem and *Terminalia arjuna* seedlings were recorded. Severe mite induced gall formation on *Ziziphus jujuba* was also recorded. Low to Moderate infestation of *Myllocerus* sp. on *Pongamia pinnata*, *Azadirachta indica*, and *Tamarindus indica* and minor incidences of the scale insect was registered in nurseries in Coimbatore. In addition, low level incidence of *Megapulvinaria maxima* on neem, *Eutectona machaeralis*, mealy bugs and grasshoppers on *Tectona grandis* clones and *Ascotis selenaria* on Eucalyptus were also recorded in nurseries in Coimbatore.

Leaf spot and leaf blight disease incidences on Eucalyptus clonal plants in Coimbatore, on *Pongamia pinnata*, *Albizia lebbek*, *Dalbergia lactifolia* and *Bambusa nutans* at Thoppur and Namakkal were recorded.

Project 9: Modelling the growth of Eucalyptus in Tamil Nadu [IFGTB/RP29/2001-2004]

Principal Investigator – Shri Raman Nautiyal

Findings: Particularly useful in evenaged plantations, distribution – shift models model

the growth of a tree species by estimating the quantitative shift in the distribution that generates the values for growth variables. Unlike regression models, they do not depend upon the predictor variables, and as such, are useful in univariate cases also. The algorithms need to be run for each successive year to identify the distribution, and as such, these models are computationally complex, but with adequate software support, such complexities are reduced.

Project 10: Threatened species recovery research for silent valley and Kolli hills MPCAs of Kerala and Tamil Nadu [IFGTB/EF-RP3/2000-2003]

Principal Investigator - Dr C. Kunhikannan

Findings: Spatial distribution mapping and population dynamics of 21 threatened medicinal plants were carried out. The species are *Aphanamixis polystachya*, *Cinnamomum sulphuratum*, *Embelia ribes*, *Garcinia gummi-gutta*, *Garcinia morella*, *Glycosmis macrocarpa*, *Hydnocarpus alpina*, *Nothapodytes nimmoniana*, *Myristica malabarica*, *Piper mullesua*, *Placanthus nilagiricus* and *Symplocos racemosa* (Silent valley) *Aristolochia tagata*, *Celastrus paniculatus*, *Rhaphidophora laciniata*, *Santalum album* and *Symplocos cochinchinensis* (Kolli hills), *Canarium strictum*, *Myristica dactyloides*, *Persea macrantha* and *Smilax zeylanica* (common for both sites). Majority of the species showed contiguous distribution in both the sites. In general, *Aphanamixis polystachya*, *Canarium strictum*, *Cinnamomum sulphuratum*, *Embelia ribes*, *Glycosmis macrocarpa*, *Hydnocarpus alpina*, *Nothapodytes nimmoniana*, *Aristolochia tagala* and *Rhaphidophora laciniata* are found to be threatened in varying degrees.

Phenology, floral biology, reproductive behaviour of *Aristolochia tagala*, *Canarium strictum*, *Embelia ribes*, *Symplocos cochinchinensis* and *Smilax zeylanica* were studied at two sites. Population of *Aristolochia tagala* showed preferential outcrossing and is aided through highly specialized insect vectors. In *Embelia ribes* fruit production is high, but very poor natural regeneration is a threat factor. Seed germination studies reveal necessity of pretreatment with GA₃.



Smilax zeylanica flowering branch

Studies on seed handling techniques for *Aristolochia tagala*, *Canarium strictum*, *Garcinia gummi-gutta*, *Persea macrantha*, *Symplocos racemosa*, *Embelia ribes*, *Smilax zeylanica* and *Myristica dactyloides* indicated that the seeds of *Persea macrantha*, *Symplocos racemosa* and *Myristica dactyloides* were sensitive to desiccation. Species such as *Smilax zeylanica*, *Aristolochia tagala*, *Embelia ribes* and *Canarium strictum* showed high rates of germination under controlled conditions.

Project 11: Impact assessment of intensive silvicultural practices on seed production in

Seed Orchards/Seed Production Areas in South India with reference to teak [IFGTB/RP 9/1999-2003]

Principal Investigator – Shri K. S. Balakrishnan

Findings : In the identified Seed Production Areas (SPAs) in Tamil Nadu (Sengampati, Coimbatore and Seechaly Valley, Top Slip) and Kerala (Pandupara, Malayattoor, Cherupuzha and Nilambur), fertilizer treatments and biofertilizer treatments were given to individual trees in the trial plots. The initial flowering in SPAs was observed. Details on management practices were collected. Also the details on rainfall in the areas were collected. The information on seed production in these SPAs in the previous year was collected. These SPAs were visited after one year and the seed production after the treatments were observed and recorded. More details on rainfall were collected.

Project 12: Afforestation and productivity studies on problem soils of Tamil Nadu [IFGTB/RP 10/1999-2003] -

Principal Investigator - Shri P.V. Krishna Rao

Findings : Under afforestation, the problem soils of ACC Madukkarai and Magnesite mine spoils have been reclaimed by planting tree species - *Grevillea robusta* (silver oak) along with existing plantation trials viz. *Acacia auriculiformis*, *Casuarina equisetifolia*, *Cassia fistula*, *Delonix regia*, *Eucalyptus tereticornis*, *Azadirachta indica* (Neem), *Muntingia calabura*, *Syzygium cumini* (Naval), *Leuceana leucocephala* (Subabul), *Ailanthus excelsa*, *Cassia siamea*, and *Samanea saman* raised during 2002-2003. Application of bio-manure and biofertilizers have resulted in satisfactory performance under adverse soil conditions.



PROJECTS CONTINUED DURING THE YEAR 2003-2004

Project 1: Identification and cloning of gene(s) encoding protein(s) toxic to *Trichosporium vesiculosum* Butler [IFGTB/RP5/2000-2005]

Principal Investigator - Dr Modhumita Ghosh

Status: 25 plant species of pharmacological significance were screened initially to identify for proteins toxic to the growth of *Trichosporium vesiculosum*, a causal organism of the blister bark disease in *Casuarina equisetifolia*. Subsequently, *Plumbago capensis*, *Andrographis paniculata*, *Piper longum* and *Rauwolfia tetraphylla* were determined to contain constitutively expressed antifungal proteins. A 20 KD protein showing toxicity to spore germination and hyphal extension was purified from the leaves of *P. capensis* which was found to inhibit the spore germination of another pathogen, *Macrophomina phaseolina*. A broad spectrum protein with antifungal activity was also purified from the leaves of *A. paniculata*. The protein with molecular mass 39.5 KD was found to be highly toxic to *Trichosporium vesiculosum*, *Macrophomina phaseolina* and *Aspergillus flavus*. An antifungal protein from a bacterial source was also purified.



In vitro hyphal extension inhibition assay of *Acorus calamus* crude protein against *Trichosporium vesiculosum*

Streptococcus sp., a common contaminant to bacterial source was determined to exudate a 16 KD protein in its stationary phase showing antifungal activity

Project 2: Utilisation of fly ash dumps to study soil amelioration and recuperation [IFGTB/RP12/2002-2005]

Principal Investigator - Dr Lalit Narayan

Status: Fly ash, a waste product obtained from burning of coal at Tuticorin Thermal Power Station (TTPS) at Tuticorin, Tamil Nadu does not contain plant nutrients and has poor water holding capacity. It is alkaline in nature and increases ambient temperature of soil inhibiting the growth of plants.

