CHAPTER I

FOREST RESEARCH INSTITUTE DEHRA DUN

Forest Research Institute (FRI), Dehra Dun has its roots in the erstwhile Imperial Forest Research Institute established in 1906 to organize and lead forestry research activities in the country. The Institute caters, in particular, to the research needs of the Indo-Gangetic plains of Punjab, Haryana, Chandigarh, Uttar Pradesh and Uttaranchal. This Institute is also a Deemed University and at present offers courses leading to M.Sc. degree in Forestry (Economics and Management), Wood Science and Technology and Environment Management. It also offers Post-Graduate Diploma courses in Plantation Technology and Biodiversity Conservation.

PROJECTS COMPLETED DURING THE YEAR 2002-2003

Project 1: Phytochemical examination for the utilisation of leaves, bark, fruits and roots of Indian forest plants [FRI-53/Chem-3]. *For technical report contact, Principal Investigator - Dr. Rameshwar Dayal.*

Sub-project (i): Screening of *Cephalotaxus harringtonia* var. *harringtonia* needles for bioactive principles [1997- 2003].

Findings: Structures of bioactive principles were elucidated using spectral data (UV, IR, NMR and MS) and were characterised as 7,4',7",4"'-tetra-O-methylamentoflavone; 4',7,7"-tri-O-methylamentoflavone; ginkgetin; sequioflavone; 2-(3-methoxy-4-hydroxyphenyl)-propane-1, 3-dioe (A); apigenin, apigenin-5-neohesperidoside (B); apigenin-5-(6"-acetyl neohesperidoside; compound (C) and β- sitosterol. Compound A, B and C have been reported for the first time. Essential oils were isolated from leaves and flowering twigs and analysed by GC-MS. Fifteen compounds were identified in each of the oil with β- caryophyllene, germacrene-D, and γ-cadinene as the major constituent in both the oils. Ginkgetin was found to possess hepatoprotective activity in rats.

Sub-project (ii): Development of pest control agents and other bioactive compounds from *Vitex negundo* [1997- 2003].

Findings: Thirty five and twenty compounds were identified in the essential oil of leaves and flowering twigs with viridiflorol as the chief

constituent, in both. October is considered to be the optimum time for harvesting the leaves. Petroleum ether, acetone, methanol extracts, essential oil and two pure compounds namely, viridiflorol and agnuside were screened for their pesticidal activity against *Sitotroga cereallela, Sitophilus oryzae* and *Clostera fulgurita*. Only essential oil has shown the insecticidal activity against the first species. All the extracts and pure compounds also showed significant dose dependant antifeedent activity against the rice weevil, *Sitophilus oryzae* and larvicidal activity against the third star larvae of *Clostera fulgurita* (poplar leaf defoliator).

Project 2: Studies on tree borne oilseeds [FRI-54/Chem-4]. *For technical report contact, Principal Investigator - Dr. P.P. Jain.*

Sub-project : Studies on oilseeds of forest origin to find new resources of oils and wetting agents [1998- 2002].

Findings: Nine species were studied. Out of which 5 species were found to be rich in fatty oil content, i.e. *Cedrela serata* (17.5%), *Fraxinus micrantha* (19%), *Garuga pinnata* (41%), *Prunus cornuta* syn. *P. padus* (25%) and *Prunus armeniaca* (31%). Seeds of *Fraxinux micrantha* were also found to be rich in essential oil (3.67%). Physico-chemical constants and fatty acid composition of fatty oils from seeds of these species and essential oil composition of *Fraxinux micrrantha* seeds were determined. Sulphated oils from *Dillenia pentagyana, Fraxinus micrantha* and *Garuga pinnata* seed may be used as substitute of TRO (Turkey Red Oil), commonly used as the wetting agent in the textile industry.

Project 3: Ecological study of *Dalbergia sissoo* (Roxb.) with special reference to mortality [FRI-147/Eco-7/2000-2003]. *For technical report contact, Principal Investigator - Dr. J.D.S. Negi.*

Findings: On the basis of observation made in Punjab, Bihar and Haldwani (Uttaranchal) for the mortality of *Dalbergia sissoo* (shisham), it can be concluded that temporal changes in the physical problem of soil and soil maturation, water stress, water logging, environmental stress and ecological succession could be the main causes for shisham mortality. It is suggested that to control the mortality, shisham should be grown in block plantation in sandy and sandy loam soils with low water table and controlled irrigation, avoiding canal irrigation as it favours the superficial root system. In water logged areas mixed plantation of the shisham with *Terminalia arjuna, Trewia nudiflora, Eucalyptus* hybrid, *Syzygium cumini, Acacia nilotica, Pongamia pinnata* and *Holoptelia integrifolia* etc. gives better results.

