

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 focuses its research 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 Utilization of Wood; Mangroves and Coastal Ecology and Research on Sandal. The focus 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 utilization of timber and non-timber products and increasing productivity. The Institute mainly aims to develop strategies for use and production of wood and other forest products in a way that sustain their supply.

The Vision of the Institute is to attain excellence in forestry and wood science research for generation of desired resource values, uses, products, services in a way that sustains diversity and productivity in an eco-friendly regime.

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

		No. of projects completed in 2007-08	No. of ongoing projects in 2007-08	No. of projects initiated in 2007-08
IWST, Bangalore	Plan Projects	13	15	11
	Externally Aided Projects	7	20	6
FRC, Hyderabad	Plan Projects	5	1	—
	Externally Aided Projects	1	1	—
	Total	26	37	17

PROJECTS COMPLETED DURING THE YEAR 2007-2008

PLAN PROJECTS

Project 1: Studies on gas permeability of secondary species of timbers [IWST/WSP/X-19/2003-08]

Findings: In transverse direction, the permeability of *Acacia auriculaeformis* and *Acacia mangium* was very low as compared to axial direction. However, permeability in *A. mangium* was relatively higher than that of *A. auriculiformis*.



Heartwood specimen of *Eucalyptus camaldulensis*, *E. grandis* and *E. tereticornis* did not indicate flow rates. On the other hand, considerably higher permeability was measured in sapwood specimens of *E. camaldulensis* and *E. tereticornis*. On the contrary, permeability in sapwood of *E. grandis* was found to be lower as compared to the other two species measured.

Project 2: Study the variability in growth stresses in clones of *Eucalyptus* [IWST/ WSP/ X-56/2006-08]

Findings: A total of 15 clones of *Eucalyptus tereticornis* of ITC, Bhadrachalam growing at Nagroor, near Bangalore and 10 clone from IFGTB Coimbatore were evaluated for the growth strain. It was observed that clone number 116 and 3 (about 400 micro strain) had lowest strain while clone number 10, 71 and 115 had maximum level of growth strain (about 1000 micro strain) from Bangalore region. Wood from clone with highest growth strains also exhibited highest volumetric shrinkage. From IFGTB Coimbatore, clone number 53 had minimum value (568 micro strain) while clone numbers 17 and 19 had maximum level of growth strain (1555 and 1546 micro strain respectively). It was observed that clones from Coimbatore had more strains than that of Bangalore region. Green density of the clones from Bangalore was found to be almost constant (about 1000 kg/m³) while the basic density varied from 550 to 750 kg/m³.

Project 3: Studies on chemical modification of wood by vapour phase treatments [IWST/ WSP/X-61/2006-08]

Findings: The chemical modification of sapwood portion of the four wood species under viz. Rubber wood (*Hevea brasillensis*), Radiata pine (*Pinus radiata*), Mango wood (*Mangifera indica*) and Chir pine (*Pinus roxburghii*) can be treated in vapour phase by benzoyl chloride at boiling temperature in the glass reaction vessel. The optimized condition i.e. with 4% lead acetate as catalyst, pyridine as swelling agent and time of treatment in vapour phase 6 hours gave the highest Weight Percent Gains (18-35 WPG).

Chemical modification of wood by vapour phase treatments are most effective in Mango wood (*Mangifera indica*) followed by Rubber wood (*Hevea brasillensis*), Chir pine (*Pinus roxburghii*) and Radiata pine (*Pinus radiata*). Modified wood shows high Anti swelling efficiency and resistance against Termites.

Project 4: Extraction and separation of chemical constituents of *Dysoxylum malabaricum* Bedd. wood [IWST/CFP/X-52/2005-08]

Findings: Hydro distillation of powdered *Dysoxylum malabaricum* wood yielded an essential oil = 0.6% W/W. GC-MS analysis of the essential oil showed the presence of 28 important chemical compounds. Ethyl acetate extract of *Dysoxylum malabaricum* wood having pleasant odour gave positive tests for terpenoids and flavonoids. Ethyl acetate extract of *D. malabaricum* wood at 0.5% concentration showed strong inhibition against wood decaying fungi namely *Polyporus meliae* (Brown rot) and *Thyromycis hirsutus* (White rot) Among various experiments conducted to reduce mortality of *D. malabaricum* seedlings and increase survival percentage, adding of locally available mulch around seedlings increased survival percentage to a great extent.

Project 5: Development of methods for detection of adulterants and evaluation of quality parameters for assessing purity of Jigat [IWST/CFP/XI-71/2007-08]

Findings: Binding property of the Jigat has been standardized by measuring its viscosity. This property of Jigat raw material is very useful to prevent peel off of finished bathis. A simple laboratory method has been developed to determine quantity of Jigat in adulterated samples by UV-spectroscopic method. The developed method will help to meet the needs of end users/stake holders. FTIR spectra were taken to differentiate functional groups of pure and adulterated samples of Jigat. Samples received from agarbathi industries/ Jigat traders for its authentication were used to study the percentage of Jigat in the adulterated mixture.

Project 6: Development of methods for detection of adulterants and determining purity of sandal oil [IWST/CFP/XI-72/2007-08]

Findings: A simple method using UV-spectroscopy has been developed for estimation of sandalwood oil in adulterated mixture. The developed method will help to meet the needs of end users/stakeholders. Solubility test using 70 % ethyl alcohol for different adulterated mixture has been studied. This will give preliminary idea of type of adulterant in the mixture. Refractive index study, optical rotation study for pure sandal oil and different adulterated mixture has been studied which also gives idea about possible adulterant in the mixture. Samples received from end users for its authentication were used to study the percentage of sandal oil in the adulterated mixture.

Project 7: Investigations on the resistance of commercially available bamboo species in Karnataka against insect borer and termite [IWST/WBD/X-45/2004-08]

Findings: The major borer identified to cause damage to commercial bamboo was *Dinoderus minutus* and the minor borers were *Lyctus africanus* and *Heterobostrychus aequalis*. The annual loss of revenue caused by insect borers in bamboo depots is around 25%. The bottom portion of the culm was found on an average to be more durable against borers and fungal attack. Bamboo from wet zone and dry zone were evaluated separately against termites and fungi. Commercially available bamboo *D. strictus* was found to be more durable against termites and fungi than *B. bambos*. Project is completed as on 31st March 2008. Project completion report is under preparation.

Project 8: Clonal test trials on *Casuarina equisetifolia* L. in north coastal Andhra region [IWST/WBD-Marine/X-004/2003-08]

Findings: Ten clones of *Casuarina equisetifolia* L. procured from Regional Forest Research Centre, Rajahmundry and planted in Chippada VSS as per Randomized Row Planting Design. Soil samples were collected and analyzed for nutrient status which revealed that the soils are devoid of any nutrients. Survival percentage of the plantation revealed that 3 clones performed well with survival over 50% as compared to other clones. Growth parameters in terms of height, basal stem diameter and average branching pattern at ground level were recorded for all the clones. Growth performance in terms of height of all the clones is good. Basal stem diameter above ground of all the clones showed good girth. The trials with the clones revealed that the clone CP4202-M is the most suitable for plantation on degraded soils.



Project 9: Periodical income generation for communities involved in coastal plantation (Old title: Community involvement in coastal forestry through periodical returns by value added produce) [IWST/WBD-Marine/X-24/2003-08]

Findings: Seeds of *Eucalyptus citriodora* Hook. were procured and nursery raised in Chippada VSS area in Visakhapatnam district. Two hectares were planted with *E. citriodora* interspersed with *Casuarina equisetifolia* L. in Quinquinox Design and one hectare was planted with only *E. citriodora*. The spacing adopted in two hectares was 3 x 3 m and 2.5x 2.5 m and in one hectare it was 2 m x 2 m. Soil was analyzed for nutrient status and it was found that it was devoid of any nutrient. The average growth in terms of height of *C. equisetifolia* was 15 m which generally is useful for different end uses. Growth in terms of average girth was 38.50 cm which yields good amount of timber. Herbage of *E. citriodora* was harvested at quarterly intervals and essential oil distilled. On an average, the oil yield was 2.866 kg per hectare. The oil quality was assessed by Chemistry of Forest Products Division, IWST, Bangalore. The studies revealed that the *E. citriodora* plantation along with traditional *C. equisetifolia* will be beneficial for coastal communities in poor quality soils as in Chippada VSS. Trials on NTFP species, i.e., *Aloe vera* (L.) Burm. f., *Gymnema sylvestre* (Retz.) R. Br. ex Schultes and *Asparagus racemosus* Willd. revealed that the soil and weather conditions were not congenial for the species and mortality was recorded. Perhaps, these species can not be adapted for plantation in coastal localities.

