
CHAPTER II

INSTITUTE OF FOREST GENETICS AND TREE BREEDING COIMBATORE

The Institute of Forest Genetics and Tree Breeding (IFGTB) was 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, by up-gradation of the Forest Research Centre (FRC), Coimbatore under the Forest Research Institute and College, Dehradun. Several 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 2004-2005

Project 1: Development of protoplast regeneration system in Eucalyptus [IFGTB/RP-7/2002-2005]

Findings: Protoplasts were isolated from *in vitro* grown leaves and embryogenic suspension cultures obtained from the cotyledons. Seven days old suspension cells were harvested for protoplast isolation and the cell were digested with the digestion solution containing 0.4 M mannitol, 0.33 % cellulase, 25.0 mg macerozyme R10, 3.0 mM MES (2-N morpholino ethane sulfonic acid), 7.0 mM $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ having pH 5.8. After washing with Artificial Sea Water (ASW), the isolated protoplasts were grown on

MS medium, B5 medium and KM8p medium as Alginate bead culture, suspension culture and on agarose solidified medium.

Yield of protoplasts from suspension culture was 2.95×10^6 protoplast/g.f.wt and *in vitro* leaves produced 1.2×10^6 protoplast/g.f.wt. Protoplast viability immediately after isolation was 65 ± 7 % in suspension cultures and 47 ± 4 % in *in vitro* leaves. After 3 days of culture as suspension in KM8p medium, based on the maintenance of the spherical shape and cell wall regeneration, 45 and 20 % viability was recorded in the case of suspension culture and *in vitro* leaves derived protoplasts, respectively. No cell wall regeneration was recorded in alginate beads. Plating efficiency (micro calli formation) of the two protoplast sources was determined as 14 and 7 %, respectively. The micro calli when transferred to medium containing BA and Kinetin showed pink coloured callus and the morphological features were very similar to embryogenic callus.

Project 2: 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]

Findings: In the identified Seed Production Areas (SPAs) in Tamil Nadu (Sengampatti, Coimbatore and Seechalay Valley, Top slip) and Kerala (Pandupara Malayattoor and Cherupuzha, Nilambur), the fertilizer treatments and biofertilizer treatments were given to individual trees in the trial plots. The initial flowering in SPAs was observed. Information on seed



production in the SPAs of previous years was collected. The results showed that biofertilizers treated trees were better in terms of flowering and seed yields.

Project 3: Afforestation and productivity studies on problem soils of Tamil Nadu [IFGTB/RP-10/1999-2005]

Findings: Under this Project the problem soils of ACC Madukkarai and Magnesite mine spoils of Burn Standard, Salem have been reclaimed by planting tree species 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 samaea*, *Samanea saman* and *Grevillea robusta* (Silver oak). About 5000 plants each at the Burn Standards mines, Salem and at the ACC mine dumps, Madukkarai have been planted.

Performance of these species and survival are satisfactory. Techniques for immediate air pollution control as well as for accelerated amelioration of completely nutrition-free soil dumps adopted in the Madukkarai area, Coimbatore have produced good results. Good quantity of litter fall in the trial plantations indicates very satisfactory soil amelioration at the site of experiments. Plantation trials have reduced the pollution problem in and around the factory premises to a great extent. Growth rate of species planted is very good. Due to this drifting of sand by wind has been controlled giving relief to the nearby villagers. Applications of biomanure and biofertilizers have resulted in satisfactory performance under adverse soil conditions.

Project 4: Studies on productivity of *Acacia mangium* plantations in Kerala [IFGTB/RP-16/2000-2005]

Status: The present study was carried out to assess performance and productivity of *Mangium* under different planting configurations in farm fields in various agro-climatic zones of Kerala. Among eight agroclimatic zones existing in Kerala, *Mangium* is grown mostly in southern, high altitude and northern zones. The mean annual increment (MAI) in terms of gbh was greater in high altitude zone (9.6 cm) than in northern (9.3 cm) and southern (8.0 cm) zone. MAI in terms of height was 1.99, 1.92 and 1.78 m in southern-northern and high altitude zones, respectively. Comparative studies on productivity of *Acacia mangium* in homesteads and block plantations have shown that the diametrical growth was greater under homestead plantation (gbh 94.5 cm) when compared to block plantation (gbh 81.2 cm) within the same locality in Kerala.

Project 5: Studies on mycorrhizal fungi (biofertilizers) and their application in nursery and field [IFGTB/RP-25/2002-2007]

Findings: Investigation on VAM fungi associated with *Casuarina equisetifolia* and *Eucalyptus globulus* revealed the association of different species of VAM belonging to four genera viz., *Acaulospora*, *Gigaspora*, *Glomus* and *Scutellospora*.

An ectomycorrhizal fungus, *Thelephora ramarioides*, was recorded for the first time in association with *Casuarina equisetifolia* and *C. junghuhniana* under field conditions; 100 per cent distribution of this ectomycorrhiza was observed in the plantations of *C. equisetifolia* while it was recorded to be 80% in *C. junghuhniana* plantations.

Investigation on distribution of Ectomycorrhizal (ECM) and Endomycorrhizal (VAM) fungi revealed the occurrence of different ectomycorrhizal fungi viz., *Amanita muscaria*, *Laccaria fraterna*, *Lycoperdon perlatum*,



Scleroderma citrinum and *Suillus brevipes* in Eucalyptus plantations of Nilgiri Hills, Tamil Nadu. Among these, the species *L. fraterna* and *S. citrinum* were found distributed in all the plantation sites. The association of these species with *E. globulus* in India is reported for the first time.

Salt tolerance capacity of two isolates of the ectomycorrhizal fungus *Pisolithus tinctorius* under laboratory conditions tested with salts like sodium chloride, sodium sulphate and sodium citrate at five different concentrations revealed that both the isolates are salt tolerant. However, there was a gradual reduction in growth and biomass as the salt concentration increased. The isolates were able to grow maximum in sodium sulphate and sodium chloride as compared to sodium citrate.

Effect of dual inoculation of both the ecto and endo mycorrhizae (VAM + *P. tinctorius*, VAM + *L. fraterna* and VAM + *S. citrinum*) on the growth enhancement of *Casuarina junghuhniana* and *Eucalyptus camaldulensis* seedlings under glass house condition was studied and it was found that the inoculated seedlings of both the tree species had better plant height, collar diameter and shoot and root biomass than the uninoculated (control) seedlings.

Project 6: Developing a suitable database on biodiversity [IFGTB/RP-27/ 1999–2004]

Findings: Information on nomenclature, habit, habitat, ecology and phenology of about 70 species of Rare, Endangered and Threatened (RET) plants of Southern India was collected from various sources in a designed format to develop a basic database for easy retrieval of information. This information was incorporated in nine different tables (prepared in MS Access) viz. basic details, bibliography, description, habit, habitat, phenology, propagation, species and

utilization. The database developed has various retrieval options and will be a valuable tool for those who are interested in research and conservation of RET plants.

Project 7: Variability studies with special emphasis on physiology, biometry and biochemistry in selected tree species for tree improvement [IFGTB/RP-4/2000-2005]

Findings: Variability studies were undertaken in 76 clones of *Casuarina equisetifolia* and 59 clones of *Eucalyptus* (*E. tereticornis*-16nos. and *E. camaldulensis*- 43 nos.). In *Casuarina*, the crown length exhibited the highest degree of variation followed by Diameter at Breast height (DBH) or collar diameter (CDM) among all the primary characters (total height, DBH, CDM, crown length, cladode length, cladode diameter and number of primary branches). Diameter at breast height showed higher degree of variation than total height. Number of primary branches, cladode length, cladode diameter and total height showed narrow difference between the values of Phenotypic Coefficient of Variation (PCV) and Genotypic Coefficient of Variation (GCV) indicating that these traits were less influenced by environment. Volume index and crown length recorded high values for broad-sense heritability coupled with high values for GCV and genetic gain indicating that these traits had considerable genetic variability, thus offering good opportunity for improvement through selection. All the clones of *Casuarina* and *Eucalyptus* were graded based on point grading, a method where both quantitative and qualitative traits were used for assessment. Based on the physiological studies, 12 *Casuarina* clones and 5 *Eucalyptus* clones were identified for semi-arid locations. These clones exhibited superior growth with favourable physiological characteristics including high photosynthesis, carboxylation efficiency and water use efficiency. Mahalanobis' D² statistics



and Tocher's clustering method was used to study the genetic divergence in clones of Casuarina and Eucalypts. Based on these studies 20 Casuarina clones and 10 Eucalyptus clones were identified for future tree improvement programmes. Observations recorded on shoot length, root length, collar diameter, shoot fresh weight, shoot dry weight, root fresh weight, root dry weight, biomass index and total biomass, from an experiment to elucidate the difference in growth performance between seedlings and rooted cuttings derived from randomly selected female clones of Casuarina grown in the clone bank showed that seedlings performed better than rooted cuttings during the study period of 3 years. The within variability estimated using coefficient of variation was also less in seedlings in around 60 per cent of the cases. Biochemical/molecular/anatomical studies were conducted to understand the characteristics of the juvenile and adult tissues of Casuarina. Total phenol content and peroxidase activity exhibited an increasing trend with maturity, whereas chlorophylls, total crude proteins and DNA content recorded a decreasing trend. However, the protein profiles (obtained from 4 different positions from lower to upper positions within a tree) 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 *C. equisetifolia* were screened for salt tolerance in a field experiment at Tiruchirapalli, Tamil Nadu. Based on growth and physiological parameters nine clones were identified for planting in sodic-soils.