Project 4: Ecological impact assessment of bioreclamation projects in Raibareli and Sultanpur [FRI-86/FSLR-9/1998-2002]. *For technical report contact, Principal Investigator- Dr. (Mrs.) P. Soni.*

Findings: Vegetation and biodiversity under arjuna mixed Eucalyptus and shisham plantations were studied. Study of litter production (kg/ha) revealed maximum litter under arjuna plantation site and minimum under shisham plantation site. Stem flow and the throughfall were analysed for pH, EC, chloride and phosphorus.

Project 5: Role of forest cover on landslides in the Himalaya [FRI - 131/Eco-6/1999-2002]. *For technical report contact, Principal investigator - Dr. H.B. Vasishta.*

Findings: Landslides survey was conducted in the catchments of Alaknanda, Mandakni, Bhagirathi, Yamuna and Tons in Garhwal Himalaya. There was high incidence of landslides in *Pinus roxburghii* dominated forests in the middle Himalayan region. In upper Himalayan region, the higher incidences were associated with *Alnus nepalensis* dominated forests. Low occurrence of landslides was found in the pasture/grasslands.

Project 6: Effect of trees on agricultural crops [FRI - 8/SF-1/1996-2002]. *For technical report contact, Principal investigator - Mr. Shivendu K. Srivastava.*

Findings: The effect of leaf litter of *Populus deltoides,* Eucalyptus species and *Dalbergia sissoo,* planted on field boundaries, was not found to be inhibitory on germination and growth of agricultural crops. Similarly, Eucalyptus and poplar leaf litter did not have any significant effect on the germination, growth and yield of the zaid crops (cowpea, moong and urd) in different soil mixtures. Removing the dropped leaves of poplar under block plantation, once a week during germination and initial growth period, significantly increases the survival and yield of wheat crop.

Project 7: Studies on agroforestry systems and development of suitable agroforestry models [FRI - 118/SF-3/1998-2003]. *For technical report contact, Principal investigator - Dr. Rajiv Kumar.*

Findings: Socio-economic survey was completed in district Gurgaon and Kurukshetra of Haryana and in district Roopnagar and Hoshiarpur of Punjab.Growth data in respect of clonal trial of *Populus deltoides* was recorded at Panchkula (Haryana). Growth data of established five experiments on upgrading nursery techniques of *Populus deltoides* at FRI was recorded viz., (i) To study performance of cuttings of G-48 with different numbers of buds, (ii) To study the growth performance in different clones, (iii) To study the effect of different doses of fertilizers, (iv) To compare performance of cuttings derived from VMG and ETPs of *Populus deltoides* and (v) To ascertain viability of cuttings survey of *Populus deltoides* based agroforestry plantation in district Dehra Dun was carried out.

Project 8: Forest community interface - A study on the impact of participatory forest management on the status of forests and on socio-economic development of rural people in Dehra Dun district of Uttaranchal [FRI-133/SF-4/1999-2002]. *For technical report contact, Principal investigator - Mr. Shivendu K. Srivastava.*

Findings: The study was taken up in thirteen villages. It was observed that reduction in livestock population, improved fodder management, picking up of stall feeding of cattle and reduced collection of fuelwood and fodder from forests due to preference for alternative sources of energy have helped both the natural and the assisted regeneration, leading to considerable improvement in the status of the forests. Integrated and participatory approach in development process has brought desirable changes in the quality of life. Significant reduction in distance and time for fuelwood and fodder collection has been observed. Agricultural productivity enhancement and diversification of income generation activities (floriculture, mushroom cultivation, pickle making and tailoring etc.) has paved way for income augmentation. Contribution in decision making by the women also getting recognition.

Project 9: Development of packing boxes.

Sub-Project: Development of packing boxes from different bamboo sp. for horticultural produces [FRI-111/FPD (TM) 24/2000-2002]. *For technical report contact, Principal Investigator - Mr. Rajesh Bhandari.*

Findings: Bamboo boxes were designed and fabricated from four bamboo species for packaging of 20 kg horticulture produce and tested. The results have indicated that the newly designed bamboo boxes are stronger, cheaper by 16% and transportation cost is lower by 10% as compared to conventional wooden boxes.

