

## CHAPTER-IV

### FOREST RESEARCH INSTITUTE DEHRA DUN

Forest Research Institute (FRI), Dehra Dun has its roots in the erstwhile Imperial Forest Research Institute established in 1906 to organise and lead forestry research activities in the country. The Institute caters, in particular, to the research needs of the Indo-Gangetic plains of Punjab, Haryana, Chandigarh and Uttar Pradesh, as well as the U.P. Himalayas. This Institute is also a Deemed University and offers post-graduate courses in forestry (economics and management), wood science and technology; post-graduate diploma courses in plantation technology, pulp and paper technology; and doctoral programmes on various forestry aspects.

#### PROJECTS COMPLETED DURING THE YEAR 1998-99

##### **Project 1: Preparation of the book "Indian Woods their identification, properties and uses, Vol. VIth".**

**Objectives:** To revise and update earlier version.

##### **Results**

A comprehensive book "Indian Woods - their identification, properties and uses" in six volumes covering 1600 woody species is being published. Five volumes have already been published. Final volume of the book is complete and will be submitted for publication shortly.

##### **Project 2: Studies on disease of Poplars and their management.**

**Objectives:** (a) To evaluate the status of existing diseases. (b) To detect new disease outbreaks. (c) To identify the associated organisms and evolve control measures.

##### **Results**

*Cercospora populina* and *Phyllosticta adjuncta* cause severe leaf spotting on *P. deltoides* G-3, germplasm and chinese hybrid clones at New Forest with incidence of 80% and 100% respectively. Bioassay of Dithane M-45 and Radonil conducted against *P. adjuncta* indicated that both the fungicides can check the fungal growth at 0.1% concentration on formulation basis. Two chinese clones namely 91-02-23 and 91-92-97 were found resistant to *Phyllosticta adjuncta* leaf spot under field conditions.

Treatment of cuttings prior to planting should form the routine nursery practice to avoid failure in sprouting and to keep the stock healthy. *Xanthomonas populi* has been reported for the first time on poplar in India from Tarai Forest Division U.P.

##### **Project 3: Studies on blending of short and long fibre pulp and additive optimization for the manufacture of MG kraft paper.**

**Objectives:** To optimize the blending of short and long fibre pulps to achieve high gloss, surface finish, burst index and tensile index in MG kraft paper.

## Results

Soda pulps prepared from depithed baggase and hessain were blended in different proportions and evaluated for strength and other properties of paper.

### **Project 4: Studies on rare and endangered plants.**

**Objectives:** (a) To enumerate rare and endangered species. (b) To study the causes of their rarity. (c) To suggest/propose different conservatory measures.

#### **Results**

Enumerated check list of nearly 600 plants from different forests of India. Assessment and evaluation of taxa were made through a threat value index (TVI) and conservation measures envisaged. As many as 300 parameters under 26 major taxonomic units were used for the development of database. With an attempt to enumerate the state-wise rare and threatened elements, a preliminary checklist of 450 species of Uttar Pradesh was prepared.

### **Project 5: Seed pathology of bamboo species, *Dalbergia sissoo*, *Eucalyptus*, *Anthocephalus chinensis*, *Acacia nilotica* and *Albizia lebbek*.**

**Objectives:** (a) To study seed mycoflora of freshly collected and stored seeds. (b) To control seed deterioration in storage and harmful seed borne pathogens.

#### **Results**

Seed-borne fungi of *Dalbergia sissoo*, *Acer caesium*, *Grewia optiva*, *Anthocephalus chinensis*, *Chuckrasia velutina*, *Acacia nilotica*, *A. catechu*, *Pinus gerardiana*, *Paulownia fortunei*, *Terminalia chebula*, *Bauhinia purpurea*, *Azadirachta indica* and *Eucalyptus* were studied. Associated fungi were isolated and identified. Seed treatment with fungicides revealed that Emisan was most effective in almost all the seed samples studied whereas Topsin and Copper oxychloride were least effective.

### **Project 6: Studies on nursery and plantation diseases.**

**Objectives:** (a) To evaluate the status of existing diseases. (b) To detect new disease outbreaks. (c) To identify the associated organisms and evolve control measures.

#### **Results**

Epidemiological studies on *Maravalia achroa*, the leaf and twig rust of sissoo, revealed that there was a direct correlation between the rust incidence and environmental factors like temperature, relative humidity, and shading.

A nursery experiment conducted to study the impact of deoiled neem cake on the growth of *Acacia catechu* and nematode population revealed that the biopesticide reduced nematode population in the soil by 75.5 % and enhanced shoot height and plant biomass by 30% and 50% respectively. Seedlings of *Paulownia fortunei* were found heavily galled by *Meloidogyne javanica* and *M. incognita*. Applications of Furadon, deoiled neem cake (5 g) enhanced plant growth and reduced gall formation.

### **Project 7: Studies on diseases of *Albizia* spp. and their management.**

**Objectives:** (a) To evaluate the status of existing diseases. (b) To detect new disease outbreaks and identify their causal organism and evolve control measures.

## Results

Periodic monitoring of diseases in the nurseries and plantations identified causal organism to be *Fusarium oxysporum*. *Camptomeris albiziae*, was found causing premature defoliation of severe nature.

Integrated disease management through cultural practices and soil fumigation with formalin is found effective in controlling the disease. A new disease outbreak causing dieback and leaf spot in *Albizia lebbek* and *A. procera* was detected.

## **Project 8: Studies on isolation and characterization of the polysaccharides of abundantly available seeds, trees/shrubs, leaves, bark and exudate gums.**

**Objectives:** (a) To investigate gums and mucilages of *Cassia tora* seeds, *Kydia calycina* bark, and *Dalbergia sissoo* leaves. (b) To prepare value added products.

## Results

Cold and hot water soluble polysaccharids were isolated from *Cassia tora* seed endosperm. Complete hydrolysis and paper chromatography was done to study different monosaccharides. Bark polysaccharide were obtained from *K. calycina*. Modification of *C. tora* gum were made by free radical polymerisation and by cyano ethylation to prepare flocculants.

## **Project 9: Studies on tree bearing oil seeds.**

**Objectives:** To explore new sources of oils and wetting agents required for need based industries.

## Results

Composition of the methyl esters of fatty oils isolated from *Fraxinus micrautha* and *Dillenia pentagyna* was determined. Wetting agents from seed oil of *Holarrahena autidysentrica* were prepared and their foaming and dispersing power were also studied.

## **Project 10: Strengthening and Developing the Indian Council of Forestry Research and Education (UNDP Project).**

**Objectives:** (a) To raise demonstration Plantations of tree species on farmers private land. (b) To train the farmers in raising nursery stock of their preferred species. (c) To Supply quality germplasm of Poplar species to the farmers for its further dissemination in other areas.

