

## FRI

### **Project 1: Evaluation of Australian seed sources and families of *Eucalyptus tereticornis* for productivity and genetic improvement PHASE II**

**Findings:** Provenance -cum- progeny trials evaluated on the basis of various morpho-metric traits after data recording and its analysis. North Queens land Provenances were identified as good performers (particularly Laura river and Petford provenance). Forty-seven promising phenotypes representing different sources and families of *E.tereticornis* were identified and marked based on index selection, their coppicing and rooting ability was ascertained. Twenty-four new clones developed and established in VMG at FRI. A clonal trial with 13 clones established at Manakpur (Haryana) Insect and disease incidence was recorded. Intra species hybridization was carried out between the best sources.

### **Project 2: Impact of ban on green felling on the plant diversity of selected sites in Uttarakhand [ FRI-357/Bot-52]**

**Findings:** Vegetative analysis of unallotted seeding and final felling sites of Chirpine and Deodar forest of Chakrata and Nainital division were carried out. Regeneration was observed in seeding and final felling sites in both the species. Regeneration of chirpine was observed in some compartments of northern aspect in Chakrata. However, in Nainital and Almora, regeneration was observed in both aspects. In case of deodar, regeneration was observed in some compartments of southern aspect. Check list of ground vegetation was made. No significant difference in plant diversity in unallotted seeding and final felling sites was observed.

### **Project 3: Preparation of Weight and Volume Tables for Agroforestry Tree Species.**

**Findings:** Weight and volume tables for *Melia composite*, Poplar and *Ailanthus excelsa* tree species have been prepared for use of tree growers based on the data from state of Punjab.

### **Project 4: Development & multiplication of superior bioactive clones of *Stevia rebaudiana* (FRI-320/ NWFP-19/ 2005-09)**

**Findings :** Fifty three accessions of *Stevia rebaudiana* have been collected from Uttarakhand, Delhi, Himachal Pradesh, Haryana, UP, and J&K States and introduced under field conditions for assessing their performance. Of these, 22 accessions have been analyzed for their biomass productivity and active constituent's viz., stevioside and rebaudioside percentage using HPLC technique. Breeding of accessions resulted in identification of eight high stevioside and 3 high rebaudioside rich selections which have been multiplied vegetatively.

### **Project 5: Bio-ecology and nutritional behaviour of polyphagous insect pests with special reference to *Spilarctia obliqua*. [FRI-304/FED-21]**

**Findings :** Studies were conducted on the biology and nutritional preference of *S. obliqua* on *Paulownia*, Poplar, Teak, Toon and *Brassica*.

- *Paulownia* was found to be preferred host followed by *Brassica campestris*, *Populus deltoides*, *Tectona grandis* and *Toona ciliata*.
- Total sugar was found to be maximum (88.54 mg/gdw) in *P. fortunei* followed by 55.61mg/gdw in *Brassica campestris*, 33.00mg/gdw in *P. deltoides*, 31.87 mg/gdw in *Tectona grandis* and lowest 23.53mg/gdw in *Toona ciliata*.
- Starch contents were also found maximum i.e. 79.76mg/gdw in *Paulownia fortunei* followed by *B. campestris* (43.10mg/gdw), *P. deltoides* (29.27mg/gdw), *T. grandis* (28.69 mg/gdw) and *T. ciliata* (21.12mg/gdw).
- Protein content was found to be maximum (18.10mg/gdw) in *Paulownia fortunei* followed by *Brassica campestris* (16.25mg/gdw), *Populus deltoides* (16.19mg/gdw), *Tectona grandis* (15.05mg/gdw) and *Toona ciliata* (14.12mg/gdw).
- Chlorophyll contents were found maximum, (1.14mg/gfw) in *P. deltoides*, (1.02mg/gfw) in *P. fortunei*, 0.73mg/gfw in *T. ciliata*, (0.71mg/gfw) in *B. campestris* and (0.36mg/gfw) in *T. grandis*.

### **Project 6: Endangered and rare entomogenous fungus *Cordyceps sinensis*, identification of its insect hosts and food plants of insect hosts in the Bugyals of Uttarakhand. (FRI-347/FED-22)**

**Findings** :*Cordyceps sinensis* infested larvae were collected from Bedini Bugyal, Ghoralathani, Kuramtoli, Kewala Vinayak, Bhaguwabasa and Auli Bugyals, Badrinath Forest Division.

The life cycle of the insect is completed in two years. Larval period is prolonged and lasts for 18 to 21 months and the pupal period lasts for 2-3 months. The insect is tentatively identified as *Thitarodes nepalensis* (Lepidoptera: Hepialodae).

### **Project 7: Studies on the Termite diversity of Northern India with special reference to species composition in relation to different tree species. (FRI-275/FED-19)**

**Findings** : The project has been completed and altogether 73 species belonging to 24 genera and 5 families have been recorded from Northern India, which includes 7 new species and many new distributional records: Delhi - 11 species with 6 genera belonging 3 families; includes 7 new records, Haryana - 21 species with 11 genera belonging 3 families, which includes 9 new records; Himachal Pradesh - 20 species with 8 genera belonging 5 families, which includes 10 new records, Punjab – 28 species with 11 genera belonging 2 families, which includes 14 new records Uttar Pradesh - 17 species with 8 genera belonging 2 families; includes 13 new records and 1 new species, Uttarakhand - 52 species with 14 genera belonging 5 families; includes 31 new records and 3 new species and Uttar Pradesh - 17 species with 8 genera belonging to 2 families; includes 13 new records and 1 new species. Diagrams of all the 73 species were prepared with the help of the *Camera lucida*. Keys for the identification of families, genera and species have been provided. All the 7 new species have been described and illustrated with line diagrams.

### **Project 8: Control of shisham leaf miner *Leucoptera sphenograpta* using systemic insecticides (FRI-349/ FED-24 )**

**Findings:** Experiment was laid out at Nahi Forest Block, Thano Forest Range for control of shisham leaf miner (*Leucoptera sphenograpt*) as per statistical design. Three different concentrations of Monocrotophas and Rogor were used for laying out the experiment. The concentrations used were 0.01%, 0.02% and 0.04% of both the insecticides having five replications. Post treatment observations on infestation of *Leucoptera sphenograpt* was taken and it was found that 0.04% of Monocrotophos has given maximum protection.

### **Project 9: Production and value addition by chemical derivatization of alpha cellulose of *Lantana camara* for its useful applications [FRI 345/Chem-17]**

**Findings :**Alpha cellulose isolated from stems of *Lantana camara* was subsequently modified to prepare industrially important cellulose derivatives as cyanoethyl cellulose (CEC), hydroxypropyl cellulose (HPC), Cellulose Sulphate (CS). Preparation of Methyl Cellulose (MS) by using methyl chloride (in gaseous phase) is in progress. All the variables for preparing the cellulose derivatives such as concentration of the reactants, solid liquor ration, time and temperature were optimized for maximum DS and solubility. The optimized product was evaluated with IR, SEM, TGA/DTA and WAXDs studies.

