

Forest Research Institute Dehradun

Forest Research Institute (FRI), Dehradun erstwhile known as Imperial Forest Research Institute was established in 1906 to organize and lead forestry research activities in the country. The institute caters, in particular, to the research needs of the States of Punjab, Haryana, Chandigarh, Delhi, Uttar Pradesh and Uttarakhand. This institute also has the status of University and at present offers three courses leading to M.Sc. Degree and two Post-Graduate Diploma Courses, besides awarding Ph.D. degree in Forestry. The year 2006 was celebrated as Centenary Year of FRI and 5th June 2006 as Centenary day. Year long celebrations included First Brandis Memorial Lecture by Dr. M.S. Swaminathan, Chairman, M.S. Swaminathan Research Foundation, Chennai; followed by many international and national events. The Centenary year ended with a special function of its kind in the country in which a two km long symbolic and ceremonious green linen bearing the signatures of lakhs of school children of Uttarakhand with their pledge to protect and conserve the forests and environment, was wrapped around the FRI Main Building, a historical event of its kind in the arena of forestry science in tropical world.

PROJECTS COMPLETED DURING THE YEAR 2006-2007

Project 1: Studies on isolation and characterization of polysaccharides of abundantly available seeds of trees/shrubs, leaves, bark and exudate gums [FRI-51/Chem-1]

Sub-project (vii): Chemical investigation of *Prosopis juliflora* seed polysaccharide [2000-2006]

Findings: Seeds of *P. juliflora* are a waste and not being utilized properly. Endosperm adhered to the interior part of the seed was separated manually from the seed coat. Two polysaccharides were isolated from the endosperm, namely hot water-soluble polysaccharide (hws) (yield~3.3%) and cold water soluble polysaccharide (cws) (yield~81%). Molecular weight of the cws polysaccharide was determined by Mark-houwink equation using ubbelohde viscometer, and was found to be 10.7×10^5 . Complete hydrolysis of polysaccharide produced a mixture of monosugars D-galactose and D-mannose. The polysaccharide partially hydrolysed with dilute sulfuric acid (0.05N), furnished mixture of oligosaccharides along with monosaccharides. Oligosaccharides and polysaccharide were completely methylated by Hakomori and Purdie methylation reactions. GLC of the polysaccharide indicates nonreducing end of the main backbone and shows that the nonreducing single galactose units are attached to the branched mannose units through $(1 \rightarrow 6)$ glycosidic linkages, 2, 3-di-O-methyl-D-mannose and 2, 3, 6-tri-O-methyl-D-mannose indicate that the main chain is composed of $(1 \rightarrow 4)$ glycosidic linkages. The structure of polysaccharide was further confirmed by ^1H NMR, ^{13}C NMR and periodate oxidation. The abundant availability of the seed as waste material makes the seed polysaccharide a potential cost effective natural thickener.

Project 2: Inventorisation of multipurpose trees and shrubs for domestication and introduction in agroforestry for socio-economic upliftment of rural sector of Dehradun [FRI-199/SF-5/2002-2007]

Findings: Experimental work has been completed; data and final report is being prepared.



Project 3: Bio-ecology of insect pests of *Paulownia* and enumeration of their natural enemies [FRI-196/FED- 11/2002-2007]

Findings: *Paulownia* nursery and plantations at New Forest, Devipur, Sahaspur in Uttarakhand and Saharanpur in U.P. were surveyed. Light to moderate intermittent infestation of *Helicoverpa armigera*, *Hyposidra talaca*, *Orgyia postica*, *Spodoptera litura*, *Acherontia styx*, *Ceryx godarti*, *Euproctis* sp., *Mimastra cyanura*, *Dolycoris indicus*, *Nezara viridula* and *Pingasa chlora* was observed.

Studies on nutritional behaviour of an important defoliator of *Paulownia* and *Spodoptera litura* indicated that the insect could consume as much as 9245.50 mm² of *Paulownia* foliage during its entire larval stage.

Project 4: Identification and updating of Braconid parasites (Hymenoptera) of major insect pests in National Insect Reference Collection (NIRC), and Doon Valley [FRI-234/FED-17/2003-2007]

Findings: Taxonomy of Parasitic Braconid Parasites (Hymenoptera) - 2 species of braconids genus *Apanteles*, 1 spp. of *Chelonus*, some braconid parasites of subfamily Hormiinae and 2 parasites of subfamily Rogadinae were collected and identified. Study of parasitoids of *Stauropus alternus* known as *Apanteles taprobanae* on *Acacia catechu* has also been done.

Updating of Parasitic Braconid Parasites (Hymenoptera) - Updating of sub family Microgastrinae, Doryctinae and Hormiinae (housed in NIRC) and family Braconidae was completed.

Project 5: Bio-ecological studies on insect pests of bamboos and their management [FRI-144/FED-8/2001-2007]

Findings: Chemical control of bamboo ghoon was carried out at bamboo depot Kotdwar (Pauri Garhwal). Efficacy of various stickers with Cypermethrin 0.4% in diesel was tested. Stickers used were Neogenpin, Neogen PAN, Teepol, Triton and molasses. Best protection of felled bamboos was achieved for one year with the application of 20 ml. of molasses per litre of emulsion of Cypermethrin 0.4% in diesel followed by 20 ml. Neogen PAN, when used as prophylactic treatment.

Project 6: Studies on effect of plank width on drying rates and seasoning degrades with special references to low girth plantation species [FRI-313/FPD (WS)/58/2005-2007]

Findings: Data on cupping, spring and bow of *Eucalyptus* planks sawn under balanced tangential sawing pattern and radial sawing was compiled. An analytical study shows that there is certain range of length for which spring and bow are minimum. There are also certain ranges of widths for which cupping is minimum. The final project report is under preparation.

Project 7: Prediction of plants for plantation on 'a soil' based on cationic properties of soil and plant roots [FRI-317/FSLR-22/2005 2007]

Findings: Experiments conducted with three leguminous (*Cassia fistula*, *Dalbergia sissoo* and *Albizia procera*) and three non-leguminous (*Eucalyptus tereticornis*, *Terminalia arjuna* and *Terminalia chebula*) species in normal and sodic soils indicated that uptake of nutrients by plants is related to cation exchange capacity of soil and plants roots that was higher in normal soil than sodic one, and

leguminous species than non-leguminous species. Plant growth (height and biomass) increased with increase in cation exchange capacity of soil and plant roots.

Project 8: Development of protocol for multiplication and Germplasm conservation of *Oroxylum indicum* and *Gymnema sylvestre* [FRI 243/G&TP 14/2003-2007]

Findings: *In-vitro* shoots were multiplied and *in-vitro* rooting was standardized for *Oroxylum indicum* and *Gymnema sylvestre*. Half strength MS medium was found to be the best for *O. indicum* and half strength MS medium supplemented with NAA was found to be the best for *G. sylvestre*.

Project 9: Development of forest fire control tools [FRI-325/Silva-27/2005-2007]

Findings: Forest fire tools were fabricated, tested and demonstrated in various conferences and workshops. The technical know how of these tools was also given to M/s Atul Trading Corporation, Dehradun for further fabrication and supply on nonexclusive basis.

PROJECTS CONTINUED DURING THE YEAR 2006-2007

Project 1: Assessment of wood quality parameter in seed raised plantations of different age series of *Dalbergia sissoo* Roxb. [FRI -299/Bot-44/2005-2008]

Status: Measurement of fibre length, fibre diameter, wall thickness, vessel length and diameter of 12 trees was completed from maceration and 2 trees from slides. Further, data on 22 growth rings of a tree was completed.

Project 2: Inventorization and monitoring of biodiversity of threatened wetland sites of Doon valley and surroundings, Uttaranchal [FRI-250/Bot-33/2003-2008]

Status: Floristics for the threat value vis-a-vis conservation value assessment was done on the fresh water swamps, namely Ramgarh, Mothronwala, Golatappar, Tinpani, Manu swamp, Nakraunda, Asan etc. Doon Valley. Categorization of threatened sites was done from the restoration point of view. Taxonomical and nomenclatural aspects on 150 species of the area were completed for a treatise.

Project 3: Exploration, ethnobotanical evaluation and preservation of rare and endangered flora of Jaunsar-Bawar [FRI -298/Bot-43/2005-2008]

Status: Floristic and ethnobotanical surveys were carried out in Chakrata hills of Jaunsar and Bhabar region of Uttarakhand. Nearly 300 specimens along with ethnobotanical data were collected.

Project 4: Evaluation of the principal chemical constituents of medicinal plants available with NWFP Division [FRI 300 / Chem.-14/2005-2008]

Status: Plant species under the project were propagated and maintained in the nursery of NWFP Division at FRI and Chakrata. Analysis of *Andrographis paniculata* and *Bergenia ligulata* was carried out in respect of Andrographolide and Bergenin content respectively for the periodic assessment of the active components. The physico-chemical analysis was also done as per Indian Ayurvedic Pharmacopoeia. The propagated materials of *Oroxylum indicum* were maintained in the nursery.

Project 5: To study ecological succession in restored mined lands [FRI 302/Eco-19/2005-2008]



Status: Phytosociological studies have been carried out at Rockphosphate mines (Maldevta), Dehradun. Floristic survey, collection of litter, plant and soil sample has been done at bimonthly intervals. Chemical analysis of plant and litter samples is in progress.

Project 6: To study the undergrowth ecology of natural and man-made forests of Terai belt of Uttaranchal [FRI-301/Eco-18/2005-2008]

Status: Natural regeneration of teak was observed in least disturbed plantations. Highly disturbed natural forests were invaded by *Parthenium hysterophorus* weed. Forest fire caused mortality to teak seedlings and boosted grass production. Undergrowth biomass production under natural forests was found higher than in teak plantations.

Project 7: Effect of *Populus deltoides* plantation on shade loving medicinal plants [FRI-305/SF-8/2005-2011]

Status: Two demonstration plots showing shade effects of *Populus deltoides* on medicinal plants were established in village Kuahedi, Gurukul Narson, District Haridwar, Uttarakhand. Survival and growth performance of medicinal plants viz. Tulsi (*Ocimum sanctum*), Satawar (*Asparagus racemosus*), Ashwagandha (*Withania somnifera*) and Chitrak (*Plumbago zeylanica*) were recorded. *Asparagus racemosus* and *Plumbago zeylanica* were found growing better than *Withania somnifera* and *Ocimum sanctum*.

Project 8: Tree crop interactions: Effect of *Melia* sp. on crops [FRI-306/SF-9/2005-2011]

Status: Survey on current practices of *Melia* spp. in certain parts of Punjab State was conducted to improve the traditional agroforestry practices with special reference to *Melia*. Twelve demonstration plots of *Melia* based agroforestry were established in Districts of Mohali, Fategarhsahib and Hoshiarpur. Data on growth performance of *Melia* plants under different planting patterns are being recorded. Soil properties of concerned agroforestry fields are under study.

Project 9: Effect of pine and oak forests on agriculture crops [FRI-327/SF-10/2005-2008]

Status: Selection for experimental site has been completed. Study on soil profile of experimental site is in progress. Surveys on agriculture practices in Khirsu (Pauri) have been done.

Project 10: Integrated pest management of mandate species in nurseries and plantations with special reference to biopesticides and microbial pesticides (Name of species: *Dalbergia sissoo* and *Populus deltoides*) [FRI-198/FED-13/2002-2008]

Status: Identified two new insect pests *Eupterote undata* and *Orgyia postica* on *Dalbergia sissoo* and two namely, *Bellipia lohor* and *Eupterote undata* on *Populus deltoides*.

In continuation of the previous year's experiments on control were repeated against major pests and the results showed that:

Two strains of *Bacillus thuringiensis* viz. BioAsp and BioLep when sprayed @ 1-1.5% proved highly effective and gave 100% mortality against the larvae of *Plecoptera reflexa*, *Clostera cupreata*, *Eupterote undata*, *Dichomeris eridantis* and *Phalantha phalantha* in the laboratory conditions in 72 hours.

Out of the identified 11 new entomopathogenic fungi of the major pests, 3 fungi viz. *Fusarium fusaroides*, *Beauveria bassiana* and *Nomuraea rileyi* were mass produced and tested for their efficiency. It was observed that all of them gave effective mortality against the pests.

Commercially available four neem products, namely Neemexel, Achook, Nimbicidin and Neemazal were tested for their efficacy against the major pests of shisham and poplar. Neemexel when sprayed @ 0.00075-0.005%, Achook @ 0.5-1.0%, Nimbicidin @ 1.5-2.0% and Neemazal @ 1.0-2.0% gave promising results. Seven species of plants e.g. *Jatropha curcas* [leaves and seeds], *Eucalyptus* [leaves], *Acorus calamus* [rhizome], *Adhatoda vasica* [leaves], *Lantana camara* [leaves], *Vitex negundo* [leaves] and *Pongamia pinnata* [leaves] were subjected to extraction in Petroleum ether, Acetone, Chloroform, Benzene, Methanol and Ethanol and tested for their efficacy against the major pests.

Project 11: Bio-ecology and nutritional behaviour of polyphagous insect pests with special reference to *Spilarctia obliqua* [FRI-304/FED-21/2005-2008]

Status: Collected larvae of *Spilarctia obliqua* and its natural enemies from the selected sites and reared on important forest tree species such as *Paulownia*, poplar (*Populus*), teak (*Tectona grandis*), toon (*Toona* spp.) etc. The insect has completed its life cycle in 42 days in laboratory with a span of 26 days as larvae. Studies on the nutritional preference on *Paulownia*, poplar, teak and toon revealed that larvae fed on *Paulownia* and poplar could survive and reached up to adult stage while larvae reared on teak and toon died at different stages of development. *Paulownia* was found to be preferred food, if choice is available. Consumption studies revealed that the larvae consumed 4752.70 mg of *Paulownia* foliage as food, whereas it is 3360.82 mg in case of poplar. Further studies revealed that 3rd instar larva of *S. obliqua* consumed 1100 mm² of *Paulownia* foliage while the 4th instar was able to consume 1650 mm².

