

INSTITUTE OF WOOD SCIENCE AND TECHNOLOGY BANGALURU

The Institute of Wood Science and Technology (IWST), Bangaluru 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 Utilisation of Wood; Mangroves & 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 utilisation 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.

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

		No. of projects completed in 2008-09	No. of ongoing projects in 2008-09	No. of new projects initiated in 2008-09
IWST, Bangaluru	Plan Projects	13	10	14
	External Aided Projects	7	19	10
FRC, Hyderabad	Plan Projects	2	2	1
	External Aided Projects	Nil	Nil	Nil
	Total	22	31	25

PROJECTS COMPLETED DURING THE YEAR 2008-2009

PLAN PROJECTS

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

Findings: Studies carried out on *Simarouba glauca* showed that the timber is dimensionally stable. Dries very quickly (4-6 days from 80% to 14-16%) without any sawing and seasoning defects. The timber was classified as moderately heavy, weak, not tough, very soft and very steady.

The timber has been found suitable for making artifacts and meet the requirements. The timber was also found suitable for match sticks. The timber can be used for tool handles, light furniture, light packing cases and found good for making 'BWR' grade plywood. Preliminary work indicated the potential of using wood for pencil making. Larger quantity of wood is required for commercial application. The timber has around 62-65% cellulose content. The seeds of the tree contain around 50-55% oil.



Various products made out of *Simarouba glauca* DC

Project 2: Evaluation of wood quality of Eucalyptus clones and plantation grown *Grevillea robusta* A. Cunn. Based on Spiral grain [IWST/WPU/XI-73/2007-09]

Findings: Sixty poles of Eucalyptus clones have been procured from two different locations (Mandya and Kolar) and also 5 trees of *G. robusta* for determination of specific gravity, shrinkage, spiral grain angle and nail holding properties. Heritability study of spiral grain and description of gross anatomy were also made. Screening of clones based on lesser grain distortion and shrinkage values completed. Data being analyzed for identifying better clones. Project completion report is under preparation.

Project 3: Effect of particle size on properties of wood filled polypropylene composites [IWST/WSP/X-53/2006-09]

Findings: Combining biological fibres and commercial plastics can bring in transition to safer and more environmentally friendly composites. Addition of wood flour to polypropylene, at all levels, resulted in more rigid and tenacious composites. Particle size and filler morphology was found to have significant effect on properties of filled composites. Particles having size between 52 and 85 mesh provides the best properties. A micro-mechanics model was developed based on shear lag theory. The properties predicted by the model were in good agreement with experimentally observed values.

A fast and reliable method to measure elastic constants using vibration method was developed. A significant improvement in density, dynamic MoE and shear modulus was observed in wood-filled polypropylene composites with the increasing wood content. The improvement in modulus was nearly 100% as against 17% improvement in density at 50% filler loading. Higher aspect ratio in wood flour resulted in better MoE. The changes in the modulus of the composites with the change in filler content were further explained using Halpin Tsai model. The model predicted values were in close agreement with the experimentally observed values.

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

Findings: Six species of plantation grown timbers (12-15 years) *Artocarpus heterophyllus*, *Lophapetalum wightianum*, *Lagerstroemia lanceolata*, *Spodias pinnata*, *Melia azadirachta* and *Sterospermum personatum* were subjected to pressure treatment by adopting full cell process with conventional wood preservatives like Copper Chrome Arsenic (CCA), Copper Chrome Boric (CCB) composition for 4 different loading of absorption viz. 4, 8, 12 and 16 kg/m³ and with Creosote + Furnace oil (1:1) the absorption was 40, 80, 120 and 160 kg/m³. The treated specimens were exposed to field test in the Test yard along with untreated controls. After 45 months of exposure, it was found that the *Lagerstroemia lanceolata* is the highly durable and the *Lophapetalum wightianum* is the least durable timber as all the specimens destroyed by the termites within 18 months of exposure. All the treated specimens are in sound conditions showing that even 4 kg/m³ of preservative is sufficient to increase the durability non-durable timbers.

Coppiced and non-coppiced poles of *Eucalyptus tereticornis* and *Eucalyptus camaldulensis*, 2.15 m - 3.10 m length and girth varied from 5 cm to 24 cm. were treated in green condition by sap displacement method and Boucherie method using 2 different concentration of CCB preservative with 2 treatment time. Distribution of preservative along the length of the pole was analyzed. Results show that the specific gravity of coppiced wood was less than the

non-coppiced. In both coppiced and non-coppiced poles, BIS recommended absorption for structural poles and fence posts is 16 kg/m^3 which can be easily achieved in both treatments with 4.25% concentration preservative for 4 days in sap displacement method and 3 hours in Boucherie method. Analysis of preservative chemicals shows that chromium and copper were present throughout the length of the pole. The treatment is more effective at higher moisture content of the pole and it also reduces the treatment time. The absorption of preservatives in coppiced poles is more than that in non-coppiced poles in *Eucalyptus tereticornis* and almost same in the *Eucalyptus camaldulensis*. Dried poles (Moisture content $<15\%$) can also be treated by vacuum pressure method by adopting the treatment schedule, initial vacuum for 30 minutes followed by pressure of 3 kg for 3 hours followed by the final vacuum for 15 minutes. Depending upon the end uses and available facility, proper treatment schedule can be followed to enhance the service life of the coppiced wood and can be used rationally for better purposes without much wasting of the natural resource.

Project 5: 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]

Findings: Fatty oil content was found to be 22.5% in *Baccaurea courtallensis* Muell. Arg., an endemic tree species of Western Ghats. One saturated fatty acid namely palmitic acid showed 43% and one unsaturated fatty acid namely oleic acid showed 36% as major constituents in the oil which are the first reports so far as fatty oil content and fatty acid composition of this species are concerned. Qualitative phyto-chemical analysis of ethyl acetate extract of the fruit rind of *Baccaurea courtallensis* showed the presence of Tannins and Flavanoids and methanol extract showed the presence of Tannins, Flavonoids and Quinones. Ethyl acetate and Methanol extracts of the fruit rind of *Baccaurea courtallensis* were found to be highly inhibitive to *Fusarium oxysporum* fungi as tested under laboratory conditions.

Project 6: Investigations on chemical composition and utility of AESP oil from exhausted sandal wood powder [IWST/CFP/X-60/2006-09]

Findings: The exhausted sandal wood powder which was considered to be a waste was subject of study for which the optimum acid treatment to yield maximum amount of new oil named AESP oil from exhausted sandalwood powder was determined. UV and GC analysis of AESP oil has been carried out and found that this oil was altogether different from sandal wood oil. The oil was evaluated and found acidic and pungent in nature and the colour of the milky white soap is getting changed. The cosmetic value of the oil is very poor and is not suitable for its application in soap making. Cost effectiveness for 1 kg of AESP oil was worked out. Its potential for other uses has to be worked out.

Project 7: Analysis of active principles in *Gymnema sylvestre* and *Phyllanthus amarus* from the forest of southern India [IWST/CFP/X-46/2005-June 2008]

Findings: They study was conducted in five states namely Karnataka, Tamil Nadu, Andhra Pradesh, Kerala and Goa. Among these five states, 35 MPCA (Medicinal Plant Conservation Area) were selected on the basis of climatic condition. Results show higher active principle content at drier part of MPCA when compared to moist region. It was seen that the variation of active principle ranged from 2% to 6% in *Gymnema sylvestre* and in *Phyllanthus amarus*, Phyllanthin varied from 0.3% to 0.6%. Results show that Kolli hills and Davaryan durga contain highest active principles respectively. Results are also showing higher active principles content in coastal, dry deciduous and scrub jungle region.



Project 8: Screening and evaluation of wild varieties of *Emblca officinalis* fruit in various agroclimatic zones of Western Ghats [IWS/CFP/X-48/2005-June 2008]

Findings: This study was conducted at ten different locations within the agroclimatic zones of western ghats. Results show that two places of western ghats namely Thenmalai and BRT hills contain high ascorbic acid content. So far as fruit yields are concerned, trees from BRT hills gave higher yield than trees from Thenmalai. Results show that fruit yield is higher in deciduous forests and ascorbic acid content was found to be higher by about 30-40% in deciduous forests.

Project 9: Productivity and interaction studies in *Acacia* hybrid based agroforestry practices in Karnataka [IWS/TIP/X-40/2004-09]

Findings: *Acacia mangium* hybrid block plantation and line planting field trials in Doddaballapur and Kolar (on-farm trials) in 2004-05 were established. In 2008, in Kolar the average ht and gbh of *Acacia* hybrid in line planting was 12m and 40 cm and in Gowribidanur it was 8m and 22 cm, respectively. The average height and gbh of *Acacia* hybrid in Block planting in Kolar was 13m and 28 cm and in Gowribidanur, it was 6m and 17 cm respectively. Intercropping carried out for 3 successive years. Nearly 25-30 % reduction in intercrop yields was observed within 5m distance from tree line under line planting method. Canopy and root management practices helped in minimizing loss in agricultural crop yields in line planting method of planting in both sites. Above Ground Biomass (AGB) was 20-25% more in *Acacia* hybrid trees under line planting. The AGB consisting of stem, branches and leaves in block planting method ranged from 70-80 kg/tree and 90-100 kg/tree in line planting in Kolar site.