Project 8: Development of database on tree improvement of mandatory species [IFGTB/RP-28/2001-2004]

Status: Forms and reports are being designed and improved. Tree improvement information from secondary sources has been updated. Plus trees/SSO/CSO/SPA etc. have been finalized.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

Project 1: Genetic variability and selection in natural population of *Artocarpus* sp. [IFGTB/RP-1/2000-2005]

Status: Seeds of *Artocarpus hirsuta* were collected from Seed Production Area (SPA) Chalakkudy, Kuzhathpuzha and Palode. Seedlings were raised in the nursery and growth data were recorded. To understand the genetic structure of populations, genetic variability within and between populations, isozyme characterization is being done with three enzymes namely, esterase, Aspartate Amino Transferase (AAT) and peroxidase. The starch gels revealed two loci for AAT, 4 loci for esterase and 2 loci for peroxidase.

Project 2: Evolving clonal propagation technology for Teak to improve productivity [IFGTB/RP-2/2000-2005]

Status: Forty selected superior trees of Teak from different parts of Kerala have been clonally multiplied and assembled in the Institute. The clonal trial of Teak established at Panayankode, Nilambur (Kerala) was evaluated one year after planting which showed superior growth performance. The height and collar girth of different clones varies from 1.8 to 2.6 m and 8.9 to 13.0 cm, respectively one year after planting. A comparative Teak trial with improved planting stock of selected clones and CSO seedlings has been established at Tirunelveli (Tamil Nadu). The seed production in Teak plantations at Nilambur (Kerala) and Mudumalai (Tamil Nadu) was studied. There was no correlation between the



size of the tree and seed production in Teak. It was found that climatic and edaphic factors influence seed production in Teak.

Project 3: Genetic improvement of *Eucalyptus tereticornis* through controlled hybridization and molecular characterization [IFGTB/RP-3/ 2002-2005]

Status: *Eucalyptus tereticornis* is a major industrial species planted widely in plains of Tamil Nadu. Inter-specific controlled pollination has been carried out in *E. tereticornis* with high altitude species such as *E. pellita*, *E. alba*, *E. grandis* and *E. urophylla* having better stem form as pollen parents to produce full sib families and thereby improve productivity. Three full-sib trials of these combinations have been established at Sadivayal and Kolapakkam (Tamil Nadu) and Panampally (Kerala). An early evaluation indicates that *E. tereticornis* x *E. pellita* is performing better in terms of establishment, height and girth.

Project 4: Enhancing productivity in *Casuarina* sp. through inter-provenance and inter-specific hybridization [IFGTB/RP-30/ 2003-2008]



An outstanding family of
Casuarina equisetifolia

Status: Twenty outstanding clones each of *Casuarina equisetifolia* and *C. junghuhniana* subsp. *timorensis* were selected and vegetatively propagated in a hybridization garden. Flowering phenology of male and female clones was studied for levels of overlapping between them. Pollen storage techniques for the two species for making available pollen for controlled pollination were standardized. Crossing between clones belonging to different provenances and species were carried out and fruit set were obtained. Open-pollinated progenies from a hybridization orchard were assessed for growth and form traits in field tests.

Project 5: Estimation of gene diversity and enhancing seed production in seedling seed orchards of Eucalyptus, Casuarina, Acacia and Teak [IFGTB/ RP-31/2003-2008]

Status: Fertility studies were taken up in Casuarina and Eucalyptus orchards established at different locations. More than 80% of the trees in *C. equisetifolia* orchards were fertile in both coastal and inland sites. In *C. junghuhniana*, the coastal orchard had twice the proportion of fertile trees than that of inland. The orchards established in coastal environment had less fertility variation in both species. To improve the flowering in Eucalyptus four treatments, namely, high N (500 g Urea per tree), NPK, Pollarding, Paclobutrazol application (as soil drench) were given in the seed orchards at Pudukottai and Panampally. It was found that only the Paclobutrazol application had significant effect on fertility of trees where 60% of trees flowered as against 10% in control and 13% each in high N and NPK application.

Project 6: Genetic transformation of Eucalyptus and Casuarina to enhance salinity tolerance [IFGTB/RP-6/2002-2005]

Status: Regeneration methods amenable for genetic transformation of *Eucalyptus tereticornis*



clones and seedlings were optimized. Shoot morphogenesis and rhizogenesis in *Casuarina equisetifolia* were obtained. A case of somatic seedling was observed in *Casuarina*. Co-cultivation studies are in progress for introduction of Osmotin gene into explant tissues of *Eucalyptus tereticornis*. Selection media for screening Kanamycin tolerant cell lines of *Casuarina equisetifolia* were deduced. Protein profile studies carried out in a highly salt tolerant *Casuarina equisetifolia* clone showed accumulation of a 41 kDa polypeptide on the fourth day after 340 mM (2%) NaCl stress. Withdrawal of salt stress on the 18 day resulted in immediate reduction in the levels of this polypeptide.

Project 7: Isolation of somaclonal variants of *Casuarina equisetifolia* for salinity tolerance [IFGTB/RP-8/2002-2007]

Status: Response of callus to varying concentration of NaCl was carried out. Callus obtained from two clones CP3501 and CP4403 were subcultured in solid media containing NaCl at 1,2 and 3%. After 15 days of exposure, 100 % mortality was observed in both the clones for 3% salt treatment. Treatments with 1% and 2% NaCl had resulted in mortality in the range 30 and 70%, respectively, in both the clones. 1% and 2% NaCl can be used for in vitro screening for salt tolerance. Callus multiplication from various clones are in progress for screening and biochemical studies.

Project 8: Selection of potential mycorrhizas and other beneficial microbes for the reclamation of bauxite mine spoils [IFGTB/RP-10a/2002-2005]

Status: This project is implemented at Bauxite mine spoils at Yercaud, Salem District, Tamil Nadu, where The Madras Aluminum Company has undertaken the open cast bauxite mining. Normally to ameliorate the mine spoils,

topsoils are spread on the mine spoils before planting tree species because topsoil is having good structure, water holding capacity and beneficial microbes like VAM fungi, which are very essential for plant growth. These qualities are lacking in the mine spoils because of removal of topsoil during mining. In this study the suitable tree species like *Acacia auriculiformis*, *Casuarina equisetifolia*, *Eucalyptus camaldulensis* and *E. tereticornis* were grown in bauxite mine spoils under nursery conditions and inoculated with cultured VAM fungi (*Glomus aggregatum*) and other beneficial microbes like *Rhizobium* and *Phosphobacterium*.

The studies from these nursery experiments revealed that the VAM fungal inoculation and other beneficial microbes improved the seedling quality in terms of biomass and growth as well as ameliorate the bauxite mine spoils by increasing soil aggregation. The VAM and other beneficial microbes inoculated seedlings were transplanted at bauxite mine spoils and after transplantation the seedlings growth and survival rates were monitored. The VAM fungi and other beneficial microbes inoculated seedlings showed 100% survival rate. Their growth is also significantly higher than the control seedlings. The *Rhizobium* inoculated seedlings also showed good performance in terms of height and survival in *A. auriculiformis*. In *Eucalyptus* spp., the inoculations of VAM + *Phosphobacterium* are found better than other bio- fertilizer treatments in terms of growth. Growth of suitable tree species grown in bauxite minespoil amended with vermicompost was found to be better than that of control seedlings. In *C. equisetifolia* the inoculations of VAM and *Frankia* are found more suitable as they improved the seedlings growth compared to that of control seedlings on bauxite mine spoils. Further, application of compost in the bauxite mine spoils improved the nutrient status whereas



inoculation of VAM fungi mobilized the nutrients to the plants.