Mass culture of *Corcyra cephalonica* was maintained on Sorghum flour. It was observed that over 6,000 moths emerged during the period. Laboratory culture of four species of egg parasitoids of *Trichogramma brasiliensis*, *T. chilonis*, *T. japonicum* and *T. poliae* was maintained on the eggs of *C. cephalonica*.

Project 12: Studies on the termite diversity of Northern India with special reference to species composition in relation to different tree species [FRI-275/FED-19/2004-2007]

Status: Studies were completed on termite collection from Punjab - 28 species with 12 genera belonging to 2 families, which include 14 new records; Haryana - 21 species with 11 genera belonging to 3 families, with 9 new records and Himachal Pradesh - 19 species with 12 genera belonging to 2 families, having 9 new records. Identification keys to the termites reported were prepared. Camera Lucida diagrams of the recorded termites were made for further studies.

Certain termites identified earlier were examined and correctly identified following latest nomenclature: *Odontotermes bangalorensis* Holmgren = now *O. obesus* (Rambur), *O. parvidens* Holmgren & Holmgren = now *O. distans* Holmgren & Holmgren, *O. feae* (Wasmann) = now *O. indicus* Thakur (specimens from northern India only as *O. feae* (Wasmann) is known only from peninsular India), *O. guptai* Roonwal & Bose = now *O. lokanandi* Chattarjee & Thakur and *Microtermes anandi* Holmgren = now *M. obesi* Holmgren.



Project 13: Up-gradation and computerisation of National Insect Reference Collection (NIRC) [FRI-233/FED-16/2003-2008]

Status: a) *Taxonomy of parasitic micro-hymenoptera (Chalcidoidea)*: A new genus and a new species *Aassamencyrtus jorhatensis* and another species of *Epitetracnemus dehradunensis* were described. Work on ten new by new described species of *Psyllaephagus*, parasites of psyllids, which make galls on many tree species, was continued. Slide preparation, diagrams and morphometrics of two new spp. of genus *Neococcidencyrtus*, and one each of *Adelencyrtus* and *Coccidencyrtus* were completed. All the four species are parasitoids of diaspidid scales.

b) *Upgradation of NIRC 314: New incorporations*: Accession of the collection was increased from 21404 to 21717. Primary and secondary types of about 1700 species, earlier scattered throughout the collection, were segregated and placed for better maintenance and safety.

c) *Computerisation of NIRC*: Data of 6000 species, totaling 17,000, belonging to the orders Coleoptera, Diptera, Dermaptera, Neuroptera, Orthoptera and Lepidoptera were incorporated into the database, with information on species name, hosts, locality, bionomics, location of the collection etc.

Project 14: Evaluation of natural termite resistance in timber species [FRI-303/FED-20/2005-2008]

Status: Four imported timber species: Ivory coast teak, Golden teak (Malaysian sal) - yellow meranti group, *Pinus sylvestris* and *Cryptomeria japonica* (Japanese cedar) have been tested in the laboratory for their natural resistance against subterranean termites.

Project 15: Studies on enhancement of natural durability of bamboo and plantation grown species with conventional/eco-friendly preservatives [FRI-236/FPD (WP)-43/2003-2008]

Status: ZiBOC, a new eco-friendly wood preservative at 0.5, 1.0 and 2.0 % concentrations and at 2.3, 5.4 and 10.8 kg/m³ exhibited complete protection of chir (*Pinus roxburghii*) veneer samples in field ground test whereas controls were badly damaged. poplar (*Populus* spp.) samples treated with 2% concentration of this preservative exhibited complete protection after 24 months of installation. In advance field trials i.e stake test of chir and poplar wood treated with CCA and ZiBOC installed at 3 test centers exhibited complete protection after six months of installation whereas moderate to bad microbial attack was observed in control samples. Borax: Boric acid, CCA and CCB treated bamboo species exhibited good protection of bamboo in ground as compared to control.

Project 16: Exploration of copper lignin complexes for wood preservation and effect of post treatment processes on precipitation or fixation in wood [FRI-252/FPD (WP)-44/2003-2008]

Status: Pine and mango sticks were treated with 1.0, 0.5 and 0.25% concentration of Copper Lignin complex A and B by five different methods. After 19 months, it was observed that pine samples at higher concentrations were either normal or very slightly affected by termite or fungus whereas mango sticks exhibited slight effect of fungus.

Project 17: Development of eco-friendly water repellent preservative finishes for handicrafts items [FRI-307/FPD(WP)-52/2005-2008]

Status: Gloss at three different degrees was taken of copperised cashew nut shell liquid-treated samples with five different polish treatments. Results show that Gloss at all three degrees increased for the treated samples compared to the control.

Studies on the effect of UV radiation on the performance of the different treatments were carried out. Observation up to 600 hours of UV radiation exposure showed that double-treated samples (preservative plus polish treatment) are better than the samples that received only polish treatment.

Project 18: Effect of Ammonia Fumigation on glue line strength of plywood from plantation species [FRI-312/FPD(CW)-57/2006-2008]

Status: The plywood boards prepared using poplar and *Eucalyptus* veneers were fumigated with Ammonia for various durations of time, i.e. 30 minutes, 2 hrs, 24 hrs and 48 hrs. In another experiment, veneers of poplar and *Eucalyptus* were first fumigated with Ammonia for similar durations of time, and subsequently combi plywood boards were prepared with them. The combi plywood boards prepared by both these methods were tested for their density, moisture content, glue shear strength in dry, wet and mycological state. The data collection and analysis are in progress.

Project 19: Velocity gradient induced single glass modified solar kiln for drying of timber and NWFPs [FRI-310/ FPD(WS)-55/2005-2008]

Status: The solar kiln with a new design consisting of single layer of glass was completed. Studies on the efficiency of this kiln are in progress.



Modified Solar Kiln

Project 20: Evaluation of physical and mechanical properties of *Leucaena leucocephala* (Subabul) and classification and grading of timber for different end uses [FRI-309/ FPD(TM)-54/2005-2008]

Status: Physical and mechanical properties of material obtained from Andhra Pradesh and Uttarakhand (FRI) were evaluated. Data analysis and writing of report is in progress.

Project 21: Bending and compression properties of small diameters round plantation timbers [FRI-311/ FPD(TM)-56/2005-2008]

Status: Testing of *Eucalyptus* spp. (*Eucalyptus*) in round form was completed. Data compilation and analysis is under progress. *Melia azedarach* (Bakain) has been procured from local market and



Dalbergia sissoo (Shisham) from Hoshiarpur, Punjab. Samples of *Melia azedarach* have been prepared and testing is in progress in round form.

Project 22: Evolving kiln schedules under vacuum drying for selected plantation species [FRI-308/FPD (WS)-53/2005-2008]

Status: A tentative two-step simple schedule has been evolved for drying 2.5 cm (one-inch) thick planks of poplar.

Project 23: Studies on soil geological and geomorphological linkages with different forest communities for sustainable management of Uttarakhand forests [FRI-314/FSLR-19/2005-2008]

Status: Collected soil and rock samples from Kempti range of Mussoorie Forest Division from five different sites with *Pinus roxburghii*, *Quercus leucotrichophora* and *Dalbergia sissoo*, mixed and barren land (Control) on the basis of types of vegetation, parent material and range of altitude. Vegetation analysis was also carried out in the study area. Physical and chemical analysis of soil samples collected has been completed and chemical analysis of rock samples is in progress. Different utility maps like location, drainage, geology, soil, vegetation are being prepared, Slides of sand fractions separated from soil samples have been prepared for mineralogical investigations and oriented slides of clay fractions are being prepared for X-ray diffraction analysis.

Project 24: Effect of different plantations on soil properties and carbon store [FRI-315/FSLR-20/2005 - 2008]

Status: Soil samples were collected from different sites selected in Uttarakhand and Haryana under poplar, *Eucalyptus*, shisham and teak plantations from predetermined depths of 0 10, 10 30, 30 60, 60 90, 90 120 cm. Barren land near plantation was selected in each site and soil samples from similar depths were also collected from there as control. Vegetation study was conducted at each site and trees were enumerated for density, d b h, crown area and height. Soil samples collected from field were processed in laboratory and analysis for various physico-chemical attributes is in progress. Organic carbon, organic matter, available nitrogen and porosity estimation was completed in the samples under poplar and *Eucalyptus* plantations of Uttarakhand and Haryana.

Project 25: Soil and vegetation survey and preparation of pedonarium in New Forest Estate Dehradun [FRI-316/FSLR-21/2005-2008]

Status: Physical and chemical properties of the soil samples collected from plantations, grassland, agricultural land and khaddar area were determined. The data was processed and interpreted. Data on temperature and humidity in plantation area were collected. Vegetation study was carried out. The Bangalore Centre of National Bureau of Soil Survey and Land use Planning was visited to make arrangements for hands-on-training for preparation of Pedonarium.

Project 26: Genetic evaluation of selected genotypes for exploring clonal forestry potential in *Dalbergia sissoo* [FRI-319/G&TP-16/2005-2008]

Status: The site of about one hectare was selected in each of three locations in Punjab (Hoshiarpur, Ludhiana and Patiala) and one in Uttarakhand (Chirapur, Haridwar) and prepared for the planting of the

trial. The clonal trial of 36 selected clones of shisham has been taken up and planting completed. The trial was maintained and gap filling was done wherever required. The wood samples collected are being tested for anatomical and wood properties.

Project 27: Establishment of breeding arboretum of *Eucalyptus* and production of interspecies hybrids [FRI-318/G&TP-15/2005-2010]

Status: Breeding arboretum has been established at Forest Research Institute with 10 species of *Eucalyptus* in 20 replications, in open pollinated mating design at 3x3 m spacing. Data on initial stage have been taken for height, collar diameter and branching pattern. Phenological observation has been recorded on flowering and fruiting in different *Eucalyptus* species growing in New Forest campus.

Project 28: To develop propagation i.e. micropropagation technique of economically important bamboos - *Arundinaria falcata* and *Bambusa balcooa* [FRI-219/G&TP-10/2002-2007]

Status: Developed tissue culture protocol for multiplication of *Arundinaria falcata* through axillary bud culture. *In-vitro* shoot multiplication experiments were conducted. Effect of different concentration of BAP, Kn was studied. Effect of pH, sucrose and number of shoots in a propagule was studied for shoot multiplication. *In-vitro* rooting was standardized and effect of different concentration of auxin studied for *in-vitro* rooting

Project 29: Development and multiplication of superior bioactive clones of *Stevia rebaudiana* [FRI-320/NWFP-19/2005-2008]

Status: Twenty one accessions of *Stevia rebaudiana* have been made from areas in Uttarakhand, Delhi, Himachal Pradesh and Haryana and introduced under field conditions for assessing their performance. The collected accessions are being analyzed for physical and chemical characterization for undertaking breeding programmes.

Project 30: Assessment of shisham die back (decline) in northern India and its remedial measures [FRI-245/Path-12/2003-2008]

Status: Pathological resistance testing on the seedlings of *Dalbergia sissoo* raised from 107 trees spread in 21 locations was carried out. The germplasm of Amritsar (Punjab) showed maximum resistance against wilt pathogen *Fusarium solani*. Similarly seeds collected from five heavily infested locations in Uttar Pradesh and Bihar, namely Gonda, Maharajganj, Tulsipur, Betiah and Motihari were tested for their pathological resistance. Motihari germplasm was found to be the most resistant while Gonda germplasm susceptible. Isolates of *Pseudomonas fluorescence* collected from rhizoplane of healthy shisham trees were tested against *Fusarium solani* in dual culture. The Khizrabad (Yamuna Nagar) isolate was found most effective.

Project 31: Screening for disease resistance in genetic material raised under tree improvement programmes [FRI-207/Path-13/2002-2007]

Status: Evaluation of 77 clones of *Dalbergia sissoo* raised at Clonal Seed Orchard (45 clones) and Seedling Seed Production Area (22 clones), Bhitmera, Hissar (Haryana) was done for phenological characters in respect to *Ganoderma lucidum* root rot. It was found that clone Nos. 219 (Compt. No.



Birpur 4A, Bhambhar Beat, Tulsipur Range, Gonda Forest Division, U.P.), 194 (Compt. No. 2, Hasanpur Beat, Tulsipur Range, Gonda Forest Division, U.P.), 266 (Comp. No. 3, Lalpani Beat, Rishikesh Range, Dehradun Forest Division, Uttarakhand), 304 (Beat Uttrinalla, Shyampur Range, Haridwar Forest Division, Uttarakhand) and 276 (Lalpani beat, Rishikesh Range, Dehradun Forest Division, Uttarakhand) were best performers for height growth, girth, clear bole and disease resistance. It is recommended that these clones should be used for raising *D. sissoo* in future plantation programmes for combating infection of *G. lucidum* under conditions prevailing in Haryana and Punjab states. The poor performing clones with respect to phenological characters and root rot mortality were identified as Clone Nos. 88, 193, 81, 57, 101, 94, 281, 272, 290, 291, 298, 288, 289 and 293, which should best be avoided for raising *D. sissoo* plantations.

In a trial for testing of *Eucalyptus* hybrids (*Eucalyptus citriodora* X *E. torrelliana*), being carried out by the Genetics and Tree Propagation Division, at New Forest campus (Kaulagarh), a new stem and twig canker disease caused by *Phomopsis* spp. along with its perfect stage in *Chrysosporthe* spp. was noticed and assessed for damage. The parents as well as F1 progeny were found to be affected.