## Results

Training in Seed Technology was provided to 179 personnel of various Forest Departments. Seed Production Areas and Seed Orchards of *Pinus roxburghii* (1105.10 ha), *Dalbergia sissoo* (703.63 ha), *Tectona grandis* (361.92 ha) and *Eucalyptus* (54.15 ha) were established at various sites in U.P., and at one site each in H.P. and Haryana. Marking of Candidate Plus Trees of *Dalbergia sissoo* was done at various sites and a total of 136 trees were marked in the first half of the project period. Grafting and Clonal multiplication was done in respect of *teak*, *shisham* and *Eucalyptus*, and guidelines for their establishment were prepared. A total of 65 clones of these three species were used for preparing ramets. Vegetative propagation of 10 prominent species of *bamboo* was carried out by using mist chamber and inexpensive chemicals and a total of 1,00,435 plants were produced. Training and Demonstration courses about identification and inoculation of VAM and Rhizobia were organized for 55 foresters and 16 farmers. Training in plantation and management to 2225 foresters, NGOs, farmers and teachers was provided from time to time.

## OLD PROJECTS CONTINUED DURING THE YEAR 1998-99

### **Project 11: Productivity study of teak plantations with high inputs.**

**Objectives:** (a) To study the effect of different doses of organic and inorganic fertilizers on teak plantations. (b) To study the effect of irrigation schedules on teak plantations.

#### **Achievements**

The experiments were laid out during September, 1997 in Madhya Pradesh, Tamil Nadu, Gujarat and also at FRI, Dehra Dun during rainy season of 1998. The data are being collected.

### **Project 12: Poplar Improvement in India.**

**Objectives:** (a) To study clonal testing, control crosses and field trials of Poplar clones. (b) Multiplication and selection of individual genotypes of different families. (c) To test different exotic poplar clones in various agro-climatic zones.

#### **Achievements**

Survey and selection of superior clones of *P. deltoides* was done. About 53 contributions were made using 24 males and 14 females in control crosses. Sixty promising clones comprising selected clones and newly released clones of WIMCO, U.P. Forest Department and U.H.F., Solan were selected for multilocal field trial and plant material (cuttings) was supplied to all coordinating centres. New species i.e. *Populus illicifolia* and *P. euphratica* were introduced in India.

### **Project 13: Improvement of nursery techniques of commercially important species.**

**Objectives:** (a) To standardize nursery techniques of *Quercus leucotrichophora*. (b) To determine of longevity and viability of *Quercus incana* seeds. (c) To assess the proper depth of seed sowing for *Quercus incana* and *Tectona grandis* in nursery.

#### **Achievements**

Studies revealed that alternate wetting and drying method of pre-treatment is the best method. The best combination of seed sowing and optimum irrigation schedule for production of maximum healthy seedlings of *Quercus leucotrichophora* under nursery condition was standardised.

### **Project 14: Investigation into viability, germination and longevity of some important species of upper Gangetic plains.**

**Objectives:** (a) To investigate tree seed problems in species of upper Gangetic plains. (b) To develop Seed Testing methodologies for species of above region.

#### **Achievements**

Seeds of *Ailanthus excelsa* stored at different temperature were tested for moisture content at bimonthly intervals. The seeds which generally lose viability within few months have been stored viably beyond two year without significant loss in germination capacity. Compilation and analysis of data is in progress.

### **Project 15: Development of forestry tools.**

**Objectives:** To develop weed clearing tools.

#### **Achievements**

The design and drawings of the weed-cleaning tool have been prepared. The raw material to be used in fabrication has been procured.

### **Project 16: Computerisation of anatomical database of Indian hardwoods for the purpose of their identification.**

**Objectives:** To develop a computerised database for the identification of hardwood tree species.

#### **Achievements**

The computer format for anatomical features and identification involving query, report building, image display, Xylarium inventory, properties and uses have been referred to NIC for further development of the software.

### **Project 17: Wood anatomy of Indian Terminalias.**

**Objectives:** To carry out detailed anatomical studies on various species of *Terminalia* for the purpose of identification and preparation of identification key.

#### **Achievements**

Wood anatomical data of ten species of *Terminalia* have been compiled.

### **Project 18: Anatomical variation vis-a-vis wood quality in different clones of *Populus deltoides*.**

**Objectives:** To study the variation in various anatomical parameters for selection of superior/better clones for better utilisation.

#### **Achievements**

Studies on radial variation at breast height have been carried out on six clones of 8 yrs - old trees of *Populus deltoides*. Data on fibre characteristics, vessel frequency, vessel length, diameter, and proportion of tissues were collected. The results offer possibilities to select the breeding stock with desired wood quality. Studies have now been initiated on six more clones on both radial and vertical variations (pith to bark and bottom to top) for developing a quick evaluation method for selection of better clones for desired utilisation.

### **Project 19: In-vitro rejuvenation of *Eucalyptus* hybrid, Chirpine, Teak, Shisham, Neem, and Bamboo.**

**Objectives:** To develop protocol for mass clonal multiplication of *Chirpine* and *bamboo* through tissue culture.

## Achievements

**Bamboo:** Axillary bud breaks from mature culms of *Gigantochloa attar* and *Bambusa wamin* were achieved. A limited in-vitro shoot multiplication was obtained in *Bambusa wamin*.

**Chirpine:** *In-vitro* shoot multiplication cultures were established. Survey and collection of immature clones (for immature zygotic embryos) were made. Cultures were established from immature zygotic embryos as well as from mature zygotic embryos.

**Shisham:** Different types of media were studied with different combination of plant hormones for axillary bud culture of *Dalbergia sissoo* and *Dalbergia latifolia*. Shoot multiplication cultures were established in case of *Dalbergia sissoo* and six clones of Eucalyptus. Sterilization treatment procedures were standardized for axillary bud cultures of *Dalbergia sissoo* and *Dalbergia latifolia* and for aseptic seed cultures.

**Neem:** The established cultures were multiplied. Three different embryogenic callus lines have been multiplied. Rooting of microshoots has been achieved.

**Teak:** Ex-plant surface sterilization experiment has been initiated and further experiments are underway to standardize technique for surface sterilization of explant.

## **Project 20: Genetic Improvement of *Pinus roxburghii* (Chir pine) including provenance research.**

**Objectives:** To identify the provenance(s) that gives highest possible economic gain based on observation from field trials.

### Achievements

Recorded data on clone production. Recorded data on height and diameter in NPTs, growing at Lachhiwala and New Forest. Seeds were collected from 4 provenances and their progenies were raised. Collected seeds from 4 CPTs belonging to Nainital provenance for inclusion in the provenance trial.

## **Project 21: Identification of superior planting material through standardization of isoenzyme analysis technique and establishing procedure for clonal identification.**

**Objectives:** (a) To standardize the Isoenzyme technique for eucalyptus. (b) To identify Eucalyptus clones using isoenzyme markers.

### Achievements

Experiments are underway.

## **Project 22: Genetic improvement of *Grewia optiva*.**

**Objectives:** (a) To study the variation in respect of growth parameter of selected superior phenotypes from different areas. (b) To standardize the techniques for vegetative propagation viz. rooting of cuttings and grafting. (c) To establish, the germ plasm and breeding orchards.

### Achievements

Survey was conducted in *G. optiva* growing areas and vegetative material was collected from 22 sources for rooting of cuttings. Cuttings have been planted in the earthen pots for further observation.

### **Project 23: Ecological Monitoring of biological diversity and development of strategy for conservation in the region of U.P.**

**Objectives:** (a) To identify and demarcate the areas for biodiversity conservation. (b) To study the functioning and structure of the dominated vegetation communities and classify them. (c) To study the population dynamics of rare and threatened species. (d) To maintain the eco-restoration efforts for biological diversity.