### **Project 10: Analytic Studies in Woody Cell Wall Architecture**

**Findings:** Role of microtubules in orientation of microfibril was analyzed. Orientation of microfibril with the help of cyto-skeletal microtubules is not a universal phenomenon. Due to liquid crystalline nature of cellulose, self assembly of cellulosic microfibrils is possible which help in proper orientation of microfibrils. Role of geometrical constituent in cell wall was analyzed as a mechanism of cellulosic microfibril orientation in woody cell wall. It seems that no single model is capable of explaining the entire range of observations.

### **Project 11: Studies on the effect of design parameters and different adhesives on the performance of finger joints in commercial timbers [Code Number: FRI-376/FPD(WWF) – 62]**

#### **Findings:**

**Mango:** Urea Formaldehyde adhesive always performs better than PVA in static bending and compression. The role of design parameters is not very explicit always. However, if one has to make a choice between the two cutters used, it is the cutter with design parameters  $L = 21 \text{ mm}$ ,  $P = 7 \text{ mm}$ ,  $t = 1.4 \text{ mm}$  and  $S = 0.1$  that gives better strength values.

**Eucalyptus:** Fingers profiled with first cutter and jointed using Urea Formaldehyde adhesive always perform better in static bending and compression. The role of the design parameters is quite clear unlike in the case of mango. The maximum crushing stress under compression parallel is lesser in jointed sections of eucalyptus unlike in the case of mango.

### **Project 12: Drying studies on timbers useful for Handicraft Code: FRI-378/FPD(WS)/64**

**Findings:** The chemical seasoning study done on mango and kikar wood showed that bulking treatment was very effective in controlling the surface cracks in both the wood species. This technique will help wood handicraft artisans in value addition of their products.

**Project 13: Studies on shrinkage, swelling behavior of edge bonded solid wood boards  
Code: FRI-379/FPD(WS)/65**

**Findings:** Studies were conducted on edge bonded boards of Shisham, Teak, Poplar and Pine. Fevicol and UF jointed boards showed similar trends of swelling irrespective of the thickness in the four species studied. Minimum swelling was observed with boards made from tangentially sawn material. Maximum swelling was observed with boards made from radially sawn material.

**Project 14: Eco-friendly preservative and fire retardants combinations for protection of structural bamboos for low cost houses FRI-350/FPD (WP)-60**

**Finding :** Six combinations of fire retardant chemicals and preservatives at 15% conc. were tested for flame penetration, surface spread & rate of burning. Data of Flame Penetration Test was analyzed through SPSS: Species are arranged in the decreasing order of Performance: *Dendrocalamus strictus* > *Bambusa tulda* > *Bambusa arundinacea*

Whereas, Composition performance on cumulative basis are as follows:

Arranged in decreasing order of performance: Comp.4 > Comp. 2 > Comp 1>Comp.5>Comp.3> Comp.6

Composition	Ratio
1. Ammonium sulphate : Ammonium Phosphate: ZiBOC	5:5:5
2. Ammonium sulphate : ZiBOC	10:5
3. Ammonium Phosphate: ZiBOC	10:5
4. Magnesium phosphate: Magnesium pyrophosphate:ZiBOC	5:5:5
5. Magnesium phosphate: ZiBOC	10:5
6. Magnesium pyrophosphate:ZiBOC	10:5

A demonstration hut of Bamboo treated with Fire retardant compositions was constructed.

**Project 15: Studies on performance of plantation grown species in cooling towers.  
FRI/351/FPD (WP)-61**

**Findings:** Samples of *P. radiata*, *A. excelsa*, *P. roxburghii* and *T. ciliata* were treated with 4% of CCA, CCB and ZiBOC were installed in cooling tower. Study shows that treated samples have shown upto 8 fold protection over the control samples.

### **Project 16: Assessing biodiversity through maintenance of Preservation Plots of Uttarakhand. (FRI-393/Silva-36I).**

**Findings:** Studies were carried out on forest composition, and enumeration in selected preservation plots situated in three forest types i.e. tropical, sub-tropical and temperate. Data was recorded on elite trees situated in the preservation plots of Uttarakhand. Thirty Preservation Plots of Uttarakhand were surveyed and data on their present status were also collected. The Project Completion report has been submitted.

### **Project 17 - Enhancing the longevity of acorns of *Quercus dilatata* and *Quercus leucotrichophora* (FRI-354/Silva-33/ 2006-09)**

**Findings:** The acorns of *Q. leucotrichophora* exhibited much better storability than the acorns of *Q. dilatata*. The acorns stored well in hydrated (non-desiccated) condition. Lowest safe moisture content (LSMC) for acorns of banoak (*Q. leucotrichophora*) was 30% whereas acorns of moru oak (*Q. dilatata*) did not tolerate desiccation due to their maturity during rainy season.

Sub-zero (-5<sup>0</sup>C) temperature proved to be fatal for the acorns. 5<sup>0</sup>C temperature was found to be suitable for the storage of seeds of banoak as they retained above 60% viability even after 610 days in storage.

Polythene bag and steel box proved to be equally good containers for the storage of acorns as seeds stored in them retained viability for longest duration.

### **Project 18: Evaluation of Seed Orchards of *Dalbergia sissoo* for Seed Quality [Project No. FRI-355/Silva-32]**

**Findings:** Clonal Seed Orchard (CSO) and Seedling Seed Orchard (SSO) of *Dalbergia sissoo* Roxb. situated at Hissar, Yamunanagar and Hoshiarpur were evaluated for seed quality and genetic divergence at the age of about 10 years. The seeds of various clones/progenies exhibited significant variability in seed size, seed weight including pod parameters. The germination % of fresh seeds from orchards is around 100 % whereas it was 90% from general population. The storing capacity of seeds collected from orchards is more as compared to the seed collected from general plantations. The estimates of variability with regard to genetic parameters for seed traits in this study depicted wide range of variation. Moderate heritability and genetic gain was observed in seedling height and collar diameter at nursery level for about one year old seedlings raised from seeds of CSO and SSO's.

### **Project 19: Multilocation trials of promising clones of *Gmelina arborea* (FRI 326/Silva-30).**

**Findings :** Assemblage of 27 promising clones of *G. arborea* were collected from RFRI, Jorhat in March 2006, Total no. of cuttings sprouted in 2006 were recorded to be 63 % and total no. of cuttings rooted in the same year were 0.66%. Maximum value of sprouting were recorded 95 % in RFRI 054 and minimum value were recorded in RFRI 053 i.e. 25%. Assemblage of 20 promising clones of *G. arborea* were collected from RFRI, Jorhat in March 2007. Total no. of cuttings sprouted in 2007 were recorded to be 73

% and total no. of cutting rooted in the same year were 1.3 %. Maximum value of sprouting were recorded 89 % in RFRI 106 and minimum value were recorded in RFRI 004 i.e. 45%. Assemblage of 20 promising clones of *G. arborea* were collected from RFRI, Jorhat in March 2008. Total no. of cutting sprouted in 2008 were recorded to be 75.7 % and total no. of cutting rooted in the same year were 1.1%. Maximum value of sprouting were recorded 95 % in RFRI 037 and minimum value were recorded in RFRI 003 and 017 i.e 45%. It was observed that all three year sprouting was above 60 % but rooting was only around 1 %. After two months of planting of cuttings in polybags /field, no good rooting percentage could take place under best possible conditions also. This result of *Gmelina* rooting proves that *Gmelina* RFRI clones were hard to root under Dehradun conditions. Field trial of cuttings and seedlings of *Gmelina* at Majari compartment no 1 of Timli range (at Kalsi forest division) was laid, Total 140 seedlings were planted along with 5 survived promising clones plants of RFRI (RFRI-079, RFRI-106, RFRI-004, RFRI-027, RFRI-007) and F.R.I Tree 1,2,3,4 and also Tree 1,2,3,4 of Barkot range (Hardwar). Of each 5 plants were planted in field.