Project 32: Biological control of *Lantana camara* and *Parthenium hysterophorus* by fungal pathogens [FRI-206/Path-12/2002-2007]

Status: Poison food technique showed that all the adjuvants and herbicides screened were toxic to fungal pathogens of *L. camara*, hence they were not applied in a tank mix with fungal pathogens. Application of herbicides prior to the fungal biocontrol agents was done in glasshouse experiments. In the subsequent glasshouse experiments, pathogens were administered 15 days after the application of herbicides.

It was concluded from the glasshouse experiments that sublethal doses of glyphosate or atrazine when followed by sequential application of *Phomopsis archeri* controlled 6 to 8 months old *Lantana camara* plants. Other pathogens were not able to kill *L. camara* plants in combination with sublethal doses of herbicides. Optimum dew period for *P. archeri* infection was also standardized.

Project 33: Evaluation of appropriate technology and its adoption as applicable in rural environment [FRI-321/PLO-3/2005-2008]

Status: Surveys in the villages Sherpur, Badonwala, Harbajwala and Mehuwala Mafi on Dehradun-Shimla road were undertaken. Villagers were motivated to raise bamboo seedlings in their area and to develop a nursery for the same. After survey, Harbajwala village was selected. A two-day bamboo training programme was organised at the Shatabdi Van Vigyan Kendra (Rangers College, City Centre), Dehradun for the selected villagers. During the training, lectures were imparted on bamboo multiplication, preparation of beds, sowing of bamboo seeds, micro proliferation technique of bamboo multiplication and its importance etc. General field visits of the participants to the Central Nursery were also undertaken. The raised seedlings during the training period were provided to the participants of the training programme for introduction in their villages during July 2006.

Project 34: Regeneration study on *Quercus semecarpifolia* and *Carpinus viminea* [FRI-324/Silva- 28/2005-2008]

Status: Seeds of *Carpinus viminea* were collected from Nainital (Uttarakhand). Seed morphology and biology of collected seeds were carried out with respect to seed length, width, colour, shape, 1000 seed

weight, moisture content, number of seeds in 1 kg. Germination study is in progress. Seeds were kept for stratification and also stored at different temperatures i.e. 5°C, 15°C and at room temperature for storage study. Soil study of Mandal forest was carried out to see the impact of soil on regeneration of *Carpinus viminea* and *Quercus semecarpifolia*.

Project 35: Development of technology for cultivation of commercially important under-exploited Lesser Known Tree Species (LKTS) [FRI-322/Silva-26/2005-2008]

Status: Fruits of *Averrhoa carambola* (kamarakh) were collected and measured for length and diameter. Hundred seed weight of kamarakh is 2.75 gm. Seeds in quartz sand showed better germination as compared to germination paper in germinator at 25-30 °C. *Ficus palmata* seeds were sown in two different media, sand and soil mix with coal. Observation revealed that seedlings grown in soil have more height and dbh than seedling in coal. Vegetative propagation studies on *F. racemosa* (Syn. *F. glomerata*) and *F. palmata* showed best rooting in 2000 and 3000 ppm of IBA treated cuttings. Hard cuttings resulted in good rooting as compared to hollow cuttings.

Project 36: Multilocation trials of promising clones of *Gmelina arborea* Roxb. [FRI-326/Silva- 30/2005-2008]

Status: Vegetative propagation material from 19 promising clones of *G. arborea* was collected from Rain Forest Research Institute, Jorhat. The cuttings were given rooting hormone treatment and planted in the shade house at FRI for multiplication.

Project 37: Field evaluation of new clones of poplar [FRI-323/Silva-27/2005-2008]

Status: Established nursery of 25,000 plants belonging to 200 clones of poplar. Plants of *P. deltoides* x *P. euphratica* were raised in nursery. These clones and hybrids have been developed by Forest Research Institute, Dehradun. Field trials will be laid out during spring the season of 2008.

NEW PROJECTS INITIATED DURING THE YEAR 2006-2007

Project 1: Impact of ban on green felling on the plant diversity of selected sites in Uttaranchal [FRI-357/Bot-52/2006-2009]

Status: Field surveyed for the unallotted, seeding and final felling compartments of Deodar and Chirpine forests of Chakrata and selected the sites for vegetative analysis.

Project 2: Studies on the development of biopesticides from *Eucalyptus* hybrid [FRI-344/Chem-16/2006-2008]

Status: Leaves of *Eucalyptus* hybrid were collected from the New Forest campus, Forest Research Institute, Dehradun. The essential oil was isolated using hydro distillation method. Three extractives using petroleum ether, chloroform and methanol were prepared. Screening of the extracts and oil demonstrated insecticidal activity against poplar defoliator, *Clostera cupreata*. Collection of the foliage and their extraction using the solvent of increasing polarity were repeated. The acetone extractive was fractionated into acetone soluble and insoluble portions. Ursolic acid rich fraction was isolated. Pesticidal screening of the extractives and the solid obtained is in progress.

Project 3: Production and value addition by chemical derivatization of alpha cellulose of *Lantana camara* for its useful applications [FRI-345/Chem-17/2006-2009]



Status: Cyanoethyl cellulose was prepared from the alpha cellulose isolated from *Lantana camara*. Thirty one derivatives were prepared. Reaction conditions were standardized with respect to sodium hydroxide concentration, acrylonitrile concentration, cyanothylation time and temperature. Degree of substitution (DS) of the modified cellulose of cyanoethyl cellulose was determined by calculating the nitrogen content in the samples.

Project 4: Utilization of fungi for biotreatment of industrial waste waters [FRI-346/Eco-20/2006-2009]

Status: Effluent analysis: Textile and distillery effluents were collected and analysed for their physico-chemical parameters like temperature, pH, turbidity, conductivity, total solids, chloride, nitrogen, hardness, calcium, alkalinity, phosphate, potassium, sodium, BOD, DO, COD and heavy metals.

Fungi culturing: Different species of fungi were collected from the dead materials from the adjacent areas of effluent disposal sites and cultured in the lab.

Fungal treatment: Effluents collected from different fungi for the preliminary screening of the effective fungi.

Preliminary screening: On the basis of optical density and mycelial weight, six fungi namely, *Merulius tremelosus*, *Pycnoporus sanguineus*, *Trametes ravidus*, *Trichoderma* species, *Penicillium* sp. and *Mucor hiemalis* treatment, 5 fungi namely *Schizophyllum commune*, *Trametes ravidus*, *Trametes versicolor*, *Trametes cingulata* and *Pyconoporus sanguineus* were screened for distillery effluent treatment.

Project 5: 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-28/2006-2009]

Status: *Cordyceps sinensis* infested larvae were collected from Bedini bugyal of Badrinath Forest Division (Uttarakhand). Average length of larvae was 2.25 cm and fruiting body 4.44 cm while average of total length of larva with fruiting body was found 6.69 cm. Some plants growing in the vicinity of fungus infested larvae were identified by the botanists of the Institute as *Jurina dolicocephala*, *Geum elatum*, *Polygonum polystachum*, *P. affinis*, *Impatiens sulcata*, *Parnesia nubicola*, *Taraxacum officinale*, *Pedicularis* sp., *Saxiphraga* sp. and *Tanasetum* sp. etc.

Project 6: Control of shisham leaf miner *Leucoptera sphenograpt* using systemic insecticides [FRI-349/ FED-24/2006-2009]

Status: Seventy seedlings of *Dalbergia sissoo* were procured from nurseries and planted in the field for study of the biology of the leaf miner.

Survey of shisham plantation and nurseries was carried out in Uttarakhand and Haryana. Cocoon of *Leucoptera sphenograpt* were collected from host plants and kept in the laboratory for emergence. Light to moderate attack of the shisham leaf miner *L. sphenograpt* was noticed at Thanu Forest Range and Chhachrauli Range. Infested materials were reared in the laboratory and emerged moth was identified as *Leucoptera sphenograpt* Meyr. (Lepidoptera: Lyonetiidae). The larval parasitoid associated with the leaf miner was identified as *Paraharmius* Jason (Hymenoptera: Braconidae). Some pupal parasitoids were also recovered and they are being processed for identification. Further work is in progress.

Project 7: Butterfly diversity in moist temperate forests of Garhwal: Evaluating species of conservation priority and indicator taxa of habitat disturbance in Ban oak forest ecosystem [FRI-348/FED-23/2006-2009]

Status: Sampling surveys of butterflies was carried out in Garhwal Himalayas: Chamoli-Rudraprayag Districts (Kedarnath Musk Deer Reserve) and Tehri Garhwal (Benog sanctuary-KotiKimoi-Dhanaulti-Nag Tibba) along fixed transects in both undisturbed and degraded Ban Oak forest habitats. Studies revealed more than 60 species of butterflies with one having new range extension from North-East India and another species new to science that is being described.

Project 8: Eco-friendly preservatives and fire retardants combinations for protection of structural bamboos for low cost houses [FRI-350/FPD (WP)-60/2006-2009]

Status: Bamboo species treated with 15% ZiBOC and fire retardants gave substantial retention of preservative in three species of bamboo, which is under testing for performance evaluation.

Project 9: Studies on performance of plantation grown species in cooling towers [FRI-351/FPD (WP)-61/2006-2009]

Status: Procurement, conversion, seasoning and treatment of timber yielding species of Toon (*Toona ciliata*), *Pinus radiata* and *Pinus roxburghii* and *Ailanthus excelsa* have been completed.

Project 10: Evaluation of Australian seed sources and families of *Eucalyptus tereticornis* for productivity and genetic improvement PHASE II [FRI-358/G&TP-20/2006-2009]

Status: Experimental plantation was maintained through execution of cleaning, weeding and soil working operations. Flowering behavior of different provenances was observed. Data recording and analysis work on various morphometric traits were completed. About forty-seven superior trees have been identified and marked. The North Queensland provenances maintained their superiority over other provenances.

Project 11: Development of organic cultivation protocols for enhancing productivity of selected medicinal and aromatic plants in Uttaranchal [FRI-359/NWFP-23/2006-2009]

Status: Research on developing organic cultivation protocol for medicinal plants such as *Asparagus racemosus*, *Rauvolfia serpentina* and *Ocimum sanctum* is under way. Experiments using FYM, vermicomposts, soil moisture conservation, soil nutrient replenishment and weed control are in progress.

Project 12: Studies on nursery diseases of important medicinal plants of Uttaranchal [FRI-352/NWFP-22/2006-2009]

Status: Studies are in progress to identify the causal organisms of various nursery diseases of medicinal and aromatic plants in the state of Uttarakhand. Many fungus related diseases are being identified in Dehradun, Rishikesh, Chakrata areas etc. in collaboration with Pathology Division of the institute. The study will cover all districts of the Herbal state Uttarakhand by March 2009.

Project 13: Identification and evaluation of disease resistance in different genotypes of poplar [FRI 353/Path-21/2006-2011]



Status: Survey of nurseries and plantations of different age class poplars for disease assessment was done in Udham Singh Nagar and nearby areas (Baghwala, Chandain and Pawan farms, Inderpur nursery) of Uttarakhand. *Alternaria*, *Phoma*, *Bipolaris*, etc. Diseases were identified on different genetic materials. Their symptoms were recorded. Isolation of these pathogens was made and studies of their biology are underway. Data was recorded on growth performance and intensity of different foliar diseases on clones of *Populus deltoides*.

Project 14: Enhancing the longevity of acorns of *Quercus dilatata* and *Q. leucotrichophora* [FRI-355/Silva-32/2006-2009]

Status: Literature was consulted on distribution, acorn collection and storage of the two species of oak. Field surveys were conducted in Dhanaulti, Mussoorie and Nainital Forest Divisions to assess the crop of the two species. Acorns of *Q. leucotrichophora*, collected from Dhanaulti and Mussoorie Forest areas were cleaned, desiccated to three moisture levels using Silica gel, to study their desiccation tolerance. Then acorns were stored in four containers at 5°, 5°, and 15° C and at ambient temperature and subjected to monthly germination tests to assess their viability.

Project 15: Evaluation of seed orchards of *Dalbergia sissoo* for seed quality [FRI-354/Silva-33/2006-2009]

Status: Seeds/pods have been collected from seedling and clonal seed orchards of *Dalbergia sissoo* from Bithmara and Hissar in Haryana and also from general populations for comparison. The pod and seed characteristics of different progenies and clones have been recorded and significant variations observed in the studied traits. The germination and storage trials of the seeds collected are in progress.

Project 16: Econometric analysis of potential and constraints for farm forestry development in Eastern UP [FRI-356/Stat-2/2006-2010]

Status: The sites were visited and a questionnaire has been developed. The data from Western UP has been collected.

PROJECTS COMPLETED DURING THE YEAR 2006-2007

(Externally Aided)

Project 1: Utilization of economic potential of *Parthenium* [FRI-262/Chem-13/External/2004-2007]

Sub-project (i): Preparation of composites

Findings: Phenol formaldehyde resin was prepared and analysed using commercial grade phenol and formaldehyde. It was observed that the particle boards prepared at 24 kg/cm² pressure level using 14 % resin meet the IS specifications.

Sub-project (ii): Preparation of alpha cellulose and handmade paper

Findings: *Parthenium* contains 78 % holocellulose and 17.8 % lignin indicating that the plant is suitable raw material for cellulose extraction. The plant contains short fibre and fibre length lies between

0.55 mm to 1.32 mm and fibre diameter 14.94 μ . Alpha cellulose (90.82%) was isolated under optimized conditions with brightness 80% and average DP 661.5. Handmade paper was developed with *Parthenium* alone with an admixture of long fibre.

Project 2: Alkaline peroxide mechanical pulping/bleaching [FRI-331/C&P-17/External/2005-2007]

Findings: Conditions optimized to produce APMP pulp from sarkanda. The technology was demonstrated at 2 kg batch level to the Executives, M/s ABC Paper (Punjab).