Project 10: Assessment of seed quality in unimproved populations, seed production areas and seed orchards of *Tectona grandis* [IWS/TIP/X-48/2005-09]

Findings: Seeds were collected from unimproved populations and SPA at Virnoli, Barchi, Baghwathi and Tittimathi, from CSO at Tittimathi and SSO at Tirupati. Fruit, seed and seedling variability studies showed that overall Tittimathi seed sources was better as compared to other seed sources. Subsequent studies from fruits collected from unimproved population, SPA and CSO at Chandrapur, Maharashtra and Warangal, Andhra Pradesh revealed that germination was highest for seeds from SPA, Chandrapur. Morphological parameters, germination and seedling growth studies revealed improvement in quality of SPA seeds as compared to unimproved populations.

Project 11: Comprehensive tree improvement program for *Gmelina arborea* in Karnataka Phase I- Progeny trial [IWS/TIP/X-41/2004-09]

Findings: Progeny trial was established using progenies of 27 plus trees (17 from Karnataka and 10 from Andhra Pradesh) during July 2007. The progeny trial was established in three replicates with nine seedlings per replicate. Growth data at 15 months indicated that the best performing families were SGA-17 from Karnataka and Andhra Pradesh-10 from Andhra Pradesh. Growth data indicated that best growth in terms of height was seen in case of SGA-17 (192.00 cm) and Andhra Pradesh-10 with average value of 101.33 cm. SGA-7 and Andhra Pradesh-3 were the poor performing families with respect to height growth with values of 90.00 cm and 53.33 cm, respectively. Similar trends were observed for collar diameter with high average values of SGA-17 (23.33 mm) and Andhra Pradesh-10 with average value of (13.33 mm). Whereas, lower values for CD were observed in case of SGA-7 (7.40 mm) and Andhra Pradesh-3 (6.66 mm). It was noted that some of the families from Andhra Pradesh after good initial growth suffered with dieback problem.

Project 12: Fuel properties of important forest weeds [IWS/WE/XI-75/2007-09]

Findings: Study on calorific value, proximate analysis (ash content, volatile content and fixed carbon content) and elemental parameters (carbon, hydrogen, nitrogen and sulphur content) of two forest weeds i.e., *Lantana camara* and *Eupatorium* spp. was carried out. The above study was undertaken with an aim to evaluate the selected forest weeds as a raw material for energy production. Basic density of *Lantana camara* and *Eupatorium* spp. was determined. The calorific value of leaves and stem of *Lantana camara* were found to be 19.17 MJ/kg and 19.02 MJ/kg, respectively. The calorific value and other fuel properties of *Lantana camara* are comparable to *E. hybrid* and *C. equisetifolia*, prominent fuelwood species. The calorific value of *Eupatorium* spp. was found 18.73 MJ/kg. The lower calorific value of *Eupatorium* spp. may be due to their higher ash content (6.07%) as compared to *Lantana* (1.00%). The amount of ultimate carbon in *Eupatorium* spp. and *Lantana camara*, ranges from 43 to 48%.

Project 13: Database Development of IWS Xylarium [IWS/IT/X-58/2006-09]

Findings: Web database prepared for IWS xylarium, GASS forest museum wood specimens collection and IPRITI wood specimens collection. It contains wood specimens related information like xylarium rack number, specimen access number, binomial name of specimen, specimen collector name, specimen collection area, specimen collection date, specimen collection country, specimen collection continent, number of specimen available, whether it is available for mutual exchange, scientific classification of wood specimen, kingdom, division, class, order, family, genus, subgenus, species, author of species, common/trade name, vernacular name, distribution of species, uses, normal picture of specimens anatomical picture of specimens, references.

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 (Funding agency: Nagaland State Forest Department) [IWS/WPU/EXT/Nagaland SD/019/2007-08]

Findings: Project is completed and a hand book on 25 Nagaland timbers is being prepared. The hand book contains information on trade name, local names, tree form, general features, gross and minute anatomy alongwith photomicrographs. Information on properties and uses wherever available is also provided.

Project 2: 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, Government of India, New Delhi) [IWS/WBD(M)/EXT/DST/020/2005-08]

Findings: *Mytilopsis sallei*, the marine fouling bivalve, collected both from Visakhapatnam and Kakinada ports responded to background levels of copper and hydrocarbon concentrations, positively. It can release the excess load of copper when transferred to clean seawater, rapidly. The bivalve can accumulate leachates from CCA treated wood according to the amount leached out. The ability to accumulate copper is more in animals collected from Kakinada than at Visakhapatnam. The animal hosts numerous microbes among which two were found to be tolerating heavy concentrations of copper. When exposed to copper and the broad spectrum antibiotic, Streptomycin, the animal accumulated less copper compared to animals exposed to copper concentrations without antibiotic, as the microbes get either killed or their activity reduced. The microbes present in the gut may be helping the bivalve in tolerating and accumulating copper at higher concentrations.



Project 3: Field performance of micro and macropropagated planting stock of selected five commercially important bamboo species (Collaborative project-IWST, KFRI and IFGTB) (Funding agency: Department of Biotechnology) [IWST/TIP/EXT/DST/021/2004-09]

Findings: Established germplasm bank of 21 industrially important bamboo species in 0.5 ha area at Gottipura, Bangaluru. Out of the 21 bamboo species, Candidate Plus Clumps (CPCs) germplasm consisted of 7 industrially important bamboo species. Established field trials of micro and macropropagated five important bamboo species in 15.0 ha area in Karnataka (Gottipura, Nallal near Bangaluru and Yelwala, near Mysore) and Andhra Pradesh (Dulapally, FRC, Hyderabad). Field trials viz; (i) type of planting material (seed base, macro and micropropagated plants) in 5m x 5m spacing (ii) spacing trial (5m x 5m, 5m x 7m and 5m x 9m) and fertilizer trials (*Bambusa bambus* and *D. strictus*) in 5m x 5m spacing were established during July–August 2005. Survival after 6 months varied from 85-100%. Minimum survival was in *D. asper* and maximum is in *D. strictus*. Micropropagated plants were comparable with seed and cutting raised plants. At the age of 40 months, maximum height (4.34 m in Bangaluru and 3.92 m in Mysore and 3.38 m in Hyderabad) and collar diameter (22.25 mm in Bangaluru, 18.10 mm in Mysore and 16.25 mm in Hyderabad) was observed in *B. balcooa*, followed by *D. strictus* and *B. bambos*. Minimum height was observed in *D. asper* (1.83 m in Bangaluru, 1.75 m in Mysore and 1.42 m in Hyderabad). Maximum culm numbers were observed in *D. asper* (15.0 in Bangaluru, 11.8 in Mysore and 10.9 in Hyderabad). Effect of fertilizer was distinct and compost and inorganic fertilizer proved the best for better growth in terms of culm height and number in *B. bambos* and *D. strictus*.

Project 4: 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) [IWST/TIP/EXT/022/2004-09]

Findings: Established 25 ha trials (20 ha in Andhra Pradesh and 5 ha in Goa) during 2007 and 20 ha during 2008 (in Karnataka) using six industrially important bamboo species viz; *B. balcooa*, *B. nutans*, *D. asper*, *D. brandisii*, *D. stocksii* and *Guadua angustifolia*. Mortality replacement at Buggapadu site in Andhra Pradesh was also completed. Some general observations about the species performance at Andhra Pradesh and Goa are as follows:

- Observation at ten months showed that *B. balcooa* and *B. nutans* performed better in terms of survival and subsequent growth, followed by *D. hamiltonii*.
- In general, tissue culture plants were performing better than micropropagated plants among various species.
- Growth performance at Agalote (Goa) was comparatively poor than that at Chintalapudi due to under storey planting.
- *D. asper* and *G. angustifolia* performance was poor at all the three sites.

Project 5: Development of Package of Practices for the management of powder post beetles in ITC timber yards (Funding agency: ITC, Bhadrachalam) [IWST/WBD/EXT/ITC/023/2007-08]

Findings: Studies were conducted in ITC timber depots at Bhadrachalam and Ongole to assess the seasonal incidence and intensity of infestation of powder post beetles on subabul logs (*Leucaena leucocephala*) stocked for paper production. The beetles were identified as *Sinoxylon anale* and *S. conigerum* (Bostrychidae) and cultured in the laboratory. Laboratory evaluation of botanicals and chemicals for the management of the pests was undertaken. Field experiments were conducted with chemicals and botanicals at ITC timber depots at Bhadrachalam. Effectiveness of the control measures was assessed and documented. A package of practice was developed for timber storage in depots.

Project 6: Evaluation of phosphine as fumigant to control insect pests in logs, chips and sawn boards (Funding agency: M/s UPL Ltd.) [IWST/WBD/EXT/UPL/024/2007-08]

Findings: Investigations to ascertain the efficacy of Phosphine as a substitute of methyl bromide for fumigation of infested wooden logs was conducted both by laboratory bioassays and field fumigation experiments. Laboratory *in-vitro* assays with different concentrations of phosphine (25, 50, 100, 150 and 200ppm) were done. One hundred percent mortality of common wood infesting insects viz. *Lyctus africanus* and *Lyctus brunneus*, *Synoxylon anale*, *S. conigerum* and *Odontotermes* sp. was obtained at 200 ppm phosphine level after a short exposure period of 24 hrs. Field trial of fumigation with with medium and high girth infected logs of Eucalyptus and Subabul was conducted in timber depots at Rajamundry and Bhadrachalam, Andhra Pradesh. In the field fumigation trails using 3g and 4g/m³ phosphine, it was found that at 3g/m³ dose, 100% mortality of insects was achieved indicating suitability of phosphine in wood fumigation.

