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 and focuses to important forestry research needs of the states of Karnataka, Andhra Pradesh and Goa at regional level. A shore laboratory at Vishakhapatnam and a research centre at Hyderabad have been established under the World Bank aided FREE Project. It has field stations at Gottipura & Nallal near Bangalore, Yelawala near Mysore and Mulugu near Hyderabad. The Indian Council of Forestry Research and Education (ICFRE), Dehra Dun has assigned the Institute the status of Centre for Advanced Studies in the areas of Improved Utilisation of Wood, Mangroves & Coastal ecology and Research on Sandal. The Institute also conducts training programmes and carries out extension activities.

PROJECTS COMPLETED DURING THE YEAR 2001-2002

Project 1 : Study of anatomical, physical and mechanical properties of plantation grown timbers *Acacia mangium, Acacia auriculiformis, Tecomella undulata* and *Eucalyptus tereticornis* clones [IWST0001/WPU001/1997-2002]. *For technical report contact, Principal Investigator- Dr. R.V. Rao.*

Findings : *Tecomella undulata* - The data on strength properties suggested that the timber is classified as heavy, moderately strong, not tough, very stable and moderately hard. The timber is recommended for furniture, doors, window shutters and frames, tool handles, agricultural implements, pallets etc. The standard specific gravity was found to decrease from pith to periphery linearly and also in axial direction from bottom to top. Data on shrinkage properties have shown that the retention of shape of this species is better than Teak.

Acacia auriculiformis - Average fibre length was found to increase from 830 mm to 990 mm with age, whereas, fibre percentage and vessel frequency were found to decrease from 46 to 41% and 13 mm^2 to 11 mm^2. These studies would help to know the age of rotation period depending upon anatomical property. Evaluations of physical of all ages have been completed in air-dry condition.

Acacia mangium - Percentage of sapwood and heartwood and variation in anatomical properties of 8 years old trees have been determined (received from Sirsi, Karnataka). Evaluation of physical and mechanical properties completed.

***Eucalyptus tereticornis* clones** - Results indicated that strength properties of clone 4 and 7 were similar whereas clone 3, 6 and 10 showed less strength properties in one out of the two localities tested.

Project 2 : Computer assisted wood identification [IWST0002/ WPU0002/1999-2002]. *For technical report contact, Principal Investigator - Mrs. T.R. Hemavathi.*

Findings: Sixty four anatomical characters required for wood identification were codified from the text of Indian Woods Vol. IV and V for the development of software. The families completed from Indian Woods Vol. IV were *Rubiacaceae, Myrsinaceae, Sapotaceae, Ebenaceae, Styracaceae* and *Symplocaceae* consisting of 33 genera and 63 species. The families completed from Indian Woods Vol. V were *Boraginaceae, Scrophulariaceae, Bignoniaceae, Verbenaceae, Myrsticaceae, Lauraceae, Hernandiaceae, Proteaceae, Thymeleaceae* and *Santalaceae* consisting of 37 genera and 100 species (Tree species only).

Project 3 : Development of software for calculating the properties - CALPRO [IWST0004/WPU004/2000-2002]. *For technical report contact, Principal Investigator- Dr. Vimal Kothiyal.*

Findings: Informations on physical properties e.g. specific gravity, shrinkage and mechanical properties e.g. static bending, compression parallel and perpendicular, tensile and shear strength, hardness, nail and screw holding power etc. have been collected from the published literature for more than 300 timber species and bamboos grown in India and neighboring countries. Based on the work, a 70 page report has been prepared on the source of information available. A final software/database can now be developed from the above information on the lines of demo/prototype software developed earlier under this project.

Project 4 : Wood quality parameters for improving planting stock of *Pseudooxytenanthera stocksii* [IWST0009/WPU009/2000-2002]. *For technical report contact, Principal Investigator- Dr. R.V. Rao.*

Findings : Fibre length, fibre diameter, lumen diameter and wall thickness was determined and found in the range of 3.3 mm to 3.5 mm for fibre length, 247-316 for vascular bundles/cm^2, 16.6 m m as fibre diameter, 5.7 mm lumen diameter and 10.9 mm as wall thickness.

Project 5: Wood quality parameters for improving planting stock of *Gmelina arborea* [IWST0011/WPU011/2000-2002]. *For technical report contact, Principal Investigator- Mr. P. Kumar.*

Findings: Core samples were drawn from different trees of *Gmelina arborea* at IWST campus with the help of increment borer and tested for specific gravity, vessel length, vessel diameter, fibre length, fibre diameter and fibre wall thickness.

Project 6 : Studies on influence of microfibril angle and spiral grain in wood on the strength properties of plantation grown timbers

(***Eucalyptus*** **spp.) [IWST0014/WPU014/1999-2002].** *For technical report contact, Principal Investigator- Dr. S.R. Shukla.*

Findings : Radial variation of specific gravity measurement was continued on 5 CPTs of *Eucalyptus tereticornis* and also carried out on *E. camaldulensis*. The shrinkage properties were measured in the radial blocks from pith to periphery in all the CPTs at different moisture contents. Identical sets of radial blocks were taken for the measurement of microfibril angle using image analysis system on the basis of pit aperture orientation as well as microcracks developed after heating and drying treatments and found to vary in the range of 10-30°. Spiral grain angle of 5 CPTs each of *Eucalyptus tereticornis* and *E. camaldulensis* was measured on the planks of these species, using scribe tester. Measurements were carried out on flat surface and sides to compute the slope of grains on the planks indicated that the spiral grain angle in these CPTs was below 10°.

Project 7 : Studies on the permeability of hardwood species grown in regions of Karnataka, Goa and Andhra Pradesh [IWST-OG06/WSP-02/1999-2002]. *For technical report contact, Principal Investigator- Mr. P. Narayanappa.*

Findings : The gas permeability of plantation grown 14 years old *Acacia nilotica* was studied. Results suggested that the gas permeability was affected by pre-treatment technique. Over all, it may be concluded that the tree, which is not mature enough, does not require any pre-treatment technique to improve its treatment behavior.

Project 8: Performance evaluation of wood coating systems [IWST-08/WSP-05/2000-2002]. *For technical report contact, Principal Investigator- Mr. Nirmal Kumar Upreti.*

Findings: Different wood surface pre-treatments based on inorganic salt solutions were tested for three commercially available paints, viz. synthetic enamel, polyurethane and water based acrylic paints. After thirteen months of outdoor exposure the coatings of synthetic enamel paint and water based acrylic paint were found intact in all samples, whereas the clear coating of polyurethane paint cracked and started flaking out in controls without pre-treatment in *Pterocarpus marsupium* as well as *Hevea brasiliensis* wood samples. Among treatments, the chromic acid treated samples performed better with respect to clear coating condition followed by copper-chromate and ferric chloride treated samples.

PROJECTS CONTINUED DURING THE YEAR 2001-2002

Project 1 : Plasticisation of palms and bamboo [IWST0005/WPU005/2001-2003]. *Principal Investigator - Dr. Vimal Kothiyal.*

Status: Ammonia plasticizations unit has been procured under WB project.