### **Project 20: Studies on seasonal distribution of weeds in forest nursery and eco-friendly methods of their control [FRI-392/Silva-35]**

**Findings:** Carried out experiments to study effect of leachates on vegetative propagules of weeds, on seeds of weed, on plants of test species vis-a-vis hand weeding and to study effect of dry leaves in combination with hand weeding on weed control.

### **Project 21: Effect of Pine & Oak forests on agricultural crops [FRI-327/SF-10]**

**Findings:** Survey of selected sites in Uttarakhand has been made to know the status of Chir pine and Oak. Soil profile of area falling under oak forest has been studied. Data on agriculture crops are being recorded and analyzed. Study on vegetation has been done in oak and chir pine forests in project area.

## **AFRI**

### **Project 1: Assessment of International Neem Provenance Trial (AFRI-78/FGTB/2006-2009)**

**Findings:** Provenance trials of Neem were established by AFRI as a collaborating institute in International Neem Network with an aim to improve the genetic quality and adaptability of Neem and to improve its utilization. The materials for the present investigation come from one of these Provenance trials located at Jaipur. This trial was initially established with 18 provenances including 8 international and 10 Indian provenances in the year 1996. At the time of initiation of the project, only 12 provenances were present and the other provenances were succumbed to extreme biotic factors like frost and heat. 3 of the 12 provenances are from Yezin (Myanmar), Geta, Dhangadhai (Nepal) and Chamnion (Tanzania), and the rest of the 9 provenances are from India. The statistical analysis showed no significant difference between the provenances in terms of growth traits i.e. height and diameter at breast height(dbh). Among the international provenances, the provenance from Nepal (Geta, Dhangadhai) showed good growth in height which was above the mean height during the years 2006 and 2008, except in the year 2007. The mean growth of this Nepal provenance (5.37 m) was the best among all other provenances. Other

two introduced provenances showed less height growth than the mean. Most of the Indian provenances, which performed better in growth, did not show stability in the assessment years. Only two provenances viz. Kalyani, Mandore and local seed source (Jaipur) maintained consistency in their growth during the assessment years. The Yezin (Myanmar) and Chamnion (Tanzania) provenances and Ramannaguda and Sagar provenances from India continuously performing poor. The Geta (Dhangadhai) provenance from Nepal showed more growth in both height and dbh than the mean. Except the Ramannaguda provenance, all other provenances from India had higher growth in Dbh than the mean.

There is sufficient synchronization in flowering of both the Indian and introduced provenances. The seeds obtained from the provenances showed variation in length and diameter which was ranging from 10.1 mm to 12.5 mm and 6 to 7.5 mm respectively. Among the introduced provenances, the seed size of the Yezin (Myanmar) provenances was almost equal to the size of the Indian provenances. The oil content was ranging from 36.34% to 43.24% in kernel. The variation in oil content amongst the provenances was statistically significant. The provenances from Ramannaguda and local seed source (control) had higher oil content (<43%) and which was followed by the Tanzanian provenance (41.13). The other introduced provenances had oil content on par with other Indian provenances (36% and above).

In the present study, all the introduced provenances had synchronization in flowering and produced seeds. Hence, these provenances can further be best utilized for further improvement programme by introducing more provenances and individual superior trees from tested ecological zone.



Neem tree (Kalyani prov.) in Peak flowering



Close view of flowering branch



Tertiary branch with fruits

## **Project 2: Relative Resistance of Neem Provenances to Insect Pests and Mites and Their Bio management In Arid Areas. (AFRI-73/FPD/2006-09)**

### **Findings:**

**Relative resistance of neem provenances to neem weevil, *M. tenuicornis*:** An experiment has been conducted to study the resistance of 39 neem provenances to neem weevil, *Myloccerus tenuicornis*. The provenance from Palanpur and Jhansi exhibited the least preference for the larvae (0.65

and 0.69 cm sq.), whereas the provenance from Mulag was found to be the most favoured or susceptible host as the leaf area consumed by larvae was 3.11 sq cm.

**Microbial control agent of neem weevil:** Infection of an entomopathogenic fungus, *Beauveria bassiana* has been observed in the adult population of neem weevil, *M. Tenuicornis*. Efficacy of this entomopathogenic fungus has been studied.

**Bioecology of neem defoliator:** A complete life cycle under different generations took an average period of 39.75 days which ranges from 29 to 47 days under different conditions of temperature and relative humidity. The population dynamics of *Myllocerus tenuicornis* on 39 neem provenances is in progress. Periodical data are being collected and being analyzed. Seasonal variation of economically important insect pests i.e. sap suckers and defoliators has been studied. The mortality data on pest incidence have been recorded.

### **Project 3: Developing strategies and methodologies for extension of forestry research technologies in semi-arid and arid areas. (AFRI-71/AFE/2005-09).**

**Findings:** Dissemination of research information was ensured by participation in farmers fair held at CAZRI, Jodhpur on 12<sup>th</sup> September, 2008 and Hast Shilp Utsav held from 2<sup>nd</sup> to 11<sup>th</sup> January 2009 at Rawan Ka Chabutra, Jodhpur. Designed the material and got 80 bilingual (Hindi-English) research display material prepared for the VVK AFRI, Bichhwal, Bikaner, Rajasthan and the Interpretation Centre, AFRI. Similarly 16 research bilingual display boards were prepared in English & Gujarati for the VVK site at Rajkot, Gujarat. Strengthened Library and Information System resource data base by addition of books related to agroforestry & Extension. Prepared report on the Bamboo training programme under NMB and forestry training held for field functionaries of State Forest Department and farmers of Gujarat held at Rajpipla and Rajkot, Gujarat respectively.

### **Project 4: Screening of Exotic and indigenous plant species for their performance potential on arid salt affected soils with different level of management. (AFRI-49/NWFP/1997-09).**

**Findings:** A total of eight experimental trials were laid out on lithic, calcid, coarse sandy to loamy sand salt affected area of Gangani in Jodhpur district in different years (from 1997 to 2003). An experimental trial was laid in August 2003 with two fodder species namely *Zizyphus mauritiana* (ber) and *Colophospermum mopane*. The trial was laid with two levels of gypsum (0 and 100% soil G.R.) and three doses of nitrogen (0, 9 and 18 g of N in the form of urea) on two modes of planting (control and circular dished mound). *C. mopane* registered 92.0 % survival on CDM and 86.5 % in control after five year of planting. There was no change in survival for mopane for 36 - 60 months period while Ber (*Z. mauritiana*) recorded 17 to 48 % survival on thus failing to survive the experimental conditions. Two Factor Analysis showed that there is no effect of planting technique on survival and growth. However, in case of above ground biomass, CDM was significantly superior to control. Application of Gypsum with 9g N recorded higher

biomass compared to all other treatments. Root biomass by excavation showed that root penetrated the kankar pan up to the depth of more than one meter.