Project 7: Insect plant relationships with special reference to herbivory in the mangroves of South India (Funding agency: Ministry of Environment and Forests) [IWST/WBD/EXT/MoEF/025/2005-09]

Findings: Herbivorous insects belonging to 12 orders, mainly, Coleoptera, Diptera, Orthoptera and Lepidoptera were documented from the mangroves of Karnataka. Total number of herbivorous species of insects recorded was 153. Twenty nine species of flower visiting insects were recorded and details of 11 major pollinators of three major mangrove species were studied. Using digital image analysis, the damage by insect herbivory in the mangroves of Karnataka was assessed, the extent of damage differing in the young and mature leaves. Damage range in young leaves was 0.13% - 5.12 in *Rhizophora mucronata*, 0.15% - 16.29% in *Avicennia officinalis* and 2.04% - 8.4% in *Sonneratia alba*. Folivory damage in case of matured leaves was 0.62%- 4.62% of leaf area loss in *R. mucronata*, 0.51% - 27.11% in case of *A. officinalis* and 1.91%- 13.44% in *S. alba*. Insects belonging to three major orders viz. Coleoptera, Lepidoptera and Diptera were found to comprise fruit affecting insect guild. Germination study was conducted to elucidate the impact of insect frugivores in the regeneration of mangroves.

PROJECTS ONGOING DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Detection of natural and biological defects in timbers by non-destructive testing techniques [IWST/WPU/X-63/2006-10]

Status: Studied the effect of moisture content on ultrasonic velocity in wood of *Acacia mangium*, *Grevillea robusta* and *Mangifera indica*. Studied the effect of grain orientation on ultrasonic velocity in wood of *Acacia mangium*, *Grevillea robusta* and *Mangifera indica*. Studied the effect of defects (hollowness) on ultrasonic velocity in wood samples of *Acacia mangium*, *Grevillea robusta* and *Mangifera indica*. Studied the strength properties (MOE, MOR, FS at LP) of *Acacia mangium* and *Grevillea robusta* and *Mangifera indica* by conventional test method. The relationship between hollowness and ultrasonic velocity is being established.



Ultrasonic Wood Tester to detect defects in wood

Project 2: Study on utilization aspects of plantation grown *Acacia mangium* Willd. from Orissa [IWS/WPU/X-57/2006-10]

Status: The shrinkage study is completed and based on the retention of shape figure, the timber is classified as steady timber and grouped along with *Dalbergia sissoo* and *Adina cordifolia*. The timber took 47 days to reach 18% moisture content from initial moisture content of 80% after drying in dehumidifier kiln. Studies on anatomical properties for 4 trees completed. The physical and mechanical properties like specific gravity, weight, static bending, compression, hardness, shear, tension, nail and screw holding are completed in the green condition. Tests on air-dry material are in progress. Installation of preservative treated samples at Nallal field station for durability study completed and periodic inspection on the condition of the samples were recorded. Some products like chair, artifacts were made as shown below.



Furniture and carvings made from *Acacia mangium* wood

Project 3: Studies on influence of microwave treatment on drying characteristics and treatability of wood [IWS/WSP-XI-69/2007-10]

Status: Treatment of silver oak using microwave with varying thickness and time completed. Comparison of drying behaviour of microwave treated and untreated wood evaluated. Experiments with Eucalyptus and Silver Oak drying using MW carried out. Ray cell of Silver Oak and Eucalyptus were found to rupture by MW treatment for 20 minutes. Dehumidification drying characteristics of MW treated and untreated silver oak and rubber wood was studied. Studies on the drying behaviour of Teak and Rubber wood completed.

Project 4: Isolation and estimation of L-DOPA from *Mucuna prurines* Linn collected from South India [IWS/CFP/XI-66/2007-10]

Status: Seeds collected from different MPCA area in Karnataka, Shimoga (Sagara, Barige and Ikkeri), Kerala (Thekady). Savandurga, Devarayanadurga, Chitradurga (Jogi matti, Neerthadi and Devaragudda), Kollur plots were identified where *Mucuna* population exists for collection of fruits. Preliminary work of standardization of procedures for extraction of L-DOPA carried



Mucuna prurines
seeds from Barige,
Shimoga

Mucuna prurines seed
from Ikkeri, Sagara

Mucuna prurines
seeds from Thekady

Mucuna prurines
seeds from Sagara

out. HPLC has been carried out for Standard L-DOPA for comparison of samples from different areas. Isolation and crystallization of L-DOPA has been carried out for seeds collected from Jogimatti (Chitradurga) and Devarayanadurga (Tumkur), Thekady (Kerala) and Sagar (Shimoga).

Project 5: Laboratory testing for the assessment of the durability of timbers against powder post beetles – standardization and evaluation [IWS/WBD/X-55/2006-10]

Status: Using the standardized test methods, adults and larvae of *Lyctus africanus* and *Sinoxylon conigerum* were employed as the test insects for studying the durability of plantation timbers against borers. Natural durability of *Mesopsis eminii*, *Hevea brasiliensis*, *Grewia robusta*, *Acacia mangium*, *Melia dubia* and *Acacia auriculaeformis* against the beetles were tested. Wood treated with neem products, CNSL, extractives from *Dysoxylum malabaricum* and insecticides, Chlorpyrifos and Imidacloprid were tested by exposure of adults and larvae of *L. africanus* and *S. conigerum*. *In-vitro* assays with different concentrations of Phosphine was conducted to prove the susceptibility of life cycle stages of the powder post beetles.

Project 6: Studies on the natural resistance of imported wood against insects and decay fungi in Indian environment [IWS/WBD/XI-74/ 2007-11]

Status: To study the natural durability of imported timbers, observations up to one year after implantations were taken at Trivandrum, Bangaluru, Visakapatanam, Hyderabad, Jodhpur and Jabalpur. Experiment at Dehradun condition has been initiated. Observation on the natural durability of 5 imported timbers against fungus has been completed. Durability observation up to one year after exposure has been taken in marine condition. So far 20 species of termites have been identified.

Project 7: Studies on age related durability of plantation grown timbers [IWS/WBD/X-50/2005-12]

Status: Durability studies against decay fungi of plantation grown timbers of low rainfall area are completed. *A. auriculiformis* and *A. mangium* of 10, 15 & 20 years timber can be classified under Class I where as 5 years comes under Class II. *E. tereticornis* showed good resistance against decay fungi (Class I) *G. robusta* belongs to class III and *M. dubia* falls under non-resistance class IV. Studies of high rainfall area grown timbers are under progress.

Project 8: Seed infestation by insects among the emergent rainforest canopies at Makutta, Western Ghats [IWS/WBD/XI-68/2007-10]

Status: Sampling work during the pre-monsoon period yielded seed fall from very few species, *Knema attenuata* and *Dipterocarpus indicus*. Although *Knema* had low infestation by insects (<5%), all the seeds of *Dipterocarpus* were damaged by insects. Data on seedling establishment of the previous year has also been recorded. The seedlings are dominated by those from *Vateria indica*. Germination and regeneration data from 61 square metre sample plots have been noted. No seeding was recorded during the January to March 2009.

Project 9: Ethnobotanical studies of Northern-Eastern Ghats in Andhra Pradesh [IWS/WBD(M)/X-170/2007-11]

Status: Conducted seven field tours to tribal areas of Srikakulam, Vizianagaram and Visakhapatnam districts. Recorded ethnobotanical data on wild genetic resources, edible, medicinal, material and social cultural aspects on 137 plant species from the tribes of Savaras, Khonds, Jatapus, Kondadoras, Nukadoras and Porjas. Collected 101 plant species, made into herbarium and Identified. Scrutinized and screened ethnobotanical data with available literature. The important medicinal plants, namely, *Drynaria quercifolia* (L.) J. E. Sm., *Stemona tuberosa* Lour. and *Trichosanthes tricuspidata* Lour. were collected from the tribal areas and their uses reported for the first time.

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

Status: Established new cultures from the Candidate Plus Clumps of *B. bambos* and *D. stocksii* from germplasm bank. *In-vitro* established cultures were multiplied in MS liquid and agar gelled media with additives + NAA (0.25 mg/l) + BAP (1.0 – 2.5 mg/l). *In vitro* shoot clumps (2-3 shoots/clumps) rooted in MS/4 basal salts medium with IBA/NAA (1.0 mg/l). Rooted plants were hardened in polytunnel in green house for 3-4 weeks, followed by 2-3 weeks in shade before keeping in open nursery. Established callus cultures of both the species and multiplied in MS medium with additives + 2, 4-D. Callus cultures were used for somatic embryos induction. Standardized DNA isolation, purification and quantification in both the species. Standardized PCR reaction mixture and cycles for DNA amplification of the mother plants and micropropagated plants of both the species for the genetic fidelity studies.

EXTERNALLY AIDED PROJECTS

Project 1: Establishment of Advanced Wood Working Training Centre at IWST (Funding agency: Italian Trade Commission/ACIMALL) [IWST/EXT/ACIMALL/026/2003-13]

Status: Advanced Wood Working Training Centre, an Indo-Italian joint project by IWST-ICE-ACIMALL entered into the seventh years of operation. The centre is equipped with 21 advanced wood working machines. A new CNC machine was installed during the year 2008-09 and CNC course has been introduced from January 2009. During the year 2008-09, the centre has imparted training to 387 trainees for conventional course and 35 trainees for CNC course. About 95% of the unemployed trainees have been benefited for employment with this training. The AWTC also participated in “DELHI WOOD 2009” which was held at Pragathi Maidan, New Delhi in February 2009.

