

CHAPTER III

INSTITUTE OF WOOD SCIENCE AND TECHNOLOGY BANGALORE

The Institute of Wood Science and Technology (IWST), Bangalore formed in 1988, is mandated to conduct research on Wood Science and Technology as its national objective and focus on important forestry research needs of the states of Karnataka, Andhra Pradesh and Goa at regional level. Taking into consideration the expertise available and contributions made, the Indian Council of Forestry Research and Education (ICFRE), Dehradun has assigned the Institute the status of Centre for Advanced Studies in the areas of Improved Utilisation of Wood; Mangroves and Coastal Ecology and Research on Sandal. The direction of research being carried out at IWST is in consonance with and in response to the aims of National Forest Policy in the areas of utilisation of timber and non-timber products and for increasing productivity. The Institute mainly aims to develop sustainable strategies for use and production of wood and other forest products.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

Project 1: Assessment of wood quality (Anatomical) of 8-10 years old *Acacia auriculaeformis* and *Acacia mangium* hybrids [IWST/WPU/X-08-2002-2004]

Findings: Data on anatomical and physical properties of 8 years old *Acacia auriculaeformis* and *A. mangium* hybrids was generated for the first time. Statistical analysis of specific gravity

and anatomical data revealed wood quality of *Acacia auriculaeformis* is more uniform than *Acacia mangium* hybrid. Both the hybrids were found as good as *Acacia auriculaeformis* and *Acacia mangium* for usage as solid wood products and for paper and pulp. However, the wood of *Acacia mangium* hybrid showed wooly nature, which may cause problems during processing.

Project 2: Development and popularization of packing boxes of plantation grown timbers from South India for Horticulture produces [IWST/WPU/ X-09/2003-2005]

Findings: Five packing boxes each having external dimensions of the box 45X30X30 cm for 20 kg load for horticulture produce were fabricated using *Acacia auriculaeformis* and *Eucalyptus tereticornis* clone wood.

Project 3: Studies on forced air drying of plantation grown timbers [IWST/WSP/X-01/2002-2004]

Findings: The forced air drying method was found superior to natural air drying method in case of all the species tested.

The moisture contents of planks of different species after drying in case of these two methods were as follows :

The technique was found superior to existing technique in respect of uniformity in drying as well as economy of drying.



Moisture contents as %

Name of species	Natural air drying	Forced air drying
<i>Albizia lebbek</i>	16.61	6.79
<i>Grevillea robusta</i>	15.60	9.26
<i>Eucalyptus tereticornis</i>	23.35	14.12
<i>Azadirachta indica</i>	17.87	15.87
<i>Casuarina equisetifolia</i>	19.07	15.82
<i>Hevea brasiliensis</i>	16.63	16.57

Project 4: Development of alternative preservatives of more economic value and schedules for their incorporation in wood [IWST/WSP-009/2000-2005]

Findings: Eco-friendly wood preservatives were prepared from plant extractives like Cashew Nut Shell Liquid (CNSL) and Neem oil by incorporating copper ions. *Hevea brasiliensis* specimens were treated with these preservatives by employing three different methods namely brushing, dipping and pressure processes. The treated samples along with control specimens have been evaluated for their efficiency against termite (field test) and fungi (Laboratory). The periodic observations show that the formulated preservatives increased the durability of the timber against termites and fungi. Pressure treated specimens were found better than dip treated ones. Copperised neem oil and copperised CNSL gave complete protection against termites wood rotters. Neem oil and CNSL treatments also showed better performance but could not bring complete protection against termites and decay fungi.

Project 5: Evaluation of ammonia based preservatives against Indian termites [IWST/WSP/2002-2005]

Findings: Specimen treated with ammonia based wood preservatives performed better compared

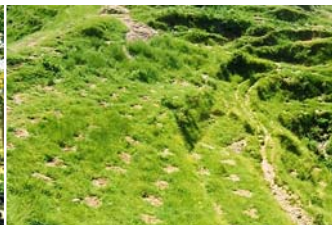
to those treated by CCA which in turn performed better than control.

Project 6: Effect of temperature, humidity and pH on CCB fixation in wood [IWST/WSP/X-11/2003-2005]

Findings: Samples of *Bombax ceiba*, *Albizia falcataria* and *Samanea saman* (size: 25 mm³) were prepared and treated with 6% CCB solution to evaluate the effect of temperature, humidity and pH on CCB fixation. All the Samples have been analysed for Cu, Cr and B content. It is observed that Cu and Cr leached more at low pH value.

Project 7: Studies on drying behaviour of timber used for handicrafts [IWST/WSP/X-20/2003-2005]

Findings: The effectiveness of anti-shrink chemicals namely common salt (50% w/v solution), Urea (60% w/v solution) and brush coating of linseed oil was assessed on *Artocarpus hirsutus*, *Gmelina arboria* and reed *Ochlandra trawanca*. Both urea and salt solution were found to be very effective in controlling any surface or end cracks in the wood samples. In case of *Ochlandra trawanca* reed, treatment reduced the drying rate and restricted any drastic shape deformation and cracking during the early stages of drying. However with the prolonged drying, the treated samples deformed to the same magnitude as untreated reeds.



Project 8: Natural products evaluation of extractives of plant origin for biological and pharmacological activity-*Nothapodytes nimmoniana* and *Garcinia indica* [CFP-003/2000-2005]

Findings: Fruits of *Garcinia indica* and wood of *Nothapodytes nimmoniana* on extraction with methanol yielded 24 % and 2.7% extracts, respectively. The above extracts on pharmacological evaluation were found to exhibit anti-inflammatory property.

Project 9: Role of biofertilizer in ecorestoration of problematic site like mine reject soil in Goa [IWST-28/WBD-3/2000-2005]

Findings: Planting work of biofertilizers treated plants was successfully completed in three places of mine reject areas in Goa state with the help of Goa Forest Department. Survival percentage, mortality rate and growth data was collected for these seedlings. *Acacia auriculiformis* and *Casuarina equisetifolia* performed better than other three species in both growth and survival percentage.

Project 10: Studies on entomofauna of mangroves of Karnataka, Goa and Andhra Pradesh [IWST-24/WBD-7/2000-2005]

Findings: Studies on the insect diversity in the mangroves of the coastal Karnataka, Goa and Andhra Pradesh was completed. Mangroves at Vishakhapatnam and Kakinada were surveyed for observations on the incidence of different groups of insects. From both coasts, 200 species were authentically identified with the help of ZSI, IRI and FRI, Dehradun. Checklist of insects belonging to different orders, which were collected from east and west coast have been prepared.

Project 11: Control of biodeterioration of wood with the help of eco-friendly preservatives and bioactive substances on staining and decay fungi under terrestrial conditions [IWST-13/ WBD-8 /1997-2005]

Findings: Pure culture of wood rotters, stain and plant pathogenic fungi were maintained in virulent condition. Significant protection of rubber wood was achieved against wood rotters by the application of *Dalbergia latifolia* extract, copperised CNSL and Neem oil. Encouraging results were obtained in the bio-assay studies with seed oils and metabolites of microorganisms like *Trichoderma viridae*, *Pencillium spinolosum* and *Bacillus coagulensis* against wood decay fungi.