The periodical monitoring for the past 10 months on the growth and survival of the planted seedlings showed that the seedlings are all performing well in their growth and survival particularly *E. camaldulensis*, *C. equisetifolia* and *A. auriculiformis*. The soil analysis showed that the status of N P and K nutrients was improved in the rhizosphere of those tree seedlings. The VAM fungi were also recovered in the rhizosphere of *E. camaldulensis*, *C. equisetifolia* and *A. auriculiformis*. These studies indicate that the bauxite mine spoils are being reclaimed through VAM fungi and other beneficial microbes associated with planted tree species. Further, the indigenous species such as *Phyllanthus emblica*, *Albizia lebbek*, and *Dalbergia latifolia* were inoculated with cultured VAM fungi and other beneficial microbes such as VAM fungi, Rhizobium, Azospirillum and Phosphobacterium bauxite mine spoils at nursery conditions and transplanted at bauxite mine spoils, Yercaud.

Project 9: Study on market dynamics relating to important Non Timber Forest Produce in Tamil Nadu [IFGTB/RP-19/2002-2006]

Status: This study was conducted in various Large Agricultural Multi-Purpose Societies (LAMPS) in Tamil Nadu. The study shows that the profit margin of the private trader ranged from 20 per cent to as high as 471% (17% to 85% profit to LAMPS). The sale price realized by the private traders was far higher than the LAMPS' due to processing, grading, value addition etc. Only 30-35% of wholesale price reached the gatherers (Rs. 4/kg for gatherers' sale price and Rs. 25/kg is the consumer's price in honey). Information on NTFP's vis-à-vis socio-economic status of local tribal people was also gathered and the study is under progress.

Project 10: Identification, isolation, evaluation and mass production of native fungi for the management of Teak and Casuarina stem borers [IFGTB/ RP-21/2002-2007]

Status: Seventy soil samples collected from various forest areas of Western Ghats and coastal area of Sirkali of Tamil Nadu were subjected to insect bait method and one more new isolate of Entomo-Pathogenic Fungus (EPF) was trapped and isolated. Of the rest 8 unidentified isolates of EPF three were identified to the species level. Pathogenicity of the rest 7 of the 12 isolates trapped from the soil samples was tested on the test insect *Galleria mellonella* and confirmed the pathogenicity.

Ten of the 12 EPF isolates trapped from the soil and 3 isolates isolated from insect cadavers were tested for their pathogenicity and bioefficacy on the two species of the targeted insect pests, *Sahydrassus malabaricus* and *Indarbela quadrinotata* and found 4 (Konni, Nilambur Thadiyankudisai (2)) of the 10 isolates trapped from soil and 2 of the 3 isolates isolated from the insect cadavers pathogenic and effective in controlling the targeted pests *S. malabaricus* and *I. quadrinotata* causing 100% larval mortality with in 3-7 days.

Project 11: Testing of promising plant derived chemicals against key pests (Component: Bioactive compounds from *Acacia nilotica* (Babul) against the major defoliators of forestry tree species) [IFGTB/RP-22/2000-2005]

Status : The target of the project is to develop methods for the identification of antifeedant and insecticidal compounds of *A. nilotica*. Therefore, the efficacy of extracts of different tissues of *A. nilotica* was evaluated against the important defoliators of Teak and Pongamia. Testing of biopesticidal properties of hexane, methanol and ethyl acetate extracts of *A. nilotica* laves, flower,



Pods, seeds and twigs were done at different doses ranging from 0.04 to 1.25 per cent on *Hyblaea puera*, *Eutectona machaeralis* and *Tephrina pulinda* at different developmental stages. Of these, Hexane extract exhibited toxic effect at the concentrations ranging from 0.32 to 1.25 per cent and induced 60-83% larval mortality due to larval weight loss, antifeedancy (40-87%), ovicidal (40-85%) and pupal mortality (10-67%) of Teak defoliators.

Project 12: Testing and evaluation of selected existing control methods for key diseases of *Casuarina* spp. with reference to blister bark and root-rot [IFGTB/RP-24/2002-2007]

Status: The second proposed field trial of *Casuarina junghuhniana* at Karikalampakkam (Pondicherry) was established for developing integrated methods of management of blister bark or stem wilt disease caused by *Trichosporium vesiculosum* and root-rot disease caused by *Ganoderma lucidum*. Periodical observations were made to record incidence of the targeted diseases in the said as well as already established trial of *C. equisetifolia* at Panampally field research station. Both biofertilizers (VAM and ECM) and bio-control agents (*Trichoderma* spp.) were mass produced and maintained for further application in the field. Biofertilizers (VAM and ECM), bio-control agents (*Trichoderma* spp.) and fungicide (bavistin/Indofil M-45) were applied to the saplings of *Casuarina equisetifolia* and *C. junghuhniana* in the field.

Roots and rhizosphere soil samples were collected from the root zone of *Casuarina equisetifolia* at Panampally at regular intervals. The samples were analysed for recording the colonization of both ECM and VAM fungi in the roots. It was observed that all the root samples had VAM fungal colonization and maximum percent colonization was observed in VAM

treated plant roots. Rhizosphere soil samples were processed and recorded for the distribution of VAM spores and the results revealed that VAM fungal spores were found in all the rhizosphere soils. Among different VAM fungi recorded, the genus *Glomus* was found maximum in most of the soil samples screened.

Periodical observations made to record the incidence of the disease problems on the saplings of *Casuarina equisetifolia* and *C. junghuhniana* in the trials laid at Kerala and Pondicherry revealed incidence of no major disease.

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

Project 1: Natural regeneration studies on important trees in Silent Valley National Park, Kerala [IFGTB/RP-32/2004-2009]

Status: Information on plant species of Silent Valley National Park was collected from relevant literature. After scanning the literature, the following tree species were selected for the study. Various maps of the study area were also collected and tentative sampling locations identified.

Species selected: *Aphanamixis polystachya*, *Actinodaphne bourdillonii*, *Aglaia anamallayana*, *Agrostistachys meeboldii*, *Artocarpus heterophyllus*, *Bischofia javanica*, *Calophyllum polyanthum*, *Canarium strictum*, *Casuarina wynadensis*, *Cassine glauca*, *Cinnamomum malabattrum*, *Cinnamomum sulphuratum*, *Cryptocarya bourdillonii*, *Cullenia exarillata*, *Dimocarpus longan*, *Drypetes elata*, *Elaeocarpus munronii*, *Elaeocarpus tuberculatus*, *Epiprinus mallotiformis*, *Erythroxylum mooni*, *Euonymus angulatus*, *Ficus nervosa*, *Garcinia gummi-gutta*, *Garcinia morella*, *Gomphandra tetrandra*, *Heritiera papilio*, *Holigarna arnottiana*, *Holigarna nigra*, *Hopea glabra*, *Hydnocarpus alpina*, *Lepisanthes*



tetraphylla, *Litsea floribunda*, *Mangifera indica*, *Mastixia arborea*, *Meliosma pinnata*, *Mesua nagassarium*, *Myristica dactyloides*, *Neolitsea scrobiculata*, *Neolitsea zeylanica*, *Nothapodytes nimmoniana*, *Nothopegia beddomei*, *Olea dioica*, *Palaquim ellipticum*, *Persea macrantha*, *Prunus ceylanica*, *Symplocos racemosa*, *Syzygium laetum* and *Toona ciliata*.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

(Externally Aided)

NIL.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

(Externally Aided)

NIL.

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Evaluation of breeding efficiency and genetic gain in seedling seed orchards of Eucalyptus and Casuarina in South India [IFGTB/EF-RP-4/2002-2005]

Status: Five seedling seed orchards of Eucalyptus and four of Casuarina in different locations were investigated for breeding efficiency and genetic gain. Unpedigreed orchards maintained higher diversity than pedigreed orchard even with low fertility as many unrelated trees contribute to seed production. Fertility was generally low in most orchards except in an unpedigreed orchard of *E. camaldulensis* located at Panampally in Kerala state where 45% of the trees contributed effectively in seed production. There was no

significant correlation between tree height and fertility. Two genetic gain trials of seed orchard seeds that were established for each genus in different locations were evaluated which showed superior growth.