Project 10: Environmental impact of leachates from Copper-Chrome-Arsenic (CCA) wood preservative under marine condition [IWST/WBD-Marine/X-23/2003-08]

Findings: A total of 200 mango stakes of 40 x 5 x 2.5 cm size were prepared, trimmed, planed, air dried and treated with CCA preservative. Treated stakes were converted into 600 test panels and 400 reference pieces. Macro grain pattern of all 600 panels was analyzed based on the nature of grain. "End penetration test" performed on all panels and preservative distribution recorded. Additionally, 120 untreated mango panels were prepared to serve as controls. Wood boring samples from all panels were obtained for chemical analyses. All treated panels were end sealed with suitable paint(s) to arrest preservative leaching. All treated panels were sorted into four CCA retention groups. Panels in triplicate of the 4 groups and controls were prepared into 200 test ladders. All the 200 test ladders were exposed to marine conditions at Visakhapatnam harbour. Test panel sets were retrieved at cumulative intervals and analyzed for preservative contents. Copper and chromium contents were found to have reduced in all treated mango timber panels exposed for different periods of time. Leaching rate of the two metals gradually decreased with progressing durations of panel exposure. As regards the impact of CCA leachates on colonization of biofoulers, it was found that these animals got abundantly recruited on all treated panels. Impact of copper and chrome leachates was also negligible on the biota growing in the test vicinity. However, the leaching metals were found to have proved lethal to the settling wood borer larvae.

Project 11: Studies on recruitment and metamorphosis of marine woodborer larvae [IWST/WBD-Marine/X-22/2003-08]

Findings: Teredinid wood borers trapped in the field were brought to the laboratory and *Lyrodus pedicellatus* and *Teredo parksii* maintained for generations by infesting fresh test coupons to serve

as stock of larvae. Inocula of two species of algae, i.e. *Isochrysis* sp. and *Chaetoceros* sp. were procured and tested for their preference as food for the larvae. It was found that there was not much difference in recruitment and metamorphosis of larvae under the influence of the algal feed. Test coupons were immersed in the harbour for facilitating formation of primary film. Different bacteria were isolated from the primary film, maintained as pure cultures and identified through biochemical tests. Wafers of pine wood were coated with individual bacteria and tested against teredinid larvae for their recruitment response.

Project 12: Studies on seed source variation, determination of age of the trees and establishment of germplasm bank in Sandal [IWST/TIP/X-47/2005-08]

Findings: Variability was found in 20 different seed sources collected from States of Karnataka, Tamil Nadu and Kerala with reference to seed and seedling traits. An *ex situ* seedling germplasm bank has been established at Gottipura, Hoskote, Bangalore. Study on core sample revealed that, it is difficult to predict age of sandal tree because of high variability in number of rings. It has also been found that sandal trees above 30 cms girth is nearly absent in natural populations of Karnataka and Tamil Nadu States.

Project 13: Carbonisation of selected fuelwood species [IWST-34/WE-1/2004-June 2007]

Findings: The yield and other properties (Calorific value, proximate and elemental analysis) of charcoal prepared from *Casuarina equisetifolia*, *Eucalyptus* hybrid, *Acacia nilotica*, and *Acacia auriculaeformis* at different experimental conditions (carbonisation temperature, soaking time, heating rate etc.) were evaluated. The carbonization was carried out at 300, 400, 500, 600, and 800°C at 1 to 3 h soaking time and three different heating rates of 4°C/min, 8°C/min and 12°C/min. In all the species studied in this work, the char yield decreases significantly with the increase in the carbonization temperature. Fixed carbon content, ultimate carbon and ash content increases with the increase in carbonization temperature, whereas the volatile content and ultimate hydrogen was found to be decreasing with the temperature. There was a slight decrease in the yield and a marginal increase in the fixed carbon content with increase in the soaking time from 1 to 3 h. The yield of charcoal prepared at 12°C min⁻¹ was slightly less as compared to its value at 4°C min⁻¹. However, the change in heating rate of the wood has marginal effect on the yield and chemical composition of the chars. Calorific values of the wood chars found to increase with increase in the carbonization temperature. The yield of charcoal was different for the different wood species under similar carbonization temperature. Wood species have different anatomical properties. Porosity of wood also determines the yield and chemical composition of char. The presence of extractives also affects the final yield of charcoal.

A detailed study of variation of fuelwood properties (proximate and elemental analysis) of *C. equisetifolia*, *E. hybrid* and *A. auriculaeformis* with age and height of tree has been carried out. The fuel properties of *E. hybrid* and *A. auriculaeformis* are not significantly affected by the harvesting age. Therefore, it can be recommended that plantations should aim towards increasing the biomass yield by adopting proper silvicultural methods, when they are grown for bio-energy purposes. The results of this study also suggest that the fuel properties of *C. equisetifolia* are better in mature tree as compared to lower age trees.



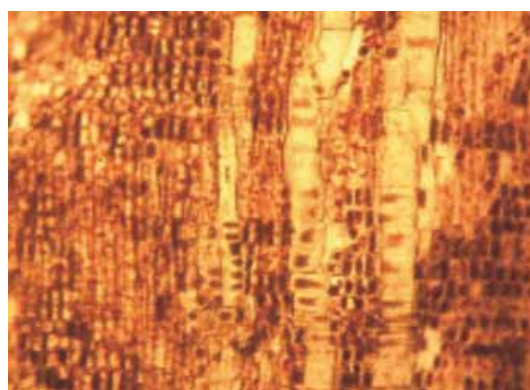
EXTERNALLY AIDED PROJECTS

Project 1: Studies on the properties of coffee wood as indicators of white stem borer resistance (Funded by Central Coffee Research Institute) [2005-08]

Findings: The project was basically consisted of training in-service officials of CCRI in histo-chemistry. As per the agreement, a number of clones (selections) were collected at regular intervals of different locations of coffee growing areas which were affected by stem borer alongwith healthy (immune) and inoculated ones. Histo-chemical tests like presence of starch, proteins and lipids were made on these samples for finding any relationships. Histo-chemical studies were also made on the presence of tannins. Studies have indicated that the presence of these food reserves in different stages of phenology have no direct relevance to borer attack. However, the presence of sclerotic cells in the bark of immune variety compared to the susceptible one is an indication of their resistance offered against the borer attack.



Sarchimor Immune Bark, Tannin, 2006



Sarchimor Susceptible Bark, Tannin, 2006

Project 2: Investigations on lesser known aspects of mangrove biodiversity and ecology in the States of Goa, Karnataka and Andhra Pradesh (Funding Agency: Ministry of Environment and Forests) [2004-08]

Findings: Survey and inventory of mangrove floral diversity in selected areas along Goa, Karnataka and Andhra Pradesh coast was carried out. Twenty two lesser known mangrove wetlands were reported for the first time from Andhra Pradesh. A total of 885 plant specimens were collected and all the specimens were made into herbarium and identified. Ecological data were also collected. *Brownlowia tersa* (L.) Kosterm. was collected and reported for the first time from Southern India. *Ruppia maritima* L.– a marshy plant was reported as new distributional record from Andhra Pradesh. Three rare mangrove species, namely, *Aegialites rotundifolia* Roxb., *Ceriops tagal* (Per.) C. B. Rob. and *Scyphiphora hydrophyllacea* Gaertn. were recorded from Andhra coast. Collected insects, foulers and borers from mangrove areas along Goa, Karnataka and Andhra Pradesh coasts and identified. Anatomical studies of selected mangrove trees were completed. Phytochemical studies on selected species, namely, *Rhizophora mucronata* Poir., *Xylocarpus granatum* Koenig, *X. mekongensis* Pierre and *Excoecaria agallocha* L. were carried out. Selected mangrove species were screened for wood energy values. A workshop on mangroves was conducted at IWST, Bangalore during February 2008.

Project 3: Community ecology of a detritus systems. Insects and fungi associated with fallen trees in the Nilgiri Biosphere Reserve (Funding Agency : MoEF, Govt. of India) [2004-07]

Findings: Different landscape elements were selected in Rajeev Gandhi National Park for assessing the role of fallen logs in biodiversity conservation. Various sampling methods, including black light traps were used to collect the insects from fallen logs. Specially designed traps for collection of emerging insects from fallen logs were fixed to each log. A weather recorder was installed for studying the effect of seasonal variation in insect and fungal biodiversity. About 300 species of xylophagous insects were recorded from fallen logs at Nagarhole national park. The insects are being identified. Twenty species of fungi and 42 species of mycophagous insects were recorded from fungi inhabiting fallen logs. Chemical characterization of different stages of fallen logs of 10 species is completed and was correlated with the community structure of insects and fungi. The role and interactions of insect and fungal communities in the fallen log system was assessed. Final technical report is prepared and submitted to MoEF.

Project 4: Studies on the Entomofaunal diversity and their interactions in selected provenances of sandal (Funding Agency: Ministry of Environment and Forests) [2004-May 2007]

Findings: The project was completed on 31st May 2007 and the completion report is submitted.

Project 5: Development of protocols for rapid and mass clonal propagation of *Bambusa pallida* Munro and *Phyllostachys bambusoides* Sieb.et Jucc. (Funding Agency: Department of Bio-technology) [2004-07]

Findings: Developed protocols for micropropagation of *Bambusa pallida* and *Phyllostachys bambusoides* from nodal shoot segments of mature clumps. High frequency (>95%) multiple shoot induction (4-6 shoots/explant) obtained in liquid MS medium with NAA 0.25 mg/l + BAP 2.5 mg/l in *B. pallida*. *P. bambusoides* MS liquid medium with NAA 0.25 mg/; + TDZ (0.5-1.0 mg/l) proved most suitable for multiple shoot induction (3-4 shoots/explants). Shoot multiplication rate was high (3-4 fold) in *B. pallida* as compared to *P. bambusoides* (2.5 fold in 4 weeks period). Low nutrient medium (MS/2 and MS/4 basal salts) with NAA/IBA (1.0-2.0 mg/l) favoured rooting in both the species. Shoot clumps (2-3 shoots per clump) proved better than single shoot for rooting. In case of *P. bambusoides*, macro-propagation using nodal branch cutting was also standardized for high rate of rooting (>80%). Attempts were also made for *in vitro* propagation through somatic embryogenesis but results were not encouraging.