Project 12: Bio-systematic studies on parasitoid complex of Sandal coccids and their utilization in biological control [IWST/WBD/2002-2005]

Findings: Identification of the hymenopteran parasitoids has been completed. Data on the population dynamics of the host and its parasitoids has also been obtained. Results indicate that there are several species of promising parasitoids that could be exploited for biological control of the coccid pests.

Project 13: Development of modern nursery techniques for propagation of important species of Goa – *Terminalia tomentosa*, *Xylia xylocarpa*, *Myristica fragrans*, *Bambusa arundinaceae* and *Dendrocalamus strictus* [IWST/TIP/ 001/2000-2004]

Findings: Nursery protocol for five important species was standardized. In all, three experiments were laid for each species. The best combination was based on overall growth, health and economics of nursery production. Nursery gestation period was 5 months in case of all



species except *Myristica fragrans* which was 8 months.

Project 14: Studies on micropropagation field evaluation and conservation of *Pseudoxytenanthera stocksii* (*Oxytenanthera stocksii*) – Threatened species [IWST/TIP/002/2000-2005]

Findings: Refined protocol for the rapid and mass *in vitro* cloning of *P. stocksii* from the explants of the Candidate Plus Clump (CPC) through axillary shoot proliferation was developed. High rate of multiple shoot (4-6 shoots, explant) was induction obtained in MS liquid medium with NAA 0.1 – 0.25 mg/l + BAP 2.0 – 2.5 mg/l. Shoot multiplication rate was 5-6 fold in MS liquid medium with PGRs within 4 weeks period. Among the various auxins, NAA proved the best auxin and about 95 per cent *in vitro* and *ex vitro* rooting could be obtained within 3 weeks period. Plantable plantlets of 4-5 tillers with miniature rhizome developed within 3-4 months period. Based on the protocol, 2000 plants were produced and provided for the field planting. Survival rate was 100 per cent in field after six months of the micropropagated plants at Gottipura.

Project 15: Variation in photosynthesis in clones of Sandal and Eucalyptus [IWST/TIP/X-28/2003-2005]

Findings: The study material comprised of clonal material of Sandal and Eucalyptus with an aim to document the variation existing with reference to photosynthetic gas exchange parameters. Significant variation has been observed across various accessions for gas exchange parameters like; stomatal inductions, intercellular carbon dioxide concentration, transpiration rate, photosynthetic rate and instantaneous water use efficiency. This preliminary data would provide base line information for further breeding programme in these two species.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

Project 1: Evaluation of wood quality parameters of plantation grown *Eucalyptus citriodora* for different end uses [IWST/WPU/X-09/2002-2005]

Status: Five trees of *E. citriodora* were procured from Yesalur range, Sakaleshpura, Hassan District. Fibre length, fibre diameter, lumen diameter, vessel diameter and vessel element length were measured from macerated material for three trees. Micro slides were prepared for five trees at 4 different radial positions and 3 vertical positions. Physical and mechanical properties in green condition were completed for all the five trees. Retention of shape was determined from its shrinkage values. The suitability of this timber for handicraft was carried out by subjecting it to various working quality operations in collaboration with handicrafts department and its performance for any defect was under observation. Tests on compression parallel and perpendicular to grain in air-dry condition were completed.

Project 2: Assessment of wood quality of *Simarouba glauca* for its timber value [IWST/WPU/X-10/2003-2005]

Status: Studies on shrinkage (longitudinal, radial, tangential and volumetric) behaviour and mechanical properties under green conditions were completed. Data on fibre length, fibre diameter, lumen diameter, vessel element length, vessel diameter and vessel frequency of stem wood and branches of all the trees were collected.

Project 3: Evaluation of culm quality before, during and after flowering in bamboo (*Bambusa bambos*, *Dendrocalamus strictus*, *Melocana* and *Ochlandra* sp.) [IWST/WPU/X-14/2003-2006]



Status : Within culm variation in starch content by gravimetry from base to top has been completed in flowered and non-flowered *Bambusa bambos*. Growth stresses study was completed. Relevant anatomical data pertaining to within culm variation in fibre length, fibre diameter, fibre lumen diameter, double wall thickness, vessel element length, vessel diameter from 1 to 10 internodal positions have been studied. No consistent pattern has been observed in any of the parameters. Histo-anatomical studies were made in relation to starch content, total proteins and phenolics in a culm of *Bambusa bambos* while flowering. Testing has been completed for different physical (specific gravity and shrinkage) and strength properties (static bending – MOE and MOR, compression parallel to grain) in green condition on non-flowered and during flowering stages of *Bambusa bambos* and non-flowered stage of *D. strictus*.

Project 4: Assessment of wood quality of *Tectona grandis* (Teak) clones from Thithimathi (Karnataka) and Andhra Pradesh [IWST/WPU/X-15/ 2003-2006]

Status : Data analysis was carried out for the physical properties - specific gravity and shrinkage properties (volumetric, radial and tangential) from green to oven dry condition from bottom, middle and top positions of logs of the Haliyal and Thithimathi clones. From the observations, it is seen that Thithimathi clones have higher standard specific gravity as compared to Haliyal clones. Both these values are found much lower than the standard Teak values. Volumetric shrinkage values of these two were found comparable but much higher when compared with the standard Teak values. Volumetric shrinkage values of these two were found comparable but much higher when compared with the Standard Teak values. Testing of strength properties – static bending,

compression parallel and perpendicular to grain hardness, shear, tension in green condition were completed and data being analysed. Testing of nail and screw holding power in green condition is being carried out.

Project 5: Studies on fracture mechanics in solid wood and wood composites using acoustic emissions [IWST/WPU/X-16/2003-2007]

Status : Compression tests were carried out on small block samples of Teak wood, *Eucalyptus citriodora*, *Acacia auriculaeformis* and *A. mangium* hybrid in longitudinal, radial and tangential directions at different UTM cross head speeds. The fracture patterns of these samples when compressed in longitudinal direction have shown a characteristic appearance. The fracture band was found to run perpendicular to the grain on the radial face and obliquely on the tangential face having an angle of 60°-70° along the grain direction. This fracture band was found to be about 1 – 2 mm wide and fibres in these bands have been observed as buckled and continuous. It was found that Teak wood is generally exhibit more fracture toughness in LT plane than in LR plane.

Project 6: Use of sonic and ultrasonic testing techniques to evaluate wood strength of plantation species - A non-destructive test method [IWST/ WPU/ X-17/2003-2005]

Status: Testing was carried out on wood materials of *Simarouba glauca* and *Acacia auriculaeformis* to study the effect of density, principal grain directions, moisture content and sample sizes on ultrasonic velocity. The preliminary tests showed that ultrasonic velocity along the longitudinal direction is greater than transverse ones (radial/tangential directions) and decreases with increasing moisture content (Y25%), while least effect of density of test samples on ultrasonic velocity was noticed. Dynamic modulus of



elasticity of above mentioned three species and *Eucalyptus citriodora* were determined at different moisture content below fibre saturation point using Elastosonic instrument (NDT method).