Project 2 : Production of reconstituted wood products/wood composites-Laminated Veneer Lumber (LVL) from different plantation grown timber species and to study different physical and mechanical properties [IWST0010/WPU010/2000-2003]. *Principal Investigator - Dr. S.R. Shukla.*

Status: Experiments on the production of LVL at laboratory scale have been carried out using veneers of Neem and Murk (Halwana). The glues used for the LVL preparation were interior grade UF and exterior grade PF. The LVL samples produced have shown excellent gluing properties with both UF and PF resins.

Project 3: Relationship of the wood properties of coppice plantation grown *Eucalyptus* species [IWST0013/WPU0013/2000-2003]. *Principal Investigator- Dr. S.K. Sharma.*

Status: The shrinkage properties were measured for all the trees of coppiced and non-coppiced plantations. Strength properties have been carried out under green condition.

Project 4 : Modifications in existing design of solar drying kiln to improve energy efficiency [IWST-OG3/WSP-01/1999-2003]. *Principal Investigator- Mr. Nirmal Kumar Upreti.*

Status : The proposed solar timber-drying kiln was erected at IWST campus. Temperature profile was recorded inside the kiln. Fan air flow was also evaluated. Temperature up to 56°C was attained in a day in the month of March 2002 as compared to outside temperature, which was 29°C as maximum. Air velocity profile showed that speed ranging from 2.5 m/s to 6 m/s is attainable with the help of fans which is sufficient for drying the wood stack.

Project 5 : Development of seasoning and preservation techniques for bamboos and rattans [IWST/03/WSP/03/2000-2003]. *Principal Investigator- Mr. M.N. Sharma.*

Status : *Dendrocalamus strictus* was given pre-treatment with ammonia and ammonical copper arsenate and was subsequently treated with CCB. An absorption of 0.73 Kg/m^3 and 0.76Kg/m^3 was obtained respectively, whereas the bamboo treated with CCB alone without any pre-treatment gave an absorption of 1.11Kg/m^3 thereby showing that pre-treatments have not resulted in getting higher absorption.

The treated samples showed absolutely no splitting at the node and few treated samples showed very minor splitting at the outer surface. Overall, the chemical seasoning of green *Dendrocalamus giganteus* using urea seems to be effective in its value addition.

Project 6 : Developments of composites from wood waste and non wood lignocellulosic materials [IWST/07/WSP/04/2000-2003]. *Principal Investigator - Mr. Ajay Karmakar.*

Status: Incompatibility between polypropylene and wood fibers pose difficulty in compounding these two materials. A new compatibilizer (m-Isopropenyl-a,a-dimethylbenzyl-isocyanate (m-TMI) grafted Isotatactic polypropylene) was synthesized to improve interfacial adhesion between wood fibers and thermoplastic matrix. The maximum grafting yield achieved in case of m-TMI, which makes m-TMI-g-pp a very efficient compatibilizing agent. Modification of wood fibers with NCO has several advantages over other coupling agents reported in literature like anhydride or epoxides. The carbamate ester bond is far more hydrolytically stable than ordinary esters. Also the link to an isopropyl moiety makes the NCO less sensitive to water, which is important, because side

reactions with residual water in wood can be avoided. Modification of wood fibers with TMI-grafted-polypropylene makes it possible to blend these two very important raw materials. Wood Fibers (Bleached kraft pulp of *Eucalyptus*) were treated with TMI-g-PP by immersing them in a solution of TMI-g-PP in hot toluene for 5 minuets. The concentration of copolymer in solution was 5 Wt % on fibers. After treatment with TMI-g-PP the fibers became hydrophobic and posed no difficulty in blending with molten polypropylene.

Project 7 : Studies on lignin filled thermoplastic composites [IWST/12/WSP/06/2000-2003]. *Principal Investigator - Mr. Ajay Karmakar.*

Status : Lignin was reacted with m-TMI-g-PP prepared by melt mixing. The hydroxyl groups on lignin formed carbamate ester bond with copolymers and the surface of lignin changed from hydrophilic to hydrophobic. FTIR spectra provided the proof of grafting. Treatments with compatibilizer decrease the surface energy of lignin to a level much closer to that of plastics and in principle, a better wetting by molten plastics should be achieved.

Project 8 : Investigation on the effect of growth stresses in processing of timbers from plantations [IWST/19/WSP-08/2000-2003]. *Principal Investigator- Mr. Pankaj K. Aggarwal.*

Status : Growth strains were measured in 6 trees of *Eucalyptus tereticornis* selected from a 16 years old plantation in Coorg (Karnataka) using hole-drilling strain gauge method. It was observed that magnitude of growth strain in these trees (1585 microstrain) was more than that of the trees from Bangalore region (900 microstrain) of the same age. Increment core method to measure growth stress was tried in 6 trees of 30 years old *Eucalyptus tereticornis*. It was observed that diameter of green core reduces in both longitudinal and tangential directions with time, but reduction in tangential direction was more than the longitudinal direction.

Project 9 : Developing technique of surface thermoplasticisation of wood [IWST/26/WSP/09/2000-2003]. *Principal Investigator- Mr. Ajay Karmakar.*

Status : Effect of different reaction parameters namely temperature, reaction time and NaOH concentration on benzylation of rubber wood particles were studied. All these parameters were found to have significant effect on extent of benzylation of wood surface. With the increase in alkali concentration and temperature, benzylation increased steadily. The modified surface was characterised with the help of FTIR spectroscopy. A significant change in chemical structure of wood was observed by benzylation.

Wood meal was also cynoethylated using acrylonitrile. Wood veneers have been cynoethylated using acrylonitrile under the optimum grafting conditions achieved from above studies.

Project 10 : Efficacy of preservative in enhancing durability of timber (Development of alternative preservatives of more economic value and schedules for their incorporation in wood) [IWST/27/WSP/10/2000-2005]. *Principal Investigator- Mr. M.N. Sharma.*

Status : To study the efficacy of formulated preservative and to develop different treatment schedules in incorporating them, panels of *Acacia auriculiformis* and

Hevea brasiliensis were treated with copper incorporated Cashew Nut Shell Liquid (CNSL) with different duration of dipping and different duration in application of pressure. It was observed that dipping resulted in an absorption of 3.72 Kg/m^3 whereas pressure processes resulted in three times i.e. Upto 9.0Kg/m^3

Project 11 : Analysis of wood and its constituents by fluorescence and FTIR spectroscopic technique - a non destructive tool for rapid characterisation of wood [(IWST/34/WSP/11/2000-2003]. *Principal Investigator- Dr. K.K. Pandey.*

Status : Characterisation of wood components, structural differences between hardwood and softwood lignin and their estimation using gravimetric chemical and spectroscopic techniques was carried out.

Changes in chemical and microscopic structure of a softwood (*Pinus sylvestris* L.) and a hardwood (*Fagus sylvatica* L) decayed by *Coniophora puteana, Trametes versicolor, Gleophyllum trabeum* and *Phanerochaete chrysosporium* fungi, was studied by FTIR and SEM. *C. puteana* and *G. trabeum* removed carbohydrate components of wood leaving syringyl moiety in hardwood and guiaicyl in softwood resulting in the increase in lignin: carbohydrate ratio. Wood decayed by selective white rot *P. chrysosporium* showed a reduction in peaks associated with lignin relative to carbohydrates, whereas simultaneous decay by *T. versicolor* meant a little change in the relative intensities of the lignin and carbohydrate bands.