Project 6: Studies on assessing growth performance of *Guadua angustifolia* Kunth under different management schedules. (Funding Agency: National Mission for Bamboo Application) [2005-08]

Status: Established field trials for assessing growth performance of *Guadua angustifolia* Kunth at two spacing (5m x 5m and 5m x 9m) and fertilizer trials consisting seven treatments at two sites



viz; Yelwala near Mysore and Gottipura near Bangalore in 1.3 ha each. Intercropping has been done continuously with horse gram since 2005. Evaluated survival rate and growth performance of the exotic bamboo *Guadua angustifolia*. Survival rate varied from 60 – 90% initially, which decreased to 45-60% in 2007 mainly due to termite infestation. Initial results suggest that *Guadua angustifolia* may not be a suitable species for semi-arid areas.

Project 7: Bamboo location trials (Funding Agency: National Mission for Bamboo Application) [2005-08]

Status: Trials were established in respect of 8 bamboo species viz; *Bambusa bambos*, *B. balcooa*, *B. nutans*, *B. tulda*, *Dendrocalamus asper*, *D. hamiltonii*, *D. giganteus* and *D. stocksii* (in Bangalore) and *Guadua angustifolia* in place of *D. stocksii* in FRC, Hyderabad) during July-Sept. 2005 and maintained at Nallal, Bangalore and Dulapally, Hyderabad. Maximum survival (100%) was in *B. balcooa* and minimum (about 50%) in *D. asper*. Based on the growth performance, *D. hamiltonii* proved the most promising species whereas, *D. asper* and *G. angustifolia* were found unsuitable in semi-arid conditions of Bangalore and Hyderabad.

PROJECTS ONGOING DURING THE YEAR 2007-2008

PLAN PROJECTS

Project 1: Processing and evaluation of plantation grown *Simarouba glauca* DC from Orissa [IWST/WPU/X-59/2006-09]

Status: Completed studies on shrinkage behaviour of timber. Timber is found to be dimensionally stable (Radial: 3%, Tangential 5% and volumetric 9% whereas in teak it is 2, 4 and 6% respectively). Studied the bark properties keeping in view the importance of bark as medicinal value. The average bark thickness was found to be 0.8 cm and its percentage varied between 17-22. The average bark specific gravity was found to be 0.448. Studied pith to periphery variation of anatomical properties. Completed strength properties (compression, static bending, hardness, shear, tension, nail and screw holding power) as tested under green condition. The cellulose content of wood varied from 62-65%. The seeds contain 50-55% oil. Few prototype products like light furniture were made.



Light Furniture for sit outs

Project 2: Detection of natural and biological defects in timbers by non-destructive testing techniques [IWST/WPU/X-63/2006-10]

Status: Studied the effect of grain orientation on ultrasonic velocity of wood in *Grevillea robusta* and *Acacia mangium*. Studied the effect of defects (hollowness) on ultrasonic velocity of wood of *Grevillea robusta* and *Acacia mangium*. The main purpose of the findings is to find a relationship between hollowness and ultrasonic velocity.

Project 3: Study on utilization aspects of plantation grown *Acacia mangium* Willd. from Orissa [IWST/WPU/X-57/2006-10]

Status: Based on shrinkage studies, the timber is classified as steady timber and grouped along with *D. sissoo* and *Adina cordifolia*. The timber takes 47 days to reach 18% moisture content from initial moisture content of 80% after drying in dehumidifier drier. Studies on anatomical properties for 2 trees completed. Compression, Static bending, Hardness, Shear, Tension, Nail and Screw holding tests were completed in green condition. Installation of preservative samples at Nallal for durability study completed. Samples were prepared and subjected to product making.

Project 4: Studies on the durability of treated and untreated timbers of selected species [IWST/WSP/X-34/ 2004-09]

Status: One hundred ninety two poles of both *Eucalyptus tereticornis* and *Eucalyptus camaldulensis* (coppiced and non coppiced) were treated by non pressure and pressure methods. In non pressure method, they were treated by Sap displacement and Boucherie methods. It was observed that the ascent of preservative is quicker in the coppiced poles than in the non coppiced poles in the Boucherie method. In pressure method, the poles were dried to 20% moisture and treated by full cell by giving vacuum and pressure. Analysis of the poles for the preservative content at 3 different positions, bottom, middle and in top is in progress.

Test yard specimens of six timber species *Lophopetalum wightianum*, *Lagerstroemia lanceolata*, *Artocarpus heterophyllus*, *Spondias pinnata*, *Melia Azadirachta* and *Sterospermum personatum* were subjected to pressure treatment by adopting the Full Cell process using 3 different preservatives viz. Copper Chrome Arsenic (CCA) composition, Copper Chrome Boric (CCB) composition and Creosote and furnace oil 1:1 preservatives for 4 different levels of absorption. Twelve specimens for each set, a total of 936 specimens are undergoing durability tests along with controls in the Test Yard. The degree of destruction by termites and decay by fungi is being recorded at regular interval.

The observations showed that the natural durability of *Lagerstroemia lanceolata* is less than 12 months as all the control specimens were destroyed within 12 months whereas all the control specimens of *Lophopetalum wightianum* are all in sound condition even after 33 months of exposure. Further observation is in progress.

Project 5: Effect of particle size on properties of wood filled polypropylene composites [IWST/WSP/ X-53/2006-09]

Status: Polypropylene was compounded with natural fibres and injection moulded into standard specimens to study the effect of filler types (Bamboo and Wood), particle sizes (five different particle sizes each for bamboo and wood), filler concentration (five concentrations 10% - 50%) and concentration of coupling agent. Evaluation of Tensile, flexural, and elastic properties was completed. Evaluation of dynamic properties completed. A model to predict stiffness of the composites based on shear lag analysis was developed.



Ganesha Idol Chiseled from the wood



Project 6: Isolation and anti-fungal activities of the chemical compounds of *Baccaurea courtallensis* Muell. Arg. - a wild edible plant of Western Ghats [IWST/CFP/X-64/2006-09]

Status: Samples collected from Makut, Virajpet and Sampaje were processed and extracted with different solvents. Other products obtained in the extraction were analysed using UV, GC and IR. Developed field method for gender identification of the species.

Project 7: Investigations on chemical composition and utility of AESP oil from exhausted sandalwood powder [IWST/CFP/X-60/2006-09]

Status: Exhausted sandalwood powder in 2 sets was treated with different concentrations of acid and extraction was repeated thrice for confirmation of results. The products obtained in different treatments were steam distilled, processed to get AESP oil. Data from all the treatments are being analyzed. Spectral properties of AESP oil have been studied. The study will be repeated for confirmation of results.

Project 8: Analysis of active principles in *Gymnema sylvestre* and *Phyllanthus amarus* from the forest of southern India [IWST/CFP/X-46/2005-June 08]

Status: Collection of plant samples from Different MPCA is over. Plant samples of Goa, Karnataka and Tamil Nadu were analyzed. Analysis of samples in remaining area is in progress.

Project 9: Screening and evaluation of wild varieties of *Emblica officinalis* fruit in various agro-climatic zones of Western Ghats [IWST/CFP/X-48/2005-June 08]

Status: Samples were collected from different areas in Western Ghats. Samples were processed and extracted to get Vitamin C content. The results are being analyzed.

Project 10: Laboratory testing for the assessment of the durability of timbers against powder post beetles – standardization and evaluation [IWST/WBD/ X-55/2006–10]

Status: Test procedures using adult release and larval inoculation in different sizes of test wood is standardized. CNSL formulation and ACA treated specimen were tested by larva and adult release method. Longevity studies of adults released on treated 4 age groups of 5 plantation species completed. Copper boric formulation was treated on rubber and was tested against adults and larvae of *L. africanus*. The contact toxicity and residual toxicity of bifenthrin was tested by larva release method.

Project 11: Studies on age related durability of plantation grown timbers [IWST/WBD/ X-50/2005–09]

Status: *Acacia auriculiformis*, *A. mangium*, *Eucalyptus tereticornis*, *Grevillea robusta*, *Melia dubia*, of 4 age group of timbers (viz. 5, 10, 15 & 20 years) grown in low rainfall area were tested for their natural durability against decay fungi. It was found that resistance of timber increases with the age. *A. auriculiformis*, *A. mangium* and *Eucalyptus tereticornis* comes under durable class. However, even 5 years age class wood of these 3 species also comes under durability class -2.

Grevillea robusta and *Melia dubia* wood comes under highly perishable group. Further work with different treatment and resistance study against termites are being done.

Project 12: Productivity and interaction studies in *Acacia* hybrid based agroforestry practices in Karnataka [IWST/TIP/X-40/2004-09]

Status: Established *A.* hybrid trials (block plantation) and line planting field trials in Doddaballapur and Kolar (on-farm trials). Intercropping carried out for 3 successive years. Biometric observations recorded and tabulated.