Project 7: Evaluation of treatability of selected refractory species [IWST/WSP/2002-2006]

Status: *Eucalyptus* hybrid was procured from IWST Campus specimens of the 3 different sizes 30 cm x 10 cm x 2.5 cm, 30 cm x 10 cm x 5 cm and 30 cm x 10 cm x 10 cm were prepared from the logs and kept for ponding for 1, 2 and 4 months. These were consecutively kept for diffusion process with two different preservatives for 1, 2 and 4 weeks along with control. These specimens were subjected to penetration tests. Chemical analysis is in progress.

Project 8: Analytic studies on Viscoelastic behaviour of wood and tree biomechanics [IWST/WSP/X-06/2002-2005]

Status: Viscoelastic behaviour was studied using four element model, consisting of one Maxwell body (having one spring and one dashpot in series) and Kelvin body (having one spring and one dashpot in parallel). Irreversible deformation, delayed and instantaneous elastic behaviour are explained through this model. Dashpot of Maxwell body which describes the viscous flow and irreversible creep was related to the slow movement of woody constituents like cellulose, Hemicelluloses and lignin under the influence of external load. Spring of the Maxwell body describing instantaneous elastic behaviour was represented by crystalline portion of the cellulose. Kelvin body with spring and dashpot in parallel was linked with delayed elasticity which resulted from cross linking of woody constituents.

Project 9: Studies on fibre formation in wood [IWST/WSP/X-07/2002-2005]

Status: Relationship between microfibril angle and fiber properties was analysed in terms of stress transformation from fibre orientation to microfibril direction. Mechanism of fibre formation in wood was explored from the point of view of self-assembly of cellulose into large scale fibres producing structures. Cellulosic microfibrils can be arranged in parallel throughout the thickness or can change direction from layer to layer due to their liquid crystalline nature.

Project 10: Studies on the gas permeability of secondary species of timbers [IWST/WSP/2003-2008]

Status: Samples of *Acacia auriculiformis* of 22 mm x 22 mm x 22 mm size which had attained last stage of conditioning (about 9% moisture content) are being studied for permeability in axial, radial and tangential directions.

Project 11: Polymerization filled composites [IWST/WSP/2003-2006]

Status: Composites of HDPE and Wood fibres were prepared using “polymerization filling” technique in S.S. high pressure stirred autoclave. The design of autoclave system was standardized. Effect of monomer concentration and time on polymerization was studied. It was found that with appropriate pretreatment of support, presence of cellulosic filler does not adversely affect the kinetics of polymerization. The polymerization was carried out at a pressure of 5 bar of ethylene and very high catalyst efficiencies (~3,000kg of PE/mol of TM/hr) were recorded. Most importantly, no reactor fouling was observed even at very high solid content (upto 40%) in the slurry. The study demonstrated that highly filled composites can be prepared by filler supported catalyst system using cellulosic materials as fillers. Also slurry reactors which are used commonly in industry for manufacture of



polyethylene can be used conveniently for production of cellulose filled HDPE composites.

Project 12: Chemical induction of heartwood in Sandal [CFP-001/2000-2006]

Status: Sandal plants were injected with 8th dose of heartwood stimulant chemicals viz. Paraquat and etherel. Different parameters like girth, height etc were recorded. The effect of these two chemical was found significantly higher than that of control. Further observations are being taken.

Project 13: Development of colouring reagents based on enzyme-substrate reaction for differentiating oil yielders of Sandal in field [IWST/CFP/ X-12/2002-2007]

Status: Modified colour reaction using guaiacol substrate is giving encouraging results for categorizing Sandal plants of varied oil contents.

Project 14: Impact of disturbance on canopy insect biodiversity: an assessment of forest health [IWST/WBD/2003-2007]

Status: Structure of canopies were sampled using the standardized canopy access techniques, thermal fogging technique. Arthropod samples have been drawn during monsoon, post-monsoon and pre-monsoon periods from disturbed and undisturbed forests. Monsoon collections have been sorted to recognizable taxonomic units and data on the diversity of different taxa analysed. The post-monsoon samples of undisturbed forests and monsoon samples obtained from rubber plantation have also been sorted. The samples are being classified to the level of species by several taxonomists across the country.

Project 15: Studies on Teak heartwood borer *Alcterogystia (cossus) cadambae* moore and its management [IWST-29/WBD-9/2000-06]

Status: Studies on bio-ecological aspects of the pest were completed at Gunjavati area

(Yellapur division). Studies on the life cycle of the pest was conducted in the laboratory and the seven instars have been found. For management of the pest nematodes, *Bacillus thurigiensis* and Neem products were tested in the *in vitro* conditions and preliminary trials on the applications were conducted in the Teak plantations of Haliyal and Yellapur divisions of North Kanara Circle. Nematodes and B.T. applications were found effective.

Project 16: Eco restoration of degraded mangrove habitat along Goa coast [IWST-2/WBD-1/2000-2005]

Status: Project has been kept in abeyance for administrative reasons.

Project 17: Studies on durability of selected Indian secondary timbers against marine wood biodeterioration agents in the marine environment along Karwar coast (Karnataka) [IWST-30/WBD-10/2000-2005]

Status: Project has been kept in abeyance for administrative reasons.

Project 18: Species, provenance and clonal test trials on *Casuarina* spp. in North Andhra [IWST/WBD-Marine/X-004/2003-2008]

Status: Ten clones of *Casuarina equisetifolia* were collected from Regional Forest Research Centre, Rajahmundry. Regular maintenance of plantations was carried out. Growth data of clones was recorded.

Project 19: Ethnobotanical studies of Godavari valley in Andhra Pradesh [IWST/WBD Marine/X-04/2002-2007]

Status: Intensive field surveys were undertaken and ethnobotanical data was collected from the agency areas of Polavaram and Rampachodavaram of East and West Godavari Districts. Ethnobotanical data on 123 plant



species were collected from Kondareddy, Koya and Kondakammara tribes of Godavari Valley. Herbarium was made and documented for the collected species. Identification of 70 plant species was completed. Five rare and endangered wild plant genetic resources of botanical and ethnobotanical importance, namely, *Dioscorea bulbifera*, *Ensete glaucum*, *Musa balbisiana*, *Piper betle* and *Zingiber zerumbet* were collected from the Godavari valley of Andhra Pradesh and introduced for *ex situ* conservation.

Project 20: Community involvement in coastal forestry through periodical returns by value added produce [IWST/WBD-Marine/X-24/2003-2008]

Status: Nursery of *Eucalyptus citriodora* was raised and plantation was taken up in the three hectare of selected area. Plantation was done in 2 m x 2 m spacing in block planting and five rows of *Casuarina equisetifolia* were planted all around the block to serve as windbreaker and shelterbelt. Casualty replacement was done in all 3 ha areas. Clipping of terminal shoot of *E. citriodora* was undertaken to facilitate production of higher quantity of herbage and essential oil in addition to periodic maintenance.