Project 12 : Thermodynamics of moisture adsorption and desorption in wood [IWST/39/WSP/12/2000-2005]. *Principal Investigator- Dr. S.P.S. Rawat.*

Status: The specimens of *Eucalyptus tereticornis* having different dimension were oven dried and then conditioned to a series of successively higher equilibrium moisture contents. The values of the equilibrium moisture contents thus obtained were plotted against the corresponding relative humidity to produce adsorption isotherms. Findings were that these changes had a strong dependence on moisture content and a weak dependence on temperature. Studies on enthalpy-entropy compensation effect were made and a linear relationship was found to exist between entropy and enthalpy for adsorption of water in wood.

Project 13 : Chemical induction of heartwood in sandal [CFP/001/2000-2006]. *Principal Investigator- Mr. K.H. Shankaranarayana.*

Status : Three years old sandal plants were injected with 2nd dose of heartwood stimulant chemicals viz. Paraquat and etherel. 100 ml of Arnon- Hoagland nutrient solution (all trace elements except boron) was given to all treated plants. Freshly girth, height and peroxidase isoenzyme were measured.

Project 14 : Phytochemical and pharmacological investigations on *Persea macrantha* [CFP002/1999-2004]. *Principal Investigator- Mr. K.H. Shankaranarayana.*

Status : Bark powder of *Persea macrantha* (Jigat) was taken for sequential extraction with benzene and methanol to get 2.5% (thick resinous mass) and 7.5% (crude mud red solid) of extracts respectively. Uniformity of separation procedure is being confirmed with more samples of Jigat bark and separation of chemical

components of the extract is also continued using solvents of varied polarity.

Project 15 : Natural products evaluation of extractives of plant origin for biological and pharmacological activity - *Nothapodytes foetida, Garcinia indica* [CFP/003/ 2000-2005]. *Principal Investigator- Mr. V.G. Angadi.*

Status : No pure compound could be isolated from extracts (hexane, chloroform and alcohol) of *Nothopodytes foetida* wood powder. Therefore on a fresh sample of the wood a single polar solvent (methanol) is being tried for extraction of active components. *Garcinia indica* fruits after drying in air, are sequentially extracted with hexane, chloroform and methanol.

Project 16: Evaluation of oil yield/composition of new cultivars/high yielding varieties of aromatic/medicinal plants - Patchouli and *Piper longum* [CFP 004/ 2000-2003]. *Principal Investigator- Mr. S.H. Jain.*

Status : The oil and compositional analysis of 27 samples belonging to 2 cultivars of patchouli, showed variation from 2.2 to 2.6 %, maximum, oil content (71 kg/ha) found in sample No. T-13 which was raised with 75 % NP + K + azato + azosp + VAM treatment. Similarly on the GLC analysis of oil samples patchouli alcohol content was found vary from 28 to 47 % and maximum patchouli alcohol content was found in the case of sample T-4 75 % N+ PK + azato.Techniques/ procedures to improve upon the odour of patchouli oil and separation of patchouli alcohol from oil by simple chromatographic method are being initiated.

An isolation procedure has been identified for separation of alkaloid piperine from commercial grade *Piper longum* spikes.

Project 17 : Impact of industrial effluents on mangrove ecosystem [IWST/9/WBD/2/2000-2004]. *Principal Investigator - Dr. Kuppuswamy.*

Status: Survey on mangrove flora was carried out in polluted as well as cleaner mangrove ecosystem. About 13 species of mangroves were recorded from a cleaner area whereas only two species could be listed from polluted areas. Data on pollution aspects of the study area were collected. The information revealed that several industries coupled with domestic sewage treatment plants discharge about 608812 m^3/day of waste water containing pollutants of both inorganic and organic nature into the Mehadri Gedda stream running through Vishakapatnam Port Trust.

Project 18 : Control of biodeterioration of wood with the help of eco-friendly preservative and bioactive substances on staining and decay fungi under terrestrial conditions (IWST/28/WBD/3/1997-2005). *Principal Investigator - Mrs. H. C. Nagaveni.*

Status : Wood decay, stain and plant pathogenic fungi are repeatedly sub-cultured and maintained in virulent condition. Treated rubber wood with combinations of maleic anhydride and epichlorohydrin, phthalic anhydride and epichlorohydrin have given protection against decay fungi, whereas individual treatment of different anhydrides have given protection only to brown rot but not for white rot fungi. Antagonism was observed with *Lantana camara* dye and *Persea macrantha* plant extract against plant pathogens like *Fusarium oxysporum*, *Rhizoctonia solani* and *Macrophomina phaseolina.*

Project 19 : Investigations on the potential of medicinal and aromatic plants as source of botanical insecticides [IWST/20/WBD/5/2000-2001]. *Principal Investigator - Dr. R. Sundararaj.*

Status: The leaf extractives of *Clerodendron inerme* were tested against teak defoliator *Hyblea puera* for their phytopesticidal properties and it was found that the water extractive is ineffective while methanol extractive is effective at 5% concentration and effected 100% antifeedant activity. In another experiment a solid dye obtained from the bark of *Persea macrantha* (*Machilus macrantha*) by repeated purification and crystallization using different solvents was tested against the teak skeletonizer *Eutectona macheralis* and teak defoliator *H. puera*. It was found that the dye was very active even at 1% concentration giving 100% antifeedant activity against these tested insects.

Project 20 : Impact of disturbances on canopy insect biodiversity: An assessment of forest health [IWST/22/WBD/6/2000-2004]. *Principal Investigator - Mr. Y. B. Srinivasa.*

Status : An extensive survey of 150 forest fragments was carried out in order to select suitable fragments. The generated data were analyzed and the fragments selected shared common characteristics of having emergent canopies of at least 25 meters from the ground, had coffee as a major component in the surrounding vegetation and had at least one Dipterocarp canopy in the canopy continuum. They differed in having different canopy continuum sizes and in the elevational gradient. Six fragments of varying sizes and two spots along the contiguous forest was identified for sampling.

Project 21 : Studies on entomofauna of mangroves of Karnataka, Goa and Andhra Pradesh [IWST/24/WBD/7/2000-2004]. *Principal Investigator - Dr. O. K. Rema Devi.*

Status : About seventy species of insects belonging to 40 families(16 are new families not collected earlier) of 9 orders were collected and identified from mangrove trees of the coast of Karnataka and Goa. Significant differences in patterns and type of herbivory could be studied. Holes, bites, trails, and spots accounted for major damages. Different patterns of herbivory in 2 species of mangroves revealed that they share different herbivores. 3.7% damage in *Kandelia* and 8.26% in *Sonneratia* sp.was noticed. Rearing of important species including parasites were attempted in the laboratory conditions.