Project 2: Investigation on Tree ring analysis (Dendrochronology) of certain species in Western Ghats to monitor climate changes and its relevance to wood quality (Funding agency: Ministry of Environment and Forests) [IWST/WPU/EXT/MoEF/029/2006-09]

Status: Two JRFs joined at the end of May 2007. Basic training was provided to JRFs at IWST. Stereo-Zoom Microscope was installed and basic training was obtained. TA system was installed. Increment borer was purchased. Teak discs were collected from Madikeri, Mundugod of Karnataka and Thane, Chandrapur from Maharashtra. Meteorological data and information on sites from Karnataka and Maharashtra were collected. Teak samples were prepared by using special technique to expose growth rings. Field training for 2 JRFs in collaboration with IITM, Pune to Bandipur, BR Hills, Kallahalla and Shimoga completed. Training provided to JRFs at IITM, Pune for handling COFECHA and ARSTAN programmes in tree ring analysis and also for handling RESPO programme. Specific gravity, ring width and age of 36 discs completed from Madikeri & Mundagod (Karnataka) and Chandrapur & Thane (Maharashtra). Study on vessel morphology completed for 30 discs from Karnataka and Chandrapur of Maharashtra. Cross dating and standardization of 30 discs from Karnataka and Chandrapur (Maharashtra) carried out using COFECHA and ARSTAN programme, respectively. Collection and sanding to expose growth rings completed for 6 core samples of *Myristica* spp. Determination of age of 6 cores of *Myristica* spp. completed.





Teak discs with wounds due to (i) Fire (ii) Insect attack



Stereo-zoom microscope with TA system for tree ring analysis

Project 3: Studies on acoustical behaviour of plantation timbers for musical instruments and wall paneling (Funding agency: CSIR) [IWST/WPU/EXT/CSIR/028/2006-09]

Status: Evaluated strength properties of 7 species. Determined sound absorption coefficient and effect of different wood parameters (grain orientation and thickness) in 7 species. Generated data on commercially available 3 musical instruments (Veena, Violin and Dholak). Determined anatomical properties like fibre and vessel dimensions of 7 species. 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. Studied the effect of anatomical parameters and strength properties on frequency spectrum generated by the commercially available musical instruments. Fabrication of Veena from plantation species (*Acacia auriculaeformis*, *Artocarpus heterophyllus*, *Azadirachta indica*, *Eucalyptus tereticornis*, *Grevillea robusta* and *Melia composite*) to find their suitability in musical industries.



FFT analyzer to record sound waves from Dholak

Project 4: 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: DBT) [IWST/WBD/EXT/DBT/031/2006-09]

Status: Twenty five *Metarhizium* isolates were maintained in the laboratory for studying the virulence and biocontrol potential against major pests on important forest tree species. The teak defoliators, *Hyblaea puera*, *Paliga machoeralis* and pests of *Ailanthus excelsa* were found susceptible to most of the isolates but pathogenecity varied among the isolates. Bioassay with Mahogany borer, *Hypsipyla robusta* reared using artificial diet revealed that 7 isolates were pathogenic to them. Pathogenecity of different isolates against arboreal termites, *Odontotermes* spp. was tested in the laboratory with different dosages/time and the LD50 and LT 50 were calculated. Field evaluation of selected isolates against *Ailanthus* pests showed mortality of 30-34%. Mass multiplication of fungus in grains, solid media and agro wastes was tested.

Project 5: Investigations on Microsporidia affecting major Lepidopteran pests of important forest trees of South India and their prospects as biocontrol agents (Funding agency: DST) [IWST/WBD/EXT/DST/032/2007-10]

Status: A total of 94 lepidopterans were tested and microsporidian parasites were isolated from 29 species. Bio-assay study was carried out on *Hyblaea puera*, *Catopsilia*, *Papilio demoleus* and *Papilio polytes* larvae by inoculating different concentrations of spores isolated from their respective hosts. Morphometry of 29 species of microsporidia were studied. Studies on morphology, Pathogenicity, rate of multiplication and lifecycle of microsporidian spores in

Hyblaea puera and 3 butterfly species was conducted. Cross infectivity studies were carried out using *H. puera* spores to other forest pests to examine the infection potential.

Project 6: IWID: Indian Wood Insect Database– A Database on diversity of indigenous and exotic wood insects/pests in India (Funding agency: DSIR) [IWST/WBD/EXT/DSIR/033/2007-09]

Status: IWID, a web based database for Indian wood insects was developed in collaboration with FRI, Dehradun. The insect museums in different research institutions, universities, national collections at ZSIs and BSI were visited and wood insects documented. The data pertaining to about 1000 wood species and 2500 wood insects have been entered into the database. The entries were checked and edited. The work is in final stages.

Project 7: Bioecology, damage potential and management of Gall formers of *Pongamia pinnata* (L.) Pierre (Funding agency: DST) [IWST/WBD/EXT/DST/035/2006-09]

Status: The biology of gall inducers of Pongam viz., leaf gall inducer *Aceria pongamiae* and the ovary gall inducer *Asphondylia pongamiae* have been studied and their lifecycles have been determined. The population dynamics of both gall inducers have been observed for two years and the analysis is underway. Experiment to evaluate the efficacy of miticides against leaf gall inducing mite has been completed. Yield loss assessment by ovary gall inducer was done in Mandya, Bangaluru urban and Chickbellapur districts.

Project 8: 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) [IWST/WBD/EXT/MoEF/059/2006-10]

Status: Pathogenicity of major pathogenic fungi and their control measures and biology of major insect pests were completed. Seventy five to Ninety percent Fusarium infection was found in *D. malabaricum* fruits and seeds. In *C. sulpharatum* seeds though there was fungal infection (80%), viability of the seeds was not affected. In *S. malabaricum*, *M. longifolia* and *H. ofponga*, fungal infection was less (30%). Total 150 fungal species were isolated from the seeds of selected plants. Out of which, 40 species were pathogen and rest of the species were saprophytic fungi. The extent of damage and the host range of causative organisms were assessed. Seven insect species were obtained. Percent of incidence of Coleopteran was 37.78, Lepidoptera was 26.50 and Dipterans were 36.22. Diversity of insects in Subramanya was more ($H=1.8099$) and in Makuta, it was less (0.808).

Project 9: Need for conserving forest canopies assessing the diversity of canopy insects in the Western Ghats (Funding agency: Ministry of Environment and Forests) [IWST/WBD/EXT/MoEF/037/2006-09]

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 tested. Sampling using the traps has been done and collections processed for identification and assessing the diversity of insects.

Project 10: Monitoring of biofouling at Visakhapatnam Port. (Funding agency: Ministry of Shipping, Road Transport and Highways, Government of India through National Institute of Oceanography, Goa) [IWST/WBD(M)/EXT/NIO/039/2006-09]

Status: Test panels exposed at three test sites, i.e., Slipway Complex, Ore Berth and Marine Foreman Jetty in Visakhapatnam Port were retrieved at monthly/long term 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 11: Utilization of alternative timber species for catamarans to conserve traditional tree species of Eastern Ghats (Funding agency: Ministry of Environment and Forests) [IWST/WSP/EXT/KFD/052/2007-10]

Status: Durability, leaching tests for *Maesopsis eminii*, *Tetrameles nudiflora* and *Albizia lebbek* initiated and work is in progress. Untreated control timber panels of *Albizia lebbek* were completely destroyed by pholadid and tereinid marine borers within 14 months of marine exposure trials in Visakhapatnam harbor whereas panels treated with Copper-Chromium-Arsenic (CCA) incurred only 3% to 7% destruction and those treated with Copper-Chromium-Boron (CCB) 8% to 13% damage within the same period depending upon the preservative loading. Untreated controls of *Tetrameles nudiflora* were totally damaged due to marine organisms attack in 12 months, while CCA treated panels showed 8% to 25% deterioration and CCB panels 18% to 28% deterioration at the end of 14 months. Fabrication of catamaran of *Bombax cecilia* (5 Catamarans), *Albizia lebbek* (5 Catamarans), *Tetrameles nudiflora* (10 catamarans) and *Maesopsis eminii* (5 Catamarans) (Total 25 Catamarans) completed. Interactive meeting with fishermen of Kuppum village, Chennai was conducted and list of beneficiary from this village has been finalized for distribution of catamarans.

Project 12: Studies on assessing growth performance of *Guadua angustifolia* Kunth under different management schedules (Funding agency: NMBA) [IWST/TIP/EXT/NMBA/043/2006-09]

Status: Established field trials viz; spacing (5mx5m and 5mx9m) and fertilizer trials consisting seven treatments at two sites viz; Yelwala near Mysore and Gottipura (Hoskote) near Bangaluru in 1.3 ha each site in 2005. Intercropping has been done in succeeding years with horse gram. Survival rate < 50% in Hoskote and < 10% in Mysore by the end of third years indicating the unsuitability of this species under semi-arid conditions.

Project 13: Conservation of Sandal (*Santalum album* L.) germplasm, production of quality planting stock and promotion of sandal cultivation practices (Funding agency: NMPB) [IWST/TIP/EXT/NMPB/046/2006-09]

Status: Produced 50,000 quality seedlings of sandal wood during 2007-08 and provided to the SFDs, farmers, sandal based industries and NGOs. Sandal stake holders meeting programmes have been conducted in Murdeswar, Kolar and in Shimoga districts in Karnataka. Two on- farm demonstration trials of sandal based agroforestry one ha each has been established in Mantralaya (Andhra Pradesh) and in Chikmagalur (Karnataka). Nearly 100 grafted sandal plants from various identified clones produced for restocking in germplasm bank at Gottipura.