Project 21: Environmental impact of leachates from Copper-Chrome-Arsenic (CCA) wood preservative under marine condition [IWST/WBD-Marine/ X-23/2003-2006]

Status: Test stakes were treated with CCA wood preservative. End penetration test was carried out to assess preservative retention in panels.

Project 22: Studies on recruitment and metamorphosis of marine woodborer larvae [IWST/WBD-Marine/X-22/2003-2008]

Status: Two species of algae, namely, *Chaetoceros* sp. and *Isochrysis* sp. were procured and maintained in Guillard's f/2 medium.

Experiments on the influence of algal species on the recruitment of teredinid woodborer larvae on wood surface and subsequent metamorphosis were carried out. Generations of teredinid woodborers were reared and maintained in the laboratory for use as stock for larval production. Running seawater system was regularly maintained for larval rearing.

Project 23: Inventory of coastal plant communities of north Andhra region [IWST/WBD -Marine/X-25/2003-2006]

Status: Intensive field surveys were undertaken along the coastal areas of Srikakulam, Vizianagaram and Visakhapatnam Districts. Several mangroves, halophytes, hydrophytes, xerophytes and psammophytes were collected. An excellent sand binder, namely, *Pupalia lappacea* var. *orbiculata* was collected for the first time from coastal areas of Andhra Pradesh. 383 plant specimens were collected and made into herbarium. Of the total collections, 174 plant specimens were identified. Ethnobotanical data were collected wherever available.

Project 24: Standardization of protocol for viability testing and prolonging the viability and vigour of *Santalum album* seeds in storage [IWST/ TIP/2003-2005]

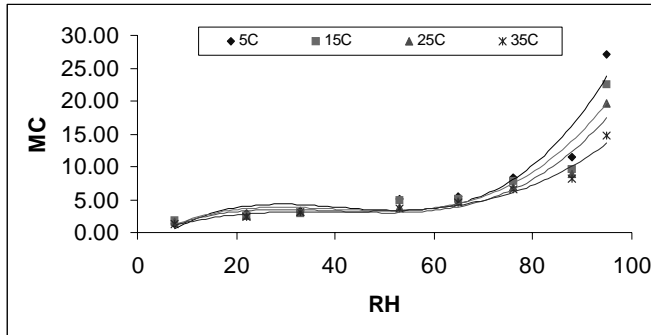
Status: Experiments were laid to study the effect of different storage conditions, viz. temperature and moisture content on viability of Sandal seeds. The seeds stored at 5°C and 15°C having 2.5% moisture content retained 50% viability after one year.

Periodic change in moisture content at different relative humidities at 5, 15, 25 and 35°C was recorded to study the effect of different RH on the equilibrium moisture content. Adsorption isotherms were developed. The isotherm obtained was validated using BET theory and the



primary and secondary water level at different RH and at each temperature was obtained.

of Karnataka (Kolar, Uttara Kannada, Haveri, Tumkur, Bidar, Shimoga and Karwar), which are considered natural habitat of *J. curcas* were collected. Estimation of oil contents is in process.



Adsorption isotherm for the seeds of Sandal at different temperatures and relative humidities.

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

Project 25: Seed studies of some of the economically important species of Western Ghats [IWST/TIP/2003-2006]

Project 1: Characterization and identification of imported timbers available in the timber markets and sea ports [IWST/WPU/X-43/2004-2007]

Status: *In situ* regeneration studies carried out for *Myristica fragrans*, revealed that the seeds germinated within 15 days, which otherwise took 90 to 120 days for germination under laboratory and nursery conditions.

Status: Started in September, 2004. Data collection is in progress.

Variability, storage and desiccation studies were carried out for seeds of *Dysoxylum malabaricum* and *Garcinia gummigutta*. *Garcinia gummigutta* seeds were desiccated at different temperatures and were periodically tested for viability. After 21 days, the seeds desiccated at 15°C, retained 50% viability.

Project 2: Development of seasoning schedules for plantation timbers using dehumidification based drying [IWST/WSP/X32]

Seed predation studies in *Dysoxylum malabaricum* revealed that 30% of seeds were infested by fruit fly of family Tephritidae, which has been reported for the first time in this species.

Status: Drying behaviour of plantation grown timbers in a desiccant based dehumidifying wood drying system is in progress. Drying of *Eucalyptus tereticornis* timber from mature and juvenile trees were studied. The wood from mature trees was slow to dry as compared to juvenile wood. In a specific drying conditions, it took 20 days to dry mature timber (mostly heartwood) to 12% moisture content from 40% moisture content. However juvenile wood (mostly sapwood) could be dried to 17% moisture content from an initial 90% moisture content within 15 days. The moisture loss rate in timber from young trees was nearly 8% per day at the initial stages. More importantly, about 90% of the dried boards were without any significant degrades like surface checking, end cracking and warp.

Project 26: Genetic screening of *Jatropha curcas* – an important biofuel species of dry areas [IWST/TIP/2003-2006]

Project 3: Influence of pretreatment techniques on the treatability of hardwood species grown in Karnataka [IWST/WSP/X-33/2004-2007]

Status: Seeds of 24 different provenances as well as clonal propagules (cuttings) from 7 districts

Status: Efforts are being made to procure *Eucalyptus grandis* from State Govt. organisation.



Project 4: Studies on natural durability of treated and untreated timbers of secondary species [IWST/WSP-X-34/2004-2007]

Status: Timber species of *Lophopetalum wightianum*, *Lagerstromia lanceolata* and *Artocarpus heterophyllus* were treated by Full Cell process with CCA preservative for four different levels of absorption: 4,8,12 and 16 Kg/m³. The treatment schedule for all these species for different loadings of absorption was developed. Highly refractory *Artocarpus heterophyllus* specimens were treated for higher absorption levels by giving alternate pressure and vacuum. Treatment with CCB preservative is in progress.

Project 5: Woodfibre plastic composite foams with improved cell morphology by continuous process [IWST/WSP/X37]

Status: A series of polystyrene wood fibre/wood flour composite materials having 10, 20, 30, 40 and 50% of wood (by weight) were prepared. All the experiments were performed in a co-rotating twinscrew extruder. The polystyrene blended with process additives was fed through the main inlet hopper of the extruder. The wood fibres were fed to the side feeder at a predefined rate using another volumetric feeder. After approximately 10 min, when steady state conditions were reached, the pure PS feed was changed to mixture of PS, compatibilizer and processing additives. Vacuum venting was used to remove the residual moisture and volatiles, which were produced during WPC production. The product was recovered by guiding the molten extrudate into a standard cold water stranding bath. The cooled strands were subsequently chopped into pellets, dried and stored in sealed plastic bags. Foaming experiment is to be carried out.