Project 3: Development of eco restoration model for Iron Ore Mines of Bihar and Orissa [FRI- 179/Eco-9/External/2001-2007]

Findings: Over burden dumps, mined benches as well as degraded site (Village) have been completely stabilized and there is a distinct improvement in the soil after restoration intervention.

Steel Authority of India Limited (SAIL) appreciated the work, as restoration trials have directly cut the cost of debris removal from the colony areas of SAIL.

Project 4: Efficacy testing of the insecticide-Actara 25 WSG (Thiamethoxam) against termites [FRI-266/FED-18/External/2004-2007]

Findings: Laboratory Testing: Laboratory testing of the insecticide Actara-25 WSG in comparison with two more insecticides, Endosulfan 35EC and Chlorpyrifos 20EC (@ 0.0125%, 0.0187%, 0.025% and 0.05%) against termites completed. Endosulfan gave comparatively better results whereas effect of Actara and Chlorpyrifos was at par statistically. Final Report of the laboratory studies of the insecticide Actara- 25 WSG has been sent to the Syngenta India Ltd., Mumbai.

Field Trial: Comparative efficacy of the insecticide Actara-25 WSG is also being tested in the field. Monthly observations were taken on the mortality of poplar and *Eucalyptus* plants due to termites, *Odontotermes obesus* (Rambur) and *Microtermes obesi* Holmgren.

Project 5: Utilization of Sisal fibre for making Composites and Handmade paper [FRI-268/FPD-49/External/2004-2006]

Findings: Fibre board prepared from *Parthenium* at different pressure and varying additives, meets most of the IS specifications. Handmade paper was developed with 100% Sisal cooked fibre and blended with waste paper.

Project 6: Micropropagation of chirpine (*Pinus roxburghii*) and shisham (*Dalbergia sissoo*) [FRI- 222/ G&TP -13/ External/2002-2006]

Findings: Embryogenic callus was established through immature zygotic embryos. Effect of phytohormones was studied for embryogenic callus proliferation. *In-vitro* shoots of Chirpine and *Dalbergia sissoo* were multiplied on MS medium supplemented with different concentration of cytokinin.

Project 7: Preparation and publication of a souvenir to mark the Centenary of FRI [FRI-342/Path-20/External/2006-2007]



Findings: Uttaranchal Council of Science and Technology (UCOST) financed the project. A publication viz., FRI: Glimpses of a Century was published which gives details of 100 years of creative scientific history of FRI.

Project 8: Technology transfer and development of a model village by skill up-gradation and capacity building of rural communities for socio-economic upliftment, SRTT funded project [FRI-297/PLO-2/External/2005-2007]

Subtitle: Integrated Utilisation of *Lantana*

Findings: Training programme was undertaken and 10 participants took part in integrated utilisation of *Lantana*. The participants were imparted training to obtain dye from the leaves and the board from *Lantana* wood through trees support of Forest Products Division of FRI during November 2006. A Demonstration-cum-Display centre depicting the articles made from *Lantana* was formally inaugurated in the newly declared Shatabadi Van Vigyan Kendra of FRI, Dehradun. Through this Kendra (erstwhile Rangers College) the artisans/farmers can draw benefits by selling the products and multiplying the planting material by using mist chamber etc.

Project 9: Networking forest plantations in a crowded world: Optimizing ecosystem services through improved planning and management strategies funded by E.U. under ECCP [FRI-288/RCS-1/External/2005-2006]

Findings: The main results achieved from the project have been development of methodology by combining the “Multidisciplinary Landscape Assessment” developed by CIFOR with typology of ecosystem functions as provided by De Groot (2005). Developing a model NETFOP in OSIRIS framework for the purposes of spatial data management and knowledge enquiry; review of silvicultural tools to enhance ecosystem goods and services from planted forests; assessment of ecosystem goods and services from forests in India, Netherlands and Germany; development of database for educational courses on ecosystem goods and services and studies on community participation in plantation planning and management. Principally six activities were planned for execution during the project.

Project 10: Development of mechanism for computation and forecast of growing stock in strip forests of Haryana taking into account the year wise plantation and survival of relevant species [FRI-289/RCS-2/External/2005-2007]

Findings: Interim report has been submitted to funding agency.

Project 11: Studies on interrelationship between production level and marketing of important forestry species in Punjab [FRI-174/RSM-9/ External/2000-2007]

Findings: Assessment of production potential of agro-forestry species viz. poplar, *Eucalyptus*, drake and khair in seventeen districts of Punjab for the next ten years in intensive and extensive plantations was carried out. Total production predictions were made from 2004-05 to 2014-15 using time series analysis method of forecasting. Market mechanism and demand and supply status of wood in Punjab was studied in 103 markets spread out in 17 districts of Punjab. Inter-market comparison and price spread analysis in the market of Ludhiana, Hoshiarpur and Patiala were also carried out. Besides market mechanism of adjoining markets of Punjab viz. Sriganganagar (Rajasthan) and Yamunanagar in Haryana were also studied. The factors leading to the price fall of poplar wood were also identified and enumerated.

Project 12: Studies on Himalayan Pines [FRI-175/Silva-12/1995-2006]

Sub-project 1: Seed Technology

Findings: Significant variations were observed for collar diameter, plant height, apical bud breaking time, number of buds, total length of buds, length of open and close buds, type of bud cluster, number of leaders, number of main branches, length of needles, etc. in different provenances of *Pinus roxburghii*. Variations were also observed in cone and seed characters of different seed sources of *P. wallichiana*, *P. roxburghii* and *P. gerardiana*. The study showed that the observed characters are under both genotypic and environmental control.

Sub-project 2: Nursery and planting technology

Findings: Developed a technique for rapid extraction of seeds of *Pinus roxburghii*. The technique resulted in seed extraction within 4 days in Dehradun conditions as compared to three weeks time required in the conventional technique of drying the cones in the sun. Cone fresh weight, dry weight, length and 100-seed weight in *P. roxburghii* show high repeatability suggesting that the traits are strongly inherited. Much of the variation in these characters occurred within the provenance rather than across provenances. Containerized seedling technology gave better survival and growth in field trials. Use of bare root technology was not recommended for large-scale planting of *P. roxburghii*. Seedling emergence in *Pinus wallichiana* was significantly enhanced by stratification. The final report has been submitted to USDA.

Sub-project 3: Plant physiology

Findings: In USDA Pine Project, physiological studies of selected genotypes and provenances of pines adapted to stress sites were conducted.

Seeds of pines collected from the entire range of distribution from Jammu and Kashmir to Arunachal Pradesh were studied to determine the nature and extent of variation in natural populations and to select the best provenance adapted to site.

Seeds of 56 parameters of chirpine were raised at three altitudes viz., FRI 600 m, Jarmola (1600 m.) and Sandra (1200 m.). The maximum height increment and collar dia. was observed at FRI. Sixty sources of Chir Pine were screened for photosynthetic efficiency at three altitudes. Augustmuni, Kedarnath seed was photosynthetically most efficient ($F_v/F_m = 0.77$).

Twenty seed sources of *Pinus wallichiana* were screened on the basis of cone, seed, seedling and early growth performance of the seedlings. Tutu, Jubbal and Bharmaur were found to be best in almost all traits studied.

UPGMA clustering of populations on the basis of four isoenzymes into 5 clusters revealed Sewai and Tutu to be divergent populations and hence could be used for future breeding programmes.

Allozyme variation in 20 populations of *Pinus wallichiana* with 16 loci revealed Trehta and Khambi Kuper with highest genetic diversity, hence be kept as biogenetic resources for conservation. Whereas, populations of Shimla and Saranan were found with different architecture. Thus could be used for future breeding strategies and improvement.

Project 13: Sample survey to update rates and ratios of Minor Forest Products and Timber in India [FRI-294/Stat-2/External/2005-2006]

Findings: The data as required for the project has been collected and submitted for further analysis.



PROJECTS CONTINUED DURING THE YEAR 2006-2007 (Externally Aided)

Project 1: Development of tissue culture technique for protocol development of *Bambusa balcooa* and *Melocanna bambusoides* [FRI-258/Bot-37/External/2004-2007]

Status: Axillary bud break was achieved in *Bambusa balcooa* and *Melocanna bambusoides*. Different media formulation was tested for axillary bud break and *in-vitro* shoot multiplication.

In *Bambusa balcooa* various media like MS, B5 and WPM were studied for axillary bud proliferation and shoot multiplication. MS medium was found to be the best. In *Melocanna bambusoides* effect of different concentration of BAP (1-6 mg/l) alone and in combination with NAA (0.5 mg/l) were studied for *in-vitro* shoot multiplication. Effect of MS, B5 and WPM medium, Sucrose (1-5%) and pH (2.8-7.8) were studied for *in-vitro* shoot proliferation.

Project 2: Network program for establishment of demonstrations of bamboo plantations in Uttaranchal [FRI -257/Bot-36/External/2004-2007]

Status: *In-vitro* shoots of *Dendrocalamus asper* were multiplied on large scale. 15-16 fold shoot multiplication was obtained on MS medium supplemented with 2.5 mg/l BAP. *In-vitro* rooting was standardized. 95% *in-vitro* rooting was standardized on MS supplemented with 10.0 mg/l IBA and 3.0 mg/l NAA. Tissue culture raised plants were hardened and acclimatized in mist chamber and shade house. Two thousand tissue culture raised plants were supplied to Uttarakhand Forest Department for field plantation.

Project 3: Micropropagation of promising interspecific F_1 hybrids of *Eucalyptus* and field plantations [FRI-220/ G&TP- 11 / External/2002-2007]

Status: Tissue culture plants of *Eucalyptus* hybrids FRI 5 and FRI 14 were multiplied and planted at seven agroclimatic regions. Field data were collected from all the seven sites of field trials with respect to plant height, collar diameter, clear bole length, no. of branches. Attempts were made for protocol development of *Eucalyptus* hybrids FRI 6, 10, 13 and 15. Aseptic cultures were established in all the four hybrids and *in-vitro* shoots were successfully multiplied on medium formulated. As a result of large number of experimentations a suitable media was also formulated for *in vitro* rooting of FRI 6, 10 and 15. Tissue culture plants were hardened and acclimatized in Mist chamber and Shade house.

Project 4: Development of micro-propagation protocol for clonal multiplication and germplasm conservation of *Swertia chirata* Buch. Ham. [FRI-332/Bot-46/External/2005-2006]

Status: Sterilization technique was standardized for nodal explant. Standardization of media was done for establishment and multiplication of cultures through axillary bud. Multiplication and elongation of shoots were obtained through root culture. Effect of different cytokinins was studied on multiplication of cultures.

Project 5: Development of suitable propagation technology of three *Terminalia* species [FRI-261/Bot-40/External/2003-2006]

Status: Rooting response of hardwood cuttings of *Terminalia* as influenced by different rooting

hormones in different concentrations was studied. The seedling growth behaviour and dry matter production were analysed. Analysis of data for publication and preparation of Final Technical Report was done.

Project 6: Creation of germplasm bank of medicinally important tree species of Punjab [FRI-336/Bot-50/External/2006-2009]

Status: Planting of *Terminalia bellirica*, *Emblica officinalis* and *Moringa oleifera* is completed at Kharkan, Hoshiarpur. Planting material of *Aegle marmelos* was developed for transportation to Punjab from F.R.I., Dehradun. Seeds of 50 trees of *T. chebula* were collected and the seed characteristics study was carried out. The seeds were sown in polybags for growing seedlings.

Project 7: Evaluation and standardization of the methods employed in identity of the medicinal plants employing woods of Himalayan and sub-Himalayan tract [FRI-276/Bot-41/External/2004-2007]

Status: List of 20 species of medicinal plants has been prepared. The wood of these species is used in medicines. The microstructure studies of 15 species were completed.

Project 8: Expert system for Indian woods - their microstructure, identification, properties and uses [FRI-277/Bot-42/External/2005-2008]

Status: Microstructure data of about 30 species have been taken. Qualitative and quantitative characters of 30 species were stored in the software.

Project 9: Ex-situ conservation of some rare and endangered plants of Uttarakhand [FRI-277/Bot-42/External/2005-2008]

Status: List of rare and threatened plant species of Uttarakhand has been prepared. Nine RET species so far not represented in the FRI Botanical Garden have been collected and introduced in the Garden. Few species viz. *Trachycarpus takil*, *Angelica glauca*, *Eremostachys superba*, *Sophora mollis*, *Valeriana wallichii* and *Acorus calamus* have been propagated and reintroduced in their natural areas of occurrence.



Eramostachys superba in pot
in FRI Botanical Garden

Project 10: Development of Live Red Data Book [FRI-277/Bot-42/External/2006-2009]

Status: List of rare and threatened plants of India has been prepared. *Diploknema butyracea*, *Jasminum arborescens*, *Rhus punjabensis* and *Itea nutans* have been introduced in the Botanical Garden of FRI.

Project 11: Identification, development and utilization of natural dyes from the forest plants of Uttaranchal [FRI-249/Chem-12/External/2003-2007] Extended upto December 2007

Status: Several trials were performed to develop the process for the isolation of natural dyes from *Cassia tora* seeds on pilot plant scale. Dyeing trials were done using the isolated dye and



colourfastness properties and CIELAB values of dyed fabrics were determined. Physicochemical properties of the dye were also determined. Pilot plant trials for isolation of dye from *Lantana camara* (leaves) and *Populus deltoides* (bark) were completed. Determination of CIELAB of various dyed fabric was completed. The technical report of the project was prepared and submitted to the DSIR. The PRC found the progress of the project to be excellent and recommended an extension of one year (upto 31st December 2007) with no additional budget.