Project 22 : Role of biofertilizers in ecorestoration of problematic site like mine reject soil in Goa [IWST/13/WBD/8/2000-2005]. *Principal Investigator - Mrs. H.C. Nagaveni.*

A four-month old *Wrightia tinctoria* after biofertilizer treatment

Status: Good association of mycorrhizal fungi was observed with increase of growth and biomass from the bio-fertilizer treated seedlings of *Wrightia tinctoria, Bombax ceiba, Dendrocalamus strictus* and *Eucalyptus camaldulensis*. Experiments of biofertilizer have been continued with *Rauwolfia serpentina, Avera lantana, Helectaris ixora, Garcinia indica, Bryophyllum calycinum, Dendrocalamus strictus* and *Calamus thwaitesil* in Goa nursery.

Project 23 : Application of pheromone technology for the management of teak heartwood borer, *Alcterogystia cadambae* Moore [IWST-29/WBD-9/2000-2004]. *Principal Investigator - Dr. O. K. Rema Devi.*

Status : Bio-ecological studies on the pest, *Alcterogystia cadambae*, has been taken up. Larvae reared in the laboratory using artificial diet could pupate and emerge into adult. Studies on larval instars were undertaken. Studies on the field incidence of the adult moths in selected locations was continued using light trapping. Hymenopteran parasites could be collected from the early instars of the pest living in bark and sapwood.

Project 24 : Studies on durability of selected Indian secondary timbers against marine wood biodeterioration agents in the marine environment along Karwar coast (Karnataka) [IWST/30/WBD/10/2000-2004]. *Principal Investigator - Dr. K. S. Rao.*

Status: Six species of Indian secondary timbers (*Albizia chinensis, Ficus asperima, Chloroxylon swite, Macaranga peltata, Kydia calcina* and *Maesopsis eminii*) were pressure treated with CCA (Cooper Chromium Arsenic) preservative at different loadings, and exposed to the test site at Karwar along with their controls. All the treated panels exposed at this test site are found to be sustaining attack of wood borers, through the initiation of the borer attack is visible at the surface. Heavy fouling by barnacles and oysters was also observed. Foulers like barnacle and oysters were also recorded. Water samples were collected to analyze the salinity content.

Project 25: Investigation on pest problems of wood in packing cases and handicraft industries [IWST/31/WBD/11/1999-2003]. *Principal Investigator- Mr. Raja. Muthukrishnan.*

Status: Handicraft dealers and artisans suffered an annual average financial loss of 20 % due to insect damage to raw handicraft wood material and finished handicraft products. *Lyctus africanus* was found to cause damage to many finished handicraft products. Surveys conducted in several packing case industries indicated that the consignments were immediately dispatched to the indentor. Consequently, the insect pest problems and financial loss faced by packing case fabricators were very negligible. However, untreated packing case timbers were found susceptible to many powder-post beetles. The screening of different pyrethroids and organophosphates were carried out against powder - post beetles using treated rubber wood and mango wood by larval inoculation and treating infested wood.

Project 26 : Development of protocol for rearing wood borer larvae: response of wood boring molluscs to (wood preservative) chemical stress [IWST/31/ WBD/12/2000-2003]. *Principal Investigator - Dr. Balaji.*

Status : Pine wood panels exposed to seawater containing adult populations of *Lyrodus pedicellatus* were brought every month to the laboratory, acclimatized

and reared separetely. The animals were induced to breed. The larvae were collected and introduced into containers with treated timber coupons. Larval settlement was observed on all the coupons. *In situ* oxygen consumption by adult wood borers was studied under normal as well as stress conditions of copper and arsenic. The wood boring organisms could be induced to spawn under laboratory conditions in filtered seawater. The larvae released were found to successfully infest the new timber coupons. Larval settlement and boring activity of the young larvae were examined. Larval settlement was observed to have started on the 18th day of exposure of coupons and the success rate of boring of larvae was found to be 50% in coupons treated to lower retentions. The effect of leachates on growth of wood borers under laboratory conditions was studied. The results revealed that the leachates neither affected growth nor the reproduction of the adult source wood borers.

Project 27 : Evaluation of buoyancy, specific gravity and water absorption characteristics of alternate timbers for catamarans [IWST/35/WBD/13/2000-2004]. *Principal Investigator - Mr. M. V. Rao.*

Status : Water absorption studies carried out on the behaviour of untreated, treated and fungal infested blocks of *Bombax ceiba* revealed that while uninfected CCA (Copper Chromium Arsenic) treated panels absorbed the least amount of water followed by uninfected untreated specimens. The fungal infested panels both untreated and treated showed enormous water absorption. Water absorption character and water repellency of *Mangifera indica* panels were studied in the laboratory. The species in untreated condition as well as after application of water repellents (polymeric methylene di-isocyanate and commercial varnish) continued to absorb more and more water with time under both the conditions. Under both treated and untreated panels, the best performance was observed in polymeric methylene di-isocyanate treated panels followed by varnish coated panels and untreated ones. The efficiency, however of the two repellents gradually decreased over time.

Project 28 : Studies on termite problems on trees and timber and development of termite testing facilities [IWST-36/WBD-14/2000-01/]. *Principal Investigator - Dr. R. Sundararaj.*

Status : Chlorpyriphos @ 1 and 2% a.i and Fenvalerate @ 1 and 2% a.i were found to give 100% protection against termites till two years of exposure. Wood treated with Cashew Nut Shell liquid, which gave 100% protection till 10 months was found with 41% damage after two years of exposure. Field test was initiated with two new formulations of Cashew Nut Shell Liquid viz., Termiguard 20% and Termiguard 30% (both ready to use formulations), synthetic pyrethroids, Bifenthrin 2% EC, Permethrin 2% and organophosphorous compound Diazinon 2% RTU.

Project 29 : Studies on enzymatic hydrolysis of wood and other lignocellulosics [IWST-6/WE/2000-2005]. *Principal Investigator- Mr. Ajmal Samani.*

Status : Preliminary experiments on enzymatic hydrolysis of wood powder of *Bombax ceiba* by *Trichoderma reesei* and *Aspergillus niger* was carried out. Dinitrosalicylic acid (DNS) and Nelson-Somogyi methods for determination of reducing sugars in hydrolysed wood were standardised. A review of means of biomass conversion into energy by different thermochemical and biological processes was carried out.

Project 30 : Development of modern nursery techniques for propagation of important species of Goa. *Terminalia tomentosa, Xylia xylocarpa, Myristica fragrans, Bambusa arundinacea* and *Dendrocalamus strictus* [TIP/1/2002-2003]. *Principal Investigator - Dr. T.S. Rathore.*

Status : Experiments on container type size and biofertilizer, completed for production of quality seedlings of *Bambusa arundinacea.* Standardization of potting media for production of quality seedlings of *Dendrocalamus strictus* in 150 cc root trainer completed and initiated for *Myristica fragrans.*

Project 31 : Studies on micropropagation, field evaluation and conservation of *Pterocarpus santalinus* and *Pseudooxytenanthera stocksii* - a threatened species [TIP/2/2000-2005]. *Principal Investigator - Dr. T.S. Rathore*

Status : Conducted studies on callus culture and somatic embryogenesis in *Pseudooxytenanthera stocksii.* Standardized explant type, medium, growth hormones for callus induction and multiplication. Standardized high frequency shoot multiplication of shoots of *P. stocksii.* Standardized physico-chemical conditions for high frequency shoot induction and initiated studies on shoot multiplication in *Pterocarpus santalinus.*

Project 32 : Phenological studies of Clonal Seed Orchard (CSOs) of teak in Karnataka [TIP/3/2000-2003]. *Principal Investigator- Mr. Ashutosh Srivastava.*

Status : Studies on various growth hormones and Potassium nitrate (18 treatments) to improve flowering and seed setting in clonal seed orchard of teak was carried out. Drench application of 2.0 per cent potassium nitrate solution favoured the enhanced flowering in low flower bearing clones.