Project 10: Studies on natural durability and efficacy of preservatives in treated bamboo and plantation grown wood species [FRI-135/FPD (WP)-31/1999-2002]. *For technical report contact, Principal Investigator - Dr. Indra Dev.*

Findings: *Bambusa arundinacea/Bambusa nutans* were treated with borax: boric acid by diffusion method in green and split form and round bamboo by Bouchrie method. The treated/untreated samples are installed in the ground under shed. Periodic inspection was continued at three test centers e.g. Dehra Dun, Chakrata and Jodhpur to assess the degree of deterioration.

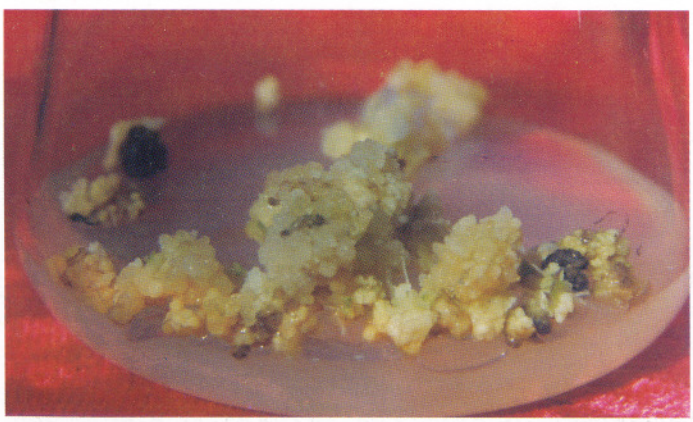
Project 11: Development of simple technology for treatment of joinery timbers [FRI-149/FPD/(WP)-32/2001-2002]. *For technical report contact, Principal Investigator - Dr. Indra Dev.*

Findings: *Melia azaderach* (bakain) and *Michelia champaca* samples were treated with LOSP and 6% ACB at 80°C for 4 hrs by dipping. In case of ACB treatment, *Michelia champaca* absorbed 4.8 kg/m^3 dry salt of chemicals whereas bakain absorbed 7.8 kg/m^3 dry salt under similar conditions. Retention data on LOSP showed that both the species absorbed required retention of chemicals in five minutes dipping.

Project 12: *In vitro* rejuvenation multiplication of *Eucalyptus* hybrid, chirpine, shisham, bamboo and neem [FRI-20/G&TP/2/1997-2002].

Sub-Project (i): *In vitro* multiplication of chirpine and bamboos. *For technical report contact, Principal Investigator - Dr. Sarita Arya.*

Findings: Somatic embryogenesis has been established in *Dendrocalamus asper* and plants were regenerated from somatic embryos. Different embryogenic cell lines were maintained in cultures. Technique for plant regeneration through inflorescence was developed in *D. asper*. Explants of different sizes showed varied responses towards shoot induction and proliferation.



Somatic embryogenesis in *D. asper*.

Chirpine plants were regenerated through adventitious bud formation and axillary bud proliferation, 40-50 buds were induced per zygotic embryos on MS medium supplemented with BAP. These buds were elongated on hormone free medium and shoots were rooted *in vitro* conditions. Embryogenic cultures were multiplied on 2, 4-D supplemented DCR medium. Effect of gel and ABA was studied for maturation. 30-60 μM ABA was found suitable for cotyledonary stage embroyo formation.

Plant regenerated through somatic embryos in *D.asper*

Sub-Project (ii): *In vitro* multiplication of shisham and Eucalyptus. *For technical report contact, Principal Investigator - Dr. I.D. Arya.*

Findings: A procedure has been developed for rapid multiplication of *Dalbergia sissoo* (sisham) through axillary bud proliferation. BAP was found more effective for axillary bud proliferation, than other cytokinins, on which 93% explants responded. Study on morphogenic behaviour of different clones revealed different requirement of phytohormones for shoot proliferation. Studies were undertaken for somatic embryogenesis. It was found that auxins alone were effective in induction of

In vitro shoot multiplication in shisham

Axillary bud proliferation in shisham

embryogenic callus on cotyledons of *Dalbergia sissoo*. Results also showed that lower concentration of 2, 4-D was more effective in inducing somatic embryos on callus. Addition of cytokinins to callus induction medium lowered number of cotyledons inducing embryogenic callus. Tissue culture technique was developed with respect to different clones selected from VMG of *Eucalyptus tereticornis* established at FRI, Dehra Dun.