Project 13: Comprehensive tree improvement program for *Gmelina arborea* in Karnataka – Phase I- Progeny trial [IWST/TIP/X-41/2004-09]

Status: Seed and seedlings have been collected from 16 sources in Karnataka and 11 from AP for the establishment of progeny trial. Established progeny trials of 27 families seedling of Karnataka and AP origin. Preliminary results on growth indicate that SGA 16 and AP 8 are two best performing families in the trial. SGA 5, SGA 6 and AP 3 are poor performing families as per survival and growth data.

Project 14: Assessment of seed quality in unimproved populations, seed production areas and seed orchards of *Tectona grandis* [IWST/TIP/X-48/2005-09]

Status: Seeds were collected from unimproved populations and SPA at Virnoli, Barchi, Baghwathi and Titimathi, from CSO at Titimathi and SSO at Tirupathi. Fruit, seed and seedling variability studies showed that overall Titimathi seed sources was better as compared to other seed sources. Morphological parameters, germination and seedling growth studies revealed improvement in quality of SPA seeds as compared to unimproved populations.

Project 15: Database Development of IWST Xylarium [IWST/IT/X-58/2006-09]

Status: Web page model of wood specimens collection was prepared for IFGTB Coimbatore GASS forest museum. Classification of GASS forest museum wood specimens is in progress. Visited IPIRTI Bangalore and primary information has been collected. The feasibility study of IPIRTI wood specimen collection has been completed. Based on the data, model of web database preparation is in progress and infrastructure requirements have been defined. One thousand eight hundred wood specimens arrangement of IWST Xylarium was completed. Arrangement of writing identification number on remaining wood specimens of IWST xylarium is in progress.

EXTERNALLY AIDED PROJECTS

Project 1: Establishment of Advanced Wood Working Training Centre at IWST (Funding Agency : Italian Trade Commission/ACIMALL) [2003-08]

Status: Advanced Woodworking Training Centre, an Indo-Italian joint project by IWST-ICE-ACIMALL entered into the sixth years of operation. The Memorandum of Understanding (MoU) was renewed between the Institute of Wood Science and Technology, Bangalore and Italian Trade Commission, Mumbai to continue the training centre for another five years starting from



21st August 2007. The centre is equipped with 21 advanced wood working machines. During the year 2007-08, the centre has imparted training to 466 trainees. About 95% of the unemployed trainees have been benefited for employment with this training. So far 75 Indian wood working industries have offered employment to the trainees. The AWTC also participated in the Biannual International Wood Exhibition "INDIA WOOD 2008" at Bangalore International Exhibition Centre, Bangalore.

Project 2: Investigation on Tree ring analysis of certain species in Western Ghats to monitor climate changes and its relevance to wood quality (Funding Agency: Ministry of Environment and Forests) [2006-09]

Status: Two JRFs have been recruited for the project work and basic training was provided to them at IWST, Bangalore and IITM, Pune. Assets like Stereo Zoom Microscope with Tree Ring Analysis System and Increment borer were purchased. Teak discs from Madikeri, Mundugod from Karnataka, Thane and Chandrapur from Maharashtra were collected. Meteorological data of these sites were also collected. Age of teak discs from Madikeri alongwith their growth rates and specific gravity was determined.

Project 3: Studies on acoustical behaviour of plantation timbers for musical instruments and wall paneling (Funding Agency: Council for Scientific and Industrial Research) [2006-09]

Status: Anatomical properties like fibre and vessel dimensions were determined. Evaluated strength properties like modulus of elasticity, modulus of rupture, and hardness. Determined sound absorption coefficient and effect of different wood parameters. Generated data on commercially available musical instruments like veena, violin and dholak. Visited Tanjore and Kumbakonam for exploring the possibility of making musical instruments from plantation species like *Acacia auriculaeformis*, *Artocarpus heterophyllus*, *Azadirachta indica*, *Eucalyptus tereticornis*, *Grevillea robusta* and *Melia composita* to find their suitability in place of Indian timbers based on acoustical properties.



Acoustic measurement unit to detect the sound waves of musical instruments

Project 4: Insect-plant relationships with special reference to herbivory in the mangroves of South India (Funding Agency: Ministry of Environment and Forests) [2005-08]

Status: The West Coast (Mangalore, Honnawar, Kundapur and Karwar) mangroves were surveyed monthly and insects were collected from solar light traps and also using other methods. Four

hundred species of insects including defoliators, fruit and propagule borers (115) were recorded and their parasites were collected and identified. Assessment was made using Leaf area metre software herbivory in 5 species of mangroves with reference to different areas and seasons. Impact of Frugivores on germination of 3 species was studied. Pollination studies on *Rhizophora* and *Sonneratia* at Kundapura and Karwar were initiated. Germination trials on pest infected propagules of *Rhizophora mucronata* at Kundapura were conducted.

Project 5: Investigations on the mechanisms of success of *Mytilopsis sallei* (Recluz) in managing toxic load arising out of biodeterioration control measures (Funding Agency: Department of Science and Technology) [2005-08]

Status: Test panels immersed at Visakhapatnam Port and Kakinada Canal for trapping of *Mytilopsis sallei* were retrieved at monthly intervals. Bacteria were isolated from the gut of *M. sallei* growing in 4 pollution zones at Visakhapatnam Port. Experiments on accumulation of leachates of CCA by *M. sallei* were conducted. Experiments on depuration of copper by *M. sallei* were conducted. Content of copper and total hydrocarbons in water samples and tissues of *M. sallei* were analyzed.

Project 6: Monitoring of biofouling at Visakhapatnam Port (Funding Agency: Ministry of Shipping, Road Transport and Highways through National Institute of Oceanography, Goa) [2006-09]

Status: Test panels were exposed at three test sites, i.e., Slipway Complex, Ore Berth and Marine Foreman Jetty in Visakhapatnam Port and retrieved at monthly/cumulative intervals. Observations on the composition, growth, surface spread and biomass of fouling organisms and incidence of wood borers were recorded. Voucher specimens of different forms were prepared and maintained.

Project 7: Testing the efficacy of TBTM-MMA preservative developed by NMRL in Visakhapatnam and Kochi ports (Funding Agency: Naval Materials Research Laboratory, DRDO, Ambernath, Mumbai) [2008-11]

Status: The project was initiated in March 2008. A meeting between Scientists of IWST and NMRL was held at NMRL, Ambernath, Mumbai during March 2008 and methodologies for exposure of panels, observation schedules, data to be collected, etc. finalized.

Project 8: Field performance of micro and macro propagated planting stock of selected five commercially important bamboo species (Collaborative project with KFRI & IFGTB) (Funding Agency: Department of Biotechnology) [2004-09]

Status: Field trials viz; mode of regeneration (seed, macro and micro-propagated plants) spacing (5m x 5m, 5m x 7m and 5m x 9m) and fertilizer (*Bambusa bambos* and *Dendrocalamus strictus*) established in 15 ha area during 2005 in Bangalore and Mysore were maintained. Six monthly data on survival and growth performance revealed that maximum survival (>90%) was in *D. asper*. *D. strictus* performed the best in terms of culm height in Bangalore, Mysore and Hyderabad, followed by *B. bambos* and *B. balcooa*. Though number of tillers were more in *D. asper*, but growth was stunted. It is revealed that micro-propagated plants performed better in most of the species as compared to seed and macro-propagated plants. *D. asper* growth was poor in micro and as well as macro-propagated plants and not suitable in semi-arid regions.



Project 9: Development of bamboo fibre reinforced thermoplastic composites (Funding Agency: National Mission for Bamboo Application) [2006-09]

Status: The research work on development of bamboo fibre filled thermoplastic composites completed under the project. Mechanical properties of the composites improved significantly when an isocyanate based coupling agent was used. The isocyanate based coupling agent proved much superior to the conventionally used coupling agent (MAPP). With the increasing filler content (from 10% to 50%), Tensile strength increased from 35 MPa to 45 MPa whereas no improvement was observed in composites prepared with MAPP as a coupling agent. Similar trends were observed for flexural strength and modulus of elasticity. The work on industrial trials was also completed. The study suggests that the product can conveniently be processed on standard industrial plastic processing machineries like extrude and injection moulding. The technology transfer to the industrial partner of the project is under progress.

Project 10: Investigations on the fungi and insects associated with fruits and seeds of selected endemic trees of Western Ghats (Funding Agency: Ministry of Environment and Forests) [2006-09]

Status: Forest areas in Gundya, Kudremukh, Makutta, Sirsi and B.R. hills were visited for the purpose of location of endemic species and collection of fruits and seeds. Insects were collected from the fruits and seeds and their biology is being studied. Fifty fungi isolated from the different fruit/seed samples were identified. Among these, 30 were potential plant pathogens, reported for their pathological effects in several other hosts. Among the isolates obtained, there are plant pathogens and also comes under field fungi category like *Paecilomyces variotii*, *Lasiodiplodia theobromae*, *Sporothrix schenckii*, *Fusarium oxysporum*, *F. solani*, *Cladosporium oxysporum*, *Alternaria* sp., *Rhizoctina* sp., *cylindrocladium*, *Acremonium strictum*, *A. kiliens*, *Phomopsis archeri* and *Colletotricum gleosporioides*. Isolates included storage fungi also. These fungi play a major role in causing the seed health problems like seed rotting, shrinkage, discolouration, and abortive and poor germination.