Project 3: Genetic variability and selection in natural population of *Artocarpus* species [IFGTB/RP1/2000-2005]

Principal Investigator - Dr Maheshwar Hegde

Status: *Artocarpus*, *A. integrifolia*, *A. hirsuta* and *A. gomezianus* ssp. *zeylanicus* (*A. lakoocha*) has been studied in Kerala and Tamil Nadu. Isolated



Seed Production Area of *Artocarpus hirsuta* at Parlode (Kerala)



patches of natural populations of *Artocarpus integrifolia* were found in Nilgiri hills (Kothagiri and Barliar), Kolli hills, Topslip and Valparai in Tamil Nadu. *A. lakoocha* has been found at Nilambur and Mukkali in Kerala and only at Topslip in Tamil Nadu, and its occurrence is found to be rare. Fruits and seeds of all the three species were collected and the variations in characteristics of fruits and seeds within populations and between populations have been recorded. Seedlings have been raised in nursery and isozyme characterization has been done to study the genetic structure of the population and variation within and between populations. Observed heterozygosity was found to be more than expected heterozygosity in *A. integrifolia*. Through estimation of genetic distance between populations it was found that Kolli hills population is more distinct from others. Natural regeneration status of all these species was studied at Topslip (TN) and found to be totally absent. Seedlings of *A. hirsuta* and *A. lakoocha* have been supplied to Tamil Nadu Forest Department for planting at Topslip.

Project 4: Evolving clonal propagation technology for teak to improve productivity [IFGTB/RP2/2000-2005]

Principal Investigator - Dr K. Palanisamy

Status: 120 superior trees of teak selected in different parts of Kerala. The morphological characteristics and the volume of the selected trees were recorded. It was found that the volume of the selected trees was significantly higher than the average volume of the trees in the

plantations indicating the possibility of enhancing the productivity of teak through clonal plantation. The selected trees were multiplied clonally and a clonal trial of teak established at Panayankode (Kerala) showed 60 percent rooting. Teak seeds have also been collected from selected superior trees and raised on the nursery bed for multiplication. Teak trial with improved planting stock established at Tirunelveli (Tamil Nadu) has been evaluated. The growth performance of the canal teak plantations in Tanjore, Tiruvarur and Kumbakonam in Tamil Nadu was assessed. Though it showed superior growth, some of the trees showed hollowness, may be due to fungal infection caused by the continuous moisture in the root zone.

Project 5: Genetic improvement of *Eucalyptus tereticornis* through controlled pollination and molecular characterization [IFGTB/RP3/2002-2005]

Principal Investigator - Shri B. Nagarajan

Status: Thirty full-sib crosses of *E. tereticornis* x *E. grandis*, *E. pellita*, *E. urophylla*, *E. alba* and *E. camaldulensis* were nursery raised and the morphological characteristics of the seedlings in different combinations has been recorded. Full-sib trials have been established with 15 full sib families of the above said combinations in two different locations at Sadivayal (Tamil Nadu) and Panampally (Kerala). One block plantation consisting of 5 families of *E. tereticornis* x *E. pellita*, *E. grandis* and *E. urophylla* has also been raised in Panampally. All the trials have been maintained for evaluation.



E. tereticornis x *E. pellita*
interspecific hybrid in
5 months old Full-sib trial at
Sadivayal (Tamil Nadu)

Project 6: Variability studies with special emphasis on physiology, biometry and biochemistry in selected tree species for tree improvement [IFGTB/RP4/2000-2005]

Principal Investigator – Shri Kannan Chandra and Sekhara Warriar

Status: Studies on total phenol content, chlorophyll levels, peroxidase activity, total crude protein content, protein profiles and DNA concentration were performed to understand the tissue characteristics of juvenile and adult materials of *Casuarina equisetifolia*. Sprigs obtained from four different positions of trees (Position 1, upto 60 cm from the ground level where no flowering was noticed in any branch; position 2, between 60 cm and 95 cm from the ground level where occasional flowering was observed in some branches; Position 3, between 95 cm and 145 cm from the ground level with flowering on many branches and Position 4, between 145 and 165 cm from the ground level with flowering noticed on all branches) were

used for anatomical studies also. Various anatomical parameters including pith diameter, thickness of the phloem tissue, number of xylem vessels per unit area, diameter and area of the xylem vessels, roundness, aspect ratio and fullness ratio of the xylem vessels were measured using an Image Analyser. Total phenol content and peroxidase activity exhibited an increasing trend when tissues from lower to upper positions were examined whereas, chlorophylls, total crude proteins and DNA content recorded a decreasing trend. However, the protein profiles of the different positions, when studied using SDS-PAGE technique, did not show any variation. Among the various anatomical parameters, pith diameter and thickness of phloem tissue varied among the stem cuttings obtained from the four positions.

Seventy-three clones of *Casuarina equisetifolia* are being screened for sodic salt tolerance in a field experiment at Tiruchirapalli, Tamil Nadu. Data on biometric traits like total height, diameter at breast height and collar diameter are being recorded and analysed at quarterly intervals. Physiological observations including photosynthesis, intercellular CO₂ concentration, transpiration rates and stomatal conductance were also recorded and studied. Analysis of the growth data revealed the superiority of eight clones (clones 23, 30, 62, 25, 68, 50, 22 and 12) when compared to others.

Project 7: Genetic transformation of Eucalyptus and Casuarina to enhance salinity tolerance [IFGTB/RP6/2000-2005]

Principal Investigator – Shri Mathish N.V.

Status: Experiments were conducted to develop *in vitro* regeneration systems in *Casuarina equisetifolia*. Callus obtained from cotyledon leaf explants of germinated seeds showed

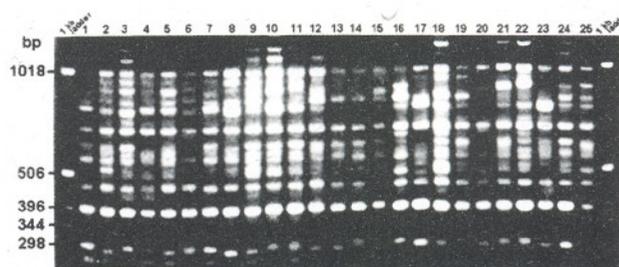
improved shoot morphogenesis after subculturing in 1 ppm Benzyl amino purine (BAP) and 0.5 ppm Naphthalene Acetic Acid (NAA). The developed shoots were rooted in Knops media containing 1 ppm Indole Butyric Acid. In a separate experiment with varying levels of BAP and TDZ, 2 ppm BAP along with 0.1 ppm thidiazuron gave organogenesis from callus tissues. Experiments on altered nutrient levels showed that MS levels at half the nutrient concentration were more effective for Callogenesis and organogenesis in *Casuarina equisetifolia*. Experiments were also carried out to induce axillary buds from branchlet explants of rooted cuttings of *Casuarina equisetifolia*. These experiments were carried out to test the suitability of using tissue culture induced juvenile needles for organogenesis. The needle tissues were subject to BAP concentrations at 0 ppm, 1 ppm, 2 ppm and 3 ppm. Other hormones used included Thidiazuron, Gibberellic acid, and NAA. BAP at 2 ppm was found to be optimally suited for induction of buds. Agrobacterium strains GV2260 and GV3101 were obtained for use in transformation experiments.