#### **Achievements**

The study reveals that there is a consistent increase in species diversity from elevation 300 m to 1500 m and thereafter a sharp decline from 1500 m onward to 2000 m. Similarly in the inner Himalaya there is an increasing trend upto 2200 m followed by consistent decline upto 3000 m elevation. The increase in the species diversity at certain elevations in outer as well as in inner Himalaya can be co-related to: (i) elevations and transitional zones coupled with heterogeneous climatic conditions and (ii) heavy disturbance as a result of population pressure.

Regeneration studies of some important tree species in moist temperate forest of Kedar Nath Forest Division reveal that the present environmental conditions are favourable for *Quercus floribunda* and *Q. leucotrichophora* evident in population frequency curve which is the reverse 'J' shape. Similarly in certain pockets where mesic conditions prevails, *Buxus semipervirens* also shows good regeneration. However, *Asculus indica* fails to regenerate due to the predation of seeds by wild animals as indicated by the absence of seedlings as well as saplings.

### **Project 24: Evaluation of the ameliorative role of tree plantations on soil properties in sodic areas.**

**Objectives:** To quantify the ameliorative changes taking place in soil properties as a consequence of afforesting the land with different species.

#### **Achievements**

The studies so far have revealed that the physical and chemical properties of soil are improving. The trees have enriched the soil with organic matter increasing the availability of nutrients. The porosity and infiltration rate have increased and the pH of surface soil has decreased. The mixed plantation of *Albizca procera*, *Pongamia pinnata*, *Acacia nilotica*, *Leucaena leucocephala* and *Prosopis juliflora* are more efficient in reclaiming the soil as compared to monoculture plantations.

### **Project 25: Sustainable management of sodic soil.**

**Objectives:** (a) To use farm and industrial wastes for biological rejuvenation of sodic soil. (b) To find out cost effective and suitable substitute of gypsum and organic residue.

#### **Achievements**

Growth parameters were monitored. Flyash is performing better than other combinations.

### **Project 26: Efficiency of organic vis-a-vis chemical fertilizer in improving the productivity of sodic soil.**

**Objectives:** (a) To evaluate the most effective, ecofriendly organic fertilizer. (b) To study the response of leguminous and non leguminous tree species to application of organic fertilizers in sodic soil. (c) To compare

the effect of applied chemical and organic fertilizers on the performance of tree species alongwith the assessment of the soil amelioration.

#### **Achievements**

Monitoring of growth parameters in the trial was done. Soil samples were collected from sodic soil to study the changes in the soil after adding the amendments, and analysed for various physical and chemical attributes. Preliminary soil studies indicate that after treatment, soil pH and soil density decreases while soil organic matter, porosity and maximum water holding capacity increase. Available nitrogen and phosphorus content of soil also showed an increase. These favourable changes in the soil condition will facilitate the plant growth under stress conditions.

#### **Project 27: Studies on sustainability of soil fertility in natural forest ecosystem of Doon Valley.**

**Objectives:** (a) To collect base line information on selected wet land forest ecosystems. (b) To work out soil indices for sustainability of soil fertility alongwith conservation plan.

#### **Achievements**

Survey was conducted and sites selected at Gola Tapper and Motheranwala. Soil and water samples were also collected. Conducted litter and vegetation study. Soil analysis is in progress.

#### **Project 28: Biogeochemistry of the forest ecosystems of Mussoorie Forest Division.**

**Objectives:** (a) To determine the effect of geomorphology and topographic positions on the properties and nutrient status of soils, variations in the forest composition, and the distribution of flora and ecological species groups. (b) To study the interrelationship between soil, geomorphology and vegetation. (c) To work out utility maps.

#### **Achievements**

Sites were selected and survey conducted. Studies have been initiated. Three soil profiles were exposed and samples collected for laboratory studies. Morphological and physico-chemical properties of soil samples are in progress.

#### **Project 29: Studies of forest operations.**

**Objectives:** To study the feasibility of developed tools i.e. stalk puller for uprooting Lantana and transportation of plant and seedlings in the hills.

#### **Achievements**

Statistical designs for data collection have been prepared. Field data collection is in progress.

#### **Project 30: Soil and geological studies in the degraded land and problem soils for sustainable afforestation.**

**Objectives:** (a) To determine interrelationship between geology, soil and vegetation. (b) To evaluate the ameliorative role of trees on sodic soils through geological and micromorphological studies. (c) To identify geological parameters of degraded and sodic soils for establishment of trees.

## Achievements

Preliminary studies carried out in the degraded sites of Raipur range of Mussoorie forest division revealed presence of low to moderate amount of weatherable minerals indicating their podzolic nature. Soil investigations of degraded sites indicate that soils are of Mollisols and Inceptisols orders. Further analysis is in progress.

Sites have also been selected in the sodic areas in Raibareli and Sultanpur districts of Uttar Pradesh. Disturbed and undisturbed soil samples have been collected. Physical and chemical analysis of soils is in progress.

## **Project 31: Reclamation and ecological monitoring of iron ore mines in Saranda Bonai Range.**

**Objectives:** (a) To develop appropriate technology for different mine areas of the country. (b) To monitor the restoration of ecosystem, structure, and functioning of the ecologically rejuvenated mine areas.

## Achievements

Phase II of the Ecorestoration studies under MOU signed with SAIL was completed and report accepted by SAIL. Memorandum of Understanding for phase III for developing ecorestoration model at Balani mines has been prepared. Comprehensive report of Phase I & Phase II of project has been prepared.

## **Project 32: Ecological Impact Assessment of bioreclamation in Raibareli and Sultanpur District.**

**Objectives:** (a) To assess the impact of biological reclamation on the development of plant communities, improvement of soil, interception of rainfall and infiltration.

## Achievements

Sites have been selected after doing reconnaissance survey. Phytosociological studies were conducted in the selected sites and trees were marked for fixing stem flow collars in all the sites.

## **Project 33: Studies on cultivation and most appropriate season of harvesting of temperate and alpine medicinal plants of high market value.**

**Objectives:** (a) To assess the range and quantity of a few species in high demand in the UP, HP & J & K hills. (b) To collect the germplasm and identify the best provenance rich in active principles. (c) To study the behaviour (Phytosocial & ecological) *in-situ* & *ex-situ* of the species. (d) To develop suitable cultivation techniques for commercial cultivation.

## Achievements

Surveys for natural distribution of *Taxus baccata*, *Nardostachys jatamansi* and *Picrorrhiza kurroa* in UP hills were conducted. Collected germplasm were established at Chakrata nursery. Stem cuttings of *T. baccata* have been successfully rooted and transplanted in field for studying their survival and growth behaviour. Provenance trials on *N. jatamansi* and *P. kurroa* have resulted in selection of superior provenances from UP hills. Phyto-sociological studies have revealed interesting associates of the above species at different sites in the UP hills. Soil samples collected from different sites of germplasm collection have been analyzed.

**Project 34: Identification of high gum yielding varieties of *Acacia nilotica* ssp. *indica* for further regeneration of socio-economic development.**

**Objectives:**

**Long Term:** Augmenting production of gum by scientific method of tapping. To find out optimum method and season of tapping. To identify high gum yielding trees.