Project 12: Studies on population status and berberine content in different provenances of *Berberis aristata* DC in H.P. and standardization of its propagation techniques [FRI-329/Chem-15/External/2005-2008]

Status: The roots of *Berberis aristata* were collected from different places of two districts of Himachal Pradesh. Roots were shade dried, powdered and extracted with methanol in a soxhlet apparatus. The extracts were concentrated on a water bath to small volumes and yield of the extracts on moisture free basis was determined. HPLC analysis of extracts was carried out and yield of berberine (alkaloid) was determined. The root sample collected from Narkanda (Shimla) in winter season was found to have maximum yield of berberine.

Project 13: Eco restoration studies in Uranium mines [FRI-265/Eco-14/ External/2005-2009]

Status: Species have been identified and ethnonobotanical studies completed. Tailings have been analysed for physico-chemical parameters and field experiments have been laid out on tailings.

Project 14: Forest fire monitoring and management [FRI-295/Eco-17/External/2005-2007]

Status: Pre-fire vegetation survey for fuel load determination and Fuel Moisture have been carried out in pine and sal forests under Nainital Forest Division, Nainital. Representative plots of 5m x 5m size were laid out in each forest area for collection of litter (fuel load) and analysis of shrub vegetation and estimation of understorey biomass. Field data such as soil temperature, soil moisture, and vegetation were also collected. Vegetation data were collected for ground, understorey and tree components. Similarly height and diameter of all tree encountered in the sample plot were also measured. Representative samples were brought to the laboratory for oven dry weight and other analysis. Other field data such as soil temperature, soil moisture, and vegetation were also collected. Organic carbon in all the soil samples was estimated.

Project 15: Impacts of tourism on environment of Roopkund and Pindari areas of Nanda Devi Biosphere Reserve of Uttarakhand [FRI-280/Eco-15/External/ 2004-2007]

Status: Field visits to Pindari and Roopkund have been conducted. Vegetation studies, enlisting rare and endangered species, collection of soil samples and their analysis for nutrients and other attributes, socio-economic surveys along the trek route were carried out. Compiled relevant references for discussions of the results obtained. Attended National /International seminars and presented papers.

Project 16: Income generation for women in rural areas of Uttarakhand through vermicomposting of organic solid waste into manure [FRI-/Eco-16/External/2005-2008]

Status: Off-campus training was imparted to the women of different villages like Rajawala, Telpura, Phoolsaini, Kandoli etc. for taking up vermicomposting of solid waste as a means to generate additional income. Vermicompost from solid waste was prepared in the FRI campus and distributed to the rural women of Phoolsaini village for applying it in their field.

Project 17: Restoration of biodiversity in the hills of Kujapuri following Badrivan Restoration Approach [FRI-264/Eco-15/External/2004-2007]

Status: Species having commercial value viz. *Dendrocalamus strictus* and biofuel yielding *Jatropha curcas* were planted in the degraded forest and village community lands adjoining Kujapuri Temple. A number of ornamental species have also been planted in the area. The planted species were monitored for their growth and survival. Awareness campaigns were organized to sensitize the villagers about the functional role of planting trees and conservation of biodiversity in the Siddhapeeth area.

Project 18: Garden of the Great Arc [FRI-263/Eco-12/External/ 2004-2008]

Status: Garden is located in the Hathibarkala Estate of Survey of India, Dehradun. The terrain of southern aspect of the park (measuring 55 acres) is characterized by a nallah, running in north south direction, eroded undulating slopes and gullies in the east, and habitation on the southern part of estate. Commensurate to Great Arc that traverses the entire length of the country from north to south, FRI has attempted to create patches of different natural forest types of India in this park. Further a site for visually handicapped was developed to facilitate their appreciation of great floral diversity of India. Besides these, different theme gardens have been developed.

Plantation of nearly all the forest types viz., sub tropical pine forest, tropical dry deciduous forest, tropical moist deciduous forest, tropical evergreen forest and avenue plantations have been completed. Tree grooves, Nakshatra Vatica, Buddha Vatica and development of picnic garden, Rose garden, Foliage garden and a special garden for visually handicapped has been completed alongwith slope stabilization works.

Project 19: Biotechnological approaches for improvement of plant species with special reference to pulp and paper [FRI-267/FPD-48/External/2004 2006]

Status: Multi-institutional project has been funded by CSIR. The aim of the project is to screen suitable material of subabul with low lignin and higher fibre content for pulp and paper. Nearly 1100 samples collected by participating institutes across India were characterized for physical, chemical and anatomical parameters. Based on the results, samples have been short listed for further work.

Component: Chemical screening of subabul

Status: Dust of 1200 samples (mesh size 40-60) of *Lucaena* sp. was made for proximate analysis (with bark and with-out bark) and sent for NIR spectroscopy analysis to Forest Products Division of the institute. Extractive percentage (Alc-benz. Solubility) varies from 0.5% to 4%. Holocellulose percentage varies from 65% to 75%. Lignin percentage varies from 19% to 31%. Ash percentage varies from 0.5% to 2.3%. Pentosan percentage varies from 10.9% to 17%. Lignin, Holocellulose, Pentosan, Extractives and Ash percentage in case of subabul (*Lucaena* sp.) collected from different geographical regions showed wide variation. Compilation of raw data generated on the basis of locality, age, girth and diameter is in progress.



Project 20: Deployment of the promising F1 hybrids of *Eucalyptus citriodora* and *Eucalyptus torelliana* for establishment of vegetative multiplication garden and their field trials [FR-338/G&TP-17/External/2006-2009]

Status: Open pollinated seeds of *Eucalyptus citriodora* and *E. torelliana* species were collected from field of FRI campus and their progenies have been raised. Hybrids of *E. citriodora* x *E. torelliana* and *E. torelliana* x *E. citriodora* have been selected at nursery stages based on morpho-genetic parameters. Two field trials of *Eucalyptus* hybrids have been laid out at Hoshiarpur, Punjab and New Forest campus (Uttarakhand).

Project 21: Follow up-project on advance genetic improvement in SPA, SO and Progeny trials of different forest tree species in Punjab [FRI-339/G&TP 18/External/2006-2009]

Status: A SPA of 5 ha of *Acacia catechu* was measured and analyzed. A report was prepared and submitted to the State Forest Department to carryout the culling operation. The operation has been completed in CSO of Pindori Mindo Mind, Hoshiarpur in Punjab. The SSO and CSO of *Dalbergia sissoo* at Ludhiana was measured and analysed for culling and a report submitted to the CF (R&T).

Project 22: Genetic improvement of *Asparagus racemosus* (Wilf) to enhance root production and saponin content [FRI-340/G&TP-19/External/2005-2008]

Status: Literature regarding *Asparagus racemosus* plant type, cultivation methodology and its different seed sources has been collected. Seeds and roots were collected from different geographical regions of Punjab, Haryana, Jammu and Kashmir, Himachal Pradesh, Rajasthan, Madhya Pradesh, Uttarakhand and Tamil Nadu. A total of 25 seed sources of *Asparagus racemosus* have been collected for evaluation. Seedlings were raised and a field trial of 20 different seed sources established at FRI campus in RBD design.

Project 23: Study on pathogenic and molecular variability in *Fusarium solani* causing shisham (*Dalbergia sissoo*) wilt. [FRI-272/Path-17/External/2004-2007]

Status: Out of 129 isolates of *Fusarium solani* collected from the high infection zones, a total of 53 isolates were selected for various studies. Nutritional studies using four nutrient media viz. Potato Dextrose Agar, Czapek Dox Yeast Extract Agar, Malt Extract agar and Joff's medium were conducted for variation in growth, sporulation and development of pigmentation. First two media encouraged only microconidial production. Macroconidia developed in Joff's medium profusely and in Malt Extract Agar sparsely. Effect of 9 pH ranges and fungicidal sensitivity using four fungicides namely Bavistin, Bayleton, Propiconazole and Topsin-M was conducted taking three concentrations for all 53 isolates. Bavistin and Propiconazole were most effective while Bayleton and Topsin-M were least effective in all concentrations.



Cultural Variability of *Fusarium solani* on different nutrient media

Project 24: Researches on natural decay resistance of juvenile timbers like poplars [FRI- 283/Path-18/External/2005-2008]

Status: Decay fungi identified in stored logs of poplar at Star Paper Mills, Saharanpur and FDC Depot, Lalkua as *Bjerkandera adusta*, *Corioloopsis telfarii*, *Daldinia concentrica*, *Ealiella scabrosa*, *Flavodon flavus*, *Lenzites acuta*, *Schizophyllum commune* and *Trametes cingulata*.

New clones being tested at WIMCO Seedlings Ltd., Rudrapur (WIMCO A26, S7C4, L 49, WIMCO 81, WIMCO 39) did not show resistance against test decay fungi.

Project 25: Collection and dissemination of market information on commercially important medicinal plants of Uttaranchal [FRI-282/RSM-16/External/2005-2008]

Status: Market price of commercially important medicinal plants was collected from Ramnagar, Tanakpur, Saharanpur and Delhi. Data were compiled and tabulated for publication of quarterly newsletters. Besides, the price data, relevant information on medicinal plants and policy decisions of Uttarakhand Government were also collected and incorporated in newsletters for the benefit of the growers. Quarterly newsletters were published and disseminated to various stakeholders throughout the country covering as many as about 50 commercially important medicinal plant species.

Project 26: Preparation of local volume tables of khair, sal, shisham and teak for UP Forest Development Corporation, Lucknow [FRI-255/RSM-15/ External/ 2003-2008]

Status: Local volume tables of khair, sal and shisham were prepared and submitted to the C.M.D., U.P. Forest Development Corporation, Lucknow. Field data on teak have been collected and being analysed for preparation of volume table.

Project 27: Preparation of Management Plan of Sukhna Wildlife Sanctuary and Working Plan of Chandigarh Forest Division [FRI-273/RSM-15/ External/ 2004-2008]

Status: The first ever Management Plan of Sukhna Wildlife Sanctuary was submitted to the funding agency for the period from 2006-07 to 2015-16. About 3 Zone Plans and 7 Theme Plans have been proposed as management interventions for scientific management of the sanctuary. Field work for the preparation of Working Plan of Chandigarh has been completed. The draft Final Working Plan (W.P.) for the period of 10 years from 2007-08 to 2016-17 has been written and submitted wherein 3 Working Circles viz. Protection W.C., Urban Forestry W.C. and Rejuvenation of Lake and Water Bodies W.C. have been proposed. The comments of the funding agency on the draft W.P. are awaited for the publication of the final report.

Project 28: Preparation of Working Plan for Dadra and Nagar Haveli Forest Division [FRI-328/NWFP-20/External/2005-2008]

Status: Field tours for enumeration and collection of data were undertaken and data compiled. The earlier Working Plan was reviewed and the First Preliminary Working Plan Report submitted to the funding agency. Socio-economic survey was conducted and results tabulated. The fund of 1st installment of Rs.4.83 lacs was utilized and the 2nd installment of Rs. 2.41 lacs has been received in March 2007. Writing of Working Plan for the period from 2008-09 to 2017-18 is in progress with 8 Chapters completed as per Working Plan Code.

Project 29: Technology transfer and development of a model village by skill upgradation and capacity building of rural communities for socio-economic upliftment [FRI-287/PLO-1/External/2005-2008]

Status: Survey in the villages Sherpur, Badonwala, Harbajwala, Malhan, Kalyanpur and Mehuwala Mafi was undertaken on Dehradun-Shimla road. Awareness was created regarding the importance of



medicinal plants and other forestry tree species by individual and group meetings with villagers. Multiplication of planting material was done by stem cuttings and also by seed sowing in the nursery beds and transferred in the polybags for distribution to the cultivators. The distribution of the *Coleus* seedlings was done during July-August 2006. Before the distribution of the medicinal plants to the cultivators meetings were held about the weeding, planting technique, caring, manuring, control of insects, pests and fungal attack. Nearly thirty cultivators in the village Badonwala, Harbajwala, Buddhi and in Pattion have started the cultivation of medicinal plants on small scale.

A demonstration-cum-display of the modern nursery has been established in the Shatabdi Van Vigyan Kendra (Rangers College) where the villagers could easily get information regarding the important medicinal plants. Training programme was organized and the identified villagers were motivated to grow seedlings in their village land. During the training in November 2006 villagers raised medicinal plants in the Shatabdi Van Vigyan Kendra, and their performance is appreciable. Modern nursery has been established from DST funded project.

Project 30: Farm forestry extension and its marketing and economic linkages [FRI-367/RSM-18/External/2005-2008]

Status: Inception report has been discussed with nodal officer of the project in June 2006. For study, markets and tree species grown under farm forestry in Punjab was finalized. Market Price data were collected in structured formats, compiled, tabulated and published in the form of Quarterly Newsletter "Market Prices of farm-grown agro-forestry wood in Punjab". First issue October-December 2006 was published and January-March 2007 issue is under preparation. A training programme on "Marketing of Farm Forestry Produce and Extension" was organized in July 2006 at Ludhiana in which 41 officials of Punjab FD participated. Development of a website was initiated with the co-ordination of the IT Cell, of FRI, Dehradun.

Project 31: Development of genetically superior planting material and cultivation technology for increasing productivity of *Jatropha curcas* [FRI-286/Silva-23/External/2005-2008]

Status: Selected 149 CPTs of *Jatropha curcas* in Uttarakhand. Identified 27 accessions, which have been rated as high oil yielders (>35% oil content on seed weight basis) by the Department of Biotechnology, Govt. of India. Three stands in Uttarakhand with high oil content are being converted into Seed Production Areas (SPAs). Nursery stock of high oil yielding germplasm has been raised for establishing Clonal Seed Orchards (CSOs), Seedling Seed Orchards (SSOs), Vegetative Multiplication Gardens (VMGs), progeny trials and clonal trials at three sites in Uttarakhand. Laid out field trials to standardise spacing, pruning, fertilizer, irrigation and type of planting stock for raising plantations of this species at three sites in Uttarakhand.