Project 11: Monitoring of biofouling at Visakhapatnam Port (Funding Agency: Ministry of Shipping, Road Transport and Highways, Government of India through the National Institute of Oceanography, Goa) [2006-09]

Status: Test panels were exposed at three test sites, i.e., Slipway Complex, Ore Berth and Marine Foreman Jetty in Visakhapatnam Port and retrieved at monthly/cumulative intervals. Observations on the composition, growth, surface spread and biomass of fouling organisms and incidence of wood borers were recorded. Voucher specimens of different forms were prepared and maintained.

Project 12: Need for conserving forest canopies: assessing the diversity of canopy insects in the Western Ghats (Funding Agency: Ministry of Environment and Forests (MoEF) [October 2006 to September 09]

Status: Canopies of *Vateria indica* suitable for sampling were identified, three types of passive insect collection traps – canopy pitfall traps, canopy light traps and canopy yellow pan traps were designed, fabricated and tested. Sampling using the traps has been commenced and collections processed.

Project 13: Development, Augmentation of efficacy and improvement of dissemination systems of *Metarhizium* based mycoinsecticide for the management of major pests in forest plantations and nurseries (Funding Agency : Department of Biotechnology) [2007–10]

Status: Seasonal surveys were conducted in the four South Indian States for studying the incidence of major pests on important forest tree species in nurseries and plantations in selected areas. *Metarhizium* infected pest insects from different locations in South India were collected. Nineteen isolates of *Metarhizium anisopliae* were collected and maintained. Studies on the pathogenicity are in progress. The defoliators of Teak, Pongamia and other trees and arboreal termites were found susceptible to some of the *Metarhizium* isolates.

Project 14: Investigations on Microsporidia affecting major Lepidopteran pests of important forest trees of South India and their prospects as bio-control agents (Funding Agency: Department of Science and Technology) [2007-10]

Status: Sixty five species of Lepidopterans including 14 pest species were screened for microsporidia and 22 species were found infected. For the first time, a Microsporidian pathogen is isolated from the teak defoliator, *Hyblaea puera*. Three species of pest insects were cultured in laboratory conditions for detailed studies. Pathogenicity and cross infectivity studies with *Paliga machoeralis* was undertaken.

Project 15: Bioecology, damage potential and management of Gall formers of *Pongamia pinnata* (L.) Pierre. (Funding Agency: Department of Science and Technology) [2006–09]

Status: The leaf gall inducer of *P. pinnata* has been confirmed as *Aceria pongamiae* and the ovary gall inducer has been confirmed as *Asphondylia pongamiae*. Many trees were observed with 100% infestation of ovary galls. So far 5 parasitoids were collected and identified on ovary gall inducers. The observation on population dynamics and biology of leaf and ovary gall inducers are in progress.

Project 16: Multilocal introduction-cum-demonstration trials and field evaluation of six important bamboo species viz., *Bambusa balcooa*, *B. nutans*, *Dendrocalamus asper*, *D. hamiltonii*, *Guadua angustifolia* and *Pseudoxytenanthera stocksii* in Andhra Pradesh, Karnataka and Goa (Funding Agency : Department of Biotechnology) [2006-09]

Status: During the year 2007-08, trials were established at two sites in Andhra Pradesh (Chintalapudi, 10 ha and Buggapadu 10 ha) and one site at Goa (Agalote, 5 ha). The trials comprised of species introduction-cum-mode of regeneration, spacing trial and nutrition management trials. Initial survival data shows that at all three sites, *B. balcooa* and *B. nutans* had survival ranging between 68-89%. Among various species, best growth in terms of height growth was found in *B. nutans* (TC) at Chintalapudi site (107.36 cm), followed by *B. nutans* (VP) with average height (85.85 cm). It is interesting to note that, although, overall survival rate was good at Agalote (Goa), subsequently growth of various species was poorest as compared to other sites.

Project 17: Conservation of Sandal (*Santalum album* L.) germplasm, production of quality planting stock and promotion of sandal cultivational practices. (Funding Agency : National Medicinal Plant Board) [2006-09]

Status: Sixty five thousand quality sandal seedlings were produced for distribution among various stakeholders like farmers, NGOs and SFD for field planting. A stakeholders training programme



was organized at Mehsana, Gujarat on sandal nursery technology and cultivation on 15th and 16th March 2007. Two on farm trials on sandal based agroforestry with grafted Amla, tamarind and mango as host plants were established in 3 ha each in Bevanahalli and Mudelahalli as demonstration plots.

Project 18: Cultivation of *Guadua angustifolia* Kunth and *Dendrocalamus asper* in Kerala and Karnataka (Funding Agency: National Mission for Bamboo Application) [2006-09]

Status: Established trial plots of 0.5 ha each of *Guadua angustifolia* Kunth and *Dendrocalamus asper* Backer in high rainfall tropical humid zones in Alwaye and Palakkad in Kerala and Thittimathi in Karnataka. Initial observations indicate that *Guadua* is best suited for silt loam soils near riverine areas like Alwaye. Growth of both the species has been impressive in the sites in Kerala and Karnataka with > 90% survival.

Project 19: Commercial cultivation of bamboo in Kodagu District: Raising of Quality Planting Material (QPM), Establishment of demonstration plots and bamboo based value addition facilities. (Funding Agency: National Mission for Bamboo Application) [2006-08]

Status: This is a multi institutional collaborative project involving College of Forestry (CoF) Ponnampet, (University of Agricultural Sciences, Bangalore), Kodagu Model Forest Trust (NGO) and IWST which is being coordinated by IWST. Entrepreneur's meet organized in Coorg involving farmers and various stakeholders to facilitate exposure to various value addition projects for bamboo. A vegetative propagation centre with capacity to produce 50,000 rooted cuttings of bamboo established in CoF, Ponnampet. 25 ha of *D. asper* (edible bamboo) plantations involving 77 farmers established in Coorg. Planting material supplied by IWST.

Project 20: Vegetative Propagation Centre (VPC) for the production of quality plants of *P. stocksii*, *D. brandisii* and *Guadua angustifolia* (Funding Agency: National Mission for Bamboo Application) [2006-09]

Status: Agroshaded net house with micro-sprinkler system has been established in an area of 17mt × 17mt. Twenty sand beds were made. Total 6500 plants of *Dendrocalamus stocksii*, *Guadua angustifolia* and *Dendrocalamus brandisii* have been raised. Two thousand plants of *G. angustifolia* and *D. stocksii* and 200 plants of *D. brandisii* have been supplied for planting in projects funded by NMBA and DBT.

NEW PROJECTS INITIATED DURING THE YEAR 2007-2008

PLAN PROJECTS

Project 1: Evaluation of wood quality of *Eucalyptus* clones and plantation grown *Grevillea robusta* A. Cunn. based on spiral grain [IWST/WPU/XI-73/2007-09]

Status: Sixty poles of *Eucalyptus* clones have been procured from two different locations (Mandya and Kolar) and also 5 trees of *Grevillea robusta*. Specific gravity and shrinkage measurements were completed for 180 samples and data entry made.

Project 2: Development of methods for detection of adulterants and evaluation of quality parameters for assessing purity of Jigat [IWST/CFP/XI-71/2007-08]

Status: Project period was for one year only and completed during March 2008.

Project 3: Development of methods for detection of adulterants and determining purity of sandal oil [IWST/CFP/XI-72/2007-08]

Status: Project period was for one year only and completed during March 2008.

Project 4: Studies on influence of microwave treatment on drying characteristics and treatability of wood [IWST/WSP/XI-69/2007-09]

Status: Preliminary studies on drying rate of *Acacia auriculaeformis* and teak wood in a 800W domestic microwave was completed. The moisture loss rate was found to depend on the cross-section of the wooden sample. A MW drier system of 2.4 kw power intensity was designed and got fabricated. The system has provision of two magnetrons each of 1.2 kw power and the total power intensity can be varied from 180 watt to 2.4 kw. The system has a conveyor belt for feeding wood to microwaves, which moves bidirectional. Both conveyor belt speed and microwave time can be varied according to requirement. Standardization trial of MW drier system controls has been completed. Treatment of Silver Oak planks of varying thickness and at different MW time completed. Comparison of drying behaviour of microwave treated and untreated wood is in progress.

Project 5: Isolation and estimation of L-DOPA from *Mucuna prurines* Linn collected from South India [IWST/CFP/XI-66/2007-10]

Status: Identified plots in different parts of Karnataka for collection of seeds. Seeds were collected from different MPCA areas. Procedure for extraction of L-DOPA has been standardized. HPLC data for pure L-DOPA has been collected.

Project 6: Studies on the natural resistance of imported woods against insects and decay fungi in Indian environment [IWST/WBD/XI-74]

Status: Twenty different types of imported timber procured and they were seasoned and converted to required size with proper label. Field experiments were laid at Trivandrum, Bangalore, Visakhapatnam, Hyderabad, Jodhpur and Jabalpur. Third month observation on the natural durability of timbers were taken in Trivandrum, Bangalore, Visakhapatnam, Hyderabad and Jodhpur. Experiment to study the natural durability in the marine condition is initiated.