### **Other Major findings**

- Exotic shrubs of genus *Atriplex* perform well on arid saline alkali lands with FYM, and nitrogen. They produce nitrogen rich fodder used for sheep and goat. High salt content necessitate mixing with cereal residue.
- *Salvadora persica*, was the best performed indigenous tree with highest survival. It is a slow growing species, application of gypsum and nitrogen gave increase in growth and biomass production.
- *Acacia ampliceps* (exotic) tree perform very well on alkali soils with good soil depth (60 cm to 75 cm minimum) and respond well to FYM, gypsum and phosphorus application. It is a very good fodder for all the animals.
- Large pit size is necessary to mix amendments to create less salty environment during seedling establishment. Double ridged and Circular dish mounds enhanced survival of all the plant spp. by providing protection from water-logging and less salty environment. Crescent shaped drainage trenches served dual purpose- helped in leaching of salts and harvested water.
- Plantation activities helped in improving the site conditions, promoting growth of natural flora (glycophytes as well as halophytes) and natural germination of *S. persica* is also observed.

Distribution of seeds collected from experimental site: One kg seed *C.mopane* and half kg seed of *Acacia ampliceps* were given to Gujarat SFD during 2008.

### **Project 5: Quantitative estimation of biologically active secondary metabolites in some of the arid zone medicinal plants to ascertain correct harvesting time (AFRI-50/NWFP/2002-09)**

Findings: Variation of secondary metabolites in *Tribulus rajasthanensis*, *Pluchea lanceolata* and *Cassia angustifolia* in different developmental stages was studied for determining the optimum harvesting time in these species. Analysis of total saponin content in the aerial parts of *Tribulus rajasthanensis* showed that the saponin content high in the vegetative stage (5.45 %) , decreases in the flowering stage (4.1%) and, then, rises again (5.40 %). Total saponin content in fruits was found to be much less (1.5%) as compared to that present in aerial parts. The secondary metabolite ( Plucheoside ) content in leaves of *Pluchea lanceolata* was found to be maximum in the flowering stage (7.3%). It was found to increase from vegetative stage to the flowering stage and, then, decrease again. The sennoside content in leaves of *Cassia angustifolia* was found to be maximum in flowering stage (1.98%).

## TFRI

**Project 1: Documentation of (traditional knowledge) ethno-medicinal information from traditional herbal healers (Vaidyas, Ojhas, Guniyas) in central Madhya Pradesh. [Project ID No.: TFRI-084/TFRI/2005/Biod. 1(4) / (2005-2008)].**



**Findings:** The ethno-botanical study was conducted at Jabalpur, Seoni, Hoshangabad, Chhindwara, Sehor, Bhopal, Betul, Harda, Raisen and Vidisha of Madhya Pradesh to document the traditional knowledge on prevailing in the tribal communities over the years. The tribal pockets and traditional herbal healers were identified for each district for documentation work. The tribal villages were selected from tribal blocks by random sampling method.

Traditional herbal healer of Seoni district of Madhya Pradesh

Herbal plant parts for sale at Van Mela

ethno-medicine

A questionnaire/schedule was developed to document the information prevailing in the community by periodical visits.

For documentation work, local guide, villagers, traditional herbal healer (Vaidyas, Ojhas and Guniyas), tribal heads and tribal persons were contacted and enquired to gather related information. Identification of plants has been made through the local name of plant with the help of existing literature. Total 563 herbal plants from 103 traditional herbal healers were documented.

**Project 2: Impact of pollutants on growth of plants. [ICFRE – 115/TFRI-2007/Ecol-1(8)]**

**Findings:** Seventy-two sponge iron factories have come up at and around Raigarh, Chhatisgarh, India during the last 20 years. A huge amount of SO<sub>2</sub> and NO<sub>x</sub> along with CO, CO<sub>2</sub>, volatile organic compounds (VOC) and suspended particulate matters (SPM) are emitted into the atmosphere during the extraction of iron from hematite that relies on burning of inferior quality coal. SO<sub>2</sub> and NO<sub>x</sub> are the primary causes of acid rain. The other most dangerous pollutant is SPM (<1mm in diameter). Study was conducted at Raigarh to determine the detrimental effects of severe pollution on the vegetation there.

The trees at the polluted sites at Raigarh, were found to be poorly grown with reduced collar girth, stem and branches deformed, leaves being chlorotic and/or necrotic with black patches. The levels of pH and organic carbon were lower in all the polluted rhizospheric soils while the EC was found to be higher in comparison to the control samples. In the present study, the levels of exchangeable Ca<sup>++</sup> and Mg<sup>++</sup> were found to be much higher in the rhizospheric soils of the polluted samples, which strongly support the hypothesis that in acidic environment, Ca<sup>++</sup> and Mg<sup>++</sup> leach out from the roots in exchange with Fe<sup>+++</sup> and Al<sup>+++</sup> from the soil leading to deformed and retarded growth of the trees. Interestingly,

except for few species, the seeds never germinated in soil-mix with SPM in nursery. SPM and slag were dumped on roadside vegetation areas. Unlike other byproduct dykes like that of fly ash or aluminium extraction wastes or different mine overburden areas, where at least some herbs or shrubs were found to be growing naturally, no vegetation came up in the sponge iron waste slag dumps and all the tree species died shortly. This indicates that perhaps the dispersion of the SPM from the sponge iron factories would slowly render the areas unfertile turning them into deserted waste lands.

**Project 3: Studies on forest dwelling Braconids (Hymenoptera : Braconidae) from central India and their role in biological control of important forest insect pests. [081 / TFRI / 2005 / Ento-2 (10) 2005-2008].**

**Findings:** A total of 1587 samples of Braconid parasitoids collected from eleven ecological/ agro-climatic zones of Madhya Pradesh. A total of 37 Braconid species viz. *Apanteles tachardiae*, *Apanteles machaeralis*, *Apanteles hyblaeae*, *Apanteles leptothecus*, *Apanteles antipoda*, *Apanteles cajani*, *Apanteles caniae*, *Apanteles colemani*, *Apanteles hasorae*, *Apanteles bambusae*, *Apanteles agilis*, *Apanteles attevae*, *Parahormius stom*, *Parahormius nr. jason*, *Parahormius deiphobus*, *Parahormius absonus*, *Parahormius zonus*, *Parahormius rameshi*, *Hormius lamidae*, *Hormius vitabilis*, *Hormius longiventris*, *Eutropobracon granulatus*, *Cassidibracon sumodani*, *Cassidibracon indicus*, *Adialyts salicaphis*, *Adialyts arvicola*, *Trioxys (Binodoxys) rubicola*, *Trioxys (Binodoxys) indicus*, *Trioxys (Trioxys) soporensis*, *Diaeretiella rapae*, *Chelonus (Chelonus) deogiri*, *Chelonus (Chelonus) narayani*, *Chelonus (Chelonus) gastrus*, *Chelonus (Chelonus) dwibindus*, *Chelonus (Microchelonus) chailini*, *Chelonus (Microchelonus) scutellatus* & *Chelonus (Microchelonus) shyamus*, were identified up to species level. Of them, six species were proposed as the species new to science. They were illustrated and described in detail. Complete host-record of all Indian Braconid species has been prepared after careful consultation of available literature on the subject.