Project 8: Development of protoplast regeneration system for Eucalyptus [IFGTB/RP7/2002-2005]

Principal Investigator – R. Yasodha

Status: Embryogenic callus cultures of *Eucalyptus camaldulensis* were produced through quantitative and qualitative experiments on MS medium with a range of plant growth regulators especially cytokinins and auxins. Rapidly proliferating friable yellowish callus was obtained on MS medium supplemented with 2-3mg/l NAA, 50g/l Sucrose and 0.5 percent agar, whereas the cytokinins did not influence the callus growth. These callus

cultures formed the basis for the development of suspension cultures for protoplast isolation. Incubation of cultures in 0.4 - 0.6 M mannitol for 24 hours with continuous shaking at 40 rpm yielded high amount of protoplasts. The protoplasts were purified through stainless sieve (320 μ m) followed by differential centrifugation at 300 rpm followed by sucrose density gradient centrifugation with 20.5 percent sucrose gradients. The density of released protoplasts per gram fresh weight tissue was estimated as 1×10^7 with haemocytometer. Viability tests with Evan's blue dye exclusion showed about 70 percent protoplasts are viable.



ISSR - PCR for identification of species specific marker of *Eucalyptus camaldulensis*

Project 9: Isolation of soma-clonal variants of *Casuarina equisetifolia* for salinity tolerance [IFGTB/RP 8/2002-2007]

Principal Investigator - Shri Santan Barthwal

Status: Cotyledonary explants were found to respond best for callus production. Media containing 0.5 and 0.75 ppm Kinetin and BAP gave best callus initiation, for explants collected from in vitro germinated seedlings. For needles and cotyledons collected from nursery, addition of NAA in range 0.01 to 0.1 ppm was found effective for initiation and proliferation of callus. Initiation and proliferation of callus from juvenile and mature tissue achieved. Initiation



of suspension culture was attempted using friable callus originated from both cotyledon and needle explants. Liquid media containing 0.75 ppm BAP and 0.01 ppm NAA or 0.1 ppm NAA were tested. Successful initiation of suspension culture was observed in media containing 0.75 BAP and 0.1 NAA. Callus multiplication for *in vitro* selection and regeneration in salt media is in progress. Suspension culture studies continued for proliferation of cultures.

Project 10: Selection of potential mycorrhizas and other beneficial microbes for the reclamation of bauxite mine spoils [IFGTB/RP10a/2002-2005]

Principal Investigator - Dr A. Karthikeyan

(Sub-project of ongoing project: Afforestation and productivity studies in the problem soils of Tamil Nadu)

Status: Mining of Bauxite to obtain high-grade ores has led to discharge of millions of tons of waste rock over hectares of wasteland at Yercaud. Reclamation of these sites has been difficult because mined soil have extremely low water holding capacity, lack organic matter and are deficient in Nitrogen and Phosphorus. Mining also affects many soil factors, such as pH, fertility, toxicity, bulk density, and soil moisture, which, in turn, reduce the Vesicular Arbuscular Mycorrhizae (VAM) propagules and other microbes in the soil that would be necessary for plants to thrive. So, to ameliorate the bauxite mine spoils the suitable tree species like *Acacia auriculiformis*, *Casuarina equisetifolia*, *Eucalyptus camaldulensis* and *E. tereticornis* were grown in bauxite mine spoils inoculated with VAM fungi and other beneficial microbes like Rhizobium and Phosphobacterium under nursery conditions. It is found that the VAM fungal inoculation to *A. auriculiformis* not

only ameliorate the mine spoils but also improved the seedlings growth particularly the root structure and leaf area by hormonal induction and mobilization of Phosphorus, respectively. Thus the VAM fungi (*Glomus aggregatum*) improved the water uptake and mineral uptake and water by the trees as it altered the root structures in terms of higher lateral orders and root length. Therefore, increased proportion of lateral root system led to increase in the area of root system. The Rhizobium inoculated seedlings also showed good performance in height and development of root nodules in *A. auriculiformis*. In *Eucalyptus* spp., the inoculations of VAM + Phosphobacterium increased growth compared to other bio fertilizer treatments. In *Casuarina equisetifolia* the inoculations of VAM and Frankia are found more effective as they improved the seedling growth. The research findings from the nursery experiments were applied to the afforestation activities in the bauxite mine spoils for the better plant survival in bauxite mined areas.

Project 11: Studies on productivity of *Acacia mangium* plantations in Kerala [IFGTB/ RP16/ 2000-2005]

Principal Investigator – Shri C. Buvaneshwaran

Status: Productivity of *Acacia mangium* was assessed at different age groups in different planting configurations under various agro-climatic zones of Kerala and the results have shown that the productivity ranged from 35 to 45 m³/ha/year at locations where climate is humid and from 20 to 25 m³/ha/year under sub-humid climatic conditions. Further, *Acacia mangium* has been grown mostly as an intercrop in homesteads in Kerala and preferred as 'standards' for vanilla, pepper, etc. as well as

'shade tree' for other crops, rather than as pure crop in block plantation.

Project 12: Study on market dynamics relating to important Non Timber Forest Produce in Tamil Nadu [IFGTB/RP19/2002-2006]

Principal investigator – Shri S. Saravanan

Status: Gathered information on various aspects of NTFPs with special reference to collection, quantity, marketing, etc. from thirteen Large Agricultural Multipurpose Societies (LAMS) of seven districts of Tamil Nadu. It was found that, the production of NTFPs showed a decreasing trend during the past decade and the socio-economic status of local tribes showed, a drastic change in pursuing conventional NTFPs collection and were forced to undertake unprofitable agricultural activities. Apart from agriculture, tribal people were working as daily labourers and for employment purpose they go to nearby states of Karnataka and Kerala to work as daily labourers. It was also found that, the middlemen played an unavoidable role in this change of socio-economic status of the tribal people. To achieve the objective on establishment of agroforestry models with high NTFPs value species, production of quality planting stock of *Albizia amara*, Soapnut and Emblica in the nursery is in progress for raising plantations of these species under agroforestry systems.

Project 13: Identification, isolation, evaluation and mass production of native fungi for the management of teak and casuarina stem borers [IFGTB/FP/RP21/2000-2005]

Principal Investigator - Dr A. Balu

Status: About 160 soil samples collected from teak and casuarina plantations of Pondicherry, Cuddalore, Sirkali range and Siruvani and at various forest areas of Lower Palani Hills of

Western Ghats were subjected to insect bait method and four new isolates of Entomopathogenic Fungi (EPF) trapped and isolated from the soil samples of Lower Palani Hills. Another new isolate was trapped from naturally infected coffee berry borers collected from Lower Palani Hills.



Isolates of entomopathogenic fungi trapped from soil and insect cadavers

Fourteen isolates of Entomopathogenic fungi so far obtained were sub-cultured and stored for evaluation against the targeted insect pests. Of the 14 isolates 7 were identified as *Beauveria bassiana*, *Fusarium* sp., *Metarrhizium anisopliae* (2 isolates), *Fusarium oxysporum* (2 isolates) and *Cunninghamella echinulata* (Isolates identified by the Institute of Microbial Technology, Chandigarh).