Project 33 : Evaluation and characterization of clonally propagated sandal (*Santalum album*) accession of diverse origin with special reference to heartwood content, oil content and other morphological characters [TIP/4/2000-2003]. *Principal Investigator - Mr. Arun Kumar A.N.*

Status : Oil estimation from periphery to pith of 50 trees has been completed. Morphological characters like girth, heartwood width and sapwood width have also been completed. Recording of morphological parameters is being continued. Variations in heartwood width, sapwood width and oil content have been observed. Quantification of the relationship between girth, heartwood and oil content carried out. Variation in oil content from periphery to pith of the heartwood was quantified.

Project 34 : Standardization of protocol for viability testing and prolonging the viability and vigour of seed in storage [TIP/5]. *Principal Investigator - Dr. Geeta Pandey.*

Status : Combined use of etheral and GA_3 enhanced germination and reduced mean germination time of sandal seeds. Periodic observations were recorded to determine the equilibrium moisture content of sandal seed till stable moisture content was attained at different relative humidities. Based on BET theory primary and secondary water level at each relative humidity was determined for the sandal seed. A total 37.5 kg seed was obtained after depulping from the

germplasm bank Gottipura and CSO Nallal. Experiment was laid for testing viability at the time of collection and variability in germination of 25 clones of sandal seed.

NEW PROJECTS INITIATED DURING THE YEAR 2001-2002

NIL

EXTERNALLY AIDED PROJECTS

PROJECTS COMPLETED DURING THE YEAR 2001-2002

World Bank Aided FREEP

Project 1 : Tree Improvement (FREEP 02). *For technical report contact, Principal Investigator- Director, IWST, Bangalore.*

Findings : Six monthly growth assessments of SSO cum progeny trails of *Casuarina equisetifolia* revealed that total height, clear bole and collar diameter varied between families. Maximum height 9.8 m, girth (above ground) 29 cm, and average height 5.3 m was observed at the age of three years in *C. equisetifolia*. High variation in height and gbh was observed across various families in case of SSO cum progeny trial of teak. At the given stage of growth, making appropriate comparison between the families was found incorrect. However, it is expected that appropriate comparison could be possible at a later stage of growth and hence further analysis in progress. Two clones of four and a half years, seven clones of one and a half years were studied for wood quality. Finalized results of two clones for pulp yield. CPTs of Eucalyptus species were evaluated for wood quality. Radial variation in fiber and vessel morphology studied in five genotypes of *Casuarina equisetifolia*. Studies related to age, period of collection, rooting media and diverse origin of clones on rooting from stem cuttings of teak completed and revealed that with ageing, rooting frequency declined and takes long time. High water retaining rooting media like vermiculite, cocopeat, saw dust are not favourable for teak. Season and origin of clones have influence on rooting. Leafy branch and leafy stem cuttings are suitable and clonal plants can be recovered in 4-5 months period. Studies on rapid *in vitro* shoot multiplication and *ex vitro* rooting (media and auxins) completed. High frequency (above 85%) *ex vitro* rooting achieved from *in vitro* shoots and developed rapid and simple *in vitro* cloning protocols of Teak *(Tectona grandis)* and Eucalyptus (*Eucalyptus tereticornis*). Clonal plants can be recovered within 4-5 months period.

Project 2: Utilisation of alternative timbers for catamarans (FREEP 03). *For technical report contact, Principal Investigator- Director, IWST, Bangalore.*

Findings : *Reduce investments in and increase service life of catamarans through improvement in protection of alternative timbers for catamaran fabrication* - Regular observations on the experimental panels treated with various preservatives, and exposed to test sites at Krishnapatnam and Visakapatnam, for studies on their durability were made. Studies on larval settlement on treated

timber coupons, and their growth was carried out. Effect of CCA on non-target organism, the fish, *Oreochromis moosunbuicam* was studied and the impact/accumualtion in different tissue parts of the fish was evaluated. The leachate analysis was done using AAS.

Introduction of 200 catamarans (revised target 100 catamarans) made of processed timbers as trials of laboratory tested timbers Total of 37 catamarans of the secondary timbers (32 made of *Bombax ceiba* and 5 made of *Anogeissus acummunata)* were fabricated, treated and distributed to the fishermen of Tamil Nadu and Andhra Pradesh.

Project 3 : Planting Stock Improvement Programme (PSIP) [FREEP].
For technical report contact Principal Investigator- Director, IWST, Bangalore.

Findings : The Seed Production Areas of teak (100 ha), casuarina (10 ha) and eucalyptus (10 ha), Seedling Seed Orchards of teak (25 ha), casuarina (4 ha) and sandal (5 ha), Clonal Seed Orchards of sandal (4 ha), eucalyptus (2 ha) and casuarina (4 ha) and Vegetative Multiplication Gardens of eucalyptus (2.9 ha) and Rhizome Bank of bamboos (2.0 ha) were maintained by the SFDs of Karnataka and Andhra Pradesh in technical assistance by IWST, Bangalore. Above assets were formally handed over to SFDs for maintenance from January 2002.

Modern Nursery : Studies were conducted on different potting media (eight media) , container size (six treatments) and biofertilizers (eight treatments) in *Dalbergia latifolia (*Rose wood*).* Results revealed that quality seedlings can be produced within five months period in 270 cc root trainer consisting compost, sand and soil (60:30:10) and application of biofertiliser (Azotobacter). Studies conducted on container size, type and biofertiliser in case of *Wrightia tinctoria,* a toy making timber species, revealed that in 270 cc root trainer consisting potting mixture of compost, sand and soil (60:30:10) and application of composite culture of VAM produced plantable seedlings in six months. Based on the protocol developed for vegetative propagation of *Eucalyptus tereticornis,* small scale production (5000) of clonal plants of 24 clones were produced and used for establishment of CSO cum clonal trial at Kolar by the SFD, Karnataka. Based on the modern nursery protocol developed 10,000 sandal seedlings were produced in 270cc block type root trainers using *Mimosa pudica* as primary host and were given to State Forest Department (Karnataka) and progressive farmers of Gujarat, Maharashtra and Haryana for planting/trials. Modern nursery technologies demonstrated to the officials of the State Forest Department (Karnataka, Andhra Pradesh, Goa, Tamil Nadu and Kerala), students (Agriculture Universities) and farmers.