Project 13: Studies on nursery techniques/cultivation of important medicinal plants for socio-economic development of rural poors [FRI-146/NWFP-7/1998-2003]. *For technical report contact, Principal Investigator- Dr. P.P. Bhojvaid.*

Findings: The cultivation packages of *Andrographis paniculata, Barleria prunitis* and *Asparagus racemosus* are being standardized. Perfected technology will be provided to growers.

Project 14: Study on disease resistance of newly introduced germ plasm (progenies of *Populus deltoides*) [FRI- 136/Path-6/1999-2002]. *For technical report contact, Principal Investigator - Mr. Amit Pandey.*

Findings: Recording of foliar diseases was carried out on the poplar clones raised at Brandis road and Central Nursery New Forest campus. All the clones were found to be infected with *Alternaria* sp. and *Phyllosticta* sp. foliar diseases. A new ceratocystis stem canker disease recorded in Doon valley was not observed in these clones.

Project 15: Seed mycoflora of important tree species and its management [FRI-137/Path-7/1999-2002]. *For technical report contact, Principal Investigator - Dr. N. S. K. Harsh.*

Findings: Seeds of *Cedrus deodara* and *Dalbergia sissoo* infected by fungi, *Alternaria alternata, Aspergillus flavus, A. niger, Chaetomium globosum, Colletotrichum gloeosporioides, Mucor* sp., *Nigrospora oryzae, Penicillium* sp. and *C. globosum* during storage was found to inhibit germination in *C. deodara*. Bavistin and Thiram was found best effective among 7 fungicides tested in controlling fungal infestation of seeds of *C. deodara* by *C. globosum*.

Project 16: Paulownia propagation and introduction [FRI-73/SF-2/1997-2002]. *For technical report contact, Principal Investigator - Mr. Dinesh Kumar.*

Findings: Results indicated that growth of paulownia in farmer's fields in the plains of Uttar Pradesh and Uttaranchal is relatively slower than poplar and its form is very poor. Hence it is not recommended for planting under agroforestry in the region.

PROJECTS CONTINUED DURING THE YEAR 2002- 2003

Project 1: Computerisation of anatomical database of Indian hardwoods for the purpose of their identification [FRI-17/Bot-7/1997-2004]. *Principal Investigator - Dr. Sangeeta Gupta.*

Status: A system entitled "Wood Anatomy Information System" has been developed for wood identification and wood anatomical research. Data are being collected to incorporate into the software. Wood images have been stored for all the three sections of wood viz., transverse, radial and tangential.

Project 2: Computerization of herbarium of Forest Research Institute, Dehra Dun [FRI-15/ Bot-5 /1997-2002]. *Principal Investigator- Dr. Sas Biswas.*

Status: With a view to computerize the Herbarium of Forest Research Institute, Dehra Dun, 600 type specimens and species diversity of 30 genera and 80 species and 75 rare and threatened forest species typical of Uttaranchal were nomenclaturally and taxonomically studied for the development of database to incorporate into software. Studies on the herbarium data on bamboos and intraspecific variability (200 clones) of *Populus deltoides* were completed. Role of FRI Herbarium for studies and development of management strategies with respect to forest biodiversity and genetic resources was ascertained.

Project 3: Improved utilization of raw materials for pulp and paper making including juvenile tree utilization [FRI-129/C&P14/1999-2005]. *Principal Investigator - Dr. Sanjay Naithani.*

Status: Proximate chemical analysis and fibre dimensions of different clones of different aged *Populus deltoides* was carried out. Soda and kraft pulping of poplars clone was carried out to produce the pulp of kappa No. 30. Unbleached pulps were evaluated for strength properties. Unbleached pulps were further delignified with oxygen at 6 kg/cm^2 to reduce the kappa number by about 50%. Oxygen delignified pulps were bleached using ECF bleaching sequences under different conditions and bleach chemical concentration. The effluent generated at each stage was analysed for total solids, COD and pH.

Project 4: Complete elimination of sulphur and chlorine compounds in pulping and bleaching in MILOX process [FRI-150/C&P-15/ 2001-2004]. *Principal Investigator - Dr. K.S. Bhandari.*

Status: *Eucalyptus tereticornis* wood chips were pulped using different doses of formic acid sandwitched between different doses of peroxyformic acid. Pulp yield was 50-65%. Pulps were evaluated for strength properties. Unbleached pulps were bleached in three stages of alkaline hydrogen peroxide bleaching sequence. Bleached pulps of about 75% ISO brightness possess adequate strength properties comparable to pulp prepared using conventional pulping and bleaching processes.