**Short Term:** To collect periodical data on different treatments for finding out suitable methods and season of tapping. To ascertain the best time of making blazes and the period required for subsequent freshening. To study correlation between the yield of gum and the diameter of the tree.

**Achievements**

Gum tapping on *Acacia nilotica* sp. *indica* was conducted in Haryana. The blazes were treated with NaOH-8%, Ammonium phosphate- 5%, Sodium carbonate 8%, Ethephon 10%, along with control as per statistical design. Few trees yielded traces of gum which were treated with Ethephon and NaOH. Young trees growing in compartment No. 2 & 7 at New Forest yielded nearly 125 g reddish gum from 4 blazes which were treated with Ethephon, whereas 20 g was obtained from one blaze treated with NaOH.

**Project 35: Studies on the cultivation and optimum time of harvesting of tropical and sub-tropical medicinal plants of high market value.**

**Objectives:** To develop suitable package for large scale plantation of *Spilanthes oleracea* for farmers and pharmaceutical companies.

**Achievements**

*Spilanthes oleracea* grown under different treatments were harvested. Preliminary results on dry weight basis show that maximum biomass was obtained as 3.57 qtl/ha under soil + FYM treatment, followed by 2.8 qtl/ha in River sand +FYM; 1.98 qtl/ha in garden soil and 1.40 qtls/ha in river sand respectively.

**Project 36: Marketing mechanism for Farm Forestry Trees - A case study of important north Indian markets.**

**Objectives:** (a) To study the agro-forestry tree species in the existing farming systems. (b) To examine existing market structure and price spread for selected forest trees in sample markets. (c) To document and analyse farmers perceptions about the role of existing harvesting laws for farm forestry trees. (d) To explore possibilities for effecting efficiency in the present forest tree marketing systems.

**Achievements**

In the present study, important commercial farm forestry tree species with particular reference to Shisham, Eucalyptus and Poplar are being considered for the detailed marketing study in collaboration with the Department of Social Science, Univ. of Hort. & Forestry, Nauni - Solan (H.P.). A critical review of the published literature related to the project has been carried out.

Timber markets of Chandigarh, Ludhiana, Amritsar, Yamunanagar and Baddi were surveyed in the first round for gathering information on structure and behaviour of timber markets, method of sale, volume

transacted, mode and costs of transportation, marketing charges of different market functionaries and consumers' profile. Information on pretested schedules have been collected from various market functionaries and the same is being tabulated.

Information on socio-economic structure of farm tree growers, inventory of farm forestry tree species (number, type and age wise distribution), method of sale by producers, harvesting and various marketing charges borne by the farmers, mode of transportation, and tree growers perception/knowledge of existing tree harvesting loss etc has been collected from the study areas and is being processed.

For the purpose of gaining better insights into the marketing systems of farm forestry trees, informal discussions with the forest officials, important market functionaries, and progressive tree growers have also been held at various stages.

### **Project 37: Preparation of Volume and yield tables of promising clones of Poplar species in North India.**

**Objectives:** Preparation of Volume and Yield tables of D-121 and G-48 clones of *P. deltoides*.

#### **Achievements**

Trees of two clones of Poplar viz. G - 48 & D - 121, the most widely and successfully planted clones at Haldwani in the Tanda and Pipalparao plantations were measured. Around ten sample trees of different diameter class from the surrounding of each sample plot have been felled and measured for volume determination.

### **Project 38: Environmental protection through modified pulping and bleaching process. Alkaline peroxide pulping and bleaching of non woods.**

**Objectives:** Modification of conventional pulping and bleaching process so that pollutants generated are less toxic, less carcinogenic and the pulp quality and quantity is enhanced.

#### **Achievements**

Wheat straw pulp of kappa no. 28 and 16 were bleached by hypochlorite and hydrogen peroxide combination and 70% brightness was achieved.

### **Project 39: Studies on behaviour of different papermaking fibres during accelerated drying for energy conservation.**

**Objectives:** (a) To study the drying behaviour of different papermaking fibres viz Eucalyptus, bamboo, rice straw and bagasse etc. (b) To evolve method to accelerate the drying of fibres having poorer dewatering properties for energy conservation.

#### **Achievements**

The dewatering properties of rice straw fibre is poorer as compared to eucalyptus and bamboo fibres. Beating treatment was tried. It was found to reduce the thickness of sheet making it denser, causing higher heat and mass transfer in the sheet, which in turn increased overall evaporation rate and thus conserved the heat energy.

#### **Project 40: Surveillance and monitoring of insect pest, their seasonal abundance, pest activity and management by light trap techniques.**

**Objectives:** (a) To study the population dynamics and relative abundance of target insect pests. (b) To study the local abundance and distribution of insect fauna. (c) To record pest population built up and predict insect outbreaks. (d) Sampling, screening and sorting of light trap collection and recording of target and non-target, incorporation of new species in NIRC. (e) Management of insect pest by daily catches in light trap, an ecofriendly measure for reducing pest population.

#### **Achievements**

Studied population dynamics of fifteen target insect pest species and recorded their population count, and its percentage based on light trap data collected during various seasonal condition throughout the year. The insect pest species (15 target pests) representing various insect orders and genus *Agrotis epsilon*, *Argina cribraria*, *Digscercus cingulatus*, *Euprocytis lunata*, *Gryllotalpa africana*, *Gryllus* sp., *Heliothes armegera*, *Plusia orichalcea*, *Prodenia litura*, *Xylotrechus* sp. *Hamodes porpita*, *Cerura* sp., *Buzura suppressaria*, *Suana concolor* and *Asota caricae*, injurious to agroforestry tree species were found in nurseries and plantations. 89237 insects were trapped and records of individual species are being maintained besides non-target insects. The highest population was found of *Asota*, *Dysdercus*, and *Buzura* while *Gryllus*, *Agrotis* and *Plusia* had a moderate population. The population of *Cerura* was found at a low level.

#### **Project 41: Management of Sal heart wood borer in natural forests.**

**Objectives:** (a) To Monitor sal heart-wood borer infesting sal trees. (b) To conduct trap tree operation for management and record pre and pest operation data. (c) To test kairomone against sal heart-wood borer.

#### **Achievements**

Incidence of sal heart-wood borer infesting sal trees in Thanu Range, Dehra Dun Forest Division was found to be 9%. During monsoon period, the trap tree operation was conducted in Thanu Range and 3,25,316 beetles of sal heartwood borer were trapped and killed with the assistance of State Forest Department. Kairomones extracted from different parts of the living sal tree were tested in laboratory in olfactometer. Efficacy of ten most effective extracts was tested in the field using locally designed kairomone trap.

#### **Project 42: Laboratory evaluation of natural termite resistance in timbers (Eucalyptus, poplar) and bamboos.**

**Objectives:** (a) To evaluate the natural termite resistance in timbers and bamboos. (b) To work out influence of various factors/parameters such as moonphase, age and girth, height, seasoning (water seasoning) etc. on natural resistance of bamboo.