PROJECTS CONTINUED DURING THE YEAR 2001-2002

Project 1 : Evaluation of physical and mechanical properties of *Acacia* hybrids [IWST/WPU/Aca.Proj./20012002]. *Principal Investigator - Dr. R.V. Rao.*
(Sponsored by M/s Mysore Paper Mills Ltd., Shimoga)

Status : Work on physical and mechanical properties of *Acacia auriculiformis* hybrid (5 trees of 8 years old), *A. auriculiformis* Spring valley (8 and 15 years five trees each), *Acacia mangium* hybrid (5 trees of 8 years and one tree of 15 years), .

Acacia mangium (1 tree of 8 years) and *A. auriculiformis* (1 tree of 8 years) completed under green condition.

Project 2 : Studies on the diversity of the aleyrodid (Aleyrodidae: Homoptera) fauna of South Western Ghats [IWST/WBD/MOEF/2000-2002]. *Principal Investigator- Dr. R. Sundararaj.*

Status: A total of 369 host plants infested by aleyrodid fauna were collected in the first season from areas of South-Western Ghats. Eighty one species of whiteflies are identified to species level. The spiraling whitefly *Aleurodicus dispersus* Russell has been found to breed on 25 host plants. Interestingly, intraspecific variation was observed in *A. dispersus* for the first time. Two new species of whiteflies were found to breed on sandal (*Santalum album* Linn.). They have been described and illustrated.

NEW PROJECTS INITIATED DURING THE YEAR 2001-2002

Project 1 : Weathering of wood surfaces, (CSIR, New Delhi) [2002-2005]. *Principal Investigator- Dr. K.K. Pandey.*

Status: Project started in February, 2002.

Research Achievements

Name of State	No. of Projects Completed in 2001-2002	No. of Ongoing Projects in 2001-2002	No. of Projects Iinitiated in 2001- 2002
Andhra Pradesh	1	8	Nil
Goa	Nil	2	Nil
Karnataka	5	30	Nil
All India	2	2	Nil

Technologies Assessed and Transferred

Technologies assessed

1. Developed strains measuring indicator to measure growth stresses in trees and logs rapidly and non-destructively.
2. Developed simple, less expensive colour reagents to distinguish high and low oil yielder of sandal in field.
3. Developed new aroma products from less utilized *Eucalyptus* hybrid oil by simple chemical modification.
4. Evolved preventive mechanism for leaching of colouring matter from the wood of *Pterocarpus marsupium* (Bijasal Wood).
5. Developed modern root trainer based nursery technique for production of quality planting stock of sandal.
6. Refinement in the macro propagation of clones of *Eucalyptus tereticornis*.

Education and Training

Training Organised

Sl.	Subject	Duration	Target Group
1.	Forestry and Wood Science.	-	632 Students from various Universities and 143 Forest Officials.
2.	Wood Science and Technology	4th Sept., 2001	IFS Officers.
3.	Timber Identification, Joinery and Timber Grading	-	27 Officials of Naval Dockyard, Vishakhapatnam
4.	Wood Science & Technology	-	Students of FRI Deemed University
5.	Intellectual Property Rights in Forestry Issues	19th-21st Dec., 2001	Foresters
6.	Advances in Wood Science and Technology	11th-15st Feb., 2002 and 18th -22nd March 2002	IFS officers
7.	Field visit	10th-28st Dec., 2001	Range Officers of Forest Department of Karnataka, Andhra, Pradesh and Goa

Training Received

Sl.	Name and designation	Training	Place of Training	Duration	National/ International
1.	Dr. S.K. Sharma	-Computer Hardware and Networking	Jetking, Bangalore	26.3.2001 to 21.07.2001	National
		-Oracle	CMC Limited, Bangalore	28.07.2001 to 21.05.2001	National
		-Management of Servers and LAN	ICFRE, Dehradun	20.05.2001 to 26.11.2001	National
2.	Dr. S.K. Sharma Dr. S.R. Shukla and Shri N.K. Upreti	Linux System & Network Administra-tion	Linux Learning Centre, Bangalore	24.12.2001 to 27.12.2001	National

3.	Dr. R.V. Rao Dr. Vimal Kothiyal Dr. K.K. Pandey and Dr. S.R. Shukla	Intellectual Property Rights in Forestry Issues	IWST, Bangalore	19th-21st December 2001	National
4.	Shri N.K. Upreti	Server and LAN Management	ICFRE, Dehra Dun	20th - 26th November 2001	National
5.	Dr. S.P.S. Rawat and Dr. K.K. Pandey	Research Writing	FRI, Dehra Dun	5th -9th Nov., 2001	National
6.	Sri. V.G. Angadi Sri. Ashutosh Srivasatava and Shri A.N. Arun Kumar	Molecular Marker Studies	Serbiotech Research Laboratry, Kodathi, Bangalore	18.12.2001 to 12.1.2001	National
7.	Dr. K.K. Pandey Shri.K.H. Shankanarayana Shri S.H. Jain and Shri G. Ravikumar	Operation and Application of Gas Chromatograph Mass Spectrometer	Toshbro Private Limited Bangalore	28th Dec.,	National
8.	Km. Surekha Sawant, and Shri Ajmal Samani	Application of Molecular Biological Tools for Genetical and Pathological Research in Sericulture	Seribiotech Research Laboratory, CSB Campus Kodathi, Bangalore	28.4-2001 to 19.5.2001	National
9.	Km. Surekha Sawant, Scientist-B	Techniques on Molecular Markers	Seribiotech Research Laboratory, Kodathi, Bangalore	18.12.2001 to 12.1.2002.	National
10.	Dr. T.S. Rathore, Scientist-D	Advances in Forest Biotechnology	Oregon State University, Corvallis, USA	2.4.2001 to 22.6.2001	International

Linkages & Collaboration

INTERNATIONAL

1.	CSIRO, Australia	2	Oregon State University, USA (Dr. J. J. Morell)
3.	Italian Trade Commission & Ascimal	4.	University of Florida, USA
5.	Jaseen Pharmaceuticals, Belgium (Dr. Alex Valcke)	6.	Forest Products Research Centre, BCUC, UK (Dr. Andy Pitman)
7.	Graduate School of Bio-Agricultural Science, Nagoya University, Japan (Professor Takashi Okuyama)	8.	French Institute, Pondichery
9.	Osmose, New Zealand (Mr. Angus Wallace)		

NATIONAL

1.	ICFRE Institutes	2.	Karnataka Forest Department
3.	A.P. Forest Department	4.	Goa Forest Department
5.	Tamil Nadu Forest Department	6.	Forestry Research and Training Institute, Bangalore
7.	BIOTRIM, Tirupati	8.	Bangalore University, Bangalore
9.	Andhra University, Vishakhapatam	10.	SV University, Tirupati
11.	University of Agricultural Sciences, Bangalore	12.	University of Agricultural Sciences, Dharwad
13.	Tamil Nadu Agricultural University, Coimbatore	14.	Kerala Agricultural University, Trichur
15.	Indian Institute of Science, Bangalore	16.	National Institute of Oceanography, Goa
17.	Indian Institute of Horticultural Research	18.	Indian Plywood Research and Training Institute, Bangalore
19.	National Law College, Bangalore	20.	Indian Institute of Management, Bangalore

21.	Indian Statistical Institute, Bangalore	22.	Kerala Forest Research Institute, Peechi
23.	Central Marine Fisheries Research Institute, Kochi	24.	Indian Institute of Forest Management, Bhopal
25.	Foundation for Revitalization of Local Health Traditions, Bangalore	26.	Centre for Envoirnmental Education, Bangalore
27.	Ashoka Trust for Research in Ecology and Environment, Bangalore Indo US Hybrid Seeds, Bangalore	28.	Mysore Paper Mills, Shimoga, Karnataka
29.	West Coast Paper Mills, Dandeli, Karnataka	30.	Harihar Polyfibres, Harihar, Karnataka
31.	ITC Bhadrachalam & Paper Boards, Sarpakka, A.P	32.	Indian Navy-Mumbai & Visakhapatnam Fisheries Departments, Tamil Nadu

Collaborative Research Work

- Mr. D. Deka, Lecturer, Department of Energy, Tezpur University visited IWST for one month under INSA visiting fellowship and carried out collaborative research work on "Firewood characteristics by lignin structure study with Fourier transform infrared spectroscopy".