**Project 4: Studies on bacterial and viral diseases of teak, *Gmelina* and *Albizia* and their management. [066/TFRI/2004/Patho-1(8)].**

**Findings:** In all 245 bacterial wilt and collar rot disease samples of teak and *G. arborea* and 5 virus infected samples of *A. lebbek*, *A. procera*, *T. grandis*, *G. arborea* from 27 forest nurseries of MP, CG and MS were collected. 2-5% economic losses were recorded in different nurseries caused by bacteria and viruses. A total of 9 bacterial isolates were purified and sensitivity test carried out to assess suitability of antibiotics for their application in nursery. Experiment was conducted in nursery to control wilt and collar rot disease of teak, *A. procera*, *A. lebbek* and *Gmelina arborea*. Incidence of *Xanthomonas* leaf curl and stunting in young teak plantations at Raipura, south Panna division was recorded. Disease was successfully controlled with the application of streptomycin 0.1% in combination with monocrotophos 0.036%. The cost of treatment was found to be Rs. 952 per acre.

**Project 5: Evaluation, modification and value addition of starches of forest origin.  
[TFRI-083/NWFP/2005-2008]**

**Findings:** Physico-chemical properties of starch isolated from *Careya arborea* seed and *Curcuma aromatica* rhizome were determined. Potential of starches for preparation of different value added products was evaluated. Seeds of *C. arborea* and rhizome of *C. aromatica* have an average of 34.08 and 25.3 % starch respectively. Value added products like dextrin, syrup and pappad from starch of *Careya arborea* and pickles from carboxymethylated starch of *Curcuma aromatic* were prepared.

**Project 6: Evaluation of management systems and level of community participation under Joint Forest Management (JFM). [071/TFRI-2004/ Silvi-1(6)]**

**Findings:** A field study was conducted for assessing plant density, regeneration, coppice growth, woody perennial species and ground flora by laying out quadrat in People Protected Area (PPA), Rehabilitation of Degraded Forest (RDF) and unprotected forest area (UPF) at Udaipur forest village in Satna Forest Division and Narwar, Nipnia, Aintajhar, Singpur forest villages of south Shahdol Forest Division in Madhya Pradesh. Under PPA scheme 19 species with 1950 tree density were observed in the first year. After two years of implementation of scheme, there was 1.35% and 1.47% increase with respect to number of species and density of trees. After three years, 1.53 % and 1.68% increase was observed in respect of above parameters. Under RDF, scheme 19 species with 1605.3 tree density were observed. After three years of implementation of scheme, there were 1.11% and 1.36% increase with respect to number of species and density of trees. In unprotected, site 16 numbers of species with 1106.3 tree density was observed during the first year. After three years, 1.11 % and 1.36 % increase with respect to number of species and density of trees was noted.

As far as density of coppice of tree species was concerned, after three years of implementation of scheme, there were 9.84 times and 5.66 times more coppice production was observed in PPA and RDF as compared to that of unprotected site. Density of regeneration of tree species after three years of implementation of scheme was noticed 3.58 times and 1.98 times more in PPA and RDF as compared to unprotected site. In PPA, the ground flora was observed 1.25 times more than that of unprotected site. Due to RDF activities status of ground flora was found less as compared to PPA.

Plant density regeneration, coppice growth of woody perennials species and ground flora were better in the forests having Joint Forest Management programme as compared to the forest areas having no JFM programme.

Closure of biotic interference (including fire protection) through patrolling and CPT under PPA scheme resulted in increased biomass of upper, lower and middle storey trees, shrubs, herbs and ground flora by active involvement of local people.

Soil and moisture conservation model with emphasis on gully plugging and nala bunding etc., water table was found to increase and the water was available throughout the year. Consequently, litter thickness increased resulting in increased moisture and nutrient status of soil. Rate of soil erosion, water run-off and loss of nutrients reduced due to soil and moisture conservation activities under RDF schemes. Population of ground flora having medicinal plants were found to increase by controlling

grazing, fire protection and with active involvement of local people. Implementation of JFM programme has positive impact on socio-economic condition of people.

## IFGTB

### **Project 1: Genetic Improvement of *Eucalyptus tereticornis* through controlled pollination and molecular characterization (IFGTB/RP 3/ 2002 – 2008).**

**Findings:** Twenty clonal selections were made in *E.tereticornis* x *E.grandis* and *E.tereticornis* x *E.alba* from a 60 months inter-specific full sib family trial developed in Panampally. Both selections could be clonally multiplied. A trial was established using twenty clones (3 tree plots in five replications) at Panampally field station, Kerala.

### **Project 2: Genetic transformation of *Eucalyptus* and *Casuarina* to enhance salinity tolerance [IFGTB/RP 6/ 2000 – 2005; 2008]**

**Findings:** Protocol for regenerating seedling explants and clonal genotypes was standardised. Sporadic shoot morphogenesis and rhizogenesis were obtained from *Casuarina equisetifolia*. Hairy root cultures were established in *Eucalyptus tereticornis*. *Agrobacterium tumefaciens* strains GV2260, EHA105, LBA4404, pCAMBIA series of plasmid vectors, and gene constructs *Osmotin* and *AtNHX* were obtained and used for transformation studies in *Eucalyptus tereticornis*. Critical parameters for transformation like media supplements (Acetosyringone, buffers, sugars), strains and their concentrations, co-cultivation durations, sonication duration, antibiotic concentrations were evaluated using the gene constructs/ vectors. Optimum distances for bombardment were found. Transient GUS expression was obtained in *Eucalyptus tereticornis* using *Agrobacterium* and particle bombardment methods.

### **Project 3: Identification of conserved motifs in genes conferring salt tolerance to develop strategies for gene isolation from salt tolerant tree species [IFGTB/RP 38/2005-2008]**

**Findings:** Genes conferring salt tolerance were classified and tables in excel sheets were created for input of gene information. DNA and protein sequence information for Sodium antiporters, Calcium Transporters, High Affinity Potassium Transporters, Low Affinity Potassium transporters, Proton transporters, Water transporters, Transcription factors, Cellular signaling components, Transcription factors and protein and membrane protection were downloaded into Excel sheets. A prototype database for sodium transporters was created using MySQL and PHP. The sequences were analyzed using Clustal W and PRIFI for identification of conserved regions and deducing PCR primers that could be tested for isolation of genes from salt tolerant tree species.

### **Project 4: Origin, distribution and genetic diversity of *Jatropha curcas* in India. [IFGTB/RP43/2006-2008]**

**Findings:** Fifteen enzyme systems provided a total of 18 loci for the 56 accessions of *Jatropha curcas*. Twenty eight percent of the resolved isozyme loci were polymorphic on an average, 26.67% were found to be polymorphic and mean observed number of alleles per locus was 1.533. Average observed heterozygosity was 0.15 and expected value was 0.14 with a gene flow value of 0.24. DNA extraction procedures were standardized to avoid latex contamination. PCR protocols were optimized by carrying out variations in MgCl<sub>2</sub> concentration, primer concentration, DNA and buffer volume. A total of 120 bands whose size ranged between 300 and 2000 bp were produced using 25 primers. Genetic identities at the RAPD level varied from 0.951 to 0.998, not significantly different from the values obtained at the isozyme level. Comparison of genetic variation showed that RAPDs consistently revealed higher levels of variability than isozymes in terms of percentage of polymorphic loci, gene flow and gene diversity. Yet, the numerical congruence between the isozyme and RAPD data suggests an indication that in *J. curcas* the isozyme data provides a fairly good picture of the genetic structure.

