

## PROJECTS COMPLETED DURING THE YEAR 2007-08

### 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/m<sup>3</sup>) while the basic density varied from 550 to 750 kg/m<sup>3</sup>.

#### **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 31<sup>st</sup> 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 parksi* 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 h and 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 h to 3 h. The yield of charcoal prepared at 12 °C min<sup>-1</sup> was slightly less as compared to its value at 4 °C min<sup>-1</sup>. 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.