Project 5: Studies on isolation and characterization of polysaccharides of abundantly available seeds of trees/ shrubs, leaves, bark and exudate gums [FRI-51/Chem-1]. *Principal Investigator- Dr. P.L. Soni.*

Sub-project (i) : Study of *Cassia tora* seed gum (CTG) to find its uses [1997 - 2002].

Status: The galactose to mannose ratio was found to be 2.9:1 and 1:19 for cold and hot water soluble polysaccharides, respectively. Three oligosaccharides (O_1, O_2, and O_3) and four oligosaccharides (O_4, O_5, O_6 O_7) were isolated from partially hydrolysed cold and hot water soluble polysaccharides, respectively. Periodic acid oxidation and methylation analysis of the polysaccharide is done.

Sub-project (ii): Chemical investigation of *Prosopis juliflora* seed polysaccharide [2000- 2003].

Status: Partial hydrolysis of the Cold Water Soluble (CWS) polysaccharide using dilute H_2SO_4 (0.01-0.5N) was carried out and molecular weight was determined. The rheological study of the CWS polysaccharide showed increase in solution viscosity with increase in concentration and pronounced thinning effect with increase in temperature in aqueous medium. The polysaccharide showed non-newtonian pseudoplastic or shear thinning behavior in aqueous solution i.e. with increase in shear rate, the viscosity decreases.

Project 6: Phytochemical examination for the utilisation of leaves, barks, fruits and roots of Indian forest trees [FRI-53/Chem-3]. *Principal Investigator - Dr. Rameshwar Dayal.*

Sub-project : Studies on vegetable dyes from *Parthenium hysterophorus, Ageratum conyzoides, Azadirachta indica* and *Eupatorium glandulosum* [2000- 2003].

Status: Methods were standardised for the isolation of dye from *Eupatorium glandulosum* and its use in dyeing of different fabrics. Charming shades with good colour fastness properties were obtained by using the dye with different mordants. The process was also standardised for the preparation of herbal gulal using the natural dye.

Project 7: Impacts of pollutants on tree species in Doon valley [FRI-116/Eco-3/1999-2003]. *Principal Investigator - Dr. (Mrs.) Laxmi Rawat.*

Status: Impact of pollutants on different parameters like chlorophyll, carotenoids, ascorbic acid, relative moisture content and pH of the leaves of different plant/tree species in different seasons were analysed. Physico-chemical properties of surface soil was also studied. Vehicular flow was recorded every month on Derha Dun - Delhi highway. Monthly air quality monitoring ($S0_2$, $N0_2$ and SPM) at selected points and control sites was done.

Project 8: Plant growth strategy characterization, diversity and vegetational dynamics of rehabilitated and derelict mined ecosystem in western Himalaya [FRI-130/Eco-5/1999-2004]. *Principal Investigator- Dr. H.B. Vasistha.*

Status: Vegetation analysis at different microhabitats selected at derelict and rehabilitated lime stone mined areas in Doon valley was carried out. Soil samples from these microhabitats were collected and analysed for organic carbon and nitrogen. Similarly, soil moisture and soil temperature at these sites in different seasons were also recorded. Herbaceous biomass were estimated at some microhabitats.

Project 9: Management of sal heart wood borer in natural forests [FRI/ 63 / FED 2/1993-2004]. *Principal Investigator - Mr. R.S. Bhandari.*

Sub-project (i): Management of sal heartwood borer in natural forest.

Status: The incidence as well as intensity of attack was considerably decreased in Forest Division Dehra Dun and Rajaji National Park in this year. While in Kalsi Soil Conservation Division, the situation is more or less similar to that of last year. In Dehra Dun Forest Division Dehra Dun, 1043 traps; in Kalsi Soil Conservation Division, 825 traps and in Ramgarh Range and Rajaji National Park, 191 traps were laid and 6,46,772, 2,05,446 and 94,500 beetles of sal heartwood borer were captured, respectively and killed.

Sub-project (ii): Phytochemical investigation of sal (*Shorea robusta*) to isolate suitable kairomone for the management of sal heartwood borer (*Hoplocerambyx spinicornis*). *Principal Investigator - Dr. Rameshwar Dayal.*

Status: Essential oil obtained from leaf, bast sap wood, heartwood using various chemical extractives was bio-assayed for their behavioral studies against sal heartwood borer using electro - anntenogram and wind tunnel techniques. Bast oil performed best for the attraction of sal heartwood borer beetle.