Project 2: Estimation of gene diversity and drift pattern in natural stands and plantations of forest tree species in South India [IFGTB/EF-RP-6/2003-2006]

Status: Fertility differences between clones were estimated in a 25 years old Clonal Seed Orchards (CSO) of Teak in South India. Clones selected from Karulai and Nilambur were more fertile than those from Thunakadavu and Sungam. A single clone, SBL 1 produced 68% of flowers and 56% fruits in the orchard. KKL1 (22%) and KLN2 (7%) were the other major seed bearers. Initial studies on reproductive output have also been undertaken in plantations of neem, tamarind and sandal.

Project 3: Evaluation of reproductive success in seed orchards of Teak in India [IFGTB/EF-RP-8/2003-2006]

Status: Studies on flowering and fruiting phenology, quantification of flower and fruit production by individuals and extent of seed filling were continued for the second flowering year. X-radiography technique for non-destructive evaluation of seed filling in Teak drupes was standardized. Collection and identification of principal pollinators were carried out. The abundance, frequency and pollination efficiency of different pollinators were evaluated.

Project 4: Full sib production in selected high yielding Tamarind clones of Tamil Nadu [IFGTB/EF-RP-14/2003-2006]

Status: A study on reproduction was conducted in 40 Tamarind clones located at eight places in



six agro-climatic zones of Tamil Nadu. Based on flowering intensity and open pollination fruit set patterns, 10 clones were chosen for control pollination studies. Crossing schedules were carried out in TNPKM1 x TNR401, TNVEP412 x TNR402, TNPKM407 x TNR402, TNHAS9 x TNR401, TNR401 x TNPKM401, TNR402x TNPKM401 and TNA5 x TNR401 at Anthiyur and Vaigai Dam Forest Research and Extension Centres. Seedlings of the above combinations were raised in the nursery for full sib testing.

Project 5: Fingerprinting of economically important clones of Eucalypts and Casuarinas [IFGTB/EF-RP-2/2000-2005]

Status: Simple Sequence Repeat (SSR) marker in *Casuarina equisetifolia*, was developed and transferability of Eucalyptus SSR markers to Casuarinaceae family was evaluated. Sequences and SSRs were identified in *C. equisetifolia*. All the three categories of SSRs (di, tri and penta nucleotide repeat motifs) were identified. Primers were synthesized for four repeat motifs and were used for fingerprinting of *C. equisetifolia* clones. The SSR targeting (GCT)₅ showed allelic variation within the Casuarinaceae family and the sequence was submitted to National Centre for Biotechnology Information, USA. This is the first report of development of co-dominant SSR marker in the family Casuarinaceae.

Project 6: Genome evaluation and characterization in Casuarinas and Eucalyptus for improving productivity and conservation [IFGTB/EF-RP-5/ 2002-2005]

Status: Species-specific markers were developed for four *Eucalyptus* sp. (*E. grandis*, *E. camaldulensis*, *E. citriodora* and *E. urophylla*), two *Casuarina* sp. (*C. junghuhniana* and *C. glauca*) and two *Allocasuarina* sp. (*A. littoralis* and *A. heugliana*). The genetic diversity existing between and within the species populations were

also estimated using Inter Simple Sequence Repeat (ISSR) markers.

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

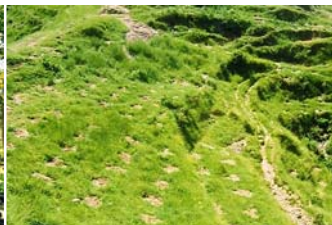
Status: A broad spectrum, non race specific and constitutively expressed antifungal protein from the leaves of *Acorus calamus* was identified. The protein with molecular weight of 13.9 KD showed significant inhibitory activity against the hyphal extension of pathogens like *Trichosporium vesiculosum*, *Macrophomina phaseolina* and *Fusarium moniliforme*. The protein was characterized as basic and intracellular in expression showing functional homology to bacterial chitinase.

Project 8: Refinement of *in vitro* multiplication protocol for *Bambusa nutans* and *Dendrocalamus giganteus* [IFGTB/EF-RP-17/2004-2007]

Status: Sterilization protocol for nodal segments from mature genotypes of *Dendrocalamus giganteus* was standardized and aseptic culture from the mature explants of *Dendrocalamus giganteus* and *Bambusa nutans* were established. Shoot multiplication was achieved in *Bambusa nutans*.

Project 9: Performance of micro and macro propagated planting stock of selected five commercially important Bamboo species [IFGTB/EF-RP-18/ 2004-2007]

Status: Three hectares of demonstration trial of tissue culture raised Bamboo species viz. *Bambusa bambos*, *Dendrocalamus strictus* and *Pseudoxynthera stocksii* was established at Veerapandi No. 4, Coimbatore. A germplasm bank of different species of Bamboos was established.



Project 10: Selection and clonal propagation of commercially important medicinal plants [IFGTB/EF-RP-19/2004-2007]

Status: Potential areas for collection of medicinal plants have been identified. Work has been initiated to find rooting ability of selected medicinal plants.

Project 11: Utilisation of fly ash in agriculture and forestry [IFGTB/EF-RP-12/ 2003-2006]

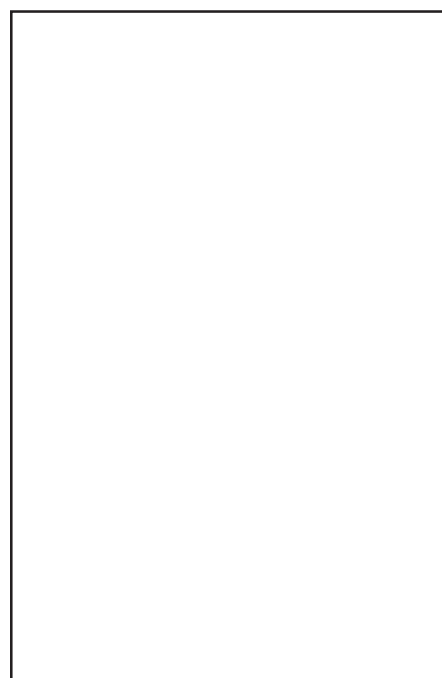
Status: The significant contributions of this project is propagating vegetation (both forestry and agricultural species) on fly ash dykes in their saline and non-saline environment. Utilizing different quantities of fly ash enhanced the yield of some of crops viz. Paddy, Sweet potato, Ginger, Turmeric, Tapioca, Banana, Green gram, Black gram, Ground nut, Bean, Sunflower, Castor, Senna, and Jatropha. The forestry species viz. *Terminalia pinnata*, *Gravelia*, *Peltophorum* sp., *Idium guajava*, *Ficus*, *elina arborea*, *Samanea* and *Dalbergia latifolia* field mixed with varied



Cultivation of Senna and Castor with fly ash

Project 12: Germplasm conservation and establishment of seed stands for production of quality seeds and seedlings [IFGTB/EF-RP-9/2003-2006]

Status: Under the selection programme several new CPTs viz. *Aegle marmelos*-11, *Asparagus racemosus*-12, *Emblica officinalis*-6, *Gymnema sylvestre*-15, *Oroxylum indicum*-2, *Rauwolfia serpentine*-5, *Saraca asoca*- 8, *Strychnos potatorum*-3 and *Tinospora cordifolia*-9 were identified and assembled in the germplasm bank. Seed handling techniques were standardized for *Aegle marmelos*, *Asparagus racemosus*, *Embelia ribes*, *Emblica officinalis*, *Oroxylum indicum*, *Strychnos nux-vomica* and *Tinospora cordifolia*. About 2000 seedlings of *Emblica officinalis*, 11000 seedlings of *Aegle marmelos* and 1000 seedlings of *Saraca asoca* were raised. Nursery raising of *Aegle marmelos* using seeds is successful. It is advisable to dibble seeds directly in polybags



Heavy fruiting in *Tinospora cordifolia*



(8 x16 cm) instead of raising initially in mother beds and later transplanting. This is to avoid transplantation shock which otherwise drastically reduces the plant survival percentage. Success rate is high in vegetative propagation of *Gymnema sylvestre* when stem cuttings are placed with at least one node inside the planting medium. Pretreatment studies on *Embelia ribes* showed that the seeds possess mechanical dormancy. Storing *Oroxylum indicum* seeds at 20°C significantly improved the germination. Soaking *Tinospora cordifolia* seeds in 1000 ppm GA3 for 24 hours was found to improve germination upto 67%. Studies on effect of fruit maturity of *Tinospora cordifolia* on seeds germination showed that seeds of ripe (dark red) fruits germinate well. Ambient condition for storage of seed of this species is the 31 ± 2 °C.