### **Project 5: Evaluation of teak CSO at Walayar using DNA profiling (IFGTB/RP 54/2007-2008)**

**Findings:** Twenty teak clones from three different geographical locations namely Topslip, Tamil Nadu (TNT), Nilambur, Kerala (KLN and KLK), Sungam, Kerala (KLS) and South Bhadrachalam (SBL-1) of Andhra Pradesh were screened using seven RAPD primers. Of the 113 fragments, 36 were monomorphic (32%) and 77 were polymorphic (68.0%). Nei's genetic distance separated the 20 clones into 4 major clusters. DNA profiles of clone SBL 1 was unique from the rest. The clone KLN 2 was close to the TNT clones (genetic distance 0.1). TNT 1, TNT 3, TNT 4 and TNT 15 were identified as duplicates in the dendrogram corresponding to 100% similarity in RAPD bands shared between them

### **Project 6: Studies on the diversity of bee fauna of the Nilgiris [IFGTB/ RP 36/ 2005-2008]**

**Findings:** Survey was carried out in 32 sampling locations in the Nilgiris, covering 9 forest types and 4 plantations. Altogether 60 species of bees, coming under 14 genera were collected. They include, *Apis* spp. (*Apis cerana indica*, *A. florea* and *A. dorsata*), *Amegilla* spp., *Braunsapis* spp., *Ceratina* spp., *Chelostoma* sp., *Halictus* spp., *Heriades* sp., *Lasioglossum* spp., *Megachile* spp., *Nomia* spp., *Sphecodes* spp., *Thyreus* sp., *Trigona* sp. and *Xylocopa* spp.

Since the occurrence of bees is closely linked to the availability of flowering plants, data on the vegetation of all these locations was collected and phenological observations of the plants made. Among the natural forests, the Dry Deciduous Forests, Thorn Forests, Moist Deciduous Forests and the Semi-evergreen Forests were found to have the maximum diversity of bees, while the Montane Wet Temperate Forests, wherein cool conditions persist almost throughout the year, had the least diversity. The monoculture plantations of *Acacia mearnsii*, *Eucalyptus globulus*, Teak and Tea were also found to be poor in bee diversity, mainly due to lack of floristic diversity.

Data on the seasonality of various bee species, the frequency of occurrence and floral associations were also collected. The frequency of occurrence of bee species, in general, was high, during the months of March, April and May, when most of the plant species in the deciduous forests

were in bloom. The occurrence was low during the winter and rainy seasons. About 100 species of plants were recorded as nectar/ pollen sources for the bee species in the study area. They include not only tree species, but also herbs and shrubs that flower in different seasons and this diversity enables the bees to sustain their populations throughout the year. The degradation of forests, due to fire and anthropogenic factors, resulting in habitat destruction and loss of floristic diversity were found to be the major threat factors on the bee fauna in this region. Although many species of exotic plants like *Ageratina adenophora*, *Cestrum* sp., *Cytisus scoparius*, *Lantana camara*, *Passiflora mollissima*, *Ulex europaeus* and *Wedelia trilobata* were also found to act as nectar/ pollen sources for some of the common bee species, the colonization of such exotic species in the forest areas is likely to adversely affect the floristic diversity and, in turn, the bee faunal diversity

### **Project 7: Natural regeneration studies on important trees in Silent Valley National Park, Kerala [IFGTB/RP-32/2004-2009]**

**Findings:** Regeneration status of different trees in different ecosystems in Silent Valley National Park, Kerala has been studied. A total of about 150 tree species have been enumerated from the park and prepared their population structure. More than 100 species including herbs, shrubs and trees are recorded as addition to the flora of Silent valley National Park, Kerala.

In forest areas, the regeneration of dominant species like *Palaquium ellipticum*, *Myristica dactyloides*, *Reinwardtiodendron anamallayanum*, *Syzygium laetum*, *Litsea oleoides*, *Dimocarpus longan*, *Mesua ferea*, *Aglaia lawii*, *Cullenia exarillata* and *Drypetes elata* etc. was found to be frequent, whereas, species like *Actinodaphne lawsonii*, *Aphanamixis polystachya*, *Appollonias arnottii*, *Diospyros nilagirica*, *Epiprinus mallotiformis*, *Holigarna nigra*, *Hydnocarpus alpina* and *Syzygium densiflorum* showed very poor regeneration.

Tree species recorded in the grasslands in their order of dominance are *Wendlandia thyrsoides*, *Glochidion ellipticum*, *Elaeocarpus serratus* var. *serratus*, *Ligustrum perrottetii*, *Symplocos racemosa*, *Apodytes dimidiata*, *Phyllanthus emblica*, *Symplocos cochinchinensis*, *Syzygium cumini*, *Maesa indica*, *Ziziphus rugosa* and *Olea dioica*.

Species generally observed only in wet evergreen forests like *Palaquium ellipticum*, *Elaeocarpus tuberculatus*, *Litsea floribunda* and *Litsea oleoides* could also be recorded in various stages of growth viz. seedlings and saplings under the shade of above species.

## **IFP**

### **Project 1: Development of appropriate silvicultural systems for selected medicinal flora of Chhotanagpur and Santhal Parganas. [IFP-022/FMS -3/2003 – 08]**

**Findings:** Plant propagules from natural forests of West Bengal and Jharkhand were collected. Vegetative propagation techniques were



standardized for *Rauvolfia serpentine*, *Gloriosa superb*, *Asparagus racemosus* and *Withania somnifera* in Jharkhand. Growth of four species of medicinal plants were recorded under the shade of trees viz. Teak, Sisham, Khair and Sal. Exploitable plant parts of three species of medicinal plants were collected and preserved year wise for a span of four years.

### **Project 2: Vulnerability assessment of climate change and development of adaptation strategies to mitigate the impact on seed and biomass production in forest trees and herbs. [IFP-029/FMS -4/2005 – 09]**

**Findings:** Developmental stability of leaves in Neem and Sissoo is demonstrated suggesting that air pollutants and their associated changes in the environment such as increase in temperature and humidity did not induce genotypes to change to their environment. Hence, plants have inherent physiological adaptations to overcome evils of environment. Plants do not suffer under optimal water regimes, even under the influence of air pollutants indicating fair resistance to them. However, herbs showed susceptibility to diseases and pests under prolonged exposure to air pollutants.