#### **Achievements**

Eight species of bamboo were studied and tested against termite *Microcerotermes beelsoni* Snyder. *Melocanna baccifera* (wt. Loss 12.2%), *Gigantochloa alter* (wt. Loss 20.2%), *Oxytenanthera albociliata* (wt. Loss 20.7%), *O. nigrociliata* (wt. Loss 22.8%) were found more resistant as compared to other species tested. Test results of four samples of *Eucalyptus* (Mysore gum) indicated that termite resistance is correlated with age, height and girth. Five species of bamboo such as *Bambusa balcoa*, *B. arundinacea*, *Dendrocalamus*

*strictus*, *D. hamiltonii* and *Ochlandra travancorica* were tested against termite *M. beesoni* after keeping 25 days in running water. The test results indicate that water seasoning can be used as a tool to develop termite resistance in bamboo.

**Project 43: Identification of forest insect, augmentation and maintenance of entomological reference collection (NIRC) and Museum.**

**Objectives:** (a) Bio-systematic/taxonomy of insect, identification of insect material (unidentified). (b) Fumigation, curation of existing insect collection (NIRC-FRI) and incorporation of new species from time to time.

**Achievements**

Identification of 500 insect specimens was completed. This included the incoming unidentified collection from various ICFRE Institutes and other agencies. Sorted out about 5000 insect specimens and arranged them systematically. Curation, fumigation, and preservation of insect collection was carried out.

**Project 44: Evaluation of natural resistance in 300 different clones/hybrids of *Populus deltoides* against important defoliators.**

**Objectives:**

*Long Term:* Improvement of *Populus deltoides* clones in terms of insect resistance.

*Short Term:* To evaluate ca 300 clones/hybrids of *Populus deltoides* and rank them according to their susceptibility/resistance against the key defoliator *Clostera cupreata* (Lepidoptera : Notodontidae) in India.

**Achievements**

100 clones of *P. deltoides* were evaluated for their comparative resistance against this pest on the basis of its feeding. 18 clones were found to be most resistant. 20 clones moderately resistant, 18 clones marginally resistant, 14 clones marginally susceptible, 10 clones moderately susceptible and 20 clones most susceptible. The sex of the pest was also found to influence resistance of clones as females fed more than males. The pupal wt. of this insect also varied significantly amongst the clones and can be used as one of the parameters to evaluate resistance/susceptibility of poplar clones.

**Project 45: Effect of Trees on Agricultural Crops.**

**Objectives:** (a) To study the effect of leaf litter of agroforestry tree on germination and growth of agricultural crops. (b) To study the growth and yield of different varieties of wheat in block plantation of poplar. (c) To study the performance of shade bearing crops in block plantation of poplar.

**Achievements**

Wheat and Barley grown in 3 yr., 5 yr. and 6 yr. old block plantation of poplar revealed that growth and yield of Wheat and Barley crops decreases with the increase in age of trees. Within the plantation, growth and yield of crops grown in the centre of 4 trees are higher as compared to crop grown close to tree stands. Average height of poplar trees ranged from 12.57m to 16.62m (3 yr.), 19.86m to 26.25m (5 years), 22.20 m to 29.87m (6 years), Average girth of Poplar trees ranged from 36cm to 50cm (3 years); 50cm to 71cm (5 years); 62cm to 100cm (6 years).

Light intensity values were found to be lower under the tree canopies than in open control plot. The relative humidity was found higher under plantation as compared to open area. The humidity was higher during morning hours as compared to noon and evening hours.

### **Project 46: Studies on agroforestry system and development of suitable agroforestry models.**

#### **Objectives:**

*Long-term:* (a) Survey of the Agroforestry Systems in Punjab, Haryana and Uttar Pradesh. (b) Studies on crop combination and geometry of plantation. (c) Studies on growth, yield and economics of various combinations and their sustainability.

*Short-term:* (a) System inventory description to undertake studies on interaction between different component and existing management practices. (b) Domestication of plant species. (c) Study on viability of the system vis-à-vis socio-economic conditions of the rural people.

#### **Achievements**

A questionnaire was developed for collection of information on various aspects. A sampling design has been developed and 4 blocks viz. Radour, Jagadhari, Bilaspur and Chachroli were selected in Yamunanagar District. In each block four villages were selected and in all sixteen villages were identified using sampling design. The farmers were grouped into five categories big farmers, medium farmers, marginal farmers, small farmers, and landless. Survey was conducted in 12 villages and data in respect of total land area, community forests, household, landless, literacy rate, livestock, population, fuelwood consumption, fuelwood supply, fodder consumption, sources of fodder supply, sources of timber, timber consumption, pattern of plantation, prominent agroforestry system, major agricultural crop, fodder crops, tree species grown, horticultural crops, and major grass and shrub species were collected. Based on the data collected, the tentative conclusion is that all the villages are practicing agroforestry for meeting their fuelwood requirement. Further, the total fuelwood supply/annum has no correlation with the number of households. The fodder consumption recorded in each village showed that the farmers are meeting their requirement using agriculture byproduct and grasses. No family is using tree fodder. The villagers are not purchasing any timber from the market and are meeting their requirement from trees grown on agriculture fields. Prominent agroforestry systems practiced by farmers are agri-silviculture, agri-silvi-horticulture, silvi-pastoral and agri-horticulture. The traditional trees grown on farmlands are *Dalbergia sissoo*, *A. nilotica*, *Azadirachta indica*, *Melia azaderach*, *Morus alba*, *Syzygium cumini*, *Tamarindus indica*, *Mangifera indica*, *Ficus benjamina*, and *Butea frondosa*. New introductions like *Eucalyptus*, Poplar, Kadam, *Tectona grandis* have also been adopted by farmers. The horticulture crops like Kenu, *Psidium guajava* and *Citrus* are also grown in orchards. The pattern of plantation adopted by farmers are generally block and boundary plantation for Poplar and rest of the species are grown as boundary plantation. The major grasses grown are *Saccharam munja*, *Eulaliopsis binata* and Bermuda. The shrubs species which were grown by most of the farmers are Karonda and Beri (*Ziziphus mauritiana*). Major existing agriculture crops are wheat, paddy, sugarcane, sorghum, and barseen which are cultivated as monoculture. The traditional agricultural crops are Maize, Bajara and mustard. In the past, traditional crops were cultivated using mixtures like wheat-gram, wheat-barley, wheat-mustard, wheat-pea, sorghum-cowpea, and sorghum-jowar.

### **Project 47: Conservation of Indigenous Poplars in India.**

**Objectives:** Conservation of India's indigenous Poplars (viz. *Populus ciliata*, *P. alba*, *P. euphratica* and *P. gamblei*) throughout their range as a basis for future conservation, breeding and improvement programmes.

## Achievements

Extensive survey and occurrence of *P. ciliata* and *P. gamblei* was undertaken and completed in Arunachal Pradesh. Survey was also undertaken and completed in respect of *P. ciliata* occurring in areas like Uttarkashi, Gangotri, Harsil, Bhagirathi, Dharli, Almora, Pithoragarh and Nanital, UP hills. The details were tabulated and critically evaluated. Report on the occurrence of Indigenous Poplars in Himachal Pradesh, Uttar Pradesh and Arunachal Pradesh is under preparation.

## **Project 48: Computerisation of Herbarium of Forest Research Institute, Dehra Dun.**

**Objectives:** To computerise and develop database on specimen of forestry and economic importance for ready reference and link the Herbarium of Forest Research Institute to other institutes/organisations.