Project 14: 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: NMBA) [IWST/TIP/EXT/NMBA/044/2006- July 2009]

Status: This is a multi institutional collaborative project involving College of Forestry (CoF) Ponnampet (University of Agricultural Sciences, Bangaluru), Kodagu Model Forest Trust (NGO) and IWST. This project is being coordinated by IWST. Farmers interaction meet organized in Coorg in February 2009 involving farmers and various stakeholders to discuss various prospects of bamboo cultivation. A vegetative propagation centre with capacity to produce 50,000 rooted cuttings of bamboo in one year was established in College of Forestry, Ponnampet. Nearly 25 ha of *D. asper* (edible bamboo) plantations involving 77 farmers established in Coorg with planting material supplied by the IWST.

Project 15: Cultivation of *Guadua angustifolia* Kunth and *Dendrocalamus asper* Backer in Kerala and Karnataka (Funding agency: NMBA) [IWS/TIP/EXT/NMBA/045/2006-09]

Status: On-farm demonstration trials established in tropical humid conditions in 2 sites (Aluva and Palakkad) in Kerala and in Thithimathi, Coorg, Karnataka at two spacings to study growth performance. Intercropping carried out with nutmeg, sandal and *C. sappan* in these 3 sites. Growth performance data collected for the 3 sites in 2008 indicate best performance in Coorg, followed by Aluva and then by Palakkad.

Project 16: Bamboo Locational Trials - BLT (Funding agency: NMBA) [IWS/TIP/EXT/NMBA/048/2005-10]

Status: Eight bamboo species viz; *Bambusa bambos*, *B. balcooa*, *B. nutans*, *B. tulda*, *Dendrocalamus asper*, *D. hamiltonii*, *D. giganteus* and *D. stocksii* (in Bangaluru) and *Guadua angustifolia* in place of *D. stocksii* (in FRC, Hyderabad) trials were established during July-September 2005 and maintained at Nallal, Bangaluru and Dulapally, Hyderabad using 5m x 5m spacing. Maximum (100%) survival rate was in *B. balcooa* and minimum (50%) in *D. asper*. Among the eight species, *D. hamiltonii* proved the best in terms of height of culm (5.89m) and diameter (31.8 mm) in Bangaluru as well as at Hyderabad, followed by the *D. stocksii*, *B. balcooa* and *B. nutans*. Minimum height (1.6 m) exhibited in *D. asper*, followed by *B. tulda* at both the locations.

Project 17: Vegetative Propagation Centre (VPC) for the production of quality plants of *D. stocksii*, *D. brandisii* and *Guadua angustifolia* (Funding agency: NMBA) [IWS/TIP/EXT/NMBA/042/2006-09]

Status: Plants were raised by rooting of culm cuttings in *D. stocksii*, from leafy branch cuttings in *Guadua angustifolia* and rhizomatous cuttings in *D. brandisii*. Total 18,000 plants have been raised. Plants raised have been used for plantation activities under NMBA and DBT funded projects and have also been supplied to Karnataka and Tamil Nadu Forest Departments and farmers for plantation. Training have been imparted to officials of Karnataka Forest Department and farmers on vegetative propagation of bamboo.

Project 18: An integrated approach of bamboo improvement propagation, agroforestry models, protection, processing and utilization (Funding agency: NBM) PI: S.C. Joshi, Co-[IWS/TIP/EXT/NBM/049/2007-10]

Status: Collected offset cuttings/plants of 15 economically important bamboo species from RFRI, Jorhat, Nagaland State Forest Department, State Forest Department, Rajamundry, KFRI, Peechi and FRL HT, Bangaluru for widening germplasm bank of bamboo species at Gottipura, Nallal. Collected CPC material of *B. balcooa*, *D. brandisii* and *T. oliveri* from various sources for germplasm bank. Carried out studies on effect of auxin, period of collection and size of cutting in *D. brandisii*. Established agroforestry trials at two locations of industrially important bamboo species in Karnataka. Surveyed bamboo nurseries and plantations in Karnataka, Kerala, Tamil Nadu, Andhra Pradesh and Goa to get information on insect pest attack and collected samples for laboratory studies. Samples of bamboo species treated with insecticide and preservatives were tested in field for durability. Fabrication of Boucherie and microwave dryer were completed. Studies on drying of *D. stocksii* carried out in microwave dryer. Drying behaviour of round *B. bambos* was studied in desiccant based dehumidification wood dryer. Specimens of *D. stocksii* were treated with CCA and CCB by sap displacement and Boucherie methods. Elemental analysis of nitrogen, oxygen and sulphur contents were carried in *D. strictus*, *D. brandisii*, *D. stocksii* and *B. bambos*. Basic densities of these four species varied from 0.48 ± 0.03 to 0.61 ± 0.3 and value was highest in *B. bambos*. Conducted demonstration of bamboo

based technologies viz; vegetative propagation, cultivation, ammonia fumigation and sap displacement in FRC of SFD, Hyderabad and VVK, Kadugodi, Bangaluru for the SFD and VFCs at farmers in ten training programme during the past one year period.

Project 19: Development of bamboo fibre reinforced thermoplastic composites (Funding agency: National Mission for Bamboo Application) [IWST/WSP/NMBA/027/2006-09]

Status: Composites of bamboo and polypropylene were prepared to study the effect of fibre loading, coupling agent, process additives and particle size on mechanical properties of the composites. Results show that at 50% loading of bamboo flour the tensile strength increases by 45% and flexural strength by 83%. The modulus of elasticity exhibited an increase of 300%. Composites prepared with m-TMI grafted polypropylene as coupling agent exhibited superior mechanical properties over composites prepared with MAPP as coupling agent. The study on the effect of particle size showed that particles having 60 to 80 mesh size provides the best properties.

NEW PROJECTS INITIATED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Anatomical approach to evaluate treatability of timbers [IWST/WPU-XI-84/2008-11]

Status: Under the project, phase contrast microscope was purchased and one technical Assistant on contract basis was appointed. Totally 9 species, were taken up for study. They are *Hevea brasiliensis*, *Melia composita*, *Grevillea robusta*, *Acacia auriculaeformis*, *Acacia mangium*, *Populus* spp, *Gmelina arborea* and two *Eucalyptus* spp. Of the 9 species wood samples were brought to moisture condition and specific gravity was determined for four species (100 samples each).

Project 2: Performance of Coatings on Modified Wood Surfaces [IWST/WSP/XI-90/2008-12]

Status: Reaction conditions of Acetylation and Benzoylation of wood has been standardized. The stands for natural weathering were fabricated.

Project 3: Studies on the permeability of selected imported timbers marketed in Karnataka [IWST/WSP/XI-83/2008-11]

Status: Five species of imported timbers namely *Xylia dolabriformis* (Pyinkado), *Instia biguga* (Merabau), *Dipterocarpus* spp. (Gurjan) and two *Shorea* spp. (Red meranti and Balau) were procured. Of these, 300 permeability samples (size: 22 x 22 x 22 mm) from two species were undergoing conditioning prior to measurement of flow rates. On the other hand, test stakes of (size: 19 x 19 x 450 mm) *Xylia dolabriformis* and *Shorea* spp. were being exposed under field condition.

Project 4: Study on Morphology and Properties of Natural Fibre Filled Polypropylene Composites (NFFPC) [IWST/WSP-XI-77/2008-11]

Status: Raw material i.e. Jute, Rubber wood powder, bamboo powder and the thermoplastic-Polypropylene and m-TMI procured for compounding both the material.

A Torque rheometer for studying the rheological properties of wood polymer composites has been procured and standardized.

Project 5: Synthesis of organometallic complex replacing arsenic component in CCA preservative by organic ligant (plant extractive) and evaluate as semi biopreservative [IWST/CFP/XI-85/2008-11]

Status: Procured leaf and bark of *Cleistanthus collinus* Roxb. and *Prosopis juliflora* DC. Optimized the extraction procedure to obtain maximum yield of plant extract with different solvents. Trials have been carried out for the reaction of CuSO_4 and CrO_3 with plant extract for further study as preservative.

Project 6: Studies on the insect pest problem of sandal under cultivation and their management [IWST/WBD/XI/80/2008-11]

Status: Three agroforestry models (Sandal and Mango; Sandal, Tamarind and Amla; *Eucalyptus* hybrid, *Dalbergia sissoo* and *Pterocarpus santalinus*) located in Bevanahalli, Mudennahalli and Gottipura (Karnataka) were selected for studying the pest and disease problems in sandalwood. The major pests collected were sap suckers followed by defoliators. At Jarakbande, sandal plantations grown along with *Acacia auriculiformis* had severe shoot borer problem by a Cerambycid pest. Sandal plants of pencil thickness, were found attacked leading to stunted growth and mortality of plants.

Project 7: Characterization of marine lignicolous fungi in traditional wooden craft [IWST/WBD(M)/XI/86/2008-12]

Status: The major fishing village in Visakhapatnam city, the Pedajalaripeta, was surveyed for identification of fungal infested traditional wooden craft and wood infested with fungi were collected from a catamaran made of *Paraserianthes falcataria*. Mixed culture of fungi present in the wood carried out and based on morphological variations, they were separated and maintained as pure cultures. Wooden test coupons were treated to a gradient of CCA absorptions and are being tested for infestation of fungi to arrive at threshold loading of CCA required to prevent fungal infestation.

Project 8: Incidence and diversity of marine borers in mangrove habitats of northern Andhra Pradesh [IWST/WBD(M)/XI/89/2008-11]

Status: Surveyed the mangrove habitats in Srikakulam, Visakhapatnam, East Godavari and Krishna districts, collected infested plant material and assessed the damage caused to vegetation. Extracted various wood boring organisms, namely, *Sphaeroma terebrans*, *S. annandalei*, *S. travencorensis*, *Bactronophorus thoracites*, *Dicyathifer manni*, *Lyrodus pedicellatus*, *L. medilobatus*, *L. takanoshimensis*, *Teredo furcifera*, *T. parksi*, *T. bartschi*, *Nausitora dunlopei*, *Bankia carinata*, *B. campanellata*, *B. brevis*, *B. gouldi*, *B. gracilis* and *B. rochi* and enumerated their incidence.