Project 7: Seed infestation by insects among the emergent rain forest canopies at Makutta, Western Ghats [IWST/WBD/XI-68/2007-10]

Status: A sample plot of 1 ha has been laid out and the species-abundance data on the emergent canopies has been drawn. Interception traps have been designed and 30 Nos. fabricated. Interception traps were set up in the one-hectare sample plot. Collections were made from 13 traps. Insect emergences and extent of seed predation have been recorded. Field and lab germination studies for *Dipterocarpus indicus* have been carried out.

**Project 8: Ethnobotanical studies of North-Eastern Ghats in Andhra Pradesh [IWST/WBD(M)/X-170/2007-11]**

Status: Literature related to ethnobotany of the region was collected. Four field tours to Patapatnam and Seethampeta tribal areas in Srikakulam district and Bhadragiri and Saluru areas in Vizianagaram district were conducted. Ethnobotanical data on wild genetic resources, edible, medicinal, material and social cultural aspects on 82 plant species from the tribes of Savaras, Khonds, Jatapus, Kondadoras, Nukadoras and Porjas were recorded. Seventy one species were collected, identified and preserved as herbarium. Ethnobotanical data from available literature was scrutinized and screened. A rare, endangered and threatened gymnosperm, namely, *Cycas spherica* Roxb. was collected for the first time from eastern ghats in Srikakulam District of Andhra Pradesh. The tender leaves and cotyledons of this species are vividly used as food by Jatapu and Savara tribes.

Project 9: Studies on genetic fidelity of the micropropagated plants of bamboo-*Bambusa bambos* and *Dendrocalamus stocksii* [IWST/TIP/XI-65/2007-10]

Status: Shoot multiplication cultures of *B. bambos* and *D. stocksii* from the plant material (explant) of the mature clump were established. Production of plants of both the species through axillary shoot proliferation was initiated. Callus cultures of both the species for raising plants through somatic embryogenesis were established.

Project 10: Genetic improvement of *Melia azadirach* and *Melia dubea* through plus tree selection assessment of genetic variation trial establishment (Phase I) [IWST/TIP/XI-67/2007-11]

Status: Survey work was conducted in Karnataka, Tamil Nadu and Andhra Pradesh and plus trees of *Melia azadirach* and *M. dubea* were collected. Seeds were collected from the plus trees of both the species and carried out variability studies based on morphological parameters. Seeds collected from plus trees of *M. azadirach* used for the raising seedlings with family identity for the establishment of progeny trial. In case of *M. dubea* seeds did not germinate.

Project 11: Fuel properties of important forest weeds [IWST/WE XI-75/2007-09]

Status: Samples of *Lantana camara* and *Eupatorium* spp. were procured. Basic density and calorific value of selected weeds was determined. Proximate analyses ash content, volatile content, moisture content and fixed carbon content of 24 samples were carried out.

EXTERNALLY AIDED PROJECTS

Project 1: Study of anatomy and properties of lesser known timbers of North -Eastern State of India with particular reference to Nagaland (Funded by Nagaland State Forest Department) [2007-08]

Status: Forty timber species have been selected for the study. Macroscopic and microscopic studies were completed for 20 species. Draft (Part-I) of 20 species was prepared for publication. Macroscopic study of additional 10 species under hand lens was completed.

Project 2: Utilization of alternative timber species for catamarans to conserve traditional tree species of Eastern Ghats (Funding Agency: Ministry of Environment and Forests) [2007-09]

Status: Activities undertaken so far under the project are (1) Recruitment of 1 no. Technical Assistant, (2) Procurement of timber of *Mesopsis emini*, *Albizia lebbek* and *Tetrameles nudiflora* for durability test (3) Procurement of *Bombax ceiba*, *Albizia lebbek* and *Tetrameles nudiflora* timber for 15 catamarans and (4) Fabrication of *Bombax ceiba*, *Albizia lebbek* and *Tetrameles nudiflora* for 15 catamarans (5 catamarans of each species).

Project 3: Development of Package of Practices for the management of powder post beetles in ITC timber yards (Funding Agency: Karnataka Forest Department) [2007-08]

Status: The project was started on 1st June 2007 as per letter of intent. Monthly visits were conducted to ITC timber depots at Bhadrachalam and Ongole. The incidence of pests was assessed. The beetles were identified and being cultured in the laboratory. Field experiments were conducted with selected chemicals and botanicals at ITC timber depots at Bhadrachalam.

Project 4: IWID: Indian Wood Insect Database – a Database on diversity of indigenous and exotic wood insects/pests in India. 18 months (Funding Agency: Department of Scientific and Industrial Research) [2007-08]

Status: The project was started on 1st July 2007. Software for database was developed with the help of professionals. Collection of information from various sources and data entry are under progress.

Project 5: Evaluation of phosphine as fumigant to control insect pests in logs, chips and sawn boards (Funding Agency: United Phosphorus Ltd.) [2007-08]

Status: The project started on 13th October 2007. Three species of beetles were cultured in the laboratory for testing against the fumigant, phosphine. One field trial of fumigation of infested subabul with phosphine was conducted at timber depots in A.P.

Project 6: An integrated approach of bamboo improvement propagation, agroforestry models, protection, processing and utilization (Funding Agency: National Bamboo Mission) [2007-10]

Status: Carried out studies on the effect of auxins (IAA, IBA, NAA and NOA) on rooting from rhizomatous cuttings of *Dendrocalamus asper* and *D. brandisii* cuttings treated with IBA proved the best followed by NAA in both the species. Established agroforestry trial of *B. balcooa*, *D. asper*, *D. brandisii*, *D. stocksii* and *Guadua angustifolia* in Devon coffee estate near Shimoga using piper and vanilla as intercropping. Conducted survey in nurseries and plantation of bamboo. Preliminary studies carried out on drying of bamboo using microwave technique. Conducted demonstration programme for the official of the State Forest Department Karnataka for bamboo (*D. stocksii*) propagation and preservative treatment to enhance life of bamboo.



TECHNOLOGY ASSESSED AND TRANSFERRED

The technology of manufacturing bamboo fibre filled thermoplastic composite is in process of transfer to the industrial partner under NMBA supported project “Development of bamboo fibre filled thermoplastic composites”.

EDUCATION AND TRAINING

Education

1. Two hundred forty students from different Universities visited the Institute from April 2007 to March 2008.
2. Thirty eight RFOs from SFS College, Coimbatore visited on 2nd April 2007. Lectures on Forestry and Wood Science were arranged.
3. A total of 38 IFS Probationers (2007-08 batch) visited the Institute on 3rd October 2007.
4. Thirty one trainees from SFS College, Dehradun visited the Institute on 8th January 2008.

Trainings

Conducted

1. Compulsory training course on Computer Application and Statistics for FRI University Research Scholars (Internal) was conducted during July-August 2007.
2. Short term training on “Wood Protection (Seasoning, Preservation and Biodegradation)” from 20th to 24th August 2007 for trainees from Govt./ Pvt. Sectors. Scientists from institute and outside gave lectures and conducted practicals to the trainees.
3. Training course on “Timber Joinery” to the in-service officials of Naval Dockyard, Visakhapatnam and from M/s Poonam Timbers, Bangalore from 26th to 30th November 2007.
4. Training course on “Classification and grading of timbers” to the in-service officials of Naval Dockyard, Visakhapatnam and O/o the PCCF, Andaman and Nicobar Islands from 3rd to 5th December 2007.
5. Demonstrated Treatment Technology of Bamboo at College of Forestry –Ponnampet-10th December 2007.
6. One week hands on training in plant tissue culture for BSc 3rd year biotechnology students (10 nos.) of Surana College, Bangalore University, Bangalore, from December 17th to 21st 2007.
7. One week hands on training in plant tissue culture for MSc Bio-technology students (8 Nos.) of Ramaiah College, Adarsha College, CMR College, Bangalore University, Bangalore from 24th to 28th December 2007.
8. Compulsory Training Course for IFS officers on “Biotechnology for Forest Conservation” was conducted from 7th to 11th January 2008.



9. Conducted Training course on “Field identification of important timbers” to the in-service officials of Naval Dockyard, Visakhapatnam and scientist from IPIRTI from 21st to 25th January 2008.
10. Short term training course on “Extraction/Purification techniques and Instrumental Analysis” was conducted from 23rd to 25th January 2008 (by CFP Division).
11. Short term training course on “Nursery Techniques” was conducted from 11th to 15th February 2008.
12. Specialized training on Histo-chemistry was given to the in-service officials of Central Coffee Research Institute, Coffee Research Station, Chikkamagalur, Karnataka as a component of the sponsored project entitled “Studies on the properties of coffee wood as indicators of white stem borer resistance”.
13. Demonstrated Treatment Technology of Bamboo-Bamboo workshop organized by Karnataka State Forest Department on 15th and 16th March 2008.
14. Demonstrated Treatment Techniques and Ammonia fumigation technology – Inaugural function of the Vana Vigyan Kendra at Kadugodi on 18th March 2008.