Pathogenicity of the five isolates identified *M. anisopliae* (2 isolates), *F. oxysporum* (2 isolates) and *C. echinulata* (1 isolate) was tested on wax moth larvae (*Galleria mellonella*) and confirmed the pathogenicity. *C. echinulata* is reported for the first time as pathogenic to insect pest.

Pathogenicity of the two species of EPF (*B. bassiana* and *Fusarium* sp.) isolated from the infected cadavers were tested on the targeted insect pest *Indarbela quadrinotata* of Casuarinas and *Sahydrassus malabaricus* (Stem and root



borer) of teak and found that *B. bassiana* was pathogenic to both the pests, whereas *Fusarium* sp. was not pathogenic.

Five of the 11 entomo-pathogenic fungal isolates so far trapped from the soil samples (Konni, Nilambur, Siruvani, Topslip and Kalanthodu) were tested for their pathogenicity against the targeted pest of *Indarbela quadrinotata* and it was found that the isolates obtained from Konni, Nilambur and Siruvani were pathogenic.

Semi-permanent micro slides were prepared for the 14 isolates of EPF and the morphological characters of each isolate analysed to identify the variations among the isolates. Distinct variations were observed to exist among the isolates.

Artificial diet used for rearing of leaf eating caterpillar was further modified with inclusion of few more ingredients and standardized for mass rearing of the host insect, *Indarbela quadrinotata*.

Project 14: Testing of promising plant derived chemicals against key pests (Component : Bioactive compounds from *Acacia nilotica* (Babul) against the major defoliators of forest tree species) [IFGTB/FP/RP22/2000-2005]

Principal Investigator - Dr S. Murugesan

Status: Methanol and Hexane extracts of leaves and flowers of *Acacia nilotica* were evaluated for their biopesticidal properties against the important defoliators of teak and *Pongamia* viz. *Ascotis selenaria*, *Tephрина pulinda*, *Epicrocis lateritialis*, *Hyblaea puera*, and *Eutectona machaeralis* and it was observed that extracts exhibited the properties such as antifeedancy (40-90 percent), larval mortality (30-100

percent), pupal mortality (8-80 percent) and ovicidal activity (20-100 percent). The extracts were also found to effecting by viz., *Alternaria* sp., *Pestalotiopsis* sp., *Trichosporium vesiculosum* and *Ganoderma* sp. causing leaf spot, leaf blight, root-rot and blister bark diseases in *Casuarina* and *Eucalyptus* plantations. By inhibiting the mycelial growth of fungal the pathogens.

Project 15: Testing and evaluation of selected existing control methods for key diseases of *Casuarina* spp. with reference to blister bark and root-rot [IFGTB/FP/RP24/2000-2005]

Principal Investigator - Dr V. Mohan

Status: Different mycorrhizal biofertilizers such as VAM fungi (mixed cultures of *Glomus* spp.) and Ectomycorrhizal fungus (*Pisolithus tinctorius*) and bio-control agent *Trichoderma viride* were mass multiplied and inoculated to the seedlings of *Casuarina junghuhniana* to be used in the II experimental trial proposed in respect of integrated methods of management of blister bark disease of casuarina. Weekly observation and no disease incidence on the seedlings of *C. junghuniana* recorded. Periodical observations were also continued to record the incidence of the targeted disease problems on the saplings of *Casuarina equisetifolia* in the I trial already laid out at IFGTB Experimental Research Station, Panampally, Kerala did not reveal the occurrence of the diseases during the period reported.

Project 16: Studies on mycorrhizal fungi (biofertilizers) and their application in nursery and field [IFGTB/RP25/2000-2005]

Principal Investigator - Dr V. Mohan

Status: *Mycorrhizae* associated with *Eucalyptus*: Investigation on occurrence and distribution of



Laccaria fraterna - An Ectomycorrhizal fungus associated with *Eucalyptus globulus*, Nilgiri hills

Ectomycorrhizal (ECM) and Endomycorrhizal (VAM) fungi revealed 8 different ectomycorrhizal fungi viz., *Amanita muscaria*, *Laccaria fraterna*, *Lycoperdon perlatum*, *Scleroderma citrinum*, *Suillus brevipes*, *Inocybe* sp., *Cortinarius* sp, and *Tricholoma* sp. to occur in July and October months in Eucalyptus plantations of Nilgiri Hills, Tamil Nadu. The basidiomata of *L. fraterna* and *S. citrinum* was found distributed in all the plantation sites. Abundance of the basidiomata was recorded maximum with the species *L. fraterna*. However, none of the plantations had the occurrence and distribution of basidiomata of these ECM fungi during April, 2003 and March, 2004.

The ECM fungi *Amanita muscaria*, *Laccaria fraternal*, *Scleroderma citrinum* and *Suillus brevipes* are reported for the first time in India in association with *Eucalyptus globulus* plantations. The percent colonization of ECM and VAM studies on root dample revealed that varied with different seasons and plantations sites. The VAM fungi viz., *Glomus* and *Gigaspora* were dominant in the rhizosphere soils.

Effect of mycorrhizal fungi on growth improvement of Casuarina and Eucalyptus seedlings: Inoculation of both the ecto and endo mycorrhizae (VAM + *P. tinctorius*, VAM + *L. fraterna* and VAM + *S. citrinum*) enhanced the growth *Casuarina junghuhniana* and *Eucalyptus camaldulensis* seedlings.

Growth performance of the ectomycorrhizae: Growth performance studies of three different isolates of the ECM fungus, *Pisolithus tinctorius* collected from Eucalyptus and Acacias plantations was assessed on four different culture media viz., Potato Dextrose Agar (PDA), Malt Extract Agar (MEA), Modified Melin Norkrans (MMN) and Palmer HacsKaylo Agar (PHA) and observed that the growth rate of individual isolate differed from other as given below. MMN and PDA were observed to be ideal for growth of the isolates of the ectomycorrhizal fungus.

Sl. No.	Isolates	Growth measurements (diameter in cm) *			
		PDA	MEA	MMN	PHA
1.	<i>P. tinctorius</i> Isolate 1	3.8	6.8	9.0	8.6
2.	<i>P. tinctorius</i> Isolate 2	7.1	3.7	7.5	6.1
3.	<i>P. tinctorius</i> Isolate 3	3.0	1.6	4.0	3.5

*Mean of 6 Replications



Salt tolerance of Ectomycorrhizal fungi: Salt tolerance capacity of two isolates of the ectomycorrhizal fungus *Pisolithus tinctorius* with salts like sodium chloride, sodium sulphate and sodium citrate at five different concentrations revealed that both the isolates are salt tolerant. Gradual reduction in growth and biomass was observed as the salt concentration increases growth in sodium sulphate and sodium chloride as compared to sodium citrate.

Project 17: Development of a database on biodiversity [IFGTB/RP27/1999-2004]

Principal Investigator - Dr C. Kunhikannan

Status: Information on nomenclature, habit, habitat, ecology, phenology of about 70 rare, endangered and threatened (RET) plants of southern India has been collected from various floras, red data books, journals and herbaria in a designed format to develop a basic database for easy retrieval of information on these species.