## Achievements

Action has been initiated for making FRI Herbarium available on worldwide Web. 200 herbarium specimens have been catalogued.

## **Project 49: Survey, selection, *ex-situ* conservation, evaluation and propagation of Himalayan bamboos with special emphasis upon the threatened species.**

**Objectives:** (a) Survey of bamboo forests to analyse the extent and frequency of occurrence of various bamboo species in the Himalayan region of Uttar Pradesh. (b) To collect and conserve germplasm of species in *ex-situ*.

## Achievements

Bamboo diversity of Indian species with reference to their phytogeographical distribution was studied.

## **Project 50: Selection, identification and evaluation of wild plant species for urban planting.**

**Objectives:** (a) Survey of wild ornamental species occurring in the forests of Garhwal Himalaya, and plains of Uttar Pradesh. (b) Identification of potential species for urban landscaping.

## Achievements

Field surveys in different parts of U.P. Himalaya were carried out.

## **Project 51: Clonal propagation of *Dalbergia sissoo*, *Tectona grandis*, *Eucalyptus hybrid* and Bamboos.**

**Objectives:** (a) To optimise clonal propagation procedure by developing and understanding the effect of growth regulatory substances, fertilizers, maturity of the mother plant, and other physiological factors affecting rooting of cuttings.

## Achievements

Effect of maturity on rooting of branch cuttings was analysed in case of *Dalbergia sissoo*. Important differences were found in rooting behaviour of mature and juvenile cuttings. Rejuvenated cuttings, compared to mature cuttings, were faster to root, showed higher percent rooting and superior growth form. The results obtained so far indicate that cuttings from mature trees root better in summer. Even auxins efficiency is more in summer months than in winter months.

## **Project 52: Identification and screening of suitable nitrogen fixing herbs, shrubs, climbers and tree species for agro-social forestry plantations and wasteland afforestation programmes.**

**Objectives:** Survey, identification and distribution of leguminous and non-leguminous nitrogen fixing herb, shrub, climber and tree species already existing in the Himalayan region and alluvial plains.

## Achievements

Survey was carried out to identify leguminous and non-leguminous nitrogen fixing plants. Four species viz *Caesalpinia pulcherrima*, *Delonix regia*, *Gliricidia macrantha* and *Adenanthera microsperma* were found to be non-nodulating and *Callindira calothyrsus*, *Abrus precatorius*, *Dalbergia sericea* and *Erythrina blakei* were identified as nodulating.

## **Project 53: Physiological effects of water stress on some forestry tree species.**

**Objectives:** (a) To identify the suitable clones and provenances for plantation in dry regions i.e., arid and semi-arid zones of India. (b) To study the moisture stress tolerance of individual clone/provenance and find out critical soil moisture condition required by a clone/ provenance to stay alive.

## Achievements

The over all growth rate and survival percentage of *Dalbergia sissoo* Roxb. at nursery stage was found to decrease with increasing water stress. Growth rate in height, number of leaves, number of branches and collar diameter declined sharply in monthly and fortnightly watering regime in comparison to daily or weekly watering regime. There is a lot of variation in effect of antitranspirants and their concentrations. Higher concentration of antitranspirants decreased the growth rate and resulted in more leaf fall than lower concentration. The total biomass significantly decreased with increasing water stress in all the antitranspirants treatments.

## **Project 54: Development of adhesives from renewable sources (Starch/Bark etc.).**

**Objectives:** To prepare adhesives from bio polymers.

## Achievements:

Tamarind Kernel Powder (TKP) seed polysaccharide was deproteinised. Carboxymethylation of *Cassia tora*, Guar gum and TKP was done.

## **Project 55: Phytochemical examination for utilisation of leaves, barks, fruits and roots of Indian forest trees.**

**Objectives:** (a) To develop natural dyes from forest biomass. (b) To isolate bioactive principles from *Cephalotaxus harringtonia* to investigate the bio-pesticidal activity of *Vitea negundo*.

### **Achievements:**

Methods for isolating dye from bark of sal, pine and poplar, and leaves of lantana were devised. Essential oil from leaves of *V. negundo* was found to be a mixture of 66 compounds of which 35 were identified by GC-MS studies. 6 compounds were isolated and characterized. Encouraging results were obtained in preliminary entomological screening. 5 compounds were isolated from needles of *C. harringtonia*. Of these, the compound (CH-C) showed significant hepatoprotective activity in rats.

### **Project 56: Standardisation of process for extraction of taxol from the needles of *Taxus baccata*.**

**Objectives:** To develop a process for isolation of bioactive compound like 10-deacetyl baccatin – III from *Taxus baccata* needles.

### **Achievements**

Solvent extraction of needles of *T. baccata* was carried out. Fractionation of the extracts was also carried out. Column chromatography was used to isolate the bioactive principles.

### **Project 57: Tree Improvement (World Bank Project FREEP).**

**Objectives:** (a) To study floral biology and breeding system and develop hybrids specific to site to maximize productivity. (b) To develop techniques for rejuvenation of mature plant tissue to maximize multiplication rates. (c) To develop in-vivo and in-vitro propagation techniques for mass multiplication of selected genotypes.

### **Achievements**

Floral biology and breeding system of *Dalbergia sissoo* were studied. Diallel crosses were attempted in clonal seed orchard. Immature zygotic embryos resulting from specific crosses are being multiplied through tissue culture. In *Populus*, intra-specific crosses were attempted involving 20 combination. Hybrid seeds have been harvested from the crosses made. Serial cutting, serial grafting and tissue culture techniques were tried on *Eucalyptus* to rejuvenate the mature plant tissue and significant success has been achieved. Standardized macropropagation technique for mass multiplication of *D. sissoo* through bi-nodal cuttings: In vitro and In-vivo propagation techniques were undertaken for *Eucalyptus*, *Shisham*, *Populus* and *Chirpine*. Twelve clones of *Eucalyptus*, three clones of *Shisham* and two clones of *Populus* were established successfully. Tissue culture technique has been introduced for *Chirpine* programme. A field trial of tissue culture raised plant has been initiated at Bithmara (Haryana) to judge the relative growth performance on tissue culture raised plants against plants raised from rooting of cuttings /seedlings.

### **Project 58: Planting Stock Improvement Programme.**

**Objectives:** To produce quality planting material through establishment of SPA's, SSPA's, CSO and hedge garden.

## Achievements:

These are summarized in the table as under.

| Species      | SSPA<br>(Target-160 ha) | CSO<br>(19 ha.) | SSPA<br>(19 ha) | Hedge<br>garden/VMG<br>(4 ha) |
|--------------|-------------------------|-----------------|-----------------|-------------------------------|
| ET           | 21.80                   | 17.00           | 7.10            | 1.20                          |
| DS           | 50.00                   | 11.00           | 10.40           | 0.75                          |
| P.R          | 110.00                  | NIL             | 3.50            | 0.50                          |
| P.D.         | -                       | -               | -               | 0.50                          |
| <b>Total</b> | <b>181.80</b>           | <b>28.00</b>    | <b>21.00</b>    | <b>2.95</b>                   |

ET.= *Eucalyptus tereticornis*, D.S.= *Dalbergia sissoo*, PR= *Pinus roxburghii*,  
P.D= *Populus deltoides*.