Project 9: Studies on scale up of protocols for *in vitro* propagation, hardening, production of cloned plants and establishment of field trials of Sandalwood (*Santalum album* L.) [IWST/TIP/XI-78/2008-11]

Status: Established shoot initiation cultures from the ramates of the clones from germplasm bank. Multiplied old cultures of five clones of diverse origin. Initiated studies on rooting of *in vitro* shoots under *in vitro* and *ex vitro* conditions. Established fragile callus cultures of four clones. Multiplied the embryogenic callus for somatic embryo induction.

Project 10: Variability studies in *Hardwickia binata* – a multipurpose tree species in Karnataka, Andhra Pradesh and Tamil Nadu [IWS/TIP/XI-79/2008-13]

Status: Survey has been carried out in different parts of Karnataka to identify the populations of *Hardwickia binata*. Preliminary morphological observations have been recorded and core samples have been collected from different aged plantations to document the variability for tree traits.

Project 11: Ecological, economic and socio-cultural evaluation of a ficus based traditional agroforestry system in Mandya district of Karnataka [IWS/TIP/XI-82/2008-11]

Status: Secondary data collection completed. Fifty percent of individual surveys covering 100 respondents and 8 village surveys completed. Litter traps under *Ficus* trees set up for ecological experiments. Crop yield measurements were conducted under various species of ficus.

Project 12: Studies on seed variability, propagation and *ex-situ* conservation of *Canarium strictum* Roxb. and *Hydnocarpus pentandra* (Buch.-Ham.) Oken - threatened medicinal trees [IWS/TIP/XI-81/2008-11]

Status: Survey had been conducted in and around Agumbe, Koppa and Ponnampet for identification of population of *Canarium strictum* and *Hydnocarpus pentandra*. Germination studies revealed that both the species have seed dormancy. In *C. strictum* dormancy is coat imposed, while in *Hydnocarpus* it is physiological. Cracking of seed coat enhanced germination in *Canarium*, while in *Hydnocarpus* pretreatment with GA3 resulted in seed germination.

Project 13: Study on combustion characteristics and fuel properties of roots from selected agroforestry tree species [IWS/WE/XI-91/2008-June 2009]

Status: A detailed study on fuelwood properties (proximate and elemental analysis) of roots of selected agroforestry species i.e., *G. robusta*, *C. equisetifolia*, *E. hybrid* and *A. nilotica* was carried out. Study on combustion characteristic under oxidizing and inert atmosphere is under progress.

Project 14: Development of database on Red Sanders (*Pterocarpus santalinus* L.) [IWS/ITCell/XI-87/2008-10]

Status: Purchased the required equipments. Recruited Project Assistant. Model design of website was prepared. Visited Tirumala hills and Sri Venkateshwara University, Tirupati for data collection.

EXTERNALLY AIDED PROJECTS

Project 1: Improvement of Weathering Properties of Wood Surfaces by Chemical Modification (Funding agency: CSIR) [2009-12]

Status: New Project initiated on 1st March 2009.

Project 2: Second National Communication (NATCOM-II) Project on “Assessment of Soil Carbon Stocks and Dynamics in Forest Soils of India for the Period 1995-2007” (Funding agency: UNDP/GEF-MoEF) [2008-09]

Status: Soil samples from 53 selected points of 16 different forest types including 8 points of non forest areas have been studied and collected from 0-30 cm depth and analysed for total organic carbon content and bulk density. The report was submitted.

Project 3: Development of package of practices for the management of teak heart wood borer, *Alcterogystia cadambae* (Moore) (Funding agency: Karnataka Forest Department) [IWS/WBD/EXT/KFD/034/2008-09]

Status: Surveyed the pest incidence in the identified study areas: Doginal and Kirwatti in Yellapur division of Karnataka. Installed 3 light traps (One is solar powered) for the monitoring of the pests in the infested plantations. Adult activity monitored from light trap collections from the infested plantations. Mechanical control by larval traps and soil traps were tested and role of bird predators documented. Biocontrol by nematode injections into infected trunk was tested at Doginal plantation.

Project 4: Improvement of planting Stock of forestry species using ecofriendly biofertilizer like VAM fungi (Funding agency: Karnataka Forest Department) [IWS/WBD/EXT/KFD/054/2008-09]

Status: Survey was carried out in Shimoga, Hasan and Mysore district collected rhizosphere soil. Spore count and percent of infection was estimated from the rhizosphere soil of selected plants. Spore density varied from one species to another and also with different location. All the selected plant species showed AM infection, but with varying frequency, altogether ten species of fungi belonging to 5 genera were recorded. Predominant species were Gigaspora, Glomus and Sclerocystis in Shimoga area and only Gigaspora and Glomus are dominating in Hasan area. 30-50% of increase in growth was observed in treated seedlings. Highest percent growth increment was observed in Eucalyptus followed by Casuarinas, Acacia and Teak. Three demonstration programmes were conducted in Kadugodi and IWS, Bangaluru. Two thousand five hundred copies of brochures, both in Kannada and English were prepared.

Project 5: Testing the efficacy of TBTM-MMA preservative developed by NMRL in Visakhapatnam and Kochi ports (Funding agency: Naval Materials Research Laboratory, DRDO, Ambernath, Mumbai) [IWS/WBD(M)/EXT/NMRL/038/2008-11]

Status: TBTM-MMA treated wooden test panels of *Paraserianthes falcataria* and *Bombax ceiba* along with controls were exposed at Slipway Complex, Visakhapatnam port and North Jetty, Naval Base, Kochi. Monthly observations were made on the fouling organisms settling on the panels and wood boring organisms attacking them. The untreated panels of both the species were destroyed in 6-12 months. Treated panels at Kochi were attacked by sphaeromatids but those at Visakhapatnam harbour remained free at the end of 12 months.

Project 6: Investigations on marine fouling and wood boring organisms in Machilipatnam and Nizampatnam ports, Andhra Pradesh (Funding agency: Ministry of Earth Sciences, Government of India, New Delhi) [IWS/WBD(M)/EXT/MoES/040/2008-2010]

Status: Wooden test panels of 150 x 80 x 20 mm size were exposed at Machilipatnam and Nizampatnam ports to trap marine fouling and wood boring organisms. They were retrieved at monthly intervals and observations made on the percent cover of panel surface by fouling organisms, species of fouling organisms, their number/density, size attained, etc. Wood boring organisms were extracted and identified. All the species of fouling and wood boring organisms were maintained as voucher specimens. Water samples were collected and analyzed for hydrographical parameters like temperature, pH, salinity, dissolved oxygen and nutrients. Long term panels were exposed at a time and retrieved at monthly intervals to study the recruitment of fouling organisms at the end of 2, 3, 4.....12 months.

Project 7: Structure, diversity and germination syndrome in tropical evergreen forest – A case study from Western ghats of Karnataka using permanent preservation plots (Funding agency: Karnataka Forest Department) [IWST/TIP/EXT/KFD/047/2008-09]

Status: Vegetation analysis of data collected of PPPs in 3 sites; Makuta, Muchiladuka and Malemane falling in South, Central and Northern part of tropical wet evergreen forests of Western ghats, Karnataka from 1937-2008 completed. Parameters like diversity index, similarity index, population structure worked out. Regeneration trends of these forest types represented by the PPPs worked out according to four regeneration category classes.

Project 8: Distribution, natural regeneration and identification of seed stands and candidate plus trees in *Chloroxylon swietenia* (Funding agency: Karnataka Forest Department) [IWST/TIP/EXT/KFD/056/2008-09]

Status: *Chloroxylon swietenia* is an important species which falls in vulnerable category as reported by IUCN. Regeneration status of this species was documented. Three seed stands and three candidate plus trees have been identified. The seed stands can be used as a source of seed collection.

Project 9: Seed dormancy and germination behaviour in *Buchanania lanzan* Spreng. and *Diospyros melanoxylon* Roxb. (Funding agency: Karnataka Forest Department) [IWST/TIP/EXT/KFD/057/2008-09]

Status: Seeds of *B. lanzan* were collected from Tumkur, Shira, Bidar and Agumbe and for *D. melanoxylon* from Kollegal, in Karnataka, Chandrapur in Maharashtra and Jabalpur in Madhya Pradesh. Between the species were found to have seed dormancy. In *B. lanzan*, fully mature depulped seeds treated with gibberlic acid enhanced germination percentage, while in *D. melanoxylon* pretreatment with bleaching powder, followed by gibberlic acid treatment enhanced germination. Natural regeneration in both species is predominantly by root suckers.

Project 10: Theoretical analysis of sorption isotherms by Brunauer, Emmet and Teller theory and standardization of optimum conditions for seed storage of *Bambusa bambos* and *Jatropha curcus* (Funding agency: IFS/Sweden) [IWST/TIP/EXT/IFS/058/2008-11]

Status: Purchased BOD incubator, glass dessicators, chemicals, colour printer and sys-stat software. Collected seeds of *Jatropha curcus*.

TECHNOLOGY ASSESSED AND TRANSFERRED

- Technology on bamboo fibre filled thermoplastic composites is being transferred to an entrepreneur.