Project 18: Development of a database on Tree Improvement on mandatory species in Tamil Nadu and Kerala [IFGTB/RP28/2001-2004]

Principal Investigator - Shri R. Vivekanandan

Status: Forms, reports are being designed and improved. Tree improvement data entry continued from secondary sources for the following components: Plus trees/SSO/ CSO/ SPA etc. Updated reports of data sent to Tamil Nadu and Kerala Forest Departments with a request to validate the same as per data sheets designed for this purpose.

NEW PROJECTS INITIATED DURING THE YEAR 2003-2004

Project 1: Enhancing productivity of *Casuarina* species through inter-provenance

and inter-specific hybridization [IFGTB/RP30/2003-2008]

Principal Investigator - Shri A. Nicodemus

Status: This project aims at combining desirable traits of provenances of *Casuarina equisetifolia* and *C. junghuhniana* through control pollination, field evaluation and molecular characterization. Twenty outstanding clones of each species from the best provenances were selected from the existing test plots at Sadivayal (Tamil Nadu) based on height, diameter, stem straightness and intensity of flowering and these clones were vegetatively propagated by rooting the cuttings. Ramets of these clones were assembled in a potted seed orchard to produce seeds and to facilitate control crosses in different combinations. Pollen from flowering male clones was stored for use in artificial pollination. Male and female clones belonging to different provenances / species will be crossed to produce fullsibs. Open pollinated progenies from a hybridization orchard housing both *C. equisetifolia* and *C. junghuhniana* provenances were raised and planted in a field trial for identification of putative hybrids.

Project 2: Estimation of gene diversity and enhancing seed production in seedling seed orchards of Eucalyptus, Casuarina, Acacia and Teak [IFGTB/RP31/2003-2008]

Principal Investigator - Dr Mohan Varghese

Status: Eucalyptus, Casuarina, Acacia and Teak orchards located in various sites like Pudukkottai, Panampally, Sadivayal and Walayar revealed that 71 percent trees in *E. camaldulensis* orchard at Panampally were fertile compared to 12 percent trees in the orchard at Pudukkottai. Various treatments to enhance flowering were attempted in orchards with low fertility rates. Paclobutrazol application enhanced the flower and fruit production in Eucalyptus.



PROJECTS COMPLETED DURING THE YEAR 2003-2004

(Externally Aided)

NIL.

PROJECTS CONTINUED DURING THE YEAR 2003-2004

(Externally Aided)

Project 1: Evaluation of breeding efficiency and genetic gain in Seedling Seed Orchards of Eucalyptus and Casuarina in South India [IFGTB/EF-RP4/2002-2005]

Principal Investigator - Dr Mohan Varghese

Status: Detailed estimates of flower and fruit production were made in trees identified for seed collection in Eucalyptus orchards at Pudukkottai, Panampally and Sadivayal, and Casuarina orchards at Pondicherry, Panampally and Sadivayal. At Sadivayal only 12 percent of the trees flowered and the variation in the quantum of flowering was very high. Seeds were collected from 30 trees each in both Eucalyptus and Casuarina orchards from different locations and seedlings raised in nursery. To study the performance of orchard progeny, genetic gain trials were established in multilocations in Sadivayal (Tamil Nadu) Pondicherry and Dandeli (Karnataka), which differ with climatic and edaphic conditions.

Project 2: Fingerprinting of economically important clones of Eucalypts and Casuarina [IFGTB/EF-RP2/2000-2004]

Principal Investigator - Dr K. Gurumurthi

Status: Estimation of genetic diversity within and between provenances is very important in selecting the right population for tree

improvement programme. This is needed to ensure that the provenance materials used for a breeding programme represent adequate amount of diversity. AFLP technique was used to estimate the genetic diversity of 20 Eucalyptus provenances obtained from various parts of Australia and India. These provenances have been used for large-scale plantations by the state forest departments and paper industries. A number of field trials are presently being run using these provenances. The leaf material for this study was collected from the provenance trial plot of Institute of Forest Genetics and Tree Breeding at Panampalli, Kerala. To estimate inter-provenance genetic diversity, samples from different families from each provenance were pooled. AFLP Analysis System I kit from Life Technologies Inc. was used. Out of twelve AFLP primer combinations that were used, eight combinations gave good banding patterns with silver staining. The amplification products were between 45 - 700 base pairs in size and resolved well in 6 percent gels after 2 hours of electrophoresis at 55 W. Data obtained was analyzed to estimate the genetic diversity. Molecular markers clearly grouped the provenances corresponding to the proximity of their location in Australia. The results of this analysis will help in various tree improvement programmes of the country

Project 3: Genome evaluation and characterization in Casuarinas and Eucalypts for improving productivity and conservation [IFGTB/EF-RP5/2002-2005]

Principal Investigator - Dr K. Gurumurthi

Status: Germplasm of Casuarina and Allocasuarina species were obtained from CSIRO, Australia and the species trial was laid at Panampally research station, Kerala. The

species selected for genetic diversity studies include *C. equisetifolia* ssp. *equisetifolia*, *C. glauca*, *A. huegeliana*, *A. littoralis*, *C. obesa* and *C. junghuhniana* ssp. *junghuhniana*. Ten ISSR primers were used to quantify the genetic diversity within and between the species. Provenance trials of *C. equisetifolia* including 24 provenances and 100 families were identified at Pondicherry, Sadivayal (Tamil Nadu) and Rajahmundry (Andhra Pradesh) for the development of provenance specific markers and genetic variation studies.

Species collections of *Eucalyptus camaldulensis*, *E. citriodora*, *E. grandis*, *E. pellita*, *E. tereticornis* and *E. urophylla*, predominantly utilized in interspecific hybrid generations were identified for the development of species specific markers (Figure 1). Breeding populations consisting of twenty-one provenances (182 families) of *E. camaldulensis* and *E. tereticornis* were sourced from CSIRO, Australia. The field trials of these provenances established at Panampally in Kerala, Pudukkottai in Tamil Nadu and Sathyavedu in Andhra Pradesh were selected for genetic evaluation and variation studies within and between provenances.

NEW PROJECTS INITIATED DURING THE YEAR 2003-2004

(Externally Aided)

Project 1: Full sib production in selected high yielding Tamarind clones of Tamil Nadu [IFGTB/EF-RP14/2003-2006]

Principal Investigator – Shri B. Nagarajan

Status: This project aims in control pollinating red jayamangalam variety with other high yielding clones of tamarind to produce full sib families. Red tamarinds are natural variants that have rich content of anthocyanin in fruits.

Project 2: Characterization of tropical and temperate forest seeds with reference to seed storage behaviour) [IFGTB/EF-RP10/2003-2006]
Principal Investigator – Shri V. Sivakumar

Status: Fruits of *Strychnos nux-vomica* was collected from Thamaraiikulam area. Fresh seeds were tested for germination and moisture content. The effect of moisture reduction on seed viability was tested. *Myristica dactyloides* fruits collected from Nilambur was studied for secondary dormancy problem and after-ripening mechanism.

Project 3: Evaluation of superior planting stock of *Acacia mangium* in agroforestry systems at different agro-climatic zones of Kerala and Tamil Nadu. [IFGTB/EF-RP11/2003-2006]
Principal Investigator - Dr M. George

Status: The project was commenced during December, 2003. Production of superior planting stock of Mangium is under progress for planting under agroforestry systems.