## Project 59: Productivity Enhancement Management for People's Participation (Ford Foundation).

**Objectives:** (a) To conduct socio-economic studies for documentation of short term and long term needs and expectations of participating societies and individuals from forest lands. (b) To develop site-specific models of rehabilitation/forest regeneration. (c) Evaluation of different production alternatives and the trade-offs in term of end produce generated. (d) To study existing channels of flow of forest products to market to identify bottlenecks and suggest means for improving marketability. (e) To develop locally feasible processing technologies for value addition, storage and marketability of non-wood forest products.

## Achievements

Study on biomass status of important tree species in the study area (the Shivalik area in the Chhachharauli Range of Yamuna Nagar Forest Division of Haryana) have been completed. Study on the fuel wood and fodder resources (*Anogeissus latifolia* and *Terminalia tomentosa*) in the study area has been completed and a yield table have been prepared. Research study on the effect of weeding on production of bhabar (*Eulaliopsis binata*) in Shivalik hill forest has been completed. The study has shown that yield of bhabar is maximum under three weedings carried out during July, August and September. Research study on the yield potential of bhabar (*Eulaliopsis binata*) under different plantation densities were carried out. The experiment has shown that the yield is maximum in case of spacing 50cm x 60cm, followed by the spacing of 50cm x 50cm. Transplanting of high yielding grasses on field bunds of the farmers was done. Market studies on bhabar, munj and timber species available in the study area were carried out.

## NEW PROJECTS TAKEN UP IN HAND DURING THE YEAR 1998-99

### **Project 60: Resin tapping by bore hole method in *Pinus roxburghii*.**

**Objectives:** (a) To study the feasibility of conservation and management of pine resources in India by this method. (b) To compare resin yield from Rill method Vs Borehole method. (c) To study the effect of chemical treatment factors, and borehole depths in sap wood and borehole diameters.

#### **Progress made**

Weekly data were collected from the Champion Block of FRI., Dehra Dun by tapping the resin from borehole and rill methods. The data have been computerized for analysis.

### **Project 61: Raising and transplanting of tall plants.**

**Objectives:** (a) To standardize nursery practice of raising tall plants (over 3 m. in height) of various species for avenue planting and landscaping. (b) To compare the economics and performance of different types and sizes of bags required for raising tall plants. (c) To develop techniques and equipments for digging out, loading, unloading and transportation of semi-mature plants.

#### **Progress made**

Planting of seedlings of *Dehonix regia*, *Grevillia robusta* and *Dalbergia sissoo* in the ground and in two different size of poly bags was carried out to study the growth of seedlings and also to workout the economics. Planting was completed by August, 1998. Collection of field data is in progress.

### **Project 62: Development of pre-treatment and seed testing procedures for hardcoated seeds of tree species.**

**Objectives:** (a) To investigate the nature and extent of seed coat within species and between species and develop suitable and practical methods to break the dormancy. (b) To develop prescription for testing of seeds of Indian Species for incorporation into the rules for seed testing.

#### **Progress made**

Preliminary action has been initiated.

### **Project 63: Studies on Himalayan Pines (USDA Project).**

**Objectives:** Identification, selection, collection and testing of superior provenances of *Pinus roxburghii*.

#### **Progress made**

Literature study has been completed regarding distribution and other aspects of pine in India. Pine cones from Himachal Pradesh, J & K and Chakrata have been collected. Physical characteristics of cones were studied and seeds are being extracted from the cones for further study.

### **Project 64: Development of computerized control kiln drying systems.**

**Objectives:** To develop computerized application for kiln drying schedules and control of drying conditions for conventional steam heated kiln.

### **Progress made**

Detail specification for procurement of automatic kiln control components such as load cells, humidity and temp. controllers, sensors and vent actuators have been prepared in consultation with the Director, USIC Roorkee University, Roorkee. Further action is in progress.

### **Project 65: Evaluation of suitability of LVL from *Ailanthus excelsa* (Gokul) for door/window shutters.**

**Objectives:** To determine the technical feasibility of producing laminated veneer LVL from plantation grown *Ailanthus excelsa* and two clones of poplar (L-34/82 and L-52/82).

### **Progress made**

Evaluation of suitability of LVL from *Ailanthus excelsa* (gokul) and two clones of poplar (L-34/82 and L-52/82) for door/window shutters has been taken up. *Ailanthus excelsa* logs were procured from Haryana and peeled into three thickness. LVL was prepared using PF glue, applying pressure at two intervals to make 600 x 600 x 12 mm size boards. LVL thus prepared was tested for specific gravity; compression loss percentage; tensile strength perpendicular to surface in dry, cyclic and accelerated test; and modulus of rupture, flatwise and edgewise. Further, work on compilation of data and preparation of full size door shutters is in progress.

Two clones of Poplar procured from Silviculturist, Haldwani (UP) were also peeled for making LVL. Further, work is in progress.

### **Project 66: Central scheme for development of Agro-Tech. & Cultivation of Medicinal plants used in Ayurved, Siddha, Unani & Homeopathy.**

**Objectives:** To develop complete package of practices of Agro-technology for cultivation of medicinal plants and ascertain: (a) Best method of raising the plants. (b) Best soil, sowing time, and harvesting time. (c) Number of plants for plantation per acre cropping/inter-cropping system; nutrient requirement, water management & weed control. (d) Best harvesting techniques storage/packing methods. (e) Commercial viability per acre output.

### **Progress made**

Following 4 species have been assigned to FRI/ICFRE to carryout Agro-techniques. (a) *Habenaria intermedia* (b) *Elaeocarpus ganitrus* (c) *Microstylis wallichii* (d) *Prunus cerasoides*. Literature surveys has been completed about three species. Preliminary survey was conducted to collect tubers/ bulbs of *Habenaria intermedia* and *Microstylis wallichii*. Five hundred (500) tubers of *Habenaria* and 50 bulbs of *Microstylis wallichii* have been collected and the germplasm is being maintained at Chakrata/ Dehra Dun NWFP nursery. Observation on its dormant period and new growth factors were made. Air-layering on the branches of mature trees of *Elaeocarpus* was done in FRI campus, and 80 percent rooting success with 50% survival has been recorded.

### **Project 67: Study on alternative eco-friendly wood varieties for handicrafts and futuristic wood availability in Rajasthan and Kerela states.**

**Objectives:** (a) To assess the overall scenario of availability of traditionally used wood varieties in handicraft sector and their sustained availability during the next twenty years and alternative eco-friendly wood varieties in the states of Rajasthan, Kerala and adjoining areas.

### **Progress made**

The project is financed by Department of Handicrafts, Ministry of Textiles, GOI. A list of tree species grown in and around the states of Kerala and Rajasthan used for handicrafts products in respective states has been prepared. Formats for collection of various type of data have been designed.

### **Project 68: Studies on delignifying industrial lignin.**

**Objectives:** Various quinone additives are used to accelerate the rate of delignification. These additives are very expensive and not very economical. So studies on alternative chemicals such as phthalic anhydride need to be taken up to accelerate the delignification reaction, protect the carbohydrate degradation and increase the pulp yield and quality.