Project 10: Bio-ecological studies on the insect pests of bamboo and their management [FRI/144/FED8/2000-2005]. *Principal Investigator - Mr. R.S. Bhandari.*

Status: Bio-ecological studies on borer of bamboo (*Estigmina chinensis)* : Laboratory studies on the biology of *E. chinensis* were conducted. The beetles emerge during May- June have copulation period of 2 hours to 8 hrs. and 15 minutes longevity of adults male and female is 13 and 29 days. Maximum eggs laid by a female were 12 in groups of 2 - 3 or 4 eggs covered with cleaved leaf material and incubation period is 8-10 days; larval period is 10-15 days and pupal period is 8-9 days. There was one complete life cycle and one partial. The insect hibernated as adult.

Seasonal abundance of insect feeding on bamboo : The incidence of insect pest feeding on bamboo was recorded from Lansdowne Forest Division, Yamuna Nagar Forest Division (Haryana), Narendra Nagar Forest Division (U.A.), Dehra Dun Forest Division (Uttaranchal) and New Forest Estate.

Project 11: Environmental conservation strategies for land use in the lower western Himalayas: Butterflies as indicators in monitoring environmental changes along urban gradients [FRI-145/FED-9/2000-2004]. *Principal Investigator - Mr. Arun Pratap Singh.*

Status: Monthly data collection was made on the relative butterfly species abundance and richness with respect to varying tree stand parameters i.e. vegetation tree and shrub density, GBH, incidence light falling from each site to know the effect of disturbance and vegetation. So far data on 140 species of butterflies, their food plants, habitats, their breeding season /period have been collected from sal forests.

Project 12: Role of forests in soil and water conservation [FRI-117/Eco-4/FS & LR/1998-2003]. *Principal Investigator - Dr. Kalyan Singh.*

Status: The upper, mid and lower slope vegetation affected slope hydrology and stream flow in different ways. Vegetation on upper slopes dominated by sandan and associates was very effective in diurnal variations as compared to sal and associates in mid and lower slopes, probably due to difference in evapo-transpiration rates. Based on the studies, it was inferred that forests can reduce three times more surface runoff, about six times more of sediment yield, conserve double of nitrogen and four times of phosphorus and potash as compared to bare lands.

Project 13 : To study and develop the techniques of cultivation of *Uncaria gambier* to propagate it in the field and popularize the species in India [FRI-126/NWFP-6/1998-2003]. *Principal Investigator- Dr. P.P. Bhojvaid.*

Status : Germplasm of *Uncaria gambier* was procured from Indonesia. Germination trials were conducted at FRI, Dehra Dun, RFRI, Jorhat and IFGTB, Coimbatore. The germination percentage was 95%.

Project 14: Parasitic and symbiotic associations of tree sp. used for harsh sites afforestation [FRI-138/Path-8/2000-2005]. *Principal Investigator - Dr. Y.P. Singh.*

Status : Shisham mortality was observed in two Primary Farm Forestry Cooperatives (PFFCs) namely, Kema and Richaura. A preliminary survey was conducted in five PFFCs and the mortality was observed in various intensities both in pure and mixed plantations. A compendium of 'Forest Diseases; Symptoms and Signs was prepared for the members of PFFCs, students and foresters.

Project 15: Development of suitable silvicultural practices for JFM [FRI- 180/ Silva 14/2001-2006]. *Principal Investigator - Mrs. Neelu Gera.*

Status: Data with respect to the forests allotted under JFM with different silvicultural practices, vegetation status and other forestry related activities were collected from 4 forest divisions namely, Lansdowne, Mussoorie, Karnprayag and Dehra Dun of Garhwal, Uttaranchal. The Socio-economic conditions of the villagers through 170 questionnaires by random sampling technique were also studied for 8 villages.

Project 16: To standardize formation of compost from parthenium under different variables with reference to quality [FRI-183/Silva-16/2001-2002]. *Principal Investigator - ASE.*

Status: Compost was prepared by Barkley process. Preparation of compost by Indore process is in progress and will be completed on extension of the project period.

Project 17: To develop knap-sack manual root trainer carrier for carrying root trainer trays in different proportions and standardize model of knap-sack type manual root trainer carrier [FRI-183/Silva-17/2001-2004]. *Principal Investigator - ASE.*

Status: The prototype root trainer carrier has been designed and developed. Two such carriers fabricated and are being tested at nursery level for further improvement.