Project 13: Characterization of tropical and temperate forest seeds with reference to seed storage behaviour [IFGTB/EF-RP-10/2003-2006]

Status: Seeds of about 15 species present in different forest types were collected and tested for their tolerance to liquid nitrogen. The seed moisture content and drying rate of a range of species growing in different forest types were studied. Desiccation and temperature tolerance studies in *Persea macrantha* seeds collected from different forest types of South India was carried out. Seeds of *Strychnos nux-vomica* were collected and studied for seed maturity, storage and germination requirements. Seeds of *Pithecellobium dulce* were studied for seed storage behaviour. Seed storage behaviour of *Symplocos cochinchinensis* is in progress.

Project 14: Establishment of agroforestry models with medicinal plants and trees for conservation, propagation and utilization [IFGTB/EF-RP-16/2004-2007]

Status: About 30,000 seedlings of various species of medicinal importance like *Aegle marmelos*, *Withania somnifera*, *Ocimum sanctum*, *Azadirachta indica*, *Pongamia pinnata* and *Cassia angustifolia* etc. were raised in the nursery for establishment of agro forestry plantations as well as for distribution to farmers. Agroforestry plantations with medicinal plants and trees have been established in seven farm fields with *Aegle marmelos*, *Azadirachta indica*, *Pongamia pinnata*, *Gymnema sylvestre* and *Embllica officinalis*.

Project 15 : Evaluation of superior planting stock of *Acacia mangium* in agroforestry systems at different eco-climatic zones of Kerala and Tamil Nadu [IFGTB/EF-RP-11/2003-2006]

Status: Seeds were collected from identified superior trees of Mangium in Panampalli, Kerala as well as from Theni, Tamil Nadu. About 2000 seedlings were raised in the nursery. Four farm fields in southern zone (in Trivandrum and Pathnamthitta District) and one in central zone (in Palakkad District) were identified in Kerala for evaluation of superior planting stocks of Mangium under agroforestry systems. Similarly, three farmlands in southern zone (in Theni District) and two fields in western zone (in Coimbatore District) were identified in Tamil Nadu for raising agroforestry plantations. About 1000 seedlings of superior trees origin were planted out in six fields each having plot size of approximately one acre (five fields in Kerala and one in Tamil Nadu).

Project 16: Development of integrated pest management package for forest nursery insect pests of some economically important tree species [IFGTB/ EF/RP-13/2003-2006]

Status: Regular surveys carried out at various nurseries maintained by the State Forest Departments of Tamil Nadu, Pondicherry and



Kerala revealed the incidence of insect pests like defoliators and sap suckers in nursery seedlings. Major pest problems recorded were defoliation on *Tectona grandis*, *Azadirachta indica*, *Sapindus emarginata* and *Pongamia pinnata* by *Myllocerus* sp. Other major defoliation problems recorded on seedlings were by *Hyblaea puera* and *Eutectona machaeralis* on Teak, *Papilio demoleus* on *Limonia acidissima*, *Nephopteryx eugraphella* on *Mimosops elengi* and *Eligma narcissus* on *Ailanthus excelsa*. A Pest Calendar for nursery seedlings is prepared and updated. Influences of biotic and abiotic factors on pest build up were studied.

Project 17: Exploitation of mycorrhizal systems in the Nilgiris Biosphere Reserve Area [IFGTB/EF-RP-15/2004-2007]

Status: Different Forest Ecosystems such as Natural Forests (Tropical Wet Evergreen Forests, Shola-Grassland Ecosystem) and Man-made Plantation Forests were selected and surveyed at regular intervals for investigating the status of mycorrhizal diversity in the Nilgiri Biosphere

Reserve Areas of the Nilgiri Hills, Tamil Nadu state. Data on occurrence and distribution of different mycorrhizal fungi such as Ectomycorrhizal (ECM) and Endomycorrhizal (AM) fungi in various forest ecosystems like grasslands, man-made plantations (*Acacia* spp., *Cupressus* spp., *Eucalyptus* spp. and *Pinus* spp.) in the Nilgiri Hill areas of South India were collected at a regular intervals.

Different species of AM fungi belonging to three genera viz., *Acaulospora*, *Gigaspora* and *Glomus* were recorded. ECM fungi like *Amanita muscaria*, *Inocybe* spp., *Laccaria fraterna*, *Lycoperdon* sp., *Rhizopogon* spp., *Russula* spp., *Suillus* spp. and *Scleroderma* spp. were recorded from different study sites under various host trees.

Project 18: Eco restoration for Tsunami devastated coastline of Andaman Group of Islands [IFGTB/EF-RP-20/2004-2007]

Status: Project has been initiated and seeds of *Cuarina equisetifolia* were collected for raising seedlings.

RESEARCH ACHIEVEMENTS

Name of State	No. of Projects completed in 2004-2005	No. of on-going Projects in 2004-2005	No. of Projects initiated in 2004-2005
Tamil Nadu	6	26	5
Kerala	5	20	5
Pondicherry	2	7	1
Andaman & Nicobar	1	1	1

EDUCATION AND TRAINING

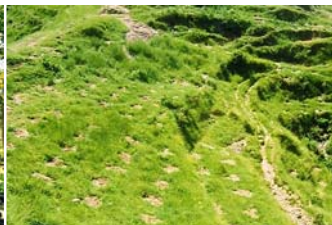
Training organized

1. Tissue culture techniques for genetic engineering for M.Sc. student from Bharathidasan University for 4 months.

2. Summer Project Training on Mycorrhizal biofertilizers techniques – isolation, identification, multiplication and application on May, 2004, for Ph.D. Scholar from University of Mumbai, Mumbai.



3. Importance of biofertilizers in agriculture and forestry – isolation, identification, mass production and application of different kinds of biofertilizers in nursery and field on 15th May, 2004 for 40 participants of Attappadi Hills Area Development Society (AHADS), Department of Rural Development (Government of Kerala), Agali, Kerala State.
4. Training on various themes of forestry from 19th to 21st October, 2004 for the farmers, NGOs and Forest Department staff of Pondicherry.
5. Cultivation of medicinal plants on 21st October, 2004 for the farmers of Pondicherry.
6. Forest Seed Management on 26th October, 2004 for Forest officers of Kerala State at KFRI, Peechi.
7. Training on Seed handling – collection, processing, storage techniques and pretreatments on 30th October, 2004 for Field officers of Attappady Hills Area Development Society (AHADS), Agali.
8. Molecular Pathology on 10th December, 2004 for Government college teachers during refresher course in Botany at PSGR Krishnammal College for Women, Coimbatore.
9. Biofertilizer and disease management in nursery/ plantation on 15th December, 2004 for Forester trainees at Southern Forest Rangers College, Coimbatore.
10. Nursery/plantation pests and their management on 17th December, 2004 for Forester trainees at Southern Forest Rangers College, Coimbatore.
11. Employment opportunities for biologists and a glimpse of bio-pesticides on 31st December, 2004 for Students of Zoology, ANJA College, Sivakasi.
12. Integrated pest management in forest nurseries and plantations on 20th January, 2005 for the serving forest officers of various state forest departments during Refresher Course at State Forest Service College, Coimbatore.
13. DNA finger printing and plant microbial interaction on 22nd March, 2005 for participants of the refresher course in Microbial Bio-technology at Bharathiar University, Coimbatore.
14. Agroforestry and inter-cropping patterns suitable for Tamil Nadu on 16th and 17th February, 2005 for the officials of the Tamil Nadu State Forest Department at SFRC, Coimbatore.
15. Chemical ecology in host selection by phytophagous insects and its role in IPM on 23rd February, 2005 for trainees of Recent Advances in HPR course at Tamil Nadu Agricultural University, Coimbatore.
16. Insect offence and plant defense on 18th March, 2005 for Zoology students of Avinashilingam Deemed University, Coimbatore.
17. Disease problems and their management in nurseries and plantations from 17th to 29th March, 2005 for trainees of the TAP training course at Southern Forest Rangers College, Coimbatore.
18. Insect pests of forest nurseries and plantations and their management from 17th to 29th March, 2005 for trainees of the TAP training course at Southern Forest Rangers College, Coimbatore.