Project 4: Development of integrated pest management package for forest nursery insect pests of some economically important tree species [IFGTB/EF-RP13/ 2003-2006]
Principal Investigator - Dr J.P. Jacob

Status: Periodic surveys conducted to identify the key insect pests of forest trees in nurseries maintained by State Forest Departments revealed severe damage on teak seedlings by *Hyblaea puera* and *Eutectona machaeralis* and low to moderate attack of *Myllocerus* beetles and grasshoppers on teak, *Acacia nilotica* and *Albizia lebbek* seedlings at Coimbatore and Mettupalayam areas. Moderate infestation of plant parasite *Cuscuta chinensis* on *A. nilotica* was also noticed at Mettupalayam. Very high incidence of leaf galls caused by Eriophid mites



on *Pongamia pinnata* seedlings and Hemipteran bugs on Casuarina seedlings were noticed in and around Coimbatore.

Project 5: Evaluation of reproductive success in Seed Orchards of teak in India [IFGTB/EF-RP8/2003-2006]

Principal Investigator – Shri A. Nicodemus

Status: An inventory of clones and ramets of different clones has been made in two teak clonal seed orchards at Walayar (Kerala) and Topslip (Tamil Nadu). All surviving ramets were measured for diameter growth. Every ramet was categorized as flowering and non-flowering. About 62 percent of ramets were flowering in Topslip whereas it was only 23 percent in Walayar. Flowering ramets were subjected to assessment of the following: number of flowering branches and number of inflorescences borne on each flowering branch, number of flowers per inflorescence. Flowering phenology of each ramet was scored as early, mid and late stages of flowering at fortnightly intervals. Five out of 20 clones did not flower in Walayar whereas all 15 clones flowered in Topslip. Nine clones flowered at both the locations. A single clone SBL 1 produced 50 percent of the total fruits produced in the Walayar orchard whereas in Topslip relative contribution of different clones was balanced. Fruit characteristics were evaluated for all flowering clones.

Project 6: Estimation of gene diversity and drift pattern in natural stands and plantations of South Indian forest tree species [IFGTB\EF-RP6\2003-2006]

Principal Investigator - Dr Mohan Varghese

Status: Fertility variation was studied in clonal seed orchards and seed production areas of teak

in different locations. The mating conditions in the seed orchard and the Seed production area were similar indicating good outcrossing potential and sufficient diversity though the total seed output was low in the clonal seed orchard.

Project 7: Identification of broad spectrum antifungal proteins from elite medicinal plants for control of plant pathogens [IFGTB/EF-RP7/2003-2006]

Principal Investigator - Dr Modhumita Ghosh

Status: The project envisages the identification of broad-spectrum antifungal proteins from elite medicinal plants against major phytopathogens like *Rhizoctonia solani*, *Macrophomina phaseolina*, *Fusarium moniliforme*, *Aspergillus flavus* and *Trichosporium vesiculosum*. The medicinal plants selected for the study are *Acorus calamus*, *Rouwolfia tetraphylla*, *Withania somnifera* and *Piper longum*. Germplasm collections were obtained for these species from Tamil Nadu, Kerala and Andhra Pradesh. The fungal isolates of *R. solani* (Phyllanthus isolate), *F. moniliforme* (rice isolate), *M. phaseolina* (blackgram isolate), *Aspergillus flavus* (sorghum isolate) and *Trichosporium vesiculosum* (Panampally, Coimbatore and Salem isolate) were maintained in potato dextrose agar medium. The extraction buffer for maximal elution of the antifungal proteins were optimized for *Withania somnifera* and *Acorus calamus*. Fifteen day old seedlings of *W. somnifera* were determined to be a better source of antifungal protein than the mature leaves. The crude protein extract from the seedlings was tested for their efficacy against *R. solani*, *M. phaseolina* and *F. moniliforme* and was found to have antifungal activity.



Project 8: Utilisation of flyash in Agriculture and Forestry [IFGTB/EF-RP12/2003-2006]

Principal Investigator - Dr Lalit Narayan

Status: Flyash has been applied in the field at the rate of 5MT to 13MT /ha and many agricultural crops viz. Paddy, Sweet potato, Ginger, Turmeric, Tapioca, Banana, Green gram, Black gram, Ground nut, Bean, Sunflower, Castor, Ragi, Senna and Jatropha etc. have been grown, which are in different stages of development.

Paddy, Sweet potato, Tapioca, Ginger, Senna and Castor exhibit better performance than that of the control. The local variety paddy, Uma or D-1-40 was grown applying fly ash @ 10MT/ha. The yield was increased and given below :

Control	With fly ash alone	With compost alone	With fly ash + compost
2.5 MT/ha	3.0 MT/	3.1 MT/ha	4.3 MT/ha

Therefore, fly ash encouraged the higher yield when applied with compost.

Sweet potato exhibited higher yield of 2 MT/ha when fly ash was applied @ 10MT/ha in the field than that of control giving yield @ 1.25 MT of sweet potato /ha. It was observed that fly ash with compost supports vigorous vegetative growth and yield of crops grown but yield is low if there is no rain (not equally compensated by irrigation). In case of ginger and tapioca.

Project 9: Germplasm conservation and establishment of seed stands for production of quality seeds and seedlings [IFGTB/EF-RP9/2003-2006]

Principal Investigator – Shri B. Gurudev Singh

Status: Population survey for *Aegle marmelos*, *Emblica officinalis*, *Embelia ribes* and *Tinospora*

cordifolia was conducted to identify better populations in and around Coimbatore, Tirunelveli and Trivandrum. Vegetative propagules of *Aegle marmelos*, *E. officinalis* and *Tinospora cordifolia* were collected from the identified populations, and propagated in the nursery. Fruits of *Aegle marmelos* and *E. officinalis* were collected and seedlings raised.

RESEARCH ACHIEVEMENTS

Name of State	No. of projects completed in 2003-04	No. of ongoing projects in 2003-04	No. of projects initiated in 2003-04
Tamil Nadu	6	29	9
Kerala	3	15	8
Pondicherry	-	2	3
Andaman & Nicobar	-	1	

EDUCATION AND TRAINING

Training Organized

1. Medicinal Plants Conservation and Seed Technology (in collaboration with Tamil Nadu Forest Department and FRLHT) from 17th and 18th July, 2003 for Officials of the Tamil Nadu Forest Dept.
2. Tree Improvement, Establishment and Management of Seed Production Areas, Plus tree selection and Clonal propagation of forestry species (at Arippa, Trivandrum) from 13th to 15th October, 2003 for Officials of the Kerala Forest Department.
3. Seed handling techniques, Designing and establishment of a modern nursery, Nursery techniques for raising agroforestry species, Vegetative multiplication and grafting techniques for agroforestry species and



- Cultivation of medicinal plants and marketing strategies, Agroforestry and its relevance to present land use (at Pondicherry) from 31st October to 18th November, 2003 for Farmers, NGOs and staff of Pondicherry Forest Department.
4. Training cum demonstration Workshop on Compost, Vermi-compost and VAM Bio-fertilizer Production and Application Methods (at Trumsi, Kuppam Area Development Authority (KADA) in co-ordination with Chittoor West Division, Andhra Pradesh Forest Department) on 23rd and 24th January, 2004 for VSS members (Forest Protection Committee), Watershed members, farmers, NGOs and Forest Department officials.
 5. Forest technologies (sponsored by Pondicherry Forest Department) on 27th and 28th January, 2004 for Farmers and staff of Pondicherry Forest Department.
 6. Various themes on Forest Technologies – Agroforestry, modern nursery techniques and cultivation and marketing of medicinal plants from 10th to 13th February, 2004 for Farmers and staff of Karaikal Forest Department.