EDUCATION AND TRAINING

Training-cum-Demonstration Programs

- A training-cum-demonstration program on “Nursery Technologies”, “Wood Utilization” and “Portable Distillation Unit” was conducted on 10th July 2008 at Van Vigyan Kendra, Andhra Pradesh.
- A training-cum-demonstration program on “Nursery Technologies” was conducted on 25th July 2008 at Van Vigyan Kendra, Bangaluru.
- An extension program at Van Vigyan Kendra at Forest Administrative Training Institute, Kadugodi, Bangaluru on 19th September 2008.



- Demonstration programmes on Forestry and Wood Science Technology was organized at VVK Karnataka from 15th to 17th October 2008.
- A demonstration-cum-lecture programme was organized at VVK, Hyderabad on 28th November 2008, Mrs. D. Venmalar and Dr. Ashutosh participated in the programme.
- Training-cum-demonstration programme was organized at Kadugodi, VVK, Bangaluru on wood utilization, portable distillation unit, nursery techniques and wood biodegradation on 23rd December 2008.
- A demonstration workshop on “New Bamboo Species Cultivation and Sandal” was conducted in Forest Department, Koppa on 16th December 2008.
- A training-cum-demonstration programme was conducted on bamboo treatment and management at VVK, Hyderabad on 23rd December 2008. A Portable distillation unit was installed.
- A training programme on “Nursery Practices, Propagation and Agroforestry Models” was organized for the farmers of Byranahalli village (Demo) at IWS, Bangaluru on 8th January 2009.
- Demonstration programme on “Wood Utilization” and “Portable Distillation Unit” at VVK, Kadugodi on 21st January 2009.
- A demonstration workshop on “Forestry and Wood Science Technology” was organized at Somwarpet on 31st January 2009.
- Training programme on “Sandal Seed, Nursery and Cultivation” was organized at IWS from 9th to 14th February 2009.
- A training program on “Nursery Techniques and Management” was organized at Van Vigyan Kendra, Kadugodi, Karnataka on 17th February 2009.
- A demonstration workshop on “Forestry and Wood Science Technologies” was organized at FRC and VVK, Andhra Pradesh.
- Two trainings were imparted to PG students of M.S. Ramaiah College, UAS, GKVK and IISc, Bangaluru on “Extraction, Chromatographic Techniques and Instrumental Analysis” from 1st to 3rd January 2009 and 10th to 12th February 2009.

Short Term Training Programs

- “Wood Seasoning & Preservation” from 15th to 19th September 2008.
- “Nursery practices of Sandal” from 24th to 26th September 2008.
- “Wood Protection” on 20th October 2008.
- “Timber Joinery” from 24th to 28th November 2008.
- “Classification and Grading of Timber” from 1st to 3rd December 2008.
- “Extraction/Chromotography Techniques and Instrumental Analysis” from 1st to 3rd January 2009.
- “Extraction/Chromotography Techniques and Instrumental Analysis” from 10th to 12th February 2009.
- “Plant Tissue Culture” for State Forest officials of Goa State Forest Department from September 8th to 10th October 2008.



Training Received

- “Statistical Techniques for Research Methodology” for scientist of ICFRE organized by Indian Agricultural Statistics Research Institute during 26th December 2008 to 7th January 2009 at New Delhi.
- “Integrated Pest Management” sponsored by NCIPM, New Delhi from 11th to 19th February 2009.

LINKAGES AND COLLABORATION

International

- Department of Forest Products Technology, Helsinki University of Technology, Finland.

National

- Collaboration with CCRI, Chikkamagalur (for the revised PCR preparation), University of Agricultural Sciences, Bangaluru, Orissa State Forest Department, Karnataka Forest Department, Office of the Development Commissioner, Handicrafts, Bangaluru.
- 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, Indian Navy, Visakhapatnam and Indian Institute of Remote Sensing, Dehradun.
- Linkages with State Forest Department, Karnataka, Andhra Pradesh Forest Department, Goa Forest Department, Bangaluru University, Bangaluru, University of Agricultural Sciences, Bangaluru, University of Agricultural Sciences, Dharwad and Indian Institute of Sciences, Bangaluru.
- Linkages developed with National Institute for Malaria Research and Institute of Bioinformatics and Applied Biotechnology, Bangaluru.

PUBLICATIONS

• Pamphlets (Telugu)

1. Sandal
2. Nursery Practices
3. Portable Distillation Unit
4. Sap Displacement Techniques for treating small girth timber and bamboo
5. *Ficus bengalensis*
6. *Pongamia pinnata*
7. *Tectona grandis*
8. *Moringa olifera*
9. *Casuarina equisetifolia*
10. *Acacia nilotica*
11. *Dalbergia sissoo*

- **Pamphlets (Kannada)**

1. Sandal
2. Nursery Practices
3. Portable Distillation Unit
4. Sap Displacement Techniques for treating small girth timber and bamboo

- **Pamphlets (English)**

1. Sandal
2. Nursery Practices
3. Portable Distillation Unit
4. Sap Displacement Techniques for treating small girth timber and bamboo

- **Pamphlets (Konkani)**

1. Nursery Practices
2. Portable Distillation Unit
3. Sap Displacement Techniques for treating small girth timber and bamboo
4. Ammonia Plasticization
5. Ammonia Fumigation

Handout on Institute Activities

- Proceedings of National Seminar on “Conservation, Improvement, Cultivation and Management of Sandal” was published.

CONSULTANCIES

- 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.
- Quality certification and development of criteria with regard to purchase and maintenance of Vahanam Thandlu/Dwajasthambams for use in TTD Temples.
- “Wood Seasoning and Wood Protection” to Mr. Jagdish Verma, Green Craft, Mumbai on 24th February 2009 at IWST, Bangaluru.
- Preparation of EIA/EMP studies for diversion of forest land for bauxite mining in Jerrela blocks of reserve forest in Visakhapatnam of APMDC, Hyderabad.
- Preparation of Catchment Area Treatment Plan for diversion of forest land for bauxite mining in Jerrila blocks of reserve forest in Visakhapatnam of APMDC, Hyderabad.
- Preparation of EIA/EMP for diversion of forest land for Iron Ore mining in Ankua Iron Ore Deposits, Jharkhand in favour of JSW Limited, Jharkhand.
- EIA/EMP studies of Sankosh Multipurpose Hydro Project, Bhutan (THDC) in favour of Tehri Hydroelectric Development Corporation Ltd.
- Study on diversion of Gorrepeta Vagu impact assessment on flora and fauna in favour of SCCL, Manuguru, Khammam district.
- Consultancy on Ammonia fumigation to SUTHAR, Bangaluru on 29th May 2008.

- Wood Treatment Technology to M/s Om Shantidham, Bangaluru during November 2008.
- Consultancy on Wood Seasoning and Protection to Green Wood Craft, Noida, UP during 24th and 25th February 2009.

PATENTS OBTAINED/FILED

A patent application on “An Improved Bamboo Fibre Polypropylene Composite and a Process for Obtaining the Composite Thereof” 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

1. Attended

The representatives from Institute of Wood Science and Technology, Bangaluru attended the Workshops/Seminars/Conferences/Symposia as given below during the period under report:

(a) International

- International Symposium on “Wood Science and Technology 2008 (IAWPS2008) at North-east Forestry University, Harbin, China from 27th to 29th September 2008.
- FORTROP II - International Conference on “Tropical Forestry Change in a Changing World” at Kasetsart University, Bangkok, Thailand held from 17th to 20th November 2008.

(b) National

- Institute participated in Krishi Melas at Mandya on 28th and 29th November 2008 and at Suttur (Mysore) from 22nd to 27th January 2009.
- Institute participated in Delhi wood 2009 from 14th to 17th February 2009 at Pragati Maidan, New Delhi.
- Institute participated in Tree Growers Mela organized by Institute of Forest Genetics and Tree Breeding, Coimbatore together with Extension Wing of Tamil Nadu Forest Department on 7th and 8th March 2009.
- Institute participated in Ply and Panel Asia 2009 organized by Ply and Panel Asia 2009 and Space Crafts at Palace grounds, Bangaluru from 20th to 22nd March 2009.
- RE division of MoEF, conducted 8th meeting of expert group on conservation and sustainable utilization of natural resources on 4th and 5th December 2008.
- Workshop on “Extension Strategy in Forestry Research” at ICFRE on 15th and 16th January 2009.
- XIVth meeting of the wood and other Lignocellulosic Products Sectional Committee, CED 20th in Joint Session with Sub-Committees CED 20:1 and CED 20:6 organised by Bureau of Indian Standards, New Delhi, BIS, Bangaluru Branch, Peenya, Bangaluru on 24 March 2009.
- National Seminar on wood based handicrafts held at Mysore on 23rd and 24th December 2008 organized by Office of the Development Commissioner (Handicrafts), Ministry of Textiles, Chennai.



- Training programme on “Technology Commercialization at ASCI”, Hyderabad from 14th to 25th October 2008.
- “Vegetation Carbon Pool Assessment” workshop at IIRS, Dehradun on 7th and 8th November 2008.
- National Symposium on “Non-Chemical Insect Pest Management” held at Entomology Research Institute, Loyola College, Chennai on 5th and 6th February 2009.
- “National Seminar on “Wood based Handicrafts”, Mysore on 23rd December 2008.
- Training on “Mainstreaming Biodiversity in Impact Assessment” at WII, Dehradun from 18th to 22nd August 2008.
- International workshop on “Nocturnal Pollination: Patterns & Process” at IISc. from 23rd to 27th March 2009.

2. Organized

(a) International

- One day Indo-Italian Seminar on “Standardization of wood testing processes” was conducted on 5th November 2008.