Publications

1. Ajmal Samani, K. K. Pandey, D.P. Khali and K.S. Reddy (2001). Energy and Chemicals from Biomass, *My Forest* 37 (3) 581-592.

2. Angadi, V.G., S. Ramalakshmi, S.H. Jain, C.R. Rangaswamy and K.S.Theagarajan. Allozymic variation in the seed tissue of Sandal (*Santalum album* L) population of different provenances. *Indian Jour. of Forestry* (In press).

3. Chauhan, S.S., P. Aggarwal, Ajay Karmarkar and K.K. Pandey (2001). Moisture adsorption behaviour of esterified rubber wood. *Holz-als-roh-und-werkstoff* 59(4), 250-253.

4. Kothiyal, V., R. Sudheendra and R.V. Rao (2001). Assessment of some strength properties of certain clones of *Eucalyptus tereticornis* Sm. from Cherupally (Andhra Pradesh), India. *Journal of Tropical Forest Products* (accepted).

5. Kuppusamy, V., M.V. Rao, M.Balaji and K.Satyanarayana Rao (2001). Treatment behaviour of fresh and inservice catamaran logs. Paper

Submitted for the 32nd Annual Meeting of the International Research Group on Wood Preservation, Nara, Japan, May 20-25.

6. Nagaveni, H.C., H.S. Anantha Padmanabha, G. Vijayalakshmi and S.S. Chauhan, (2001) Effect of water repellency on deterioration of rubberwood. *Wood News*, 11 (2): 38-39.

7. Nagaveni, H.C. and H.S. Ananthapadmanabha (2002). Nutrient mobility from seed to seedling during germination in sandal wood (*Santalum album* L.) seedlings. *My forest*, 38 (1): 1-5.

8. Pandey, K.K. and A. J. Pitman (2002): Weathering characteristics of modified rubber wood: *J. Applied Polymer Science.* (In press.)

9. Rao, M.V., V. Kuppusamy, K. Satyanarayana Rao and L.N. Santhakumaran (2001). Leaching of CCA preservative from treated timber in marine environment. Paper submitted for the 32nd Annual Meeting of the International Research Group on Wood Preservation, Nara, Japan. May 20-25.

10. Rao, R.V., T.R. Hemavathi, M.Sujatha and S.Shashikala (2001). Wood anatomical variation in *Casuarina equisetifolia*, SPA, Nellore. Fifth Annual Workshop on *Casuarina* network at Regional Forest Research Centre, Rajahmundry (AP), 8-9 Oct., 2001.

11. Rao, R.V., P. Kumar, K.S. Rao and R.M. Singhal (2001). Better utilization of lesser known and plantation timbers from south India. Paper presented in the International Conference on Forestry and Forest Products Research (CFFPR 2) Kuala Lumpur, Malaysia, Oct.

12. Rao, K.S., Surekha Sawant and Pankaj K. Aggarwal (eds) : Proceedings of National Workshop on "Forestry, Forest products and Coastal Population" held at Chennai. ISBN No-81-8900 284-3-X , ICFRE No. BK-59 IWST Bk-1:2001, Dec. 2001, 190 pp.

13. Rao, K.S. and K.S. Reddy (eds) "IPR in Forestry Issues": Proceedings of a Workshop conducted at Bangalore during 19th - 21st December, 2001.ISBN No. 81-900 284-4-8, ICFRE No.91 ICFRE BK- 66IWST BK-2002.

14. Remadevi, O.K. (2001). Cultural control the most viable component of IPM for the management of teak defoliators. In Recent trends in insect pest control to enhance forest productivity. p. 23-27. Proceedings of a Workshop on Entomology and Biological Control held at TFRI, Jabalpur, India, 25th September 2000, ICFRE No. 67: ICFRE BK 55.

15. Remadevi, O.K., R. Sunderaraj and Raja Muthukrishnan (2001). Evaluation of the efficacy of permethrin as a termiticide for timber protection in field conditions. Presented the paper in National

Conference on Environment, Biodiversity and Bioethics: Current Trends and Future Directions, September 20-22, p.77.

16. Remadevi, O.K. (2002). Loss of plantation timber in depots due to powder post beetle attack and its management. *My forest*, 38 (1): 23-27.

17. Remadevi, O.K., M. Rajamuthukrishnan, B. Rajji, L.N. Santhakumaran, and K.S. Rao, (2001). Insect pests of mangroves and coastal trees along east coast of India. Proceedings of Workshop on Forestry, Forest Products and Coastal Population. Eds. K.S. Rao, Surekha Sawant and P.K. Aggarwal. ISBM No. 81-900284-3-X, ICFRE No. 82, ICFRE BK-59 IWST BK-1, 2001.

18. Satyanarayana Rao, K., M.V. Rao, M. Balaji and V. Kuppusamy. Use of wood in aquatic environments of Andhra Pradesh. Presented at the Workshop on Use of Wood in Aquatic Environments, Hyderabad (In press).

19. Shankaranarayana, K.H., G. Ravikumar and C.R. Rangaswamy (2001). On the isolation of santalols from Sandal wood. *Indian Perfumer* 45(2) 79-80.

20. Shanmughavel, P. and R.S. Peddappaiah. 2001. Biomass production in ten years old plantation of *Bambusa bambos*. *Journal of Non-timber Forest Products*. 8 (½); 129-132.

21. Shukla, S.R., R.V. Rao and K.S. Rao, (2001). Price trends of *Casuarina* poles in Bangalore and Hyderabad markets. Fifth Annual Workshop on *Casuarina* Network at Regional Forest Research Centre, Rajahmundry (AP), 8-9 Oct. 2001.

22. Sindhuveerendra, H.C., P.V. Somashekar, R.N. Lakshmikanth, and T.S. Rathore, (2002). Variation and performance of *Eucalyptus tereticornis* clones in Bangalore. *My Forest*, 38 (1); 89-94.

23. Tarakanadha, B., and K. Satyanarayana Rao (2002). Effects of two wood preservatives and one water repellant on the settlement of fouling communities in a tropical marine environment. Paper submitted for the 33rd Annual Meeting of the International Research Group on Wood Preservation, Cardiff, UK.