Project 6: Performance and evaluation of selected bamboo species treated by modified Boucherie process [IWST/WSP/X44/2004-2006]

Status: Freshly felled three species of Bamboo, viz. *Dendrocalamus strictus*, *Pseudooxytenanthera stocksii* and *Bambusa arundinacea* bamboo culms with branches and leaves were collected. Eight per cent solution of three preservatives viz. CCA, CCB and Borax (Boric acid) were prepared. Two culms of each species were treated with each preservative for six hours by Boucherie process. Immediately after the treatment the same culms were treated with 2% solution of CCA, CCB and Borax for four hours for the uniform distribution of the preservative chemical. After the treatment the branches of the treated culms were removed. These culms were kept for drying in shade for fixation of preservatives. Treated and dried bamboo culms were cut into small pieces of 30 cm length having at least one node. One small ring adjacent to each sample (2.5 cm length) from bottom, middle and top portions were removed for the analysis. Six samples from each culm with one control sample were buried such that half portion is below and half portion above the ground in the test yard for their durability test. Chemical analysis was carried out. The results of the analysis showed that the absorption of the chemical are more in the bottom portion and least in the top portion in all bamboo species.

Project 7: Gender identification of *Garcinia indica* and *Simarouba glauca* using isoenzyme studies and assessment of fruit characters, yield and market potential of *Garcinia indica* in Karnataka state [IWST/CFP/X-39/ 2004-2006]

Status: Literature was surveyed for *Garcinia indica* and *Simarouba glauca*. Male and female plants of *Garcinia indica* and *Simarouba glauca* were marked in Kodagu district and GKVK campus, Bangalore, respectively, for undertaking isoenzyme study. Isoenzyme studies by PAGE technique on *Simarouba glauca* are in progress.



Preliminary results are encouraging and needs further confirmation with more number of samples. A questionnaire has been prepared for conducting market survey and data are being collected.

Project 8: Studies on the sucking pest complexes of Sandal and their management [IWST/WBD/X-13/2004-2007]

Status: Insect pest survey was conducted in Sandal Clonal Seed Orchard raised at Sri Venkateshwara University campus. So far 15 sucking pests belonging to eight families were identified down to species level. Study on the life history of the spiralling whitefly *Aleurodicus dispersus* Russell on Sandal from August to September, 2004 indicated that it takes 49.25 days from egg to adult. The males lived for 6.33 days and female for 7.66 days.

Project 9: Role of Fungi biodeterioration of timber under marine conditions [IWST/WBD/X-35/ 2004-2007]

Status: Bacteria, actinomycetes and fungi from infested wood samples collected from Visakhapatnam coast were isolated. Characterization of biodegrading activity of isolates is in progress.

Project 10: Investigations on the resistance of commercially available bamboo species in Karnataka against insect borers and termites [IWST/WBD/X-45/2004-2008]

Status: Two commercially available Bamboo species, viz. *Bambusa bambos* and *Dendrocalamus strictus* have been taken up for this study. The adult borers collected from these bamboos are being cultured to test them on bamboos. Durability tests of treated and untreated bamboo stakes procured from the wet zone are being carried out against termites in the field.

Project 11: Studies on Productivity and Management of *Tectona grandis* (Teak) in Agroforestry practices in Karnataka and Andhra Pradesh [IWST/TIP/X-38/2004-2007]

Status: Few preliminary studies were initiated on assessing growth performance and productivity of farm Teak planted in farmlands in Devanahally taluk, Bangalore Rural district, Karnataka and in Tirupathi, Chittor district, Andhra Pradesh under an UNDP project executed 10 years back. The growth performance (height and gbh) of the Teak planted on farm bunds was distinctly superior as compared to block plantations. Wood samples from felled Teak trees were collected and samples were prepared for testing wood properties as per standard procedure for evaluation of wood quality parameters relating to physical and mechanical properties. Data is also being compiled on socio-economic parameters through semi-structured questionnaires among beneficiary farmers.



10 years old block plantations in study area



10 years old Teak on farm boundary in study area

Project 12: Productivity and interaction studies in *Acacia* hybrid based agroforestry practices in Karnataka [IWST/TIP/X-40/2004-2009]

Status: A trial on agroforestry with *Acacia* hybrid has been laid out on a farmland near Kolar, adopting 10 m x 2 m spacing to study its performance/productivity and tree crop interactions in agroforestry. During first year, Tomato and Ragi were cultivated in the interspaces and the observations are in progress.

Project 13: Screening clonal propagation, *ex-situ* conservation and genetic improvement of *Pongamia pinnata* [IWST/TIP/X-36/2004-2007]

Status: Study was conducted to see the effect of different growth regulators and their concentrations on cuttings of *Pongamia pinnata*. Among the growth regulators, IBA performed better in terms of rooting percentage, root length, number of leaves and survival percentage of rooted cuttings. Similarly, the cuttings treated with IBA @ 2000 ppm performed the best for early rooting greater root length, shoot length and number of leaves.

The seeds collected from different plus trees of *Pongamia pinnata* in Central Northern Silvicultural zones of Karnataka were sown in the sand bed for germination studies. The seeds collected from 15 plus trees of northern silvicultural zone performed better in terms of high germination percentage.

Project 14: Evaluation of genetic variability and mating system analysis of *Aegle marmelos* Corr. and *Feronia elephantum* Corr. using isoenzyme markers [IWST/TIP/X-42/2004-2007]

Status: For evaluation of genetic variability, fruits and leaf samples of *Aegle marmelos* were collected from six different genotypes at Ramakrishna Ashram, Mysore. Fruits and leaf samples of *Feronia elephantum* were collected from ten different trees in Savanadurga reserve forest. Six clones from the clonal seed orchard at Mudugere, Karnataka state forest department were also collected. Data were recorded on morphological characters, viz. shape and weight of fruit and number of seeds per fruit, presence or absence of thorns, size and shape of leaf, number of pinnules per pinnae, petiole length and size of pinnules. Morphological variation was distinct between the clones. Three isoenzymes, viz. peroxidase, esterase and malate dehydrogenase were standardized and studied for 6 genotypes of *Aegle marmelos*. In case of *Feronia elephantum* esterase, polyphenol oxidase and peroxidase were standardized.

Variation in fruit & leaf size of *Aegle marmelos*



Project 15: Comprehensive tree improvement program for *Gmelina arborea* in Karnataka – Phase I- Progeny trial [IWST/TIP/X-41/2004-2007]

Status: Fifty seeds of each of 49 families of *G. arborea* obtained from the RFRI, Jorhat were sown for germination. Out of these, seeds of 14 families only germinated with low germination percentage.

Project 16: Carbonisation of selected fuelwood and Bamboo species [IWST-34/WE-1/2004-2005]

Status: Samples of different age groups ranging from 3 to 6 years of *Eucalyptus* hybrid and *Acacia auriculaeformis* were procured. Measurements of basic density of wood and bark and wood/bark ratio for different ages and heights of the tree were carried out. Variation in calorific value of the *Eucalyptus* hybrid with age (3 to 6 years) and height (bottom to top) of the tree was studied. It was found that calorific value does not significantly vary with age and height.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Bio-invasion, SPS measures and import of wood and wood products into India [2003–2004]

Findings: Survey of six ports, viz. (Mangalore, Tuticorin, Kandla, Mumbai, Calcutta and A&N Islands) have been completed to study the bioinvasion of insects and fungi through wood import. Insects and fungi collected were identified. The final report is submitted.