Project 18: Poplar improvement in India [FRI-2/Silva-2/1997-2003]. *Principal Investigator - Mr. Dinesh Kumar.*

Status: Recorded data of one-year-old field trials of poplar clones (*Populus deltoides*) clones developed by (i) seeds collected from natural stands in USA, (ii) through hybridisation among promising clones of previous introductions, and (iii) developed abroad. Established a germplasm bank of 100 clones produced by step (i) mentioned above at site, Kharkan, district Hoshiarpur, Punjab in collaboration with Botany Division, FRI. Assembled 300 clones in a clone bank-cum-nursery at FRI campus.

NEW PROJECTS INITIATED DURING THE YEAR 2002-2003

Project 1: Screening of ten new poplar clones developed by FRI based on wood quality parameters [FRI-190/Bot-29/2002-2004]. *Principal Investigator - Dr. Sangeeta Gupta.*

Status : Wood quality of clones were assessed and the anatomical variation is being studied.

Project 2: Assessment of the performance of different clones of *Dalbergia sissoo* and *Eucalyptus* sp. on the basis of wood quality under different farm forestry programs [FRI-192/Bot-31/2002-2005]. *Principal Investigator - Dr. P.K. Pande.*

Status: Collection of increment cores of selected clones of *Dalbergia sissoo* developed by Forest Research Institute (FRI), Dehra Dun on the basis of diameter and height from the site of FRI, Lachhiwala, Lalkuan, Haldwani and collection of increment cores of *Eucalyptus* sp. grown in Lalkuan, Haldwani from three directions were carried out.

Project 3: Studies on isolation and characterization of polysaccharides of abundantly available seeds of trees/shrubs, leaves, bark and exudate gums [FRI-51/Chem-1]. *Principal Investigator - Dr. P.L. Soni.*

Sub-project : Chemical investigation of *Dalbergia sissoo* roxb. leaf polysaccharide [2002-2006].

Status: Polysaccharide was isolated from *Dalbergia sissoo* leaves, purified and subjected to IR spectroscopy. Partial hydrolysis of the water-soluble pure polysaccharide with different conc. of H_2SO_4 was done and hydrolyzed products were subjected to qualitative paper chromatography.

Project 4: Phytochemical examination for the utilisation of leaves, barks, fruits and roots of Indian forest trees [FRI-53/Chem-3]. *Principal Investigator - Dr. Rameshwar Dayal.*

Sub-project : Screening of medicinally important plants (i) *Achyranthes aspera* (ii) *Casearia tomentosa* (iii) *Clematis roylei* (2002-2005).

Status: *Achyranthes aspera* (seeds), *Casearia tomentosa* (bark) and *Clematis royaeli* (leaves) were extracted sequentially with petroleum ether, acetone and methanol. The fatty oil obtained from the petroleum ether extract of *Achyranthes aspera* (seeds) was saponified to obtain free fatty acids, converted to methyl esters and analysed by GLC.

Project 5: Chemical modification of cellulose and its industrial uses [FRI-194/Chem-7/ 2002-2006]. *Principal Investigator - Dr. V.K. Varshney.*

Status: Conditions for carboxymethylation of $\alpha-$ cellulose of cotton linter were optimised with respect to solvent, solid - liquor ratio, concentration of alkali and monochloro acetic acid, time and temperature. 33 derivatives were prepared and their DS were determined.

Project 6: Bio-ecology of insect pests of *Paulownia* and enumeration of their natural enemies [FRI/196/FED/ 11/2002-2007]. *Principal Investigator- Dr. Mukhtar Ahmad.*

Status: Survey conducted in *Paulownia* nursery and plantation indicated light intermittent infestation of *Orgyia postica* and *Spilarctia oblique* from July onwards. Some phytophagous bugs were found feeding on the foliage of *Paulownia.* Termite infestation on the base of the plant, light attack of *Helicoverpa armigera* and tingid bugs on the foliage of *Paulownia fortunei* was seen.

Project 7: Integrated pest management of key defoliators of shisham and poplar using biopesticides and microbial pesticides [FRI-198/FED-13/2002-2007]. *Principal Investigator - Dr. (Mrs.) Shamila Kalia.*

Status: Dead and diseased larvae were collected and microbes isolated on PDA, pure cultures obtained and identified in the laboratory. *Fusarium* sp. on *Crypsiptya coclesalis* and bamboos and *P. reflexa* on *D. sissoo* were isolated. Pathogenicity test revealed that the fungi are highly pathogenic. A parasite *Enicospilus* sp. on *P. reflexa* was identified.