## **IWST**

### **Project 1: Processing and evaluation of plantation grown *Simarouba glauca* DC from Orissa. (IWST/WPU/X59/2006-2009)**

**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 73/2007-2009)**

**Findings:** 60 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 53/2006-2009)**

**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 micromechanics 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/X34/2004-2009)**

**Findings:** Six species of plantation grown timbers (12-15years) *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 composition for 4 different loading of absorption viz. 4, 8, 12 and 16 kgm<sup>3</sup> and with Creosote + Furnace oil (1:1) the absorption was 40, 80, 120 and 160 kg/m<sup>3</sup>. 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/m<sup>3</sup> 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 16kgm<sup>3</sup> which can be easily achieved in both treatments with 4.25% concentration preservative for 4days 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 30minutes followed by pressure of 3 kg for 3hours 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/X64/2006-2009)**

**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 sandalwood powder (IWST/CFP/X60/2006-2009)**

**Findings:** The exhausted sandalwood 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 sandalwood 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/X46 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 *Emblica officinalis* fruit in various Agro-climatic zones of Western Ghats. (IWST/CFP/X48 2005-June 2008)**

**Findings:** This study was conducted at ten different locations within the Agro-climatic 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 (IWST/TIP/X40/2004-2009)**

**Findings:** *A. 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 *A. hybrid* in line planting was 12m and 40cm and in Gowribidanur it was 8m and 22cm, respectively. The average height and gbh of *A. hybrid* in Block planting in Kolar was 13m and 28cm and in Gowribidanur, it was 6m and 17cm 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 (ABG) was 20-25% more in *Acacia* hybrid trees under line planting. The ABG consisting of stem, branches and leaves in block planting method ranged from 70-80 kg/tree and 90-100kg/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* (IWST/TIP/X48/2005-2009)**

**Findings:** Seeds were collected from unimproved populations and SPA at Virnoli, Barchi, Baghwathi and Tittimathi, from CSO at Tittimathi and SSO at Tirupathi. 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, A.P. 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 (IWST/TIP/X41/2004-2009)**

**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 AP-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 AP-10 with average value of 101.33 cm. SGA-7 and AP-3 were the poor performing families with respect to height growth with values of 90.00 cm and 53.33cm, respectively. Similar trends were observed for collar diameter with high average values of SGA-17 (23.33mm) and AP-10 with average value of (13.33 mm). Whereas, lower values for CD were observed in case of SGA-7 (7.40 mm) and AP-3 (6.66 mm). It was noted that some of the families from Andhra Pradesh after good initial growth suffered with die-back problem.

### **Project 12: Fuel properties of important forest weeds (IWST/WE/XI-75/2007-2009)**

**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 IWST Xylarium (IWST/IT/X58/2006-2009)**

**Findings:** Web database prepared for IWST xylarium, GASS forest museum wood specimens collection and IPRTI 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.

## **HFRI**

### **Project 1: Studies on plant diversity in cold deserts of district Kinnaur, Himachal Pradesh [HFRI-029/02(EBC-11)PLAN/2004-2009]**

**Findings:** Carried out phyto-sociological studies at an altitude varying from 2700m to 5000m above msl in Labrang, Pooh, Ropa-Giavung, Lippa- Asrang, Namgia and Hango areas. Labrang area showed that the total number of plant species was 191 belonging to 47 families and 127 genera. In Lippa – Asrang area, total number of plant species was 191 belonging to 49 families and 134 genera. Pooh area revealed that the total number of plant species was 192



Nako Lake

belonging to 55 families and 136 genera. In Ropa-Giavung area, total number of plant species was 160 belonging to 51 families and 119 genera. Namgia area revealed that the total number of plant species was 142 belonging

to 49 families and 105 genera. In Hango area, total number of plant species was 130 belonging to 41 families and 101 genera. The dominant families were Asteraceae, Rosaceae, Ranunculaceae, Lamiaceae and Polygonaceae. The distribution pattern of most of the plant species was contiguous in all the areas. The Index of similarity for shrub and herb species between different altitudes was low indicates remarkable degree of dissimilarity in plant species between different altitudes.



*Waldheimia glabra*



*Arnebia guttata*



*Corydalis crassissima*

Out of 114 medicinal plant species as recorded from the areas, 24 species fall in the category of threatened plants. The ethnobotanical study carried out in Labrang, Dubling, Nako, Maling, Leo, Namgia and Hango villages of Pooh sub division and documented 40 plant species used for different purposes.

## **Project 2: Diagnostic studies of indigenous and institutionalized Participatory Forest Management in Himachal Pradesh to assess the most suited approach and its impact on forest conservation. [HFRI-025/08(PFM01) Plan 2005-2008]**

**Findings:** The most preferred species of timber, fuel and fodder were documented by local people in different PFM areas of Himachal Pradesh. The role of woman in PFM was studied. It was found that as per the guidelines of VFDC formation under PFM, women were given due representation in the state of Himachal Pradesh. However, practically in the execution of work, their role was not up to satisfactory level except in few VFDs, such as, Dhalwan in Mandi Circle and Kohbag in Shimla Circle, etc. The Participatory Forest Management may not have achieved its objectives completely but it has brought positive change in mind frame and thinking of local people and field staff towards the forest conservation.



Women participation in plantationactivities

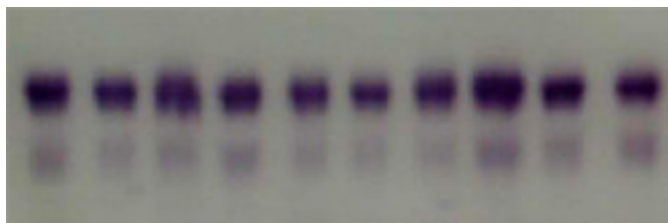


Water harvesting structure constructed

It was observed that the PFM scheme has brought positive change in attitude of people throughout the state barring few places. The PFM scheme was viewed as income generation source on daily wages basis by common people for short duration. Barring the few shortcomings, PFM scheme has helped in creation of awareness among common people regarding the importance of forest and its conservation.

**Project 3: Allozyme variation in natural populations of Deodar (*Cedrus deodara*) [HFRI-030/05(SFG-10) PLAN-03/2005-2008]**

**Findings:** Isozyme analysis has provided new information about the relative amounts of genetic variation present within and among fifteen populations of *Cedrus deodara*. Within population genetic variation was found to be higher as compared to total variation among populations. The population from Cheog forests showed higher genetic distances more than 0.03 with all other remaining populations. The tendency of grouping was witnessed between the populations based on population parameters. Taking allelic diversity and differentiation into consideration population Cheog and Nankhari remains separated from the rest of the populations. Population Chopal, Manali, Chowai, Jhungi, Dhgamoon, Chamba, Shillaru and Mashobra makes one group and the populations Sarain, Chail, Kupwara, Bhadrawah, and Kalpa can be combined into one group. The same tendency is observed for genotypic differentiation. The genetic distance values further supports this grouping as population Cheog shows relatively higher genetic distance with the remaining populations followed by population Nankhari, whereas, the other populations show less genetic distance within the group. The tendency of grouping among different populations, despite altitudinal differences, suggests common descent of the populations.



A1 A11 A1 A11 A1 A11 A1 A11 A11 A11  
 B2 B11 B1 B22 B1 B11 B1 B12 B11 B11

**RFRI**

**Project 1: Evaluation of different existing land use systems for development of viable economic models in North East India. (RFRI/ SC/06/2003-2008)**

**Findings:** The benefit cost ratio worked out for Land Use Systems (LUSs) identified at different jhum areas in Assam, Nagaland and Meghalaya. The results revealed that in Assam *Trichosanthes dioca* with

B: C (3.75) followed by *Anona comosus* (3.23) were potential LUSs among other in the list, whereas in Meghalaya *Citrus* sp. (6.09) followed by *A. comosus* were practiced as well accepted LUSs because of its prospective characteristics. The data collected from various LUSs in Nagaland revealed that the *Areca catechu* (11.4) followed by *Musa paradisiaca* (10.78) were established and highly sustainable LUSs.