### **Progress made**

It was found that pulping with additive decreased the Kappa number by 20-30% and increased the pulp yield by 2.8-5.2%. The optimum dose of additive was found to be 0.5-1.0%.

### **Project 69: Studies on high yield pulping and environmental friendly bleaching of bamboo and hardwoods for printing papers.**

**Objectives:** To produce high yield pulps from bamboo and hardwoods and bleach the pulp using environmental friendly bleaching sequence.

### **Progress made**

High yield pulps was bleached using OP, OPP, OHP and ODP sequences resulting in 48%, 48.2%, 54% and 60 % of brightness respectively.

### **Project 70: Effluent treatment in pulp and paper industry; production of nitrogen fertilizer/soil conditioner.**

**Objectives:** Utilization of waste lignin by modifying lignin through oxidative ammonolysis into N-modified lignin to be used as a slow nitrogen releasing fertilizer which would act as a good soil conditioner.

### **Progress made**

Soda lignin from pulping of bagasse and straw black liquor was isolated which resulted in 90% COD and 70% colour reduction. Isolated lignin was purified and characterised for elemental composition, methoxyl group and molecular weight determination.

### **Project 71: Studies on variation in lignin and vessel ratio in different clones of *Eucalyptus* hybrid with respect to paper making.**

**Objectives:** To study the variation in lignin and fibre vessel ratio in different clones of *Eucalyptus* hybrid in order to enhance the quality of pulp and reduce the pollution.

## Progress made

Material of *Eucalyptus* clones received from IWST, Bangalore and FRI viz AT1, AT2, AT3, AT4, BT1, BT2, BT3, BT4, CT1, CT2, CT3, CT4 and composite mixture of AB&C were cooked by using kraft process using 16% total chemicals at 170°C for 3 hours. The pulp yield varies from 41.0-50.19%.

**Project 72: Development of Neem in various agro-ecological regions of India (FRI: Punjab, Haryana, Western Uttar Pradesh; TFRI: MP and Orissa; AFRI: Gujarat; IFGTB: Tamilnadu, Andhra Pradesh and Karnataka).**

**Objectives:** Seed Resource assessment, collection and storage. Phenological and chemical evaluation for characterization and improvement. Tree Improvement to get quality and reliable seed. Development of techniques for mass multiplication, particularly clonal propagation. Rasing village plantation under agroforestry models. Preparation of Database. Dissemination of information. Training of various target groups. Interaction with industry and other users.

## Progress made

Preliminary action has been started.

## EXTENSION

Testing of wood and wood products/adhesives/preservatives etc., was done for the wood processing industry/Government Organisations and individuals. A sum of Rs.2,38,475/- was earned as revenue.

Technical consultancy has been rendered to Govt., Semi-Govt., Autonomous agencies, NGO's and farmers. A sum of Rs.3,77,797/- was earned as revenue.

Memorandum of understanding between ICFRE and NRDC was signed for promotion of ICFRE technologies. NRDC has initially selected seven technologies for promotion and marketing.

Consultancy was provided to Nepal Govt. on Sal mortality in Dandeldhura Distt. of Nepal. Training was imparted to U.P. State Forest Officers on regeneration and ecological management of forest ecosystems at Forest Research Training college, Haldwani.

Field training was imparted to SFD staff of Haryana, Punjab, and U.P. on production of quality seeds/planting material. Staff engaged in research activities was given demonstrations regarding propagation of superior phenotypes.

Two Workshops—cum-peer review on Chir pine (*Pinus roxburghii*) and Eucalyptus were held. Two training courses were organised on 'Trap Tree Operation' for Sal borer management for SFD officials of M.P. and U.P. Forest Department. The training was imparted to 164 SFD's officials in 2 batches. Transfer of Technology on wood bending though NRDC, New Delhi was executed.

The following Training to farmers NGOs, SFDs, Institutes were also organised:

1. One months course on "Wood Processing Technology for handicrafts" sponsored by DC(H), New Delhi.
2. One week course on Grading of timber and product performance evaluation.

3. One week Special course on timber technology for railway officers.
4. Two weeks training on wood bending & forming.
5. One week course on wood technology.
6. One week course on Wood Preservation technology.
7. One week course on Plywood Manufacturing Technology.
8. Two weeks regular course on "Field Identification of Timbers" for trainees from various Govt. Depts..
9. A special 3 weeks training course on "Bamboo classification and identification" for trainee from Forest Science Institute of Vietnam, Chem-Tu liem - Hanoi, Vietnam.

An exhibition on medicinal Wealth of Uttranchal region was organized at Dehradun during the Health Mela 1999. A training course on 'Environmental Management of Mine Areas' for Executives of Steel Authority of India Ltd. was also conducted.

Patent applications on following processes were filed. (a) Process for the preparation of katha from Gambier extract, (filed in India, Indonesia, Malaysia and Thailand). (b) Preparation of compost from Forest Biomass.

Brochure entitled "Improved planting Stock of *Eucalyptus tereticornis*: a protocol for mass clonal multiplication through Tissue Culture" was published.

## FINANCIAL STATEMENT

| <b>I. PLAN</b>             |          |   |                              |
|----------------------------|----------|---|------------------------------|
| Sl.No.                     | SUB-HEAD |   | Expenditure<br>(Rs. in lakh) |
| 1.                         | A.       | <b>REVENUE EXPENDITURE</b>                      |                              |
|                            |          | (a) Research                                    | 400.85                       |
|                            |          | (b) Administrative Support                      | 424.19                       |
|                            |          | <b>Total for Revenue Expenditure 'A'</b>        | <b>825.04</b>                |
|                            | B.       | <b>LOAN AND ADVANCES</b>                        |                              |
|                            |          | (a) Loan Advances (Conveyance)                  | 3.49                         |
|                            |          | (b) House Building Advance                      | 0.60                         |
|                            |          | <b>Total for 'B'</b>                            | <b>4.09</b>                  |
|                            | C.       | <b>CAPITAL EXPENDITURE</b>                      |                              |
|                            |          | (a) Building & Roads                            | 707.86                       |
|                            |          | (b) Equipments, Library Books                   | 120.00                       |
|                            |          | (c) Vehicles                                    | 4.05                         |
|                            |          | <b>Total for 'C'</b>                            | <b>831.91</b>                |
|                            |          | <b>GRAND TOTAL FOR A+B+C(PLAN)</b>              | <b>1661.04</b>               |
| <b>II. NON-PLAN</b>        |          |   |                              |
| 1.                         | A.       | <b>REVENUE EXPENDITURE</b>                      |                              |
|                            |          | (a) Research                                    | 298.97                       |
|                            |          | (b) Administrative Support (Salary)             | 283.42                       |
|                            |          | <b>Total Non-Plan</b>                           | <b>582.39</b>                |
|                            |          | <b>TOTAL FOR PLAN + NON-PLAN</b>                | <b>2243.43</b>               |
| <b>III. FUNDED PROJECT</b> |          |   |                              |
|                            | A.       | World Bank Project                              | 164.57                       |
|                            | B.       | UNDP Project                                    | 6.68                         |
|                            | C.       | NABARD Project                                  | -                            |
|                            | D.       | FORTIP  | -                            |
|                            |          | <b>GRAND TOTAL for (A+B+C+D) FUNDED PROJECT</b> | <b>171.25</b>                |