Exhibition

1. The Institute participated in the Krishi Mela at Suttur, Mysore from 4th to 8th February 2008.
2. The Institute participated in the India-Wood from 29th February to 4th March 2008.

LINKAGES AND COLLABORATION

National

1. Collaboration with CCRI, Chikkamagalur, University of Agricultural Sciences, Bangalore, Orissa State Forest Department, Grasim Fibres continued.
2. Collaborative Research work on “Aging of Wood and its Prevention” with Department of Forest Product Technology, Helsinki University of Technology, Finland.
3. Linkages developed with Karnataka Forest Department for laying out regeneration plots of *Dysoxylum malabaricum* at Soraba, Makut and Virajpet.
4. Andhra Pradesh Forest Department; Fisheries Department; Andhra University, Visakhapatnam; Central Marine Fisheries Research Institute, Visakhapatnam; Central Institute of Fisheries Technology, Visakhapatnam; National Institute of Oceanography, Visakhapatnam and Goa; Naval Materials Research Laboratory, Ambernath, Mumbai; State Institute of Fisheries Technology, Kakinada; Visakhapatnam Port Trust and Indian Navy, Visakhapatnam.
5. Scientists of W. B. Centre (Marine), Visakhapatnam developed collaborative research projects with National Institute of Oceanography (CSIR), Goa and Naval Materials Research Laboratory (DRDO), Ambernath, Mumbai.
6. Linkages 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 and Indian Institute of Sciences, Bangalore.



7. One operational DBT project in collaboration with KFRI, Peechi and IFGTB, Coimbatore on “Field performance of micro and macro-propagated planting stock of selected five commercially important bamboo species”.
8. Institute has collaborated with State Forest Departments of Karnataka, Andhra Pradesh and Goa for establishment of Van Vigyan Kendra(VVK). It is proposed to transfer the recent technologies of ICFRE to end users through these VVKs.

- **VVK, Karnataka**

Van Vigyan Kendra, Karnataka was inaugurated on 18th March 2008 at Forest Technical and Administrative Training Institute (FTATI), Kadugodi, Bangalore by Shri A.K. Verma, PCCF, Karnataka Forest Department. Shri B.K. Singh, Additional PCCF (EWPR&T), Shri V. Rangaswamy, CCF (Training), Karnataka, Dr. U.V. Singh, Conservator of Forests, Bangalore Circle, Shri Suresh Gairola, Director and other senior scientists of IWST were present.

“Abstracts of the published research papers (1988-2007)” in English and Pamphlets in regional language (Kannada) on “Sandal” and “Simple techniques of treating poles, fence posts, tree guards and bamboo by wood preservatives were released by PCCF, Additional PCCF (EWPR&T) and CCF (Training), Karnataka.

An interactive meeting-cum-demonstration program on following technologies was organized on the occasion.

- a. Ammonia fumigation for imparting colour to different wood species
- b. Planting technique of sandal, casuarinas, eucalyptus and bamboo
- c. Sap displacement method to treat freshly felled bamboo and poles
- d. Use of alternative timber for different end users like handicrafts, furniture etc.

An MoU between Director, IWST and Additional Chief Conservator of Forests (EWPR&T) on behalf of Karnataka Forest Department has been signed during March 2008. Deputy Conservator of Forests (training), Kadugodi and Incharge (Extension), IWST have been nominated as Nodal Officers for this centre.

- **VVK, Andhra Pradesh**

Van Vigyan Kendra is being established at Dulapally in Hyderabad. A MoU between Director, IWST and PCCF on behalf of Government of Andhra Pradesh has been signed during March 2008. Chief Conservator of Forests (Research), Hyderabad and Incharge (Extension), IWST have been nominated as nodal officers for this centre.

- **VVK, Goa**

Van Vigyan Kendra is being established at Satpal, about 50 kms from Goa. An MoU between Director, IWST and CCF, Goa is being signed. Deputy Conservator of Forests (Research & Utilization), Margoa, Goa and Incharge (Extension), IWST have been nominated as nodal officers for this centre.

- **Model Village**

Institute of Wood Science and Technology, Bangalore has adopted Byranahalli village which is under the administrative control of T. Begur gram panchayat in Nelamangala Taluk of Bangalore Rural District. The village is about 45 kms. From the institute on National Highway No.4. There are around 486 households in the panchayat with a population of around 2268 with around 1159 males and 1109 females. The village Byranahalli along with a small hamlet called Kambaihnalya is having around 175 households with a population of about 1200 with around 601 males and 579 females approximately.

The model village was inaugurated on 28th Jan 2008 and MoU has been signed by Director, IWST and Village Panchayat Chief. An interactive meeting was organized with the villagers to make them aware about the purpose of establishing the model village. A demonstration program on forestry and wood science technologies was also organized.

PUBLICATIONS

Book

M.V. Rao, M. Balaji, V. Kuppusamy, K. Satyanarayana Rao and L. N. Santhakumar, 2007. *Biodeterioration of timber and its prevention in Indian coastal waters: Third progress report 1982-2005*. Institute of Wood Science and Technology, Bangalore: 198 pp.

Brochure (English and Kannada)

1. Sandal Brochure

Pamphlets (English and Kannada)

1. Sandal
2. Nursery Practices
3. Portable Distillation Unit
4. Sap Displacement Technique (Simple techniques of treating poles, fence posts, tree guards and bamboo by wood preservatives)
5. Wood Seasoning
6. Wood Plasticization and Bent Wood Products from Coconut Wood
7. Value Addition of timber – Plantation grown and lesser known species

Technical Bulletin

1. Sap Displacement Techniques for treating small girth timber and bamboo -(English/Kannada) compiled by D. Venmalar and Pankaj K. Aggarwal
2. Ammonia Plasticisation of coconut wood for value addition – compiled by S.K. Sharma, R. Vijendra Rao and S.R. Shukla.



3. Information Series I entitled "A guide to some Imported Timbers in South Indian markets"
4. Information booklet of IWST - English
5. Abstracts of the published research papers (1988-2007) - English
6. Short term training calendar for 2008-09
7. Proceedings: "Conservation, Improvement, Cultivation and Management of Sandal"

CONSULTANCIES

1. 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.
2. Preparation of Catchment Area Treatment Plan including microplanning and placement of suitable SMC works to prevent soil erosion for exploitation of bauxite in Jerrela Block in favour of Andhra Pradesh Mineral Development Corporation Limited, Hyderabad
3. Preparation of EIA/EMP for diversion of forest land for bauxite mining in Jerrela Block III of reserve forest in favour of Andhra Pradesh Mineral Development Corporation Limited, Hyderabad.
4. Preparation of EIA/EMP along with Catchment Area Treatment Plan for diversion of forest land for Iron Ore Mining in Ankua Iron Ore deposits in Jharkhand in favour of JSW Limited.
5. Attended several enquiries from Forest department officials and NGO's with respect to insect and pathological problems in nursery and plantations and timber-in-service and suitable remedial measures were suggested.
6. Efficacies of commercial preservatives against termites/ borers/ wood rotters were tested for various agencies.
7. Dr. O. K. Remadevi visited Madahally, Mysore on 28th November 2007 to investigate the gall problems in Eucalypts.

PATENT

A patent application on "An improved cellulose fibre product and a process for making the same by grafting vinyl monomer using Manganese ions" filed.

COMMERCIALIZATION OF TECHNOLOGY

A technology on Bamboo fibre filled polypropylene composites is being transferred to a polymer industry for commercialization.

CONFERENCE/MEETINGS/WORKSHOPS/SYMPOSIA/EXHIBITIONS

International

A one day international seminar on "Wood drying: Principles and Practices" (Indo-Italian seminar) at IWST, Bangalore on 19th November 2007.

National

1. National Seminar on “Conservation, improvement, cultivation and management of Sandal (*Santalum album L.*)” on 12th and 13th December 2007.
2. National workshop on “Mangroves in India Biodiversity, Protection and Environmental Services” during 7th and 8th February 2008.
3. A one day Regional workshop on Forestry statistics under the ITTO funded on “Establishment of a network to facilitate collection, processing and dissemination of statistics pertaining to tropical timber and other forestry parameters in India on 18th December 2007 at IWST Bangalore.

AWARDS

1. Mr. Pankaj Aggarwal and Mr. Suresh Gairola were awarded prestigious “Brandis Award” for the best research paper in Indian Forester.
2. Dr. O. K. Remadevi was awarded ITTO fellowship to attend the IUFRO all division 5 conference held at Taipei (29th October 2007 to 2nd November 2007).
3. Dr. R. Sundararaj has been awarded with travel fellowship by DST, Govt. of India and Centre for Cooperation in Science and Technology among the developing countries (CCTDAC) and Fellowship under Scientist Assistant Programme of IUFRO to attend the IUFRO all division 5 conference on Forest Products and Environment: a productive symbiosis held at Taipei, Taiwan from 29th October to 2nd November 2007.
4. The Institute was awarded 3rd Prize for Official Language Implementation in the function organized by Town Official Language Implementation Committee, Bangalore on 27th July 2007.