Training Received

International

Shri G. Chevanan and S. Thangaraj attended training on Plantation tree seed technology from 16th to 25th February, 2004 at Sri Lanka.

National

1. Shri S. Murugesan attended training on Instrumental Methods of Chemical Analysis from 20th to 22nd November, 2003 at South India Textile Research Association, Coimbatore.
2. Shri N.V. Mathish attended training on Current trends in Bio-informatics from 6th January, 2004 at Government College of Technology, Coimbatore.
3. Dr M. George attended training on Participatory Monitoring and Evaluation from 22nd February to 1st March, 2004 at National Institute of Rural Development, Hyderabad.
4. Shri T. Gunasekaran attended training on Natural Resource Management and the New Business Environment from 13th to 17th October, 2003 at Indian Institute of Management, Lucknow.

LINKAGES AND COLLABORATION

Collaborative work is being implemented for identification and benchmark studies in Gene Pool Conservation Area (GPCA) in Kerala with people's participation. Plant species were inventorized under this programme in Achankoil Forest Division, Pathanamthitta District, Neriyaamangalam, Manandavady and Wayanad, Kerala.

PUBLICATIONS

Papers published in books / proceedings of Seminar

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 9. Palanisamy, K.; Hegde, Maheshwar; Giresan, K. and Durai, A. (2003). Clonal Propagation and Clonal Seed Orchard for Yield Improvement in Neem (*Azadirachta indica* A. Juss), *Indian Forester*, 129: 1211-1216.
 10. Saravanan, S. (2003). Marketing of NTFPs and functions of LAMPS in Salem district of Tamil Nadu. *My Forest*, 39 (4): 395-403.
 11. Saravanan, S. and Buvaneshwaran. C. (2003). Wind – An unfavourable factor for teak growth. *My Forest*, 39 (3): 247-249.

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National

1. Buvaneshwaran, C.; George, M. and Mohan, S. (2003). Distribution of Rainfall under Teak Plantation. *Indian Forester*; 129 (5): 571-577.
2. Buvaneshwaran, C.; Saravanan, S. and Jambulingum, R. (2003). Role of tree stands in the rehabilitation of degraded lands of Auroville, India. *Indian Journal of Forestry*, 26 (4): 333-338.
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2. Dominic Savio, M. Maria and Singh, Mudit Kumar (2004). Future conservation strategies for the mangroves of Andaman and Nicobar Islands. In *National Workshop on Conservation, Restoration and Sustainable Management of Mangrove forests in India* held at Visakapatnam from 18th to 22nd February, 2004.
6. Karthikeyan, A. (2003). Inoculation of arbuscular mycorrhizal fungi (*Glomus aggregatum*) to *Acacia auriculiformis* A. cunn ex. Benth for the reclamation of bauxite mine spoils (In *International Conference on Eco-restoration* held at Dehradun from 14th to 19th October, 2003).
7. Kumar, Ashok; Paramathma, M.; Maria, Dominic Savio and Acharya, Vivek. (2003). Clonal evaluation of *Casuarina equisetifolia* L. Johnson. In *International Conference on World Perspective on Short Rotation Forestry for Industrial and Rural Development* held at Dr Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India from 7th to 13th September, 2003.



8. Kunhikannan, C.; Venkatasunramnian, N. and Sivalingam, R. (2003). Studies on Ecology of some Threatened Medicinal Plants in Medicinal Plant Conservation Areas (MPCA) in Silentvalley and Kolli hills. In *National Seminar on Medicinal plants and Health care* held at Dept. of Botany, P.S.G.R. Krishnammal College for Women, Peelamedu, Coimbatore from 27th and 28th August, 2003.
9. Mohan, V.; Jacob, J. Prasanth and Manokaran, P. (2004). Disease problems and their management in forest nurseries and young plantations. In *National Symposium on Recent Trends in Biology, Biodiversity and Biotechnology of Fungi* held at University of Madras, Chennai.
10. Nagarajan, B.; Kunhikannan, C.; Mutharaian, V.N. and Venkatasunramnian, N. (2003). Species Recovery and Conservation methods for *Aristolochia tagala* Cham. Natural populations. In : "*National Seminar on Medicinal plants and Health care*" held at Dept. of Botany, P.S.G.R. Krishnammal College for Women, Peelamedu, Coimbatore from 27th and 28th August, 2003.
11. Nagarajan, B.; Varghese, M.; Ravi, N.; Nicodemus, A. and Sivakumar, V. (2003). Control pollination and hybrid production in *E. tereticornis*. In *IUFRO International Conference on World Perspective on Short Rotation Forestry for Industrial and Rural Development* held at Dr Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh from 7th to 13th September, 2003.
12. Narayan, Lalit (2004). If a single group of plants to be conserved for the conservation of others – it is only mangroves. In *National workshop on Regional strategy for Plant Conservation* held at TFRI, Jabalpur on 26th and 27th February, 2004.
13. Narayan, Lalit (2004). Strategy for the conservation of flora in Andaman and Nicobar Islands. In *National workshop on Regional strategy for Plant Conservation* held at TFRI, Jabalpur from 26th and 27th February 2004.
14. Narayan, Lalit and Surendranathan, A. (2004). Potential skilled crafts from the woods of Gamari, Mango, Rain tree and spider trees – languishing in a hamlet of Tamil Nadu. In: *National Workshop on Conservation and sustainable utilization of lesser known tree species*, held at Forest Research Institute, Dehradun from 8th to 10th March, 2004.
15. Narayan, Lalit and Surendranathan, A. (2004). The luxuriant performance of mangroves on fly ash dumps at Tuticorin Thermal Power Station – a case study. In *National Seminar on Rehabilitation of lands under Anthropogenic stress and Degradation*, held at Institute of Forest productivity (ICFRE), Ranchi on 20th January, 2004.
16. Narayan, Lalit; Gunasekaran, T; V. John, Anil and Surendranathan, A. (2004): Conservation strategy of mangroves with special reference to island ecosystem of Andamans. *National workshop on Regional strategy for Plant Conservation* held at TFRI, Jabalpur on 26th and 27th February, 2004.
17. Narayan, Lalit; Surendranathan, A.; V. John, Anil and Krishnan, C. (2004). Rehabilitation of degraded sites with the cultivation of