Project 2: Introspection into the phytosanitary procedures for storage of forest seeds in Karnataka [2003–2004]

Findings: The insect infestation levels in the seeds of different forestry species stored in government and private storages were assessed. The insects were identified and preserved. Package of practices for the phytosanitary measures to be adopted in tree seed storages have been recommended. Final report has been submitted.

Project 3: Field incidence and management of major pests of Neem and Pongamia in Karnataka [2003–2004]

Findings : Survey work in Bangalore and adjoining districts was conducted to study pest status and the damaging levels of different pests of Neem and Pongamia. The important pests and their field incidence was documented. Management of the leaf and fruit gall of Pongamia in the field conditions have been standardized based on field trials with insecticides/acaricides. The detailed checklist was prepared for insect pests of Neem and Pongamia. Final report is submitted.

Project 4: Estimation of demand and supply of fuelwood and other available biomass in three districts of eastern plains of Karnataka [2003-2004]

Findings: Survey of two districts in Karnataka (Kolar and Tumkur) was carried out and data was collected from these districts were compiled and analyzed with respect to (i) per capita fuelwood consumptions in villages and (ii) distribution of the fuelwood and other biomass consumption pattern according to land holding of the farmer, economic status of the farmer and distance from forest. Estimated per capita consumption of fuelwood in rural areas of Tumkur and Kolar districts of Karnataka were 1.79 and 1.63 kg/day, respectively, whereas per capita consumption in urban areas was 0.13 kg/day for each of the districts. In urban areas, per capita fuelwood



consumption decreases with increase in the population of town. It was found that agriculture waste forms an important source of fuel in rural areas. Dependence on forest is much less than was envisaged. Source of fuelwood is farm forestry and trees on roadside, bunds and marginal land. Biogas use is still very less despite cattle population. Project completed and final report has been submitted to Karnataka Forest Department.

Project 5: Weathering of wood surfaces [2002-2005]

Findings: Study on effect of irradiation on photodegradation of wood surfaces of *Hevea brasiliensis* and *Pinus roxburghii* showed rapid colour changes, reduction in lignin content and increased concentration of chromophoric groups. Overall colour changes were linearly correlated with decay of lignin and formation of carbonyl groups during weathering. The rate of photodegradation increased with the intensity of irradiance source and radial surfaces were found to discolor faster than tangential faces. Presence of extractives in *Acacia auriculaeformis* and *Pterocarpus marsupium* increased rate of discoloration and rate of photodegradation at the short exposure period. Esterification of wood with benzoyl chloride was found very effective at inhibiting photodiscoloration and photostabilizing wood polymers. Photostability of wood surfaces of rubber wood and Chir pine esterified with acetic anhydride, maleic anhydride and phthalic anhydride (PA) was assessed. Acetylated wood showed good stability. Maleic anhydride was partially effective in suppressing photodegradation whereas phthalic anhydride was not effective at all. A method of chemical modification of solid wood blocks using fatty acid chlorides synthesized from fatty acids (Octanoic and lauric acid) was developed. Rubber wood specimens esterified by Octanoyl

chloride showed good dimensional stability and consistent Anti-Swelling Efficiency (ASE). Project has been completed and Final Technical Report of the project has been submitted to CSIR, New Delhi.

Project 6: Analysis of existing agroforestry practices – A study in Bellary district of Karnataka [2004]

Status: A study was undertaken to analyze socio-economic factors influencing existing agroforestry practices in semiarid regions covering Bellary district of Karnataka. Three regions; viz. rainfed region, mining region and irrigated region were selected to represent distinct ecological features. The data was collected from respondent farmers covering 12 villages in the three regions using a semi-structured questionnaire.

Crop species cultivated, tree diversity and patterns of plants were found to vary with agro-ecological regions. Analysis of existing agroforestry models reveals that majority of the respondents were practicing agri-silviculture model, followed by agri-horticulture and least practiced model was silvi-horticulture. Analysis of the association between independent variables and adoption of agroforestry reveals that variables like, education, income, material possession, social, mass media, extension, contact and environmental awareness had significant association with the adoption of agroforestry, while family size, farm size, number of animals owned and management orientation had no association with adoption level of agroforestry practice.

Project 7: Assessment of fruit characters in *Garcinia cambogia* and gender identification of economically important forestry species using isozyme studies - *Garcinia cambogia* and *Myristica fragrans* [2003-2004]



Findings: Three methods of gender identification have been developed : (i) using isozyme studies (Laboratory method), (ii) based on peroxidase enzyme activity – Laboratory method and (iii) a simple, less expensive and user-friendly colour reaction (a field method to be used by forester/ farmer/common man).

Market dynamics study of the fruits of *Garcinia cambogia* has been made in the districts of South canara, Hassan, Kodagu. A field kit has been developed to undertake gender identification work. Three demonstration programmes (Chikkamagalur, Hassan and Uttar Kannada Forest Divisions) were conducted in connection with gender identification to forest officers, farmers. Information on morphological characters have been gathered from the local people and forest department personnel and efforts are being made to distinguish male and female plants by studying the morphological characters on a large number of individuals in the forest.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Investigations on lesser known aspects of mangrove biodiversity and ecology in the states of Goa, Karnataka and Andhra Pradesh [2004- 2008]

Status: Survey of mangroves in Vizagapatnam and Kakinada (Koringa Wildlife Sanctuary) was conducted to study the occurrence, distribution and intensity of insects on the different species of trees which are true halophytes and also mangrove associates. The major tree species encountered were *Avicennia*, *Rhizophora*, *Sonneratia* and *Ceriops* etc. Defoliators, fruit borers and also wood borers were encountered.

Project 2: Establishment of Advanced Wood Working Training Centre at IWST

Status: Advanced Wood Working Training Centre has been established at IWST jointly by IWST and Italian Trade Commission in March, 2003. Training courses under three modules are being conducted. Eight hundred trainees have been trained in 48 modules.

Project 3: Characterization and quantitative analysis of decayed wood by Fluorescence and Fourier Transform Infrared (FTIR) spectroscopy [2003-2006]

Status: Lignin modification in *Pinus sylvestris* L. (Scots pine) and *Fagus sylvatica* L. (beech) wood decayed to different weight losses by the brown-rot fungus *Coniophora puteana* was investigated by FTIR. Polysaccharide components of wood were selectively degraded as decay progressed. Polysaccharide to lignin ratios estimated using FTIR correlated well with lignin contents determined by acetyl bromide method. Samples of softwood (*P. roxburghii* and *A. pindrow*) and hard wood (*H. brasiliensis* and *B. ceiba*) were exposed to brown-rot (*P. melia* and *T. palustris*) and white-rot (*C. hirsustus* and *C. versicolor*) fungi up to 15 weeks. *H. brasiliensis* and *B. ceiba* samples showed a significant weight loss (maximum up to 45 %) by all these fungi. FTIR spectra were measured from wood samples decayed by brown rot *T. palustris* and relative changes in lignin/carbohydrates ratio as a result of decay were determined. A progressive increase in lignin content relative to carbohydrate was evident from increases in the relative height of lignin associated bands and a corresponding decrease in the intensities of carbohydrate bands in Rubber wood and *B. ceiba*.