Sub-Project: Seed Technology

Status: Seeds of *Jatropha curcas* were collected from different places of Uttarakhand. The shade dried, decorticated and crushed seeds were extracted with petroleum ether and stored in twelve different containers at different environmental conditions (viz. Damp room, aerated room, 5°C, 15°C, room temperature and at freezing temperature). Seeds were taken out at particular intervals for estimating the fatty oil percentage of all the containers. At the end of the year seeds stored in the polybag at low temperature with low moisture content, were found best suited among rest of the containers.

Project 32: Genetic improvement of *Jatropha curcas* for adaptability and oil yield [FRI-293/Silva-24/External/2005-2010]

Status: Collected germplasm and made 40 accessions of *Jatropha curcas* from Punjab, Haryana, Himanchal Pradesh, Uttar Pradesh and West Bengal. The material was multiplied clonally and provided to five collaborating institutions, on exchange basis in different parts of India. With the accessions exchanged laid out field trial of 206 accessions at Etah, Uttar Pradesh to standardise spacing, pruning, fertilizer, irrigation and type of planting stock for raising plantations of the species in Uttar Pradesh.

Project 33: Development of silvicultural practices for promoting cultivation of *Taxus baccata*, *Rhododendron arboreum* and *Phyllanthus amarus* [FRI-294/Silva-25/External/2005-2008]

Status: Cuttings of *Taxus baccata* (collected from Chakrata, Uttarakhand) were treated with different IBA concentration and Bavistin (0.02%) and planted in poly-house for rooting. 100 ppm IBA resulted in best rooting in *T. baccata*. 100 wildlings of *Rhododendron* were planted at Chakrata nursery for undertaking budding experiments. Seed maturity studies on *Phyllanthus amarus* Sch. & Th. showed that germination of freshly harvested seeds was slower than older. Seeds from the first capsules to dehisce after harvest (dark green seeds) had higher germination percentage than those from dehiscing later (light tan seeds). Experiment on different spacing regimes, sowing methods, sowing time etc on *P. amarus* are in progress.

Project 34: Development of technological package for the production and quality evaluation of seeds of important medicinal plant species under National Medicinal Plant Board [FRI-285/Silva-22/External/2004 2007]

Status: Seeds of 30 species of medicinal plants were collected from different parts of Uttarakhand and seed morphological parameters in respect to seed length, width, shape, colour, 1000 seed weight, number of seeds in a single fruit and number of seeds in 1 kg have been measured. Seeds were given pretreatment of GA_3 - 0.1%, KNO_3 - 2%, H_2O_2 - 0.1% for enhancing the germination along with experiments in controlled condition and in germinator (25/30°C) at monthly intervals. Hard coated seeds like those of *Myrica esculenta* (Syn. *M. nagi*), *Rauvolfia serpentina*, *Rauvolfia canescens*, *Wrightia arborea* (Syn. *W. tomentosa*) and *Heracleum candicans* were soaked in water to obtain good germination by overcoming their dormancy. Seeds of *Zanthoxylum alatum*, *Rauvolfia serpentina* and *Rauvolfia canescens* were scarified with sulphuric acid and stratified. Germination record of one year of earlier collected 30 species was compiled for publishing as a seed booklet.

NEW PROJECTS INITIATED DURING THE YEAR 2006-2007 (Externally Aided)

Project 1: Planting stock improvement of some indigenous fuelwood and fodder tree species for higher biomass production in relevance to the hilly regions of Garhwal Himalaya [FRI-337/Bot-51/External/2006-2009]

Status: Seeds of *Grewia optiva*, *Melia composita*, *Kydia calycina*, *Terminalia tomentosa*, *Albizia lebbeck*, *Quercus leucotricophora* and *Terminalia chebula* were sown in nursery.



Sites for three nurseries for Tropical, Sub-tropical and Temperate species were identified at Fatehgram (Tropical), Chowki Gholtir (Sub-tropical) and Jarmola (Temperate). Nursery development activities like preparation of nursery beds, preparation of sand, soil and farm yard manure mixture and filling of polybags have been done. The quality planting stock of *Grewia optiva*, *Melia azedarach*, *Ficus recemosa* (Syn. *F. glomerata*), bamboos, *Bauhinia variegata*, *Bauhinia purpurea* and *Terminalia chebula* has been prepared.

Project 2: Wood anatomy of important commercial timber of Assam with notes on their properties and uses [FRI-292/Bot-43/External/2006-2008]

Status: The data and write up of 10 species has been completed.

Project 3: Improvement and development of Bambusetum of FRI, Dehradun [FRI-335/Bot-49/External/2006-2007]

Status: Bambusetum has been established with state of art innovative lay-out explanatory displays. Surveyed the southern parts of country for collection of 12 bamboo species. Fifteen species duly studied in field in different parts of Arunachal Pradesh and adjoining tracts were collected for introduction. Seven species of bamboo, typical of hills of Kumaon region of Uttarakhand were introduced in the FRI Bambusetum. Irrigation channels were laid out. Fencing work on the southeastern and southern boundaries of bambusetum was completed. An inaugural-cum-field workshop was held in the Bambusetum during the Centenary Year of FRI to emphasize on the botanical research on bamboos being carried out by FRI.

Project 4: Development of improved chemical formulation and equipment for efficient treatment of bamboo for long term preservation and fire retardance [FRI-FPD]

Status: Installation of Boucherie equipment for treatment of 24 green bamboos was completed. Treatment of *Bambusa arundinacea*, *D. strictus* and *B. balcooa* with CCB was done. Three green bamboo species viz *D. Strictus*, *B. tulda* and *B. arundinacea* was treated with ten combinations of fire retardants and preservatives in split form. Performance evaluation against fire as per BIS: 5509 was carried out. It was found that some combinations performed satisfactorily and trials on further reproducibility of results are under progress. Equipment of flame penetration test is modified and upgraded compared to the earlier equipment.

Project 5: DNA fingerprinting of shisham (*Dalbergia sissoo*) clones planted in Punjab [FRI-364/G&TP-21/External/2006-2008]

Status: 53 clones of shisham were collected from Punjab. DNA isolation technique has been standardized and perfected. DNA has been extracted from 53 different clones. PCR-RAPD conditions standardized for shisham. Screening of 10 polymorphic RAPD primers has been completed and clonal material characterized with primers. Six clones (C174, S179, SDB, C361, C86 and C235) were clearly resolved showing maximum variation. Smaller cluster comprised of 8 clones and remaining were clustered together with least genetic variation between them. It was observed that there is no indication of clustering of clones based on area.

Project 6: Development of non-destructive harvesting methods for medicinal plants [FRI-341/NWFP-21/ External/2006-2009]

Status: Development and maintenance works continued at nursery sites in Chakrata and FRI Dehradun. Experiments on Project species at NWFP nursery, Chakrata and Dehradun have been conducted. Seeds of *Picrorhiza* sp. and *Rheum* sp. were collected from available sources and propagated in NWFP production nursery. The germination percentage and seedlings survival were found better in *Rheum* seeds as compared to *Picrorhiza*. The seedlings of these species transplanted in Chakrata nursery for further studies on survival and growth. Sites were selected for laying out the harvesting field trials in natural conditions.

Project 7: Exploration, conservation and propagation of important medicinal climbers of Garwhal Himalayas [FRI-365/NWFP-24/External/2006-2009]

Status: Collection of germ plasm, preparation of nursery beds and propagation of some climbers has been done. Review of literature on climbers of target species of the project was continued. Appointment of JRF and procurement of equipments mentioned in the Project has been done.

Project 8: Biological control of root diseases of some medicinal plants using selected antagonistic fungi [FRI-411/Path-26/External/ 2007-2009]

Status: The project was started in January 2007. The equipments for the project were procured and process for appointment of a SRF was initiated.

Project 9: Status of wood based industries in Kumaon, Uttarakhand [FRI-366/RSM-17/External-2006-2008]

Status: Inventorization of wood based industry in Udham Singh Nagar, Uttarakhand was carried out. Demand and supply status of raw materials were studied, collected data was compiled and the interim report is under preparation for submission to funding agency.

Project 10: Inventorization and replacement plan for the trees planted by NDMC [FRI-405/RSM-19/External-2006-2008]

Status: Inventorization of trees, diseased trees and replacement plan for trees at Central Vista has been prepared and submitted. List of trees in Nehru Park and Talkatora Garden was prepared and submitted. Field demonstration of disease control techniques to NDMC officials at New Delhi was given. Layout Plan for the bio-aesthetic landscaping of Rajpath and C-Hexagon with choice of plant species along the Central Vista, New Delhi prepared and submitted.

Project 11: Raising of demonstration plantations for augmenting fuelwood and fodder resources and promoting income generation in two villages of Uttarakhand [FRI-343/Silva-31/External/2006-2007]

Status: Two villages have been selected in Uttarakhand under the project. Information about species preferred by the growers has been recorded. The choice of species in village in Chakrata block is dominated by fuel and fodder species while species that provide monetary returns are preferred by people in the village located in Chamba block. Planting material of the selected species is being raised.

Project 12: Study on the impact of riverbed material collection on ecology, silviculture and environment in Uttarakhand [FRI-407/Silva-38/External/ 2006-2008]



Status: Conducted surveys in river bed extracted sites and catchments of river Yamuna and Amlawa river and selected 3 sites for collection of field data covering a distance between 15-20 km. Field data were collected on ecology, change of successions, change of river course, water flow, biotic pressures, river environment and socio-economic conditions of people living near the extracted sites. The data are being compiled and analysed.

Abstract: No. of Projects

	No. of projects completed in 2006-2007	No. of ongoing projects in 2006-2007	No. of projects initiated in 2006-2007
Plan Projects	9	37	16
External Projects	13	34	12
Total	22	71	28

TECHNOLOGY ASSESSED AND TRANSFERRED

Field demonstration of techniques of disease management in nursery and plantations was given to the officers and staff of New Delhi Municipal Council by Dr. N.S.K. Harsh.

EDUCATION AND TRAINING

Visits

1. Dr. Vineet Kumar made a visit as a Visiting Scientist to Polytechnic University, New York and worked on 'Chemo-enzymatic modification of hyaluronic acid' and also supervised a student on 'Chemical modification of oligopeptides synthesized using reverse equilibrium catalysis'. He completed the research work by filing one US Patent on modification of Hyaluronic Acid.
2. Dr. Pradeep Sharma visited Department of Primary Industries and Fisheries (DPI and F) Brisbane, Australia as a Visiting Scientist (Period 22nd November 2006 to 11th April 2007). AT DPI and F, he worked on the chemical analysis of *Callitris glaucophylla* sawdust oil by fractionation and Gas chromatography Mass spectroscopy.

Training imparted

1. One month training was given to Mr. Mohamad Yusaf Khan, M. Pharma, Jamia Hamdard University, New Delhi on the topic 'Chemical modification of alpha Cellulose to prepare Cyanoethyl Cellulose (CS) and Cellulose sulfate'.
2. One month training was given to. Ms. Maria Khan, M. Pharma, Jamia Hamdard University, New Delhi on the topic 'Phytochemical analysis of *Berberis aristata*'.
3. Training imparted to villagers and member of HESCO on natural dye and compost under the project "Integrated Utilization of Lantana" sponsored by Sir Ratan Tata.

4. Dr. Sas Biswas organized a training programme on Biodiversity and Environment for School and College Teachers of Uttarakhand on 10th and 11th August 2006.
5. Two programmes of two days each on “Biodiversity: Nurturing Nature for our future” were organised for school children and teachers of KVs of Dehradun by FRI.
6. Three training courses organized for Deputy Director level Horticulture Officers of New Delhi Municipal Council at FRI, Dehradun for disease control techniques by Dr. N. S. K. Harsh.
7. Two training courses organized on “Integrated Utilization of Lantana” at Shatabdi Van Vigyan Kendra (SVVK), Rangers College, Dehradun by FRI.
8. Training course on Medicinal plants at Shatabdi Van Vigyan Kendra (SVVK), Rangers College, Dehradun was organized from 6th to 10th November 2006 by FRI.
9. A training programme on “Marketing of Farm Forestry Produce and Extension” was organized by FRI in July 2006 in Ludhiana in which 41 officials of Punjab Forest Department participated.
10. Training was conducted for Forest Rangers and Foresters of Punjab Forest Department on 10th and 11th March 2007.

The following Short Term Training Courses were organized for officials of Government of India, State Forest Departments, Public Sector Undertakings, NGOs and representatives from various Industries:

1. Management of Forest Herbarium and Arboreta.
2. Development of Green Belts.
3. Afforestation and its management.
4. Exposure to identification of timbers through field and lab orientation.
5. Plywood Manufacture.
6. Wood Seasoning.
7. Classification and Grading of Timber.
8. Nursery and Plantation Technology.
9. Hi-tech Nursery and Plantation Technology.
10. Low cost Nursery and Plantation Management.
11. Low cost Seed Technology.
12. Low cost training on Bamboo Utilisation, Medicinal Plants, Vermicomposting and Soil testing.

Training received

1. Under ISO programme, three scientists of Chemistry Division, namely Shri Rakesh Kumar, Dr. Rashmi and Dr. V.K. Varshney acquired four days (26th to 29th March 2007) training in advanced instrumentations techniques-HPLC, GC-MS and HPTLC for their skill upgradation at Indian Institute of Chemical Technology (IICT), Hyderabad.



2. Dr. Santan Barthwal, Scientist C, attended 21 days, Department of Biotechnology, Gol (DBT) sponsored training programme on “Plant Tissue Culture, Genetic Transformation and Genome Analysis with Molecular Markers and PCR walking” at the Tata Energy and Resources Institute (TERI), Lodhi Road, N. Delhi from 4th to 23rd December 2006.