Training received

National

1. Shri C. Bhuva-Neswaran attended training on Capacity building of CBOs for participatory development, National Institute of Rural Development (NIRD), Hyderabad from 26th April to 1st May, 2004.
2. Shri Kannan C.S. Warriar attended training on Participatory planning and management of natural resources for sustainable livelihoods, National Institute of Rural Development (NIRD), Hyderabad from 23rd to 28th August, 2004.
3. Shri C. Kunhikannan and D. Rajasugunasekar attended training on ISO 14001 Environmental Management System Auditor Course (IEMA Approved), ICFRE, Dehradun from 23rd to 27th November, 2004.
4. Shri D. Rajasugunasekar attended training on Sample survey to estimate rates and ratios of timber and non-timber forest products in India, ICFRE, Dehradun from 27th to 29th January, 2005.
5. Shri T. Gunasekaran attended training on Combating desertification, Forestry Training Institute, Jaipur from 7th to 11th February, 2005.
6. Shri S. Saravanan attended training on Participatory planning and management of agroforestry under IWDP for sustainable development, National Institute of Rural Development (NIRD), Hyderabad from 28th February to 5th March, 2005.
7. R. Vivekanandan, Maria Dominic Savio, M. P. Che-zhian and R. Kamalakannan attended training on Plant Genetic Resources, data bases and their application in Agriculture, Centre for Plant Molecular

Biology, Tamil Nadu Agriculture University, Coimbatore from 27th to 31st March, 2005.

International

1. Shri V. Sivakumar, Scientist-C attended training on Characterization of tropical and temperate forest seeds with reference to seed storage behaviour, Swedish University of Agricultural Sciences, Umea from May, 2004 to August, 2004.
2. Dr. Mohan Varghese, Scientist-D attended training on Estimation of gene diversity and drift pattern in natural populations and plantations of forest tree species in South India, Swedish University of Agricultural Sciences, Umea from May, 2004 to July, 2004.

LINKAGES AND COLLABORATION

Mr. John Fryer and Dr. John Davidson of ACIAR (Australia) visited the Institute from 2nd to 5th May, 2004 to review the progress of the collaborative project – Domestication of Australian trees. The officials visited the Pannampally and Karunya field stations of IFGTB and seed orchards and genetic trials of Australian species.

PUBLICATIONS

Published in Journals

National

1. Das, Gupta, Modhumita and Gurumurthi, K. (2005). Isolation of antifungal proteins from leaves of *Acorus calamus*. *The Biome News*, Vol.6, No.1.
2. Gurudev Singh, B. and Warriar, R.R. (2004). *Tinospora cordifolia*. *Indian Forester*, 130(9): 1806.
3. Hegde, Maheshwar; Mohan, V., Manokaran, P. and Palanisamy, K. (2004). *Alternaria* Leaf Blight Disease on *Artocarpus* seedlings - A



- New Record. *Indian Forester*, 130(11): 1339-1342.
4. Hegde, Maheshwar, Ramteke, P. K. and Subramanian, K. (2004). Genetic Variation and interse correlation of seedling characteristics in Teak (*Tectona grandis* L.). *Indian Journal of Forestry*, 27(1): 19-24.
 5. Jacob, J.P., Murugesan, S, Balu, A. and B. Sunitha. (2004). Organic pest control methods against some insect pests of forest trees. *My Forest*, 40(3): 209-216.
 6. Mohan, V. and Manokaran, P. (2005). Control of Leaf Rust of *Terminalia chebula* caused by *Uredo terminaliae*. *Indian Forester*, 131(1): 115-17.
 7. Murugesan, S. (2004). Biopesticidal effects of different tissues of *Acacia nilotica* (Babul) extracts on *Tectona grandis* (Teak) pests. *Ad. Plant. Sci.*, 17(1): 203-206.
 8. Murugesan, S. (2004). Induced defence research and potential application of induced defenses in forestry. *Indian Forester*, 130(11): 1227-1234.
 9. Narayanan, C. and Nicodemus, A. (2005). Incidence of wilt (blister bark) disease of *Casuarina junghuhniana* in India. *Indian Forester*, 131: 257-258.
 10. Nicodemus, A. and Jacob, J.P. (2004). Bird pollinators of Teak. *Newsletter for Birdwatchers*, 44: 68-69.
 11. Rajagopal, K., Buvaneswaran, C., Subramanian, V. and George, M. (2005). Nutrient cycling in young Teak plantation: I- Restitution of nutrients through litter and rain-wash. *Indian Forester*, 131(2): 221-228.
 12. Saravanan, S. (2004). Functions of Large Agricultural Multipurpose Societies (LAMPS) in marketing of Non-timber forest products in Vellore district of Tamil Nadu – A case study. *Journal of Non -Timber Forest Products*, 11(2): 94-98.
 13. Saravanan, S. and Buvaneswaran, C. (2004). A socio-economic analysis on cultivation of a potential medicinal plant – *Coleus forskohlii*. *Journal of Economic and Taxonomic Botany*, 28(3): 729-733.
 14. Saravanan, S., Buvaneswaran, C. and Nautiyal, Raman (2004). Growth performance of Teak (*Tectona grandis*) in farmlands under different agro-climatic zones of Tamil Nadu. *My Forest*, 40(3): 227-234.
 15. Warriar, K.C.S. (2004). Kavukal – Jaiva Vaividhyathinte Kalavarakal (Language: Malayalam) (meaning Sacred groves – The treasure house of Biodiversity). *Kumkumam*, 39(11): 22-23.
 16. Warriar, K.C.S. (2004). Nammude Kavukal (Language: Malayalam) (meaning: Our Sacred groves). *Matruvani*, 20(14): 30-31.
 17. Yasodha R.; Kathirvel M.; Sumathi R., Gurumurthi, K. and Nagaraju, J. (2004). Clonal identification of *Casuarina equisetifolia* using DNA polymorphisms generated by PCR with arbitrary primers. *NFT News*, 7(1): 5-6.
 18. Yasodha R.; Sumathi, R. and Gurumurthi, K. (2004). Micropropagation for quality propagule production in plantation forestry. *Indian Journal of Biotechnology*, 3: 159-170.

International

1. Ghosh, M.; Thangamani, D.; Thapliyal, M., Yasodha, R. and Gurumurthi, K. (2004). Isolation of *Andrographis Paniculata* leaf protein with antifungal property. *Acta Phytopathologica et Entomologica Hungarica*, 39(4): 377- 381.



2. Ghosh, M.; Thangamani, D.; Thapliyal, M., Yasodha, R.; and Gurumurthi, K. (2004). Purification of antifungal protein against blister bark pathogen of *Casuarina equisetifolia*. *Acta Botanica Croatica*, 63(2):75-81.
3. Karthikeyan, A., Muthukumar, T. and Udaiyan, K. (2004). Response of tea (*Camellia sinensis* (L.) O. Kuntze) to arbuscular mycorrhizal fungi under plantation nursery conditions. *Biological Agriculture and Horticulture*, 22 (4): 305-319.
4. Varghese, M.; Lindgren, D. and Nicodemus, A. (2004). Fertility and effective population size in seedling seed orchards of *Casuarina equisetifolia* and *C. junghuhniana*. *Silvae Genetica*, 53(4-5): 164-168.
5. Warriar, R.R.; Sivakumar, V.; Anandalakshmi, R.; Vijayachandran, S.N., Mahadevan, N.P. and Gurudev Singh, B. Improving storability of *Bambusa arundinacea* (Retz.) Wild. Seeds. *Journal of Bamboo and Rattan*, 3(4): 375-382.
6. Zhang, Y., Murugesan, S. and Nair, M.G. (2004). Novel Lipid-Peroxidation and Cyclooxygenase-Inhibitory Tannins from *Picrorhiza kurroa* Seeds. *Chemistry and Biodiversity*, 1: 426-441.
2. Buvneswaran, C. (2005). Nutrient dynamics under Teak based agro-forestry systems. Paper presented in the *Workshop on Agro-forestry for Attappady Wastelands* at AHADS, Agali, Palakkad, Kerala on 8th and 9th January, 2005.
3. Kunhikannan, C. (2004). Botanical garden, IFGTB. In: *Working Document, National Workshop on Information management of biodiversity resources in Botanic Gardens of India* at NBRI, Lucknow, conducted from 6th to 10th September, 2004.
4. Kunhikannan, C. (2004). Traditions, rituals and biodiversity in sacred grove of *Karakkakavu*, Kasargod district, Kerala state: A case study - presented in the *National Workshop on Strategy for Conservation of Sacred Groves* held at IFGTB, Coimbatore from 27th and 28th May, 2004.
5. Kunhikannan, C., Rao, Rama N. and Bisen, S.S. (2004). Diversity of Plant Communities in Dry Deciduous Forests of Tadoba National Park, Chandrapur, Maharashtra, India. In: *XIV Annual Conference of IAAT and National Seminar on New Frontiers in Plant Taxonomy and Biodiversity Conservation* held at Thiruvananthapuram, Kerala from 29th to 31st December, 2004.