Project 4: Refinement of protocols for rapid clonal propagation of Sandal and Red sanders; Demonstration of field performance and evaluation of genetic fidelity [2003-2006]



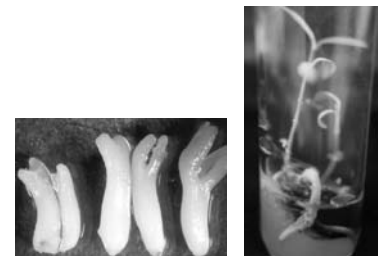
Status: Shoot initiation cultures of five clones of Sandal were established. Medium, growth hormones, additives, pH, agar-agar, sucrose concentrations, inoculum density and sub culturing period for shoot multiplication in Sandal were standardized. Leaching and browning problems were overcome in shoot initiation cultures in red sanders. Five genotypes shoot initiation cultures in red sanders were established. Shoot multiplication rate was high (4 fold) in Sandal as compared to red sanders (2-3 fold) in 6 weeks period. Studies (auxins and media) on *in vitro* and *ex vitro* rooting in Sandal were conducted and a maximum of 50 per cent rooting was achieved in 5-6 weeks period from mature trees.

Medium, PGRs, additives, incubation conditions for embryogenic callus induction and further multiplication were standardized.

Protocol for the isolation, purification, quantification of DNA and PCR reactions for molecular markers studies of micropropagated plants of Sandal and Red sanders were standardized.



In vitro cloning of Sandal



Somatic embryo induction and germination in Sandal

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Bio-composites from Engineered Natural Fibres

Status: Mechanical properties, measured in tensile, flexural and impact tests, demonstrated that the fibres used in this work act as effective reinforcing agents for PP. Addition of wood fibres, at all levels, resulted in more rigid and tenacious composite. Tensile strength of composites increased by almost 45%, whereas an 85% increase in flexural properties was observed. Modulus of elasticity increased by almost 200%. However, impact energy and percentage of elongation decreased with increase in wood content.

Project 2: Community ecology of a detritus systems. Insects and fungi associated with fallen trees in the Nilgiri Biosphere Reserve [2004-2007]

Status: Permission from PCCF (Wildlife) has been obtained for the surveys and studies in the Nagarhole National Park (Nilgiri Biosphere Reserve) and survey work has started. Various species of logs in different stages of deterioration were selected from three landscape elements viz. moist deciduous forests, dry deciduous forests and Teak plantations. An emergence trap has



been designed for the collection of insects emerging from the fallen logs in the study area.

Project 3: Studies on the Entomofaunal diversity and their interactions in selected provenances of Sandal [2004-2007]

Status: Floral composition in all the selected provenances of Sandal including trees, shrubs and herbs was collected, identified and documented. Entomofauna of all selected Sandal provenance was also documented. So far 66 species of insects in Bangalore provenance, 48 species in Thangali, 32 species in Mandagadde, 41 species in Chitteri, 43 species in Javaddis and 40 species in Munnar could be identified.

Project 4: Revision of subfamily Ponerinae (Hymenoptera:Formicidae) in India with special emphasis to western ghats [2004-2007]

Status: Ponerinae fauna were taken as loan from Forest Research Institute Museum and studied. Key to the Indian subfamilies of the family Formicidae is being revised. Survey was conducted in Goa and ponerinae were collected. A checklist of type species distribution list for Indo-Australian and Oriental species is prepared in order to determine genus distribution pattern. Key to the genus *Platythyrea* is revised.

Project 5: Investigations on the mechanisms of success of *Mytilopsis sallei* (Recluz) in managing toxic load arising out of biodeterioration control measures [2005-2008]

Status: The project was approved for funding for a period of 3 years by the Department of Science and Technology, Government of India. Release of first installment of the grant is awaited.

Project 6: Development of protocols for rapid and mass clonal propagation of *Bambusa pallida* Munro. and *Phyllostachys bambusoides* [SIEB/ET/ JUCC/ 2004-2007]

Status: As a source of material for *in vitro* cloning studies, offset cuttings of *Bambusa pallida* were collected from Chesa (Arunachal Pradesh and Jorhat, Assam). Whereas, in for *Phyllostachys bambusoides*, cuttings and vegetatively propagated plants were collected from Y.S. Parmar University, Solan (Himachal Pradesh) and Chesa (Arunachal Pradesh). Shoot initiation cultures were established in both the species. Studies on explant, media and PGRs for shoot initiation in both the species were conducted. Maximum 6-8 shoots/explants were obtained from nodal shoot segment of *B. pallida* in MS liquid medium with PGRs. Initial shoot multiplicate rate was 3-4 fold in *B. pallida* in 4 weeks period. In *P. bambusoides* severe leaching and browning of the shoot at sub-culturing (shoot multiplication) stage was encountered.

Project 7: Field performance of micro and macropropagated planting stock of selected five commercially important Bamboo species [2004-2007]

Status: Offset cuttings of 25 Candidate Plus Clumps (CPCs) of *Dendrocalamus strictus*, 20 CPCs of *Pseudoxytenanthera stocksii* from Sirsi Forestry College (UAS, Dharwad), Sirsi and 3 CPCs of *B. bambos* from TNAU., Coimbatore for the establishment of germplasm garden were collected. Germplasm garden of seven species of bamboo (*B. bambos*, *D. strictus*, *D. asper*, *P. stocksii*, *Ochaleandra travencorica*, *Guadua angustifolia* and *Phyllostachys bambusoides*) in 0.4 ha at Gottipura (Karnataka) and five genotypes cultures of *B. bambos* and *D. strictus* and further multiplied for *in vitro* rooting and production of plantlets was established. In *P. stocksii* cultures of five CPCs material were established and multiplied. Based on the protocols, 2000 plants of *P. stocksii*, 500 plants of *B. bambos* and 100 plants of *D. strictus* were produced.





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
Andhra Pradesh	1	4	1
Karnataka	1	3	6
Goa	2	1	-
General	12	18	10

EDUCATION AND TRAINING

Education

- Shri A.G. Koppad, Asstt. Professor, University of Agricultural Sciences Dharwad, College of Forestry, Sirsi was awarded Ph.D. degree for his thesis entitled “Studies on effect of *in-situ* moisture conservation techniques and fertilizers on early growth and wood properties of *Tectona grandis* (Teak)” by FRI Deemed University, Dehradun.
- Shri E.V. Anoop, Asstt. Professor (Wood Science), Kerala Forest Research Institute, Peechi, Thrissur, presented his pre-submission synopsis on the thesis entitled “Studies on anatomical variation in the juvenile wood of acacias grown in Kerala for provenance trials” for his Ph.D. degree under FRI Deemed University, Dehradun.
- Two research scholars have been registered for their Ph.D. degree in forestry under FRI, Deemed University, Dehradun.
- Four researchers from the W. B. D. Division (A. K. Dubey, B. Raji, K. V. Jamuna, B. Tharakanadha and R. Veeranna) were awarded Ph. D degree of the FRI Deemed University, Dehradun.
- P. Sarasija presented the Ph.D. Synopsis seminar on the topic ‘Diversity, Community, Structure and Ecology of insects occurring on fallen trees in Nilgiris Biosphere Reserve. Mrs. Hemalatha presented her Ph.D. synopsis seminar on “Tannin-microbe interactions in the biodegradation of the litter of *Acacia nilotica*”.
- Two M.Sc. Microbiology students from Oxford College of Science, Bangalore and three M.Sc. Microbiology students from Narayan Guru College, Coimbatore have completed their Project work in the Institute during December to February, 2005. M.Sc. students from Vishakapatnam, Andhra Pradesh, Ramaiah College, Bangalore visited the Pathology lab to learn microbial aspects of wood.