(b) National

- An Interactive Meeting with fishermen of Kuppam (Kovallam) village near Chennai, was conducted on 22nd June 2008. Director, IWST explained the objectives of the meeting and informed the fishermen that the Institute will be distributing catamarans made of alternative timber species under MoEF project. The farmers were informed about the economic benefit on using such catamarans.
- An interactive meeting with the farmers of Byrenahalli village (adopted for transfer of technologies) was organized on 3rd July 2008.
- Liaison meeting with stakeholders was held on 15th July 2008.

AWARDS

- The Director General, ICFRE has announced the “ICFRE Awards for Excellence” in Forest Protection for the year 2005-06 to Dr. O.K. Remadevi, Scientist-F and Head, WBD in May 2008.

DISTINGUISHED VISITORS

- Sri J.C. Kala, Former DG (Forests), Special Secretary to Govt. of India and Member, ICFRE Society visited the Institute on 11th April 2008.
- Additional Chief Secretary (Forests), Government of Maharashtra visited the institute on 30th April 2008.
- Sergio Mina, Director, BIESEE visited the Institute on 17th July 2008.
- Mr. Chowna Mein, Honourable Minister Rural Development & Rural Works Department, Arunachala Pradesh visited the Institute on 1st September 2008.
- Prof. (Dr) Lidia Szpyrkowicz, Scientific Counsellor, Embassy of Italy, New Delhi visited the institute on 5th November 2008.



- Rajan Gurukul, Vice Chairman, Mahatma Gandhi University, Kottayam; Dr. R.S. Deshpandey, Director, ISEC; Dr. Michael Tharakkan, R.K. Hegde Chair, ISEC; Dr. N.H. Ravindranath, Professor and Chairman ASTRA visited the Institute and held interactive meeting with the scientists on 17th December 2008.
- Sri. Sudhir Pandey, former DG (Forests), MoEF, Government of India and Advisor, NMBA visited the Institute on 27th February 2009.

MISCELLANEOUS

- Celebrated International Day for Biological Diversity (IBD) 2008 on 22nd May 2008.
- Timber testing: During the year, 104 enquiries for identification (246 samples) including enquiries of confidential nature, 30 enquiries (72 samples) for moisture content and bulk density, 2 enquiries (16 samples) for strength properties tests were attended.

FOREST RESEARCH CENTRE HYDERABAD

The Forest Research Centre (FRC), Hyderabad started functioning under the administrative control of Institute of Wood Science and Technology, Bangaluru 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 office administrative buildings, laboratories, library, rest house, research nursery, experimental plots and a residential quarters for the office staff. The research activities have began to meet the research needs of the Southern Dry Deciduous Ecosystems of the states of Andhra Pradesh, Karnataka and Goa on all aspects in the field of forestry research.

PROJECTS COMPLETED DURING THE YEAR 2008-2009

PLAN PROJECTS

Project 1: Reclamation of Iron Ore Minespoil in Karnataka through afforestation

Findings: Eucalyptus the physical, chemical, biological analysis of Iron Ore Minespoil, and selection of suitable plant species for the Iron Ore Minespoil in the nursery were completed. *Pongamia pinnata*, *Eucalyptus*, *Casuarina equisetifolia*, *Cassia siamea*, *Emblia officinalis* were selected in the nursery experiment for the afforestation of Iron Ore Minespoil. Planting of 5 tree species with different soil amendment techniques were also completed by imposing the treatment with biofertilizers VAM, Rhizobium, Azospirillum, *Pisolithes tinctorius*, mulching, sowing of cover crops such as *Senna angustifolia*, *Catharanthes roseus* were done in the Iron Ore Minespoil. The growth data were collected. Interpretation of growth data, soil chemical data collected from the Iron Ore Minespoil is in progress. Iron Ore Minespoil amended with biofertilizer along with cover crops have encouraged better growth compared to other treatments. The preparation of the final project report is being continued for submission.

Project 2: Bioecology and Integrated management of Insect Pests of Aonla, *Emblia officinalis* Gaertn.

Findings: The seasonality of insect pests of Aonla was recorded at two locations at Hyderabad and Rajahmundry. Fifty one insect species of economic importance and twenty spider species



were recorded during the study period. The following were identified as key insect pests in Aonla production system and needs deliberate management tactics to be followed for realized yield potential of aonla cultivars.

1. Aonla aphid, *Schoutedenia* (=Cerciaphis) *emblica* Patil & Kulkarni
2. Gall insect, *Betuosa stylophora* Swinh.
3. Bark eating caterpillar, *Indarbela* sp.
4. Sphearical mealybug, *Nipaecoccus viridis* (Newstead)

S. emblica density was rated on a scale of 0-10, where 0 is for no incidence and 10 for highest density. The mean rating of density of *S. emblica* was 1.7. In cultivars Krishna, Kanchan and PD, *S. emblica* density was higher than the over all mean density and in the rest of the cultivars it is lower. Cultivar Kanchan was recorded for highest density (2.8) and Anand for lowest aphid density. In case of stem galls caused by *B. stylophora*, mean no. of galls per plant were highly variable. In cultivars Krishna lowest number of galls (3.5) per plant was recorded. On the other hand in Anand (27.2) followed by Kanchan (22.2), highest number of galls per plant were noticed. Number of galleries caused by *Indarbela* sp. were maximum in the cultivar Francis (8.7) followed by the cultivars LU (8.2) and Anand (7.5). Cultivar PD was noticed with minimum number of galleries per plant.

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, *S. emblica* on the cultivar Chakiya. Experiment was replicated thrice with three trees per replication. One untreated control was maintained. In this preliminary trial, normal dosages that are recommended in tree crops for were followed. Absolute counts of number of aphids per determinate branch (5th or 6th from the growing tip) were taken with the help of a hand lens. Counts were taken before the treatment and one day after treatment (DAT), 3 DAT, 5 DAT and & 7DAT. Perusal of data revealed that before the treatment aphid population was distributed homogeneously on all the treatments. After the spraying all the insecticides were found effective. However Dimethoate, Confidor, and Profenophos were found highly effective. Neemarin was least effective.

PROJECTS ONGOING DURING THE YEAR 2008-2009

EXTERNALLY AIDED PROJECTS

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+Sanddal, Rosewood+Sanddal, Eucalyptus+Sanddal trees and in combination with Teak and their respective sole crops. Rosewood+Sanddal 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 Districts 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.

Project 2: Genetic Improvement of *Melia dubia* and *Melia azadirach* through plus tree selection assessment of genetic variation and establishment of progeny trial (phase – I)

Status: 1. Raising of *Melia dubia* seedlings for progeny trial establishment. Collection of seeds from plus trees of *Melia dubia* and *Melia azadirach* for oil extent estimation. Studied morphological attributes of seeds of *Melia dubia* and *Melia azadirach*.

NEW PROJECT INITIATED DURING THE YEAR 2008-2009

Management of insect pests of *Gmelina arborea* Roxb. with particular emphasis on *Tingis beesoni* Drake (Tingidae: Hemiptera) and disease surveillance.

EDUCATION & TRAINING

- Training on “Mainstreaming Biodiversity in Environment Impact Assessment” held in Wildlife Institute of India, Dehradun during 18th to 22nd August 2008.
- One week compulsory training programme for the senior Forest Officers at Indira Gandhi National Forest Academy, Dehradun in the month of October 2008.
- Tissue culture training organised at IWS, Bengaluru was attended from 1st to 7th February 2009.
- Tissue culture training organised at IWS, Bengaluru was attended from 21st to 25th January 2009.
- Training on “Pest Management” held in NCIPM, IARI, New Delhi during 10th to 19th February 2009.
- Training on Vegetation Carbon Pool Assessment on Biomass estimation in Forests and outside Forests by IIRS, Dr. Sarnam Singh at Srisailem, Mahabubnagar from 8th to 12th December 2008.

LINKAGES & COLLABORATION

FRC, Hyderabad presently has two ongoing projects in collaboration with NMPB, Hyderabad.

CONSULTANCIES

1. Consultancy on Biomass estimation and Carbon Sequestration Carbon foot prints ITC Infotech, Bengaluru.
2. “Study on diversion of gorrepata vagu impact assessment on flora and fauna – Singareni Collieries Company Limited, Manuguru, Khammam, Andhra Pradesh”.

CONFERENCE/MEETINGS/WORKSHOPS/SYMPOSIA/EXHIBITIONS

1. Attended

The representatives from Forest Research Centre, Hyderabad attended the Workshops/Seminars/Conferences/Symposia as given below during the period under report:

International

- International seminar on Green Growth on 18th December 2008 in ICFAI Business School, Hyderabad organised by ICFAI Business School, Hyderabad and Andhra Pradesh Forest Academy.



National

- National workshop on Biopiracy organised by Andhra Pradesh State Biodiversity Board on 23rd August 2008.
- National Workshop on “Vegetation Carbon Pool Assessment (ISRO-GBP)” at Indian Institute of Remote Sensing, Dehradun on 7th and 8th November 2008.

2. Organized

- One day training organised for 30 graduates in Pharmacy College on 18th February 2009 on Conservation of Biodiversity and cultivation of Medicinal plants.
- One day training organised for 50 members from Andhra Pradesh Forest department Andhra Pradesh forest Academy, Nursery growers, Carpenters and Saw Mill owners on 19th March 2009.
- Training organised for 25 farmers from semi-arid regions on 23rd March 2009 on Agroforestry systems with special reference to cultivation of medicinal plants.

MISCELLANEOUS

- Vana Mahostava was organised in the campus on 29th July 2008.
- Vigilance Week Celebrated from 3rd to 7th November 2008.
- Hindi Diwas was celebrated on 22nd December 2008 and awards given to the best officers who implement the Hindi.