News Articles

1. Prajavani, 20/12/2001. A photograph of VIP's participating in Training Workshop on IPR in Forestry Issues.

2. Deccan Herald, 8/2/2002. "Italy to help upgrad tech input in Indian Wood Craft".

3. The Hindu, 8/2/2002. "Italian Wood Research Institute, Planned".

4. The New Indian Express, 8/2/2002. "Institute forges Italian connection."

5. Deccan Herald, 16/2/2002. "Bangalore to get wood technological training centre".

6. Based on the Wood Identification report pertaining to a case, an article appeared in Deccan Herald dated 08.05.2001 appreciating the work done by the Institute under the Heading "Operation Blackboard funds siphoned off".

Consultancies

Sl. No.	Title	Organization from where taken	Amount (Rs.)
1.	Testing of Termi Giard(20%) and Termi Guard Super Power (30%)	Advamce Agrisearch Limited, Valsad Gujarat	20000 20000
2.	Testing of Talstar® 2.5 EC against termites & borers	Dr. S.A. Ram, Director Plant Products Development, 17/2 Palace Road, High Grounds, Bangalore 560 052	20000
3.	Testing of Chlorpyriphos (Tagban® 20% EC)	Tropical Agro Systems (India Ltd.), Chennai	10000
4.	Testing of Permethrin 50 EC against termites & fungi	Dr. C. Kandasamy Sr. Manager, Tagros Chemicals (India) Ltd, Egmore, Chennai	15000
5.	Testing of Diazinon 2% RTU	M/s Sudarshan Chemical Industries Ltd, Agro Chemicals Division. 662, Wellesly Road, Pune	18000
6.	Testing of Termiguard® 20% against fungi	Advance Agrisearch Limited, Valsad, Gujarat	5000
7.	CCA Comparison with Permethrin	Tagros Chemicals India Ltd., 19, Marshalls Road, Egmore, Chennai	9000
8.	Microwave digestion charges of 54 fish tissue samples	Sri. N.H.K. Durga Prasad, Department of Zoology, Andhra University	2160

Services Rendered

Timber Testing

Testing services have been rendered to different users from Industry, Govt. Departments, Police, Vigilance, CBI, Defence, Railways, Construction Industry, NGOs and Private Sectors for the following:

Timber identification, Moisture content, Strength property determination and Technical information on use of wood and wood products.

During the year, 45 enquiries (4133 samples) for identification and 10 enquiries (17 samples) for moisture content test were attended and reported upon by WPU Division. 25% - 30% of the time spent for the above work.

Total **Rs. 80,050/-** earned as testing charges.

Analysis of samples:

- 21 Sandal samples from Police, Forest Departments, Judicial Courts and other agencies were received for analysis and report submitted. In this regard, revenue of Rs 22,000 was earned by the CFP division.
- Testing of efficacy of commercial preservatives.
- Attending the enquiries of pathological problems and suggesting the remedial measures.
- The WBD Division demonstrated the techniques of multiplication, application to the nursery plants and use of biofertiliser to officials of Goa Forest Department.

Conference, Meetings, Workshops, Symposia, Exhibitions

Sl.	Subject	Duration
1.	CTA Workshop on Bamboo	24th Sept., 2001
2.	Research Advisory Group Meeting	27th Sept., 2001
3.	CTA Workshop on Eucalyptus	19th Oct., 2001
4.	CTA Workshop on Sandal	30th Oct., 2001
5.	Workshop on Intellectual Property Rights in Forestry Issues	19th - 21st Dec., 2001
6.	Group meetings of Fishermen of Tamil Nadu and Andhra Pradesh	September and December, 2002

Workshop /Exhibitions /Meetings

Sl.	Subject	Duration	Organised by
1.	CTA Workshop on Casuarina	8th -9th Oct., 2001	IFGTB, Coimbatore
2.	CTA Workshop on Biofertiliser	5th -6th Oct., 2001	IFGTB, Coimbatore
3.	CTA Workshop on Nursery	28th -29th Nov., 2001	TFRI, Jabalpur
4.	CTA Workshop on Seed	11th -12th Dec., 2001	CSFER, Allahabad
5.	National Seminar on Implications of WTO agreement on forestry and wood product sector	12th February 2002	IPIRTI, Bangalore
6.	Workshop on Coastal Biodiversity Training and Capacity Building	24th -28th July 2000	National Institute of Oceanography Palla, Goa sponsored by MoEF, New Delhi
7.	First National Workshop on 'National Action Programme to Combat Desertification'	18th-19th Febraury 2002	Bangalore
8.	Workshop on Fast Growing and high yielding selected cultivars in non-timber forest products and medicinal plants	16th -18th Jan., 2002	Regional Centre, National Afforestation and Eco-Development Board, University of Agricultural Sciences, GKVK, Bangalore
9.	Workshop on Social Development in Rural Areas and Strategies and Programmes	3rd -8th Dec., 2001	National Institute of Rural Development, Hyderabad

Distinguished visitors

National

- Dr. D.N. Tewari, Hon'ble Member Planning Commission on 16/04/2001 and 13/09/2001.
- Shri A.K. Mukerjee, IFS, Former Inspector General of Forests, MoEF, Govt. of India, 01.06.2001.

- Prof. S.S. Iyengar of Louisiana State University, U.S.A. Visited the Institute on 01/08/2001 and delivered lecture on Bio-information in Relation to Forestry and Allied Subjects.
- Shri S.K. Pande, IFS, Director General of Forest, Govt. of India visited the Institute on 21st December, 2001.
- Shri P.V. Jayakrishnan, IAS, Secretary, MoEF visited the Institute on 24/09/2001.

Training Workshop on Intellectual Property Rights

Dr. D.N. Tewari, Honble member, Planing Commission, Government of India interacting with ICFRE officials during the Workshop on "Intellectual Property Rights in Forestry Issues"

International

- Dr. Andy Pitman, Forest Product Research Centre visited the Institute and delivered the lecture on "An Overview of Wood Deterioration Research".
- Mr. Peter Birkett and Mr. Angus Wallance, OSMOSE New Zealand on 23/08/2001.
- An Indonesian Forest Seed Project delegation visited the Institute on 28/11/2001.

- Dr. ALEX VALCKE President of International Research Group on Wood Preservation visited the Institute on 30/11/2001.
- Prof. Takashi Okuyama, Professor in Bio-material, Physics, Nagoya University, Japan visited the Institute from 03/01/2202 to 06/01/2002.
- Mr Andrew T.K. Kong, Executive, Malaysian Timber Council, Kualalumpur, Malayasia on 07/02/2001.
- Shri Akash Chopra, Director, Biosys group visited the Institute and delivered a lecture on "Organic Farming" on 15/03/2002.
- Italian Trade Commission delegates visited the Institute on 9th February, 2002.

Miscellaneous

Functions/Programmes

- World Environment Day was celebrated on 05/06/2001. An in-house seminar on "Role of Wood Technologies in Promoting Environmental Security" was organised on the occasion.
- Hindi Fortnight was celebrated during 10.9.2001 to 24.9.2001.
- Vigilance Awareness Week was also observed from 31/10/2001 to 4/11/2001.