Training

- Compulsory training on IPR in Forestry Issues for the in-service IFS officers from 13th to 17th December, 2004.
- One week training on Wood Seasoning and Technology for the representatives of Wood Based Industries from 29th November to 3rd December, 2004.



3. Training on Timber Joinery for the officials of Naval Dockyard, Visakhapatnam from 24th to 28th January., 2005.
4. Training in Classification and Grading of Timber to the in-service officials of Customs House, Tuticorin from 21st to 23rd March, 2005.

LINKAGES AND COLLABORATION

1. Linkages developed with State Forest Department, Karnataka, Andhra Pradesh Forest Department, Goa Forest Department, Bangalore University, Bangalore, University of Agricultural Sciences, Bangalore, University of Agricultural Sciences, Dharwad, Indian Institute of Science, Bangalore, College of Forestry, Sirsi, Kerala Agricultural University, Vellanikara, Thrissur, Acharya Institute of Technology, Bangalore, FRLHT, Bangalore,
2. One operational DBT project in collaboration with KFRI, Peechi and IFGTB, Coimbatore on “Field performance of micro and macropropagated planting stock of selected five commercially important bamboo species”

CONSULTANCIES

1. Testing services were rendered to different users from Industry, Government Departments, Police, Vigilance, CBI, Defence, Railways, Construction industry, NGOs and Private sectors on 1. Timber Identification 2. Moisture content 3. Strength property determination 4. Technical information on use of wood and wood products.
2. Analytical service was rendered to Police Department, Forest Department and public in analysis of essential oils from Sandalwood

samples. A number of technical inquiries on utilization of various non-wood forest products from Government Departments and public were attended to and advice given.

3. Enquiries from Larsen and Tourbo, Pondicherry regarding the timber decay problems were attended.
4. The test report on the bioefficacy of TERMINATOR ‘A’ and ‘E’ against termite and borer was prepared and submitted to the Pidilite Industries, Mumbai.
5. The presence of pathogens on timber from M/s. Chambal Fertilisers and Chemicals Limited was assessed.
6. Services were rendered to the Karnataka forest department in finding out the causal organism and suggesting the remedial measures for the entomological and pathological problems of the plantations and other forest tree species (*Tectona grandis* and *Shorea talura* etc.).
7. Efficacy of some commercial preservatives was tested for their resistance against termites, borers and pathogens.
8. The institute along with other experts of ICFRE Institutes undertook an consultancy of *Final mine closure plan for KIOCL iron ore mine* at Kudremukh and submitted the final draft plan on “Biological Eco-rehabilitation Plan for Kudremukh iron ore mine”.

CONFERENCES/MEETINGS/ WORKSHOPS/SEMINARS/ SYMPOSIA/EXHIBITIONS

Organized

1. A one day demonstration programme on Treatment of Bamboo Through Sap



Displacement Method at Virajpet (Karnataka), Kodagu District on 17th July, 2004. A total of 400 participants attended the programme.

2. A demonstration programme on gender identification of dioecious forestry species (*Garcinia cambogia* and *Myristica fragrans*) in the field to the staff of forest department/ local farmers at following places.
 - a) Balehonnur, Shrungeri forest ranges (Koppa Forest Division) and Kerekatte wildlife range (Kudremukh Wildlife Forest Division) from 21st and 22nd July, 2004
 - b) Sakaleswapur, Hassan ranges in forest division and Bisle forest area in Mercara Forest Division of Karnataka state during September, 2004.

Participated

1. Institute participated in “Bio-2004” organized by Vision Group on Technology from 11th to 13th July, 2004 at Palace Grounds, Bangalore. The theme of the event was Biotechnology for a billion people.
2. The Institute participated in Krishimela organized by University of Agricultural Sciences, Bangalore at GKVK from 5th to 7th November, 2004. About 165 stalls were put up in the mela. The Institute exhibited furnitures made from secondary wood species like, *Acacia auriculiformis* and *Eucalyptus tereticornis* etc. Seedlings reared though tissue culture techniques were also on display, chemical aspects of wood were also highlighted. Shri Srinivas Gowda, Honourable Agricultural Minister of Karnataka inaugurated the exhibition and visited IWST stall too. A total of 60,000 visited the mela.

3. Meeting of BIOSPORA was organized by Karnataka Biotechnology Development Council, Bangalore on 1st October, 2004 at the Institute of Wood Science and Technology.
4. Dr. K.S. Shashidhar, Shri Suresh Gairola and Shri Pankaj Aggarwal attended workshop on “Perspective in IPR” organized by Government Science College, Bangalore on 28th January, 2005.

AWARDS

Dr. K. K. Pandey, Scientist-E was granted a "Ron Cockcroft Award" (RCA) for attending the *International Research Group on Wood preservation (IRG-35)* meeting held in Ljubljana, Slovenia from 6th to 10th June, 2004.

DISTINGUISHED VISITORS

1. Shri N. Vittal, IAS (Retd.), Former Chief Vigilance Commissioner, Govt. of India visited the Institute on 25th June, 2004.
2. Dr. Alex Valcke, President IRG (2000-2004) and Mr. Joran Jermer, Secretary General, IRG visited the institute and held a meeting regarding IRG 36 arrangements on 13th July, 2004.
3. Mr. Antonio Armellini, Ambassador of Italy, Dr. Andrea Bonardi, Secretary General of Indo-Italian Chamber of Commerce and Industry, Mumbai, Mr. Rafaele Langella, Head, Economic and Commercial Section, Embassy of Italy and Dr. Vittorio Mecozzi, Trade Commissioner, Italian Trade Commission, Mumbai has visited the Institute on 31st August, 2004.
4. Mr. Brue Mattinsow, ITC Preferring Farming, Australia and Mr. David Wettenhall,



Business Development Manager, WA, CSIRO (Forestry and Forest Products) visited the Institute on 21st October, 2004.

among the children of the Institute's staff. Prizes were distributed to the winners.

MISCELLANEOUS

1. A Fortnight long celebration was organized for National Science Day from 28th February to 13th March, 2005 by the Institute. Poster presentation competition was conducted

2. National Science Week was celebrated by the Institute.

3. The Information Technology Cell of the institute developed a website for 36th Annual Meeting of International Research Group on Wood Protection held from 24th to 28th April, 2005 at Bangalore, India.