LINKAGES AND COLLABORATION

1. National Institute of Technology, Jalandhar and Sports Forum, Jalandhar for a consultancy project on identification of technology gaps in Sports Goods manufacturing.
2. Linkages were developed with Forest Department Jaipur, Forest Department Bundi, Forest Department Hanumangarh, Forest Department Haldwani, Forest Department Roorkee, Forest Department Haridwar, Forest Department Ranikhet and Forest Department Narendranagar Division.
3. Linkages with various wood and wood products manufacturers and user industries, important among them are NTPC, Talchair; BIS, New Delhi; Northern Coal Fields Ltd., Singrauli; Delhi Development Authority; Ashahi Glass Ltd., Mumbai; Reliance Industries Ltd., Gujarat; Garhwal Mandal Flush Door Factory, Kotdwar etc.
4. With IHBT, Palampur for giving training to local artisans on bamboo processing and utilization.
5. An agreement on the project titled “Identification, development and utilization of natural dyes from forest plants/weeds and agriculture waste” was signed on 18th August 2006 between Sikkim Khadi Village Industry Board, Gangtok (Sikkim), Forest Research Institute, Dehradun, Department of Scientific and Industrial Research, New Delhi and National Research Development Corporation, New Delhi.
6. NWFP Division carried out monitoring and evaluation of NMPB sponsored projects implemented by various States.
7. State Forest Departments.
8. Department of Biotechnology (DBT).
9. Space Application Centre (ISRO).
10. Department of Atomic Energy, Govt. of India, Mumbai.
11. Damodar Valley Corporation (DVC).
12. GB Pant Institute of Himalayan Environment and Development.
13. Linkages with organization like Railway, Defence, Bureau of Indian Standards, NTPC, Telecommunications, C.P.W.D., Punjab Police Housing Corporation, ONGC etc for wood related properties.
14. Creation of germplasm bank of medicinally important tree species of Punjab is running in Plant Physiology Discipline with the collaboration of Punjab Forest Department.

PUBLICATIONS

Books

1. S.S. Negi, R.K. Srivastava and S. Nautiyal (2006). Studies on Himalayan Pines. Edited Book FRI.
2. Singh, Y.P.; Kumar, D.; Nautiyal, R.; Thapliyal, M. and A.S. Chauhan, Eds. 2006. Hundred Years of FRI. Forest Research Institute, Dehradun. 112p.
3. Singh, Y.P.; Kumar, D.; Nautiyal, R.; Thapliyal, M. and A.S. Chauhan, Eds. 2006. FRI: Glimpses of a Century. Forest Research Institute, Dehradun. 80p.

Brochure

1. A brochure on "Research Highlights in Chemistry of Forest Products" during the last 100 years.
2. Published a booklet entitled 'Lantana Key Ekikrit Upyog' (in Hindi).

Proceedings

Proceedings of the XII Silvicultural Conference. (Eds.) S.S. Negi, R.K. Srivastava, Manisha Thapliyal and Ombir Singh, Forest Research Institute, Dehradun.

CONSULTANCIES

Long-term consultancies

- 1) **Title:** Installation of a 250cft solar kiln at Agra
Organization: M/s Shashee Industries, Sikandra, Agra
Amount: Rs. 0.84 Lakhs
Status: The Kiln has been installed and handed over to the client after successful trial and training of their staff.
- 2) **Title:** Installation of a solar kiln at Jalandhar
Organization: M/s Process cum Product Development Center (PPDC), Meerut
Amount: Rs. 4.26 Lakh
Status: The Kiln is in final stage of installation.
- 3) **Title:** Identification of technological gaps and possible remedial measures in wood based sports goods cluster at Jalandhar.
Organisation: Dr. B.R. Ambedkar National Institute of Technology, Jalandhar.
Amount: Rs. 3.03 Lakhs
Status: A questionnaire regarding the problems faced by the Industry about the performance of cricket bats, hockey sticks and carom coins has been prepared for distribution among the industries through NIT, Jalandhar.



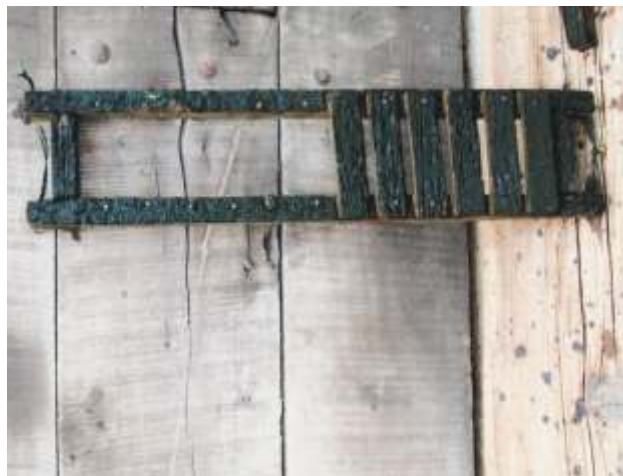
- 4) **Title:** Inspection of cooling tower timbers for Reliance Industries, Surat

Amount: Rs.1.9 Lakhs

Status: Scientists and staff of the Forest Products Division visited the cooling tower of RIL, Surat, Gujarat and completed inspection and sample collection under the consultancy.



Timber structure inside the cooling tower



Test sample placed in the cooling tower

- 5) **Title:** Preparation of Working Plan of Chandigarh Forest Division and Management Plan of Sukhna Wild life Sanctuary.

Period: 2004-2008

Organization: Chandigarh administration

Amount: 8,57,000/-

- 6) **Title:** Preparation of Working Plan/Management Plan for Dadra and Nagar Haveli Forest Division.

Period: 2005-2008

Organization: Dadra and Nagar Haveli Forest Department

Amount: 9,67,000/-

- 7) **Title:** Inventorization and Replacement Plan for the trees planted by NDMC

Period: 2006-2008

Organization: NDMC, New Delhi

Amount: 6,88,000/-

Short-term consultancies

1. Developing Optimal Afforestation Plan for DVC command area.

2. M/S Faridabad Gurgaon Minerals for ecological rehabilitation of stone mines.
3. Forest Department of Uttarakhand for Biostabilization of Varunavat landslide.
4. From Uttarakhand Bamboo Fibre Board Development for “Softening of Bhang (industrial hemp), Bichhu Ghaas Himalayan Nettle, Bhimal for textile”.
5. Uttaranchal Bamboo Fibre Board Development awarded the job on “Softening of Bhang (industrial Hemp), Bichhu Ghaas Himalayan Nettle, Bhimal for textile”. Rs. 70,000/- (Seventy thousands only) was charged for the job.
6. Women's Development organization, Dehradun awarded the job on “Softening of sisal fibre” at a cost of Rs. 2000/- (Two thousand only).
7. Handmade paper was made from herbal waste. The job was assigned by Himalayan Drug, Dehradun. Rs 5000/- was charged for the work.
8. Paper samples were tested on charged basis supplied by Defence Organisation, Dehradun.
9. About 239 wood samples have been examined and identified and revenue for about Rs.10,85,000/- earned.
10. Revenue earned through various consultancies, testing and other services above Rs. 15.5 Lakhs.

PATENTS

1. R. Gross and Vineet Kumar filed PCT application no. PCT/US07/63671 dated 9th March 2007 on 'Acrylation of Hyaluronic acid' to USPTO.
2. Director, Forest Research Institute, Dehradun. A process for the preparation of Katha from Gambier Extract, Patent No 125863 A, 30th August 2006 (Malaysia).

CONFERENCES/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/EXHIBITIONS

Organized

1. International conference was organised on “Ecosystem Goods and Services from Planted Forests” from 3rd to 7th October 2006 at Bilbao, Spain and “Planted Forests: Ecosystem Goods and Services” at FRI, Dehradun, India from 13th to 15th December 2006.
2. Organized 10 seminars and symposia during the Centenary celebration of the institute. Organized the Vaniki Mela in Forestry at the Shatabdi Van Vigyan Kendra (SVVK) erstwhile Northern Forest Rangers College, campus of FRI, Dehradun. In the event Forest Departments of U.P., Uttarakhand, Punjab and Haryana participated. Sir Brandis Walking Trail and a Nursery were laid out in the premises of SVVK.
3. A Vermi mela was organized in the Shatabdi Van Vigyan Kendra during Vaniki Mela Programme on 24th and 25th November 2006. Vermicompost prepared from organic solid waste and leaf litter in the FRI campus was analysed for micronutrients (Organic carbon, Nitrogen, Phosphorus, Potassium, Sodium, pH, etc).



4. Asia Pacific Forestry commission meeting at FRI Dehradun was organized from 17th to 21st April 2006.
5. National Workshop on “Role of Forestry in Employment” on 29th and 30th August 2006 organised at FRI Dehradun.
6. National Symposium on “Plant Biotechnology and 28th Plant Tissue Culture Association Meeting” from 12th to 14th October 2006 organised at FRI Dehradun.
7. Three days International seminar on “Planted Forest Eco system Goods and Services” was organized from 13th to 15th December 2006 at FRI Dehradun.
8. National Workshop on “Role of Forestry in Employment Generation and Rural Development” was organised on 29th and 30th August 2006, by FRI, Dehradun.
9. A National conference entitled “Natural Products and Biodiversity: Chemistry and Utilization” was organized on 2nd and 3rd November 2006.
10. Organized IUFRO-ISTS-FRI “International Symposium on Breeding and Improvement of Asian Conifers during 20th Century” at FRI, Dehradun from 11th to 13th September 2006.
11. National Technology Day at FRI, Dehradun on 11th May 2006.
12. FRI Centenary celebration on 5th and 6th June 2006.
13. Hindi Advisory committee at FRI Dehradun on 9th June 2006.
14. Van Mohotsava at FRI Dehradun on 21st July 2006.
15. Hindi Saptaha at FRI, Dehradun from 18th to 22nd September 2006.
16. Vigilance Awareness week at FRI, Dehradun from 6th to 10th November 2006.
17. “Kauthik Mela” at Shatabdi Van Vigyan Kendra (Rangers College) ground, Dehradun from 15th to 21st November 2006.
18. “Vaniki Mela” was organized on 24th and 25th November 2006 at Shatabdi Van Vigyan Kendra (Rangers College), Dehradun.



Vaniki Mela at FRI, Dehradun

19. Closing ceremony of the centenary celebration of Forest Research Institute, Dehradun was organised on 15th December 2006.
20. World Forestry Day was celebrated on 21st March 2007 at FRI, Dehradun.

Participated

National

1. Dr. N.S. Bisht and H.P. Singh attended the National Seminar on "Trees outside Forests" in Chandigarh on 25th and 26th April 2006.
2. Dr. (Mrs.) Prafulla Soni, Dr. H.B. Vasistha, Dr. Mridula Negi and Research Scholars attended the National Conference on "Eco-Restoration of Derelict Mined Lands" jointly organised by Department of Botany, Dhempe College of Arts and Science, Goa and FRI in Goa on 1st and 2nd March 2007. Dr. Soni delivered key note address on "Ecological Restoration of Mined Lands: Problems and Prospects". Dr. H.B. Vasistha, Dr. Mridula Negi and Research Scholars also presented papers separately.
3. Dr. Vineet Kumar, Scientist-D, delivered an invited Talk at XXI Carbohydrate Conference CARBO XXI organized by Delhi University, Delhi and Association of Carbohydrate Chemists and Technologists (India) on "Chemo-enzymatic modification of Hyaluronic Acid" from 26th to 29th November 2006 at Delhi University, Delhi.
4. Dr. Rameshwar Dayal, P.C. Dobhal, Rakesh Kumar, Praveen Onial and Raj Dev Rawat. Standardization of process for isolation of Natural Dyes. Poster presented in International symposium on Natural Dyes held at Hyderabad from 6th to 12th November 2006.
5. Dr. Rameshwar Dayal, Head, Chemistry Division, Dehradun delivered an invited talk on topic entitled "Forests: A Treasure of Chemicals" at Sardar Bhagwan Singh Institute of Biomedical Sciences and Research, Balawala, Dehradun on 10th March 2007.
6. Dr. V.K. Varshney and Dr. Vineet Kumar participated in a "Technology and Innovation Finding Workshop" organized by Confederation of Indian Industry (CII) and Technology Development Board (TDB) of Ministry of Science and Technology at Dehradun on 9th February 2007. A presentation entitled "Value added products from forests" was made by Dr. V.K. Varshney.
7. Dr Vineet Kumar attended XXI Carbohydrate Conference at Delhi University, Delhi from 26th to 29th November 2006 and following lecture was presented: An invited lecture on "Chemo-enzyme modification of Hyalouronic acid" by Dr Vineet Kumar.
8. Neetu Bhatt, P. K. Gupta and S. Naithani presented a paper on "*Lantana camara*, a potential weed for preparing alpha cellulose and its cellulose sulfate derivative" in Carbohydrate conference at Delhi University, Delhi from 26th to 29th November 2006.
9. Dr. V.K. Varshney participated in the ICS-UNIDOSEA Regional workshop on "Extraction Technologies for Medicinal and Aromatic Plants (MAPs)" held at CIMAP, Lucknow from 29th November to 1st December 2006 and presented a country presentation on status of MAPs.
10. Dr. A.N. Shukla participated in Brain Storming Workshop on "Aerosols and its impact on climate with special reference to Indo-Gangetic plains", on 10th and 11th November 2006, Indian Institute of Technology, Kanpur.