### **Project 2: Management of *Bambusa nutans* for enhancing the productivity of marketable culm through silvicultural practices (RFRI/TI/13/2005-2008)**

**Findings:** Trial on thinning and soil mounding revealed that proper thinning and soil mounding of the clumps helps to enhance the productivity. Treatment combination of 20% thinning and 30 cm soil mounding was recorded with highest collar diameter and plant height. Application of fertilizer (DAP) was also found to be helpful in increasing the production with respect to culm height and collar diameter.

### **Project 3: Development of nursery for production of quality planting stock of bamboos in N.E. (RFRI/SM/06/2005-2008)**

**Findings:** In nursery, the sand, soil, FYM and vermicasting (cultured) was found to be the best media for production of bamboo planting stock in polybags. The bamboo seedlings raised in polybags were evaluated for field performance. Seedling raised in soil and vermicasting (wild) seedlings gave best performance in the field.

### **Project4 : Standardization of nursery technique of *Bambusa pallida* (RFRI/SM/07/2007-2008)**

**Findings:** Soil, sand and FYM (1:1:1) was found suitable media for propagation of *B. pallida* through culm cuttings. Culm cuttings treated with IBA 300ppm gave maximum production of new shoots with 20-25% survival. Further proliferation of plantlets gave 75-85% survival. A total of 1200 seedling raised through macro proliferation technique.

### **Project 5: The potential bamboo species with reference to carbon sequestration in Assam & Mizoram. (RFRI/EE/07/2005-2008)**

**Findings:** Carbon sequestration potential of 1, 2 & 3 years old *Bambuasa tulda* and *Dendrocalamus hamiltonii* from Hudamuagaon, Bhakatgaon and Bosepather Borgurigaon of Jorhat district, Assam and Lawipu Ram & Tural Aizawl, Mizoram and from New Sonowal, Jorhat district of Assam and Lawipu Ram & Zembouk Dai of Aizawl, Mizoram respectively was studied through biomass estimation. Above ground biomass of *D. hamiltonii* was 50% in most of the samples. In *D. hamiltonii* dry biomass ranged from 46 to 54% in 1<sup>st</sup> year, 50 to 56% in 2<sup>nd</sup> year and 48 to 57% in 3<sup>rd</sup> year culms. Whereas in *B. tulda* it ranged from 43.5 to 56.3% in 1<sup>st</sup> year., 49.5 to 56% 2<sup>nd</sup> year and 53.7 to 68.7 % in 3<sup>rd</sup> year culms.

### **Project 6: Diversity and dynamics of Arbuscular Mycorrhizal fungi and their influence on biomass production of some medicinal and aromatic plants of Assam (RFRI/FP/10/2005-2008)**

**Findings:** Diversity study of Arbuscular Mycorrhizal fungi associated with medicinal and aromatic plants was done for fifteen districts of Assam (i.e. Dibrugarh, Sivasagar, Jorhat (including Majuli Sub-Division), Golaghat, Karbi Anglong, Nagaon, Marigaon, Kamrup (Rural), Kamrup Metro, Nalbari, Barpeta, Sonitpur, North Lakhimpur, Dhemaji and Baska). Mycorrhizal spores were isolated from the collected samples and their quantification was done. Root infection percentage was also calculated and it was found that AM fungi infect the plants with varying degree.

### **Project 7: Studies on structural formation of vegetation for the conservation of biodiversity in Gibbon Wildlife Sanctuary Assam (RFRI/SC/08/2005-2008)**

**Findings:** A total of 225 plant species were enumerated from the forest (91 species of tree, 18 species of shrub, 74 species of herb and 36 species of climber). The canopy height of most of the trees (about 50%) in the study area ranged between 20-35m. The feeding height of gibbons in this study was found to be between 25 to 30 m. Identified 3 vegetation communities and other associate species. Most preferred food plants by Hoolock Gibbons were found to be 45 in number. Their phenological observations were recorded. Quantitatively all these trees are quite abundant in the study area except degraded sites.

### **Project 8: Development of Patchouli based viable agroforestry models for NE region of India (RFRI/CFE/04/2005-2008)**

**Findings:** Organized farmer visits to the On-farm trials for demonstration of the patchouli agroforestry practices. Training was imparted through lectures and practical sessions during field visits. The local entrepreneurs were also invited in the program to facilitate liaisoning with the farmers. The farmers were assured 30 % higher price by these entrepreneurs for the raw material (dry leaves) to be supplied to their industries with a purchase guarantee. Under the technical guidance of RFRI, the farmers have already started growing patchouli in their tree gardens. Primary observations reveal that the practice will be highly beneficial on sustainable basis.

### **Project 9: Comparative studies on natural resistance of bamboos to biodegradation in Assam. (RFRI/ FP/08/2005-2008)**

**Findings:** Evaluation trial of eleven bamboo species was conducted for their natural resistance against the biodegrading agents under the natural conditions of Assam. Test yards were laid at three sites *viz*, at Jorhat, Nagaon and Burnihat and were observed for the period of 18 months. The final results revealed that *Bambusa pallida* as the most resistant bamboo species and *Melocanna baccifera* the least resistant based on biomass loss during the period.

**Project 10: Investigations on the formation of agar wood in *Aquilaria malaccensis* Lamk. (RFRI/ FP/11/2006-2007)**



Infection in agar (*Aquilaria malaccensis*)  
TCS



Infection in agar (*Aquilaria malaccensis*)  
TIC

**Findings:** Symptoms of infection in agar trees have been identified. *Zeuzera conferta* (Walker), a stem borer larva along with the fungi viz., *Fusarium* spp., *Penicillium* spp., *Mucor*, *Rhizopus* sp., *Aspergillus* spp. and *Cladosporium* sp. were found to be associated with agar wood formation in Agar tree. Artificial inoculation with dominant fungi isolated from diseased wood found to be the best method for agar wood induction in agar tree as compared to other artificial methods.

**Project 11: Appraisal of tree-crop association pattern in selected Jhum areas of NE region for efficient land use under agroforestry (RFRI/SC/12/2008-2009).**

**Findings:** Keeping in view the objective to explore information on intercropping pattern and their socio-economic impacts, required for formulation of comprehensive agroforestry project with an aim of efficient utilization of land, studies were carried out in specific areas of Meghalaya (selected jhum practicing villages of West Garo Hills and East Garo Hills districts) and Mizoram (Aizawl district). Information on marketing channel and market data of raw and value added products were collected. New LUSs have also been observed in practice with some newly introduced crops under different programs of Govt. and Non-govt. agencies.

**FRC**

**Project 1: Reclamation of Iron Ore mine spoil in Karnataka through afforestation.**

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, Azospyrillum, 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.**

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. Spherical 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 (5<sup>th</sup> or 6<sup>th</sup> 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.