- Gloriosa superba* and *Azadirachta indica* – a case study. In: *National Seminar on Rehabilitation of Lands under Anthropogenic Stress and Degradation* held at Institute of Forest productivity (ICFRE), Ranchi on 20th January, 2004.
18. Nicodemus, A.; Varghese, M. and Nagarajan, B. (2003). Geographic variation and genetic control of growth and form traits in *Casuarina equisetifolia*. In: *IUFRO International Conference on World Perspective on Short Rotation Forestry for Industrial and Rural Development* held at Dr S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh from 7th to 13th September, 2003.
19. Nicodemus, A.; Nagarajan, B.; Narayanan, C.; Varghese, M. and Subramanian, K. (2003). RAPD variation in Indian teak populations and its implications for breeding and conservation. In: *International Conference on Quality Timber Products of Teak from Sustainable Forest Management* held at KFRI, Peechi, Kerala from 2nd to 5th December, 2003.
20. Palanisamy, K.; Gireesan, K. and Hegde, Maheshwar (2003). Clonal propagation technology for teak for production of improved planting stock. In: *International Conference on Quality Timber Products of Teak from Sustainable Forest Management* held at KFRI, Peechi, Kerala from 2nd to 5th December, 2003.
21. Saravanan, S., George, M. and Buvaneshwaran, C. (2003). Cultivation of teak in farmland under different agro-climatic zones of Tamil Nadu - an analysis of ecological and economic factors. In: *International Conference on Quality Timber Products of Teak from Sustainable Forest Management* held at KFRI, India from 2nd to 5th December, 2003.
22. Singh, B. Gurudev; Sivakumar, V.; Kumar, Sudhir; Anandalakshmi, R.; Shanthi, K. and Parimalam, R. (2003). Improvement of Oil Yielding Trees. In: *National Conference on Tree Borne Oilseeds as a Source for Decentralized Energy Planning* held at Coimbatore 28th October, 2003 and in P. Radhakrishna (ed.), Renewable Energy Science Series XII, organized by Govt. of India, Ministry of Non-conventional Energy Sources, Regional office, Chennai, 184-191.
23. Varghese, M.; Nicodemus, A. and Nagarajan, B. (2003). Fertility variation and dynamics of two clonal seed orchards of teak in South India. In *International Conference on Quality Timber Products of Teak from Sustainable Forest Management* held at KFRI, Peechi, Kerala from 2nd to 5th December, 2003.
24. Zhang, Y. DeWitt; D. Murugesan, S. and Nair, M.G. (2003). Novel Antioxidant and Cyclooxygenase inhibitory compounds from *Picorhiza kurroa* seeds. In *44th Annual Meeting of the American Society of Pharmacognosy: The changing face of Natural Product Chemistry* held at Chapel Hill, North Carolina from 12th to 16th July, 2003.

CONFERENCES/MEETINGS/WORKSHOPS/ SEMINARS / SYMPOSIA / EXHIBITIONS

National

1. Attended Twin Workshop of Genepool Conservation in natural forests with the support of VSS and imparted Training on sustainable collection and management of



- NWFP for VSS and Department Personnel from 20th to 24th May, 2003 at Kerala Forest Department, Thekkady, Kerala.
 2. Attended National Seminar on Medicinal Plants and Healthcare on 27th and 28th August, 2003 at PSGR Krishnammal College for Women, Coimbatore.
 3. UGC sponsored Symposium on Bio-resources and their Management on 5th and 6th September, 2003 at Kongu Nadu Arts and Science College, Coimbatore.
 4. Attended National Workshop on Mycorrhizal Technology from 12th to 14th September, 2003 at Sheth L.U. Jhaveri College of Arts and Sir M.V. College of Science and Commerce, Mumbai.
 5. Attended National Conference on Tree borne oil seeds as a source for decentralized energy planning conducted by Ministry of Non-conventional Energy Sources, Chennai on 28th October, 2003 at P.S.G. College of Technology, Coimbatore.
 6. Attended Introductory Seminar on Australian Fumigation Accreditation Scheme for India on 1st December, 2003 at Regional Plant Quarantine Station, Chennai.
 7. Attended Annual Research Seminar on 16th December, 2003 at Salim Ali Centre for Ornithology and Natural History, Anaikatty, Coimbatore.
 8. National Consultation Meeting for the Review of the Eco-restoration Project implemented by Attapady Hill Area Development Society from 17th and 18th December, 2003 at Agali, Palakkad, Kerala.
 9. Attended National Seminar on Bio-diversity Conservation and Participatory Forest Management on December, 2003 at Calicut, Kerala.
 10. IV Annual Discussion Meeting on Biodiversity, Biosignalling and Biotechnology in Insect Plant Interactions on 29th December, 2003 at Chennai.
 11. Attended National Seminar on Rehabilitation of Lands under Anthropogenic Stress and Degradation on 20th January, 2004 at Institute of Forest Productivity (ICFRE), Ranchi.
 12. Attended Seminar on the Draft of the State Development Report of Andaman & Nicobar Islands on 29th and 30th January, 2004 at Port Blair.
 13. National Symposium on Recent Trends in Biology, Biodiversity and Biotechnology of Fungi and 40th Annual Meeting of the Mycological Society of India on 5th and 6th February, 2004 at Centre for Advanced Studies in Botany, University of Madras, Chennai.
 14. Attended National Seminar on Microbial Technology-2004 on 12th and 13th February, 2004 at G.R.D. College of Science, Coimbatore.
 15. Attended National Workshop on Conservation and Sustainable Utilization of Lesser Known Tree Species from 8th to 10th March, 2004 at Forest Research Institute, Dehradun.
- International**
1. Attended 5th IUFRO Working Party Meeting on Diseases and Insects in Forest Nurseries from 6th to 8th May, 2003 at Kerala Forest Research Institute, Peechi.
 2. IUFRO International Conference on World Perspective on Short Rotation Forestry for



Industrial and Rural Development from 7th to 13th September, 2003 at Dr Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, H.P.

3. Attended International Conference on Eco-restoration from 14th to 21st October, 2003 at ICFRE, Dehradun and New Delhi.
4. Attended International Conference on Quality Timber Products of Teak from Sustainable Forest Management from 1st to 5th December, 2003 at Kerala Forest Research Institute, Peechi, Kerala.

CONSULTANCY

A technical consultancy was provided to West Coast Paper Mills (WCPM), Dandeli, Karnataka for improving the pulp wood production. Eucalyptus and Casuarina seeds from IFGTB seed orchards were supplied to WCPM.

Exhibitions

Poster exhibits on various research achievements of IFGTB have been displayed at *International Trade Fair* organized by the Ministry of Science and Technology from 11 to 27 November, 2003.

AWARDS

- ◆ Dr K. Gurumurthi, Director, IFGTB received the "Great son of the soil" award during the

22nd National Annual Intellectuals Conference at Chennai during December, 2003.

- ◆ Dr K. Gurumurthi; R. Yasodha; Modhumita Ghosh; N.V. Mathish; R. Sumathi and Shashi Bhushan Tripathi received the "ICFRE Award for Excellence" for outstanding contribution in the field of *Forest Bio-technology* for the year 2001-2002.
- ◆ Dr K. Palaniswamy, Scientist-E received "ICFRE Award for Excellence" for the outstanding contribution in the field of *Forestry Research* for the year 2001-2002.

MISCELLANEOUS

- ◆ Dr M. George, Scientist-F won the gold medal in shuttle badminton (doubles - veteran category) and silver medal in the badminton (singles - veteran category) in the National Forest Sports Meet held on February, 2004.
- ◆ Shri N.P. Mahadevan, Research Officer received the Jeevan Seva Award for donating blood for 25 times in the National Peace Conference-2003 held at Coimbatore on 31st August, 2003.

Digitisation of Herbarium

- ◆ About 3000 herbarium plant species were uploaded into the 'Image Analyzer' programme and would be made available to the entire country through website.