11. Amit Pandey, N. S. K. Harsh, Meenakshi Khalkho and Suresh Chandra, attended National Seminar on Trees Outside Forests; Potential for Socio-economic and Ecological Development, Department of Forest and Wildlife Preservation, Govt. of Punjab, Chandigarh, April 2006.
12. Dr. S. Nautiyal attended International Conference and Expo on “Botanical Products”, held at Rajasthan University, Jaipur from 25th to 27th March 2007.
13. Dr. S. Nautiyal attended the Research Advisory Committee Meeting of HNB Garhwal University, Srinagar as an Expert Member held at HAPPRC, Srinagar (Garhwal) on 11th and 12th May 2006.
14. Dr. S. Nautiyal attended the Meeting on “Constitution of Sub-Groups Sectors and Suggest a Policy Framework/Strategy for Development of the Textile Sector during next five years” held under the Chairmanship of Joint Secretary, Ministry of Textile, Central Silk Board, Bangalore and represented ICFRE/FRI as a Member on 17th July 2006.
15. Dr. S. Nautiyal and Monika Tyagi attended International Seminar on “Forests, Forest Products and Services: Research, Development and Challenges Ahead”, held at Department of Forestry, HNB Garhwal University, Srinagar from 1st to 3rd November 2006.
16. Dr. S. Nautiyal attended Uttranchal First Science Congress held at Dehradun Institute of Technology, Dehradun on 10th and 11th November 2006.
17. Dr. S. Nautiyal attended the meeting of Task Force on “Nutrient Management in Plantation and other Cash Crops”, held at KFRI Peechi, on 10th August 2006.
18. Dr. Veena Chandra participated in GEF Project Development session on Biodiversity.
19. Dr. Sas Biswas, Dr. Veena Chandra and Shri Anup Chandra participated in Expert Committee Meeting on Plants and Workshop on “Revision of Species in Schedules of the Wildlife (Protection) Act”.
20. Dr. Veena Chandra participated in National Symposium on Plant Biotechnology.
21. Dr. Veena Chandra participated and presented a paper in Workshop on Optimum Afforestation Plan
22. Dr. Veena Chandra participated in Project Conference on Planted Forests (Ecosystem Goods and Services).
23. Dr. H.S.Ginwal and Dr. Ashok Kumar attended the “National Seminar on Trees Outside Forests” on 25th and 26th April 2006 sponsored by Punjab Forest Department, Chandigarh.
24. Dr. H.S.Ginwal attended “National Biotechnology Conference 2006: Current trends and future perspectives” held on 2nd and 3rd September 2006 at Indian Institute of Technology, Roorkee (Uttarakhand).
25. Dr. H.B. Vasistha participated in the International Seminar on Soil and Forest Degradation in the Himalayan Region, organized by Norwegian University of Life Science (UMB), Aas, Norway in Shimla on 5th and 6th April 2006.
26. Deepak Kholiya, JRF attended International Conference on “Cutting Edge Research in Tourism Emerging Issues and Challenges”, organized by Himachal Pradesh University, Summer Hill, Shimla on 17th and 18th March 2007 and presented paper.

International

Dr. S.S. Negi, Dr. A.K. Hooda, Dr. N.S. Bisht, Mr. D. Khanna, Dr. Rajeev Srivastva and Mr. Rajiv Pandey attended a workshop on the 'Ecosystem Goods and Services' from 3rd to 7th October 2006 at Bilbao, Spain.

AWARDS

1. Dr. S. Nautiyal has been awarded the Rajiv Gandhi Excellence Award by Economic Growth and National Integration Council, New Delhi on 31st August 2006.
2. Mr. Jagdish Pant received the Best Paper Award for research paper "Determination of Berberine in Berberis aristata by HPTLC" in Conference 'Phytochemical and Ayurveda potential and prospects' by Universities' Journal of Phytochemistry and Ayurvedic heights, Dehradun on 3rd December 2006.
3. Paper entitled "Amelioration of Neem leaves and Oil for wood protection" by Swati Dhyani and Sadhna Tripathi was presented in First Uttaranchal Science Congress on 10th and 11th November 2006. It was considered best paper in Environmental Sciences and Forestry Section and 1st Prize of Rs. 5000/- was awarded.
4. Junior Young Scientist Award 2007 for Best Paper presentation, won by Ruma Bisht (Project Associate), in "National Seminar on Medicinal Plants: Conservation, Cultivation and Utilization" at Gurukul Kangri University, Haridwar, Uttarakhand.

DISTINGUISHED VISITORS

1. Shri V.L.Chopra. Member, Planning Commission, visited FRI on 18th May 2006.
2. Shri Charnjit Singh Atwal, Deputy speaker of Lok Sabha visited FRI on 3rd July 2006.
3. Shri Digamber V. Kamat, Minister for Power, Mines, Art and Culture, Govt. of Goa Panaji-Goa, visited FRI on 18th October 2006.



Shri Digamber V. Kamat, Minister
for Power, Mines, Art and Culture, Govt. of Goa



4. Lt. Gen. R.K.Rampal, Commandant, I.M.A., Dehradun, made a visit to FRI on 8th February 2007.
5. Grandson of Mr. Brandis from Germany visited FRI on 12th March 2007.
6. Dr. J.S. Yadav, Director, IICT, Hyderabad, visited FRI on 2nd November 2006.
7. Prof. Akito Nagatsu, College of Pharmacy, Kinjogakuin University, Omori, Moriyama, Nagoya 463-8521, Japan, visited FRI on 2nd November 2006.
8. Prof. Deepak Pental, Vice Chancellor, Delhi University visited FRI on 13th October 2006.
9. A delegation of 29 (twenty nine) Civil Servants of Afganistan visited FRI on 29th August 2006.
10. Members of ITTO consisting Mr. J.R. Palmer and others visited FRI on 25th September 2006.
11. Dr. Prodipto Ghosh, Secretary, Ministry of Environment and Forest visited different disciplines of the FRI and went through various research activities on 8th March 2007.



Visit of Dr. Prodipto Ghosh, Secretary,
MoEF, New Delhi

12. Prof. Gajendra Singh, Vice Chancellor, Doon University, Dehradun, made a visit to FRI on 22nd November 2006.

MISCELLANEOUS

1. A special cover to mark the Centenary Celebration was released by Mrs. Amrita Rai, Director, Postal Service Uttarakhand.
2. Dr. A.N. Shukla delivered a radio talk in Hindi on the mortality of shisham in India and its control from All India Radio, Nazibabad, U.P.
3. Dr. N.S.K. Harsh gave a talk about the diseases of poplars and their management for All India Radio, Nazibabad.
4. Dr. Sas Biswas provided significance of monumental trees growing in Shatabdi Van Vigyan Kendra, City Campus of FRI in Bhoomi programme of Delhi Doordarshan.

NATIONAL FOREST LIBRARY AND INFORMATION CENTRE

The National Forest Library and Information Centre (NFLIC) of the institute is richest in document collection in South and South-east Asia. NFLIC provides various types of library and information services to its users viz. reference, referral, lending, reprography, current awareness, inter-library loan, retrieval of information from machine readable databases etc.

During the year a total of 27,204 books were loaned to the users for outside reading. Besides, 58,936 documents were consulted.

The document collection was enriched by the addition of 1018 documents, out of which 654 books were purchased at a cost of Rs. 11.64 lakhs and 364 books received as gratis.

NFLIC subscribed to Indian and foreign periodical titles at a cost of about Rs. 53 lakhs. It also received about 335 periodical titles as gratis. Besides, back issues of 12 periodical titles were acquired at a cost of Rs. 6.20 lakhs.

The binding of loose periodicals is an essential library activity. During the year, 400 sets of periodicals were bound.

The NFLIC has been selling ICFRE publications through its Book Depot. During the year 509 books and 19 VCDs were sold to the State Forest Departments, Universities etc.

The NFLIC extended its expertise in library and documentation work by holding a Training Course on Library and Documentation for the officials of the Institute of Forestry, Tribhuvan University, Nepal from 3rd to 18th July 2006. Four officials attended the course.

The Ministry of Environment and Forests, Govt. of India established an ENVIS Centre on Forestry at NFLIC. The Centre, during the year enriched the following databases by the addition to new references, which have Internet accessibility through the website of the Centre having URL: www.frienvis.nic.in.

Indian Forestry Abstracts, Joint Forest Mangement, *Prosopis juliflora*, poplars, Forests and Environment, Current Forestry Literature. Besides, the content pages of journals, forest cover of India, state wise and then district wise, announcements of forthcoming National and International conferences, seminars, symposia, training courses were also put up on the website. The ENVIS Centre on Forest published issues of ENVIS News Digest and an issue of ENVIS Forestry Bulletin during the year.

FOREST RESEARCH INSTITUTE UNIVERSITY

Forest Research Institute, Dehradun was conferred the status of 'Deemed University' by the Ministry of Human Resource Development, Government of India, New Delhi vide Notification No. F-9-25/89 U-3 dated 6th December 1991. After the conferment of University status academic activities of the institute have increased tremendously and it has been fostering research and education in Forestry, Environment and other allied disciplines in a more meaningful and productive way. Besides turning out students having formal academic and practical education of University standard in specialized areas of study newly introduced in the country, such as, Forestry, Wood Science and Technology, Environment Management, Plantation Technology, Non-Wood Forest Products, Natural Resource Management, wood based industries and Plantation activities. The university has been fostering pioneering research in specialized areas under Ph.D. Programmes.



ACADEMIC COURSES AND ADMISSION

The FRI University has been offering the following academic courses on a regular basis: -

- M.Sc. Forestry (Economics and Management)
- M.Sc. Wood Science and Technology
- M.Sc. Environment Management
- Post Graduate Diploma in Natural Resource Management
- Post Graduate Diploma in Management of Non Wood Forest Products
- Six months Certificate Course in Pulp and Paper Technology.

The M.Sc. courses are of two years duration, whereas the Post Graduation Diploma Courses are of one year duration. The certificate course in Pulp and Paper Technology is only of six months duration. The intake capacity of each course is 25 in M.Sc; 15 in PG. Diploma courses of Natural Resource Management, 22 in PG. Diploma courses of Management of Non Wood Forest Products and 15 in Six months Certificate course in Pulp and Paper Technology.

Admissions to these courses are made on the basis of candidate's performance through All-India Competitive Entrance Test.

During the year 95 students were admitted in all the above mentioned six courses.

Lectures on above mentioned courses were mostly delivered by internal faculty. Visiting faculty were also invited from IIRS, WII, IGNFA, DAV (PG) College, and retired scientists from these institutions and retired forest officers were also invited to deliver lectures on specific topics.

Besides, regular lectures/programs and dissertation/Project work on specific topic relevant to course, students were sent to one month's industrial attachment to different industries/ organizations. Local excursions, short and long study tours and training programmes were organized during the academic session.

During the year 2006-08, 95 (ninety five) students were admitted. The course strength is as follows:

1. M.Sc. Forestry (Economics and Management)	- 20
2. M.Sc. Wood Science and Technology	- 25
3. M.Sc. Environment Management	- 21
4. P.G. Diploma in Natural Resource Management	- 11
5. P.G. Diploma in Management of Non wood Forests Product	- 9
6. Certificate courses in Pulp and Paper Technology	- 9
TOTAL	<u>-95</u>

EXTRACURRICULAR ACTIVITIES

Students of FRI University (FRIU) participated in a workshop on "Forestry Education in India" organized by FRIU.

Annual Sports Meet of FRIU was held from 23rd to 26th February 2007 at IGNFA playground which was actively participated by students.

A cultural program “Srijan 2007” was organized on 31st March 2007 by the students and research scholars of the FRI University.

STUDENTS WELFARE ACTIVITIES

1. FRI University provides medical facility to its students.
2. Hostel accommodation is available in F.R.I. Campus.
3. The facilities for indoor games and common room are provided to the hostlers.
4. Library and Computer facilities are available to the students.

OTHER ACTIVITIES

1. FRI University students participated in the Centenary Year celebration of FRI on 15th December and helped the students of different schools from Uttarakhand in the cloth presenting ceremony, where cloth was signed by lakhs of students from different educational institutions of Uttarakhand.
2. Dr. Prodipto Ghosh, IAS, Secretary, Ministry of Environment and Forests visited the FRI University on 8th March 2007 and addressed the students of the FRI University and discussed various issues related to them.
3. Mr. Michael Vetha Siromany, IAS delivered a lecture to the PG Students of the FRI University on the topic “Human Rights in Relation to Forest Management”, on 11th August 2006.
4. Mr. Mudit Kumar Singh, IFS, Chhattisgarh delivered a lecture to M.Sc. Students of 3rd Semester on the topic “Project Formulation” on 14th August 2006.
5. Mr. S.K. Sinha, IFS, Haryana delivered a talk on green areas around Panipat Oil Refinery and Afforestation on 14th August 2006.
6. Ms. Yuka Makino, Natural Resource Management Specialist, South East Region, World Bank, Washington delivered a lecture to the students of PG Diploma in NRM and NWFP on the topic “Global Learning development network on NRM” on 25th August 2006.
7. Mr. B.D. Suyal, IFS delivered a lecture to M.Sc. students of the FRI University on RTI Act on 25th September 2006.
8. Mr. Rakesh Taneja, Director, Ministry of Commerce delivered a talk to M.Sc. Environment Management and NRM students on 16th October 2006.
9. A Blood donation camp was organized by Indian Medical Association on 8th February 2007.

Ph.D. PROGRAMME

Research is an essential function of a National Institute like the Forest Research Institute University and increasing emphasis is being given to this important aspect of academic pursuit. Highly



qualified Foresters/Scientists and talented Research Scholars have continued to be active in the front areas of research and their efforts have been generally supported by sponsoring agencies like the ICFRE, UGC and CSIR, etc. With the support of these organizations coupled with the guidance of talented researchers of the institutes and established Research Centers, the research activities under Ph.D. Programmes have increased manifolds. At present 436 Research Scholars have been registered including registration of 62 Research Scholars in the current year. During the year 42 Research Scholars were awarded Ph.D. Degree.