Papers Presented in Seminars

1. Buvaneswaran, C. and George, M. (2004). Performance of *Acacia mangium* in plantations and homesteads under various agro-climatic zones of Kerala. Paper presented in the *IUFRO International Conference on Multi-purpose trees in the tropics – Assessment, Growth and Management* held at Arid Forest Research Institute, Jodhpur from 22nd to 24th November, 2004.
6. Narayan Lalit; Kumar Anil; John, Anil V. and Surendranathan, A. (2005). Prospect of growing Senna (*Cassia angustifolia*) in soils mixed with fly ash. Paper presented in National Symposium on *Emerging Technologies and their Application and Management of Threatened Wild Medicinal Plants and their Habitats* from 23rd to 25th February, 2005 at State Forest Research Institute, Jabalpur (M.P).



7. Maria Dominic Savio, M. and Singh Gurudev, B. (2004). Plus tree selection in tree borne oil seeds. Presented during ICAR sponsored Winter School – short course on *Strategies for improvement and utilization of Tree Borne Oilseeds* conducted at the Forest College and Research Institute, TNAU, Mettupalayam from 20th to 30th September, 2004.
8. Maria Dominic Savio, M. and Singh, Mudit Kumar (2004). The role of multipurpose trees in saving the forestry resources of Andaman and Nicobar Islands. Souvenir cum Abstracts of *IUFRO International Conference on Multipurpose trees in the Tropics: Assessment, Growth and Management* held at Arid Forest Research Institute, Jodhpur from 22nd to 25th November, 2004. pp. 173.
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10. Mohan, V. (2004). Role of mycorrhizal fungi as biofertilizers in agriculture, horticulture and forestry. Presented in UGC sponsored National Conference on *Current trends in Biological Scenartio* at PG and Research Department of Botany Vellalar College for Women, Erode, Tamil Nadu on 11th and 12th August, 2004.
11. Mohan, V. (2004). Selection of disease resistant phenotypes of the multipurpose tree species, *Casuarina equisetifolia* in South India. Presented in the *IUFRO International Conference on Multipurpose Trees in the Tropics: Assessment, Growth and Management* held at Arid Forest Research Institute (Indian Council of Forestry Research and Education), Jodhpur – 342 005, Rajasthan, India from 22nd to 25th November, 2004.
12. Mohan, V. (2004). Studies on the status of arbuscular mycorrhizal fungi in association with some important medicinal plants. Presented in UGC sponsored National Symposium on *Rural and Ethnomedicinal Plant Remedies – Conservation and Utilization (Ayush Remedies)* held at Kongunadu Arts and Science College, Coimbatore from 23rd to 25th September, 2004.
13. Mohan, V. (2005). Distribution of Mycorrhizal Fungi and their Effect on Growth Improvement of Forest Trees in Nursery and Field”. Presented in the Workshop on *Agroforestry for Attappady Wastelands Potential and Prospects* at Attappady Hills Area Development Society, Agali, Govt. of Kerala, Kerala, India on 8th and 9th January, 2005.
14. Mohan, V. (2005). Mycorrhizal biofertilizer technology – A tool for forestry improvement. A lead paper presented in 4th *National Level Biological Congress on Biotechnology – A Boon to Humanity* held at Department of Biological Science, Muthayammal College of Arts and Science, Rasipuram, Nammakkal District, Tamil Nadu, India on 28th and 29th January, 2005.
15. Mohan, V. (2005). Role of mycorrhizal fungi as biofertilizers in agriculture, horticulture and forestry. A lead paper presented in the State Level Seminar on *Important Microbes: Present and Future Scenario* held at



Department of Microbiology, Karpagam Arts and Science College, Coimbatore – 641 021, Tamil Nadu, India on 9th March, 2005.

16. Murugesan, S. (2005). Plant natural products, induced defense and their potential application research in forest IPM. Presented in the National Seminar on *Insect Growth Regulators and Natural Products in IPM* organized by UGC and KSCSTE at St. Joseph's College, Calicut on 11th January, 2005.
17. Nicodemus, A., Varghese, M. and Nagarajan, B. (2004). Selection of *Casuarina junghuhniana* Miq. provenances for multiple end uses in India. Paper presented in the IUFRO International conference on *Multipurpose Trees in Tropics: Assessment, Growth and Management* held at AFRI Jodhpur from 22nd to 25th November., 2004.
18. Palaniswamy, K. (2004). Clonal technology for Teak for production of quality planting stock to improve productivity. Paper presented in *XIII ICFRE Society Meeting* at Ministry of Environment and Forests, New Delhi on 2nd November, 2004.
19. Rekha R., Warriar; Anandalakshmi, R.; Sivakumar, V. and Gurudev Singh, B. (2005). Conservation of medicinal plant diversity through cultivation and utilisation. In: International Conference on *Modern Trends in Plant Sciences — Role of Biodiversity in Conservation* (ICPSBC-05), Amravati University, Amravati, India from 19th to 21st February, 2005.
20. Saravanan, S. and George, M. (2004). *Casuarina equisetifolia* – A potential multipurpose tree species for agroforestry systems in Tamil Nadu. Paper presented in the *IUFRO International Conference on*

Multipurpose trees in the tropics – Assessment, Growth and Management held at Arid Forest Research Institute, Jodhpur from 22nd to 24th November, 2004.

21. Subramanian, K.N., Sasidharan, K.R and Venkatasubramanian, N. (2004). Floristic Diversity of Iringole Kavu, Ernakulam District, Kerala State. Presented in the National Workshop on *Strategy for Conservation of Sacred Groves* held at IFGTB, Coimbatore from 27th and 28th May, 2004.
22. Yanjun Zhang, Murugesan, S. and Nair, Muraleedharan G. (2004). Triterpenoids and lignans from *Picrorhiza kurroa* seeds. Paper presented in 2004 – *International Congress on Natural Products Research* from 31st July to 4th August, 2004, Phoenix, Arizona, USA.

Brochures / Reports

1. George, M. and Buvaneswaran, C. (2004). Final report on *Greening the Islands of Lakshadweep and environment protection* – Submitted for incorporation in the State Development Report of Lakshadweep.
2. Gunasekaran and Maria Dominic Savio, M. (2004). Final report on the *Role of Panchayati Raj Institutions in Lakshadweep Administration* (modified). Submitted to the Planning Commission, Government of India, pp. 94.
3. Gurudev Singh, B. (2004). Report on *Lakshadweep Islands – Biodiversity Conservation and Sustainable Use*. Submitted for incorporation in the State Development Report of Lakshadweep, pp. 84.
4. Kunhikannan, C.; Nagarajan, B., Sivakumar, V. and Venkatasubramanian, N. (2004). *Species Recovery in a few Rare, Endangered and Threatened Plants of Silent Valley and Kolli*



Hills. Final Report submitted to Foundation for Revitalization of Rural Health Traditions (FRLHT), Bangalore, IFGTB, Coimbatore.