DISTINGUISHED VISITORS

1. Shri R.P.S. Katwal, Former DG, ICFRE visited the Institute and addressed the Scientists on 27th June 2007.
2. Shri S. Reghupathi, Ministry of State for Forests, Government of India visited the Institute on 31st July 2007.
3. Shri Jagdish Kishwan, IFS, Director General, ICFRE visited the Institute and reviewed the progress of the internal and external projects of IWST on 7th and 8th August 2007.
4. Ms. Meena Gupta, IAS, Secretary, MoEF visited the Institute on 7th September 2007. Director presented the Institute activities followed by lab visit.
5. Dr. Anand Sanadi, Scientist, Forest Products Laboratory, Madison, USA visited IWST for three days during 4th to 7th December 2007.



MISCELLANEOUS

1. Mid term evaluation of FDA in Karnataka (Chamrjnagar W/L, Chikmagalur) and Goa (North Goa) was carried out.
2. “Investigations on bacterial flora of the biofilms on timber in marine environment”. Project work done under the Supervision of M. V. Rao, Scientist-C by N. S. Rama Devi, Visakha Government College for Women in partial fulfillment of the requirement for the award of the degree of M. Sc. in Microbiology.
3. “Marine heterotrophic bacterial colonizers of wood at Visakhapatnam harbour” Project work done under the Supervision of Dr. M. Balaji, Scientist-C by S. Navya Sri, Visakha Government College for Women in partial fulfillment of the requirement for the award of the degree of M. Sc. in Microbiology.
4. “New strategies for timber preservation in marine environment: an approach via biocidal intervention”. Project work done under the Supervision of M.V. Rao, Scientist-C by P. V. Bhargavi, Dr. V. S. Krishna Government P. G. and Degree College in partial fulfillment of the requirement for the award of the Degree of M.Sc. in Bio-technology.
5. Design and Development of database for Project Completion Reports (PCR) of Institute of Wood Science and Technology, Bangalore.
6. Design and development of current website, Update and maintenance the institute website and all the tender advertisement is updated in the NIC web site.
7. Implementation and maintenance of Anti Virus software, MS office, Adobe reader, WinZip, etc for client systems.
8. Implementation and maintenance of databases of Indian Forester Information System, Winsprirs, Teak Defoliator, KFRI Research Reports 1-200, Libsys for the Library.
9. Implementation and maintenance of RDBMS server and FAS, PIS, RIS modules have implemented in the client systems.

FOREST RESEARCH CENTRE HYDERABAD

The Forest Research Centre (FRC), Hyderabad started functioning under the administrative control of Institute of Wood Science and Technology, Bangalore from July 1997. The Centre was established to cater research needs of the States of Andhra Pradesh, Karnataka and Goa in the field of forestry. It is situated 22 km away north of Secunderabad railway station. The campus is spread over 100 acres of area in Dulapally reserved forests facilitated with administrative buildings, laboratories, library, rest house, research nursery, experimental plots and a residential quarters for the office staff.

PROJECTS COMPLETED DURING THE YEAR 2007-2008

PLAN PROJECTS

Project 1: Screening of natural populations of *Lagerstroemia* spp. for domestication [FRC-05/TI-02/2003-07]

Findings: Two species of *Lagerstroemia* prevalent in Andhra Pradesh and Karnataka were surveyed and several populations were identified. The processes of germplasm collection and multiplication by vegetative means have not been successful. The seed from different places is collected and planted from the better known populations.

Project 2: Natural variation studies in Rosewood (*Dalbergia latifolia* Roxb.) for tree improvement [FRC-04/TI-02/2003-07]

Findings: The number of plus trees were marked in various parts of the Andhra Pradesh and Karnataka. There is a total of 399 trees raised from 48 plus tree population from both Karnataka (100) and from Andhra Pradesh(299). Apart from this, a total of 30 root suckers survive in the field which was well maintained.

Project 3: Estimation of variability in *Pterocarpus marsupium* and germplasm collection [FRC-07/TI-04/2003-07]

Findings: The number of plus trees were marked in various parts of the Andhra Pradesh and Karnataka. A total of 400 seedlings were planted in FRC Campus from selected mother trees from different places.

Project 4: Studies on phenotypic variation in *Pterocarpus santalinus* and collection of germplasm [FRC-04/TI-01/2003-07]

Findings: Survey was conducted in AP in the districts of Kurnool, Cuddapah and Chittoor and identified prominent trees for collection of germplasm. Vegetative propagation technique has been standardized. Propagated 250 plants from different collections and maintained them well.

Project 5: Dynamics of insect populations in cotton based agroforestry systems of Andhra Pradesh [FRC-08/EB-04/2003-08]

Findings: An agroforestry system with six tree species and cotton as intercrop was established in an area of two ha in FRC, Hyderabad campus. The tree components are *Eucalyptus* sp., *Azadirachta*



indica, *Annona squamosa*, *Emblica officinalis*, *Moringa oleifera*, and *Dendrocalamus strictus*. Central idea of the project is to study the insect pest dynamics in diversified habitat conditions. Data on incidence of insect pests and their natural enemies were recorded on intercrop as well as tree components.

EXTERNALLY AIDED PROJECT

Project 1: Bioecology and Integrated Management of Insect Pests of Aonla, *Emblica officinalis* Gaertn.

Findings: Insect pest incidence and their seasonality in Aonla was recorded at Rajahmundry and Hyderabad locations. Aonla aphid, *Cerciaphis emblica*, stem gall insect, *Betuosa stylophora* and Bark eating caterpillar, *Inderbela* sp. followed by *Nipaecoccus viridis* were identified as key pests of Aonla. Five synthetic and one botanical insecticide viz., Dimethoate, Imidacloprid, Spinosad, Profenophos, Neem Seed Kernel Extract and Acetamipride were evaluated under field conditions at Hyderabad in the month of March 2008 against Aonla aphid, *Cerciaphis emblica* on the cultivar *Chakiya*. Dimethoate 30 EC, Confidor 17.8 SL, and Profenofos 50 EC were found highly effective at 0.06, 0.036, and 0.1 per cent concentration respectively. The project is funded by National Medicinal Plants Board, New Delhi.



Menochilus sexmaculatus a predator on Aonla aphid, *Cerciaphis emblica* on *Emblica officinalis*

PROJECTS ONGOING DURING THE YEAR 2007-2008

PLAN PROJECT

Project 1: Reclamation of Iron Ore Mine spoil Karnataka through afforestation [FRC-03/EB-02/2002-05]

Status: Field experiment is continued in Iron Ore Mine spoil at RMMPL, Hospet for selection of suitable tree species, and soil amendment for the Iron Ore Mine spoils.

EXTERNALLY AIDED PROJECT

Project 1: Development of multitier cropping models for medicinal plants in Andhra Pradesh

Status: Three crops of medicinal plants namely, *Andrographis paniculata*, *Oscimum sanctum* and *Withania somnifera* were raised in six ha area in combination with Teak + Sandal, Rosewood +



Sandal, Eucalyptus + Sandal trees and in combination with Teak and their respective sole crops. Rosewood + Sandal combination was found to be very suitable for the growth of all the three medicinal plants. *A. paniculata* followed by *O. sanctum* and *W. somnifera* are found to be better suited in that order. The germplasm of Asparagus was collected from Darwar, Vishakhapatnam, Ranga Reddy, Medak Dists, Mahabubnagar and Srisailam. Seed was harvested from *O. sanctum* and *A. paniculata*. The growth data of Teak trees reveal better growths in inter crop as compared to control.

A comprehensive training-cum-workshop was organized on 18th March 2008 for a group of 32 farmers with scientists from CRIDA, APAU and CIMAP during this project. A group of 30 farmers on extension training were exposed to multitier agroforestry models with medicinal plants on 25th March 2008. A group of corporate people were exposed to the multitier medicinal plants system in February. Three willing farmers were identified for on-farm trials in the forth coming year.

EDUCATION AND TRAINING

Dr. Y. Sridhar, Scientist-C attended training programme on 'Research Methodology' at Indian Agricultural Statistical Research Institute, ICAR, New Delhi from 7th to 19th January 2008.

LINKAGES AND COLLABORATION

National

FRC, Hyderabad presently has one ongoing projects in collaboration with NMPB, Hyderabad and Andhra Pradesh Forest Department.

CONSULTANCIES

1. Mid Term Monitoring and Evaluation of FDAs of Andhra Pradesh under NAP. Submitted to National Afforestation and Eco-development Board, New Delhi (Part of National Consultancy Project of ICFRE).
2. Biological Environment Report (for the proposed bauxite mining site of Chittamgondi, Galikonda, Raktakonda, Eastern Ghats, Visakhapatnam, Andhra Pradesh) submitted to Andhra Pradesh Mineral Development Corporation Limited, Hyderabad (part of National Consultancy Project of ICFRE).
3. Biological Environment Report (for the proposed bauxite mining site of Jerrela Eastern Ghats, Visakhapatnam, Andhra Pradesh) submitted to Andhra Pradesh Mineral Development Corporation Limited, Hyderabad (part of National Consultancy Project of ICFRE).



CONFERENCE/MEETINGS/WORKSHOPS/SYMPOSIA/EXHIBITIONS

1. Integrated Insect Pest Management in Forestry from 18th to 20th December 2007.
2. Extension Training on “Agroforestry Systems for Semi Arid Tropics of Andhra Pradesh.” on 25th March 2008.