5. Sasidharan, K.R.; Madhavan Pillai, S.R.; Balu, A.; Rajarishi, R., .Deeparaj, B. and Mahalakshmi, R. (2004). *Selection of pest resistant trees from wild population, provenances and exotic trials and progeny tests (Project Completion Report)*, Institute of Forest Genetics and Tree Breeding, Coimbatore, pp. 78
6. Singh, Mudit Kumar, Maria Dominic Savio, M. and Krishnan, C. (2004). Final Report of the *State Development of the Andaman & Nicobar Administration* (modified). Submitted to the Planning Commission, Government of India. pp. 81.
7. Warriar, K.C.S.; Gurumurthi, K.; Barthwal, S., Warriar, R.R. and Venkataramanan, K.S. (2005). *Variability Studies with Special Emphasis on Physiology, Biometry and Biochemistry in Selected Tree Species for Tree Improvement. (Project Completion Report)*. Institute of Forest Genetics and Tree Breeding, Coimbatore, p. 130
8. Warriar, K.C.S., Rajasugunasekar, D. and Kunhikannan, C. (2004). *Status of Preservation Plots in Kerala - Survey Report*. Institute of Forest Genetics and Tree Breeding (Indian Council of Forestry Research and Education), Coimbatore, p.10

CONSULTANCIES

- Technical Advisory Consultancy for enhancing productivity of forest plantations was provided to West Coast Paper Mills, Dandeli (Karnataka).

- Technical consultancy was offered to Andhra Pradesh Forest Department on implementing breeding programmes for native and introduced tree species.
- Consultancy service were provided to Singareni Collieries Company Limited, Kothagudem, Khammam District Andhra Pradesh for the study of the changes likely to occur with the diversion of R.F on flora and fauna in the area of 11.96 ha of forest land sought for realignment of Tellavagu nallah - a seasonal stream.
- A technical consultancy was given to Kudremukh Iron Ore Company Ltd., Kudremukh in preparation of Final mine closure plan along with Eco-restoration plan.

CONFERENCES/MEETINGS/ WORKSHOPS/SEMINARS/ SYMPOSIA/EXHIBITIONS

Organized

Organized a National Workshop on *Strategy for conservation of Sacred Groves* sponsored by the Ministry of Environment and Forests (MoEF), Government of India on 27th and 28th May, 2004 at the Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore. The workshop was inaugurated by Dr. Kulaindaivel, Chancellor, Avinashilingam Deemed University, Coimbatore and attracted more than 110 participants. 48 papers were presented.

Attended

National

1. Consultative Workshop on Propagation and Cultivation of Bamboo on 30th and 31st July, 2004 at G.B. Pant University of Agriculture, Uttaranchal.



2. Consultative Meeting for formation of umbrella project on LKTS from 16th to 18th August, 2004 at ICFRE, Dehradun.
3. Workshop on Regional cooperation on conservation of biodiversity hot spots of the Indian sub-continent and taxonomy databases for conservation on 30th August, 2004 organised by ATRI and UAS, Bangalore
4. Workshop on Information management of bio-diversity (plant genetic) resources in Botanic Gardens of India from 6th to 10th September, 2004 at NBRI, Lucknow.
5. National Workshop on Conservation of Sacred Groves from 16th to 18th September, 2004 organised by KFD, Kozhikode.
6. Interaction Workshop on Participatory Forest Management and Genepool Conservation Areas on 20th September, 2004 at High Range Circle Office, KFD, Kottayam.
7. ICAR sponsored Winter School short course on Strategies for improvement and utilization of tree borne oil seeds from 20th to 30th September, 2004 at Forest College and Research Institute, TNAU, Mettupalayam.
8. Workshop on Advanced Techniques in Plant Biotechnology on 22nd September, 2004 at J.J. College of Arts and Science, Pudukottai.
9. Seminar on State Development Report for Lakshadweep from 12th and 13th October, 2004 organised by IAMR at Kavaratti, Lakshadweep.
10. 5th Annual Discussion Meeting on Dimension of Molecular Entomology on 27th November, 2004 organised by Prof. T.N. Anantahakrishnan, Emeritus Professor at Chennai.
11. XIV Annual Conference of IAAT and National Seminar on New frontiers in plant taxonomy and biodiversity conservation from 29th to 31st December, 2004 at Tropical Botanical Garden and Research Institute, Thiruvananthapuram.
12. National Seminar on Healthy Environment for the next generation from 2nd to 4th December, 2004 at Loyola College, Chennai.
13. Workshop on Agroforestry for Attappady Wastelands: Potentials and Prospects on 9th January, 2005 at Attappady Hill Area Development Society, Agali, Palakkad.
14. ICAR National Symposium on SYMBIOHORT from 10th to 12th January, 2005, Kerala Agricultural University, Thrissur.
15. Round Table Consultative Meet on Bamboo Location Trial on 15th and 16th January, 2005 at G.B. Pant University of Agriculture, Uttaranchal.
16. Annual Research Seminar of Salim Ali Centre for Ornithology and Natural History on 17th January, 2005 at SACON, Coimbatore
17. Symposia on Microbial and Plant Biotechnology from 17th to 19th February, 2005 at Loyola College, Chennai.
18. Seminar on State Development Report, Lakshadweep on 23rd February, 2005 at IAMR Campus, Narela, Delhi.
19. National Symposium on Emerging Technologies and their management of threatened wild medicinal plants from 23rd to 25th February, 2005 at State Forest Research Institute, Jabalpur.



International

1. IUFRO International Conference on Multipurpose Trees in Tropics: Management, Growth and Assessment jointly organized by IUFRO and ICFRE from 22nd to 25th November, 2004 at Arid Forest Research Institute, Jodhpur.

AWARDS

Best Poster Award was given for the poster on *Protoplast isolation and Regeneration in Eucalyptus camaldulensis* (R. Yasodha, R. Sumathi and P. Malliga) at National Symposium on *Microbial and Plant Biotechnology* held at Loyola College, Chennai from 17th to 19th February, 2005.

DISTINGUISHED VISITORS

Thiru A. Raja, Hon'ble Union Minister, Ministry of Environment and Forests, Govt. of India visited the Institute on 25th January, 2005.

MISCELLANEOUS

- Mrs. V. Bhanumathy, LDC won the *Gold medal in Chess* during *XIII All India Sports Meet* held at Raipur, Chhattisgarh from 28th December, 2004 to 1st January 2005.
- A lecture on *Origin, Genesis and Functions of Judiciary in India* was delivered by Shri B. Mohan, B.A., B.L., Attorney, Coimbatore. The programme was jointly organized by Indian Institute of Public Administration (IIPA) and IFGTB on 24th March, 2005 at IFGTB,
- A total of 640 visitors visited the Institute during April, 2004 to March, 2005. It includes the students of various educational institutions, NGOs, industrialists, academicians etc. The research activities

were explained to them by arranging visits to laboratories, botanical garden, modern nursery, vegetative multiplication garden, Gass Forest Museum etc. and they were provided with relevant technical information on Forestry. Pamphlets and handouts were distributed to the visitors. ICFRE and IFGTB publications were made available for sale.

- Participated in the radio programmes organized by AIR, Coimbatore on various forestry related topics and a special radio feature on *IFGTB's research activities with special reference to Agroforestry* was presented.

Service Rendered

- Plants and plant products slated for export were examined and subjected to the appropriate quarantine measures and 643 Phytosanitary Certificates were issued to various organizations and individuals.
- Queries relating to the pests and disease problems and bio-fertilizers received from the State Forest Departments, farmers and NGOs were attended and provided appropriate solutions.

Gass Forest Museum

- Collection management, upkeep and maintenances, visitor's service and educational service were undertaken. A total of 7073 peoples visited the museum during the year.

Maintenance of Seed Bank

- Seeds of various important species viz. *Jatropha curcas*, *Azadirachta indica* and *Tectona grandis* were collected from



different localities of Tamil Nadu and Kerala. Seeds of *Acacia auriculiformis*, *A. mangium*, *Casuarina equisetifolia*, *C. junghuhniana*, *Eucalyptus camaldulensis* and *E. tereticornis* were supplied to other divisions of the Institute, SFDs, Industries, NGOs and other user agencies. Ten kg seeds of *Jatropha curcas* collected from Tamil Nadu and Kerala were supplied to Union Territory of Lakshadweep.

- Seed testing for viability, seed count, purity

were conducted and provided the test results to various clients and researchers.

Library and documentation

The Library has a collection of 8100 books, 35 Indian journals, nearly 250 number of back volumes, other research reports, Seminar Proceedings, tour reports and non-subscribed periodicals received as complimentary and resource sharing of library documents.