Project 8: Inventorisation of multipurpose trees and shrubs for domestication and introduction in agroforestry for socio-economic upliftment of rural sector of Dehra Dun [FRI-199/SF-5/2002-2005]. *Principal Investigator - Dr. Veena Chandra.*

Status: Villages of Doiwala, Herbertpur, Chakrata, Vikasnagar, Sahaspur and Raiwala Blocks were selected on the basis of the population and questionnaire was prepared to collect data on the people's preference for planting trees and shrubs in fields along with other crops.

Project 9: Green dimensioning aspects of bamboo and Eucalyptus processing [FRI-200/FPD (WWF)-40/2002-2004]. *Principal Investigator- Mr. S.P. Badoni.*

Status: Two sets of 10 bamboos (green) in each case are taken. In one set, the nodes were shaved off and the other set is treated as control. Studies on drying behaviour of these sets is in progress to access the relative gain in drying due to shaving off the nodal areas of bamboo to promote drying. It is expected that the dressed bamboos may dry much faster as compared to the control.

Project 10: To study the suitability of different combinations of plantation grown species for plywood manufacture [FRI-201/FPD (CW)-41/2002-2006]. *Principal Investigator- Mr. D.P. Khali.*

Status: Plywood in different combination of poplar, Eucalyptus and *Paulownia* species were prepared for Moisture Resistant (MR) and Boiling Water Resistant (BWR) grade and are being evaluated for its glue shear strength in dry, wet and mycological state. Compression loss at different pressure level is also being studied.

Project 11: Evaluation of physical and mechanical properties of plantation grown *Paulownia fortunei* and two bamboo species, viz. *Bamboosa balcooa* and *Bamboosa nutans* [FRI-202/FPD(TM) 2002-2003]. *Principal Investigator- Mr. Rajesh Bhandari.*

Status: Testing of *Bambusa nutans, Paulownia fortunei* and *Bambusa balcooa* is completed. Computation of data is in progress.

Project 12: Evaluation of Australian seed sources and families of *Eucalyptus tereticornis* for productivity and genetic improvement [FRI- 203 /G&TP-9/2002-2006]. *Principal Investigator- Dr. H.S. Ginwal.*

Nursery of *E. tereticornis* belonging to Australian origin

Status: Seeds of more than 100 families belonging to 12 sources of *Eucalyptus tereticornis* of Australian origin were sown in the nursery to raise the seedlings for laying out trials at FRI campus, Dehra Dun, Chiryanpur, Hardwar (Uttaranchal) and Midnapur (West Bengal). Field layout designs of the trials prepared in the form of provenance cum progeny trial with more than 90 families. During the rainy season (2002) planting was carried out at each site and trials established.

Project 13: To develop propagation technique i.e. micro propagation of economic important bamboos - *Arundinaria falcata* and *Bambusa balcooa* [FRI-219/ G&TP-10/ 2002-2006]. *Principal Investigator- Dr. I.D. Arya.*

Status: Explant culture experiments started.

Project 14: Development of cultivation techniques of some commercially important medicinal plants [FRI- 204 / NWFP - 9/2002 - 2005]. *Principal Investigator - Dr. A.K. Sharma.*

Status: Surveyed the population of the project species in Hardwar and Dehra Dun (UA), Panchkula and Yamunanagar (Haryana). The population of *Oroxylum indicum* and *Desmodium gangeticum* in the surveyed area has been marked for further collection of germplasm in the ensuing season. Collection of the germplasm of *Oroxylum indicum* from Haryana has been undertaken. Seed germination trials were undertaken using different soil mediums. Phenological observations on seedlings of *Oroxylum indicum* raised from seeds in the nursery are continuing. Seed collection of *Desmodium gangeticum* was undertaken from Hardwar forest area. The seed germination trials have been initiated.

Project 15: Introduction of commercially important medicinal plants in the NWFP nursery, Dehra Dun (Uttaranchal) [FRI-205/NWFP-10/2002-2005]. *Principal Investigator - Mr. Ram Dayal.*

Status: Nearly 100 plant species of medicinal value were collected from tropical and sub-tropical areas and introduced in NWFP nursery at FRI, Dehra Dun.

Project 16: Biological control of *Lantana camara* and *Parthenium hysterophorus* by fungal pathogens [FRI-206/Path-12/2002-2007]. *Principal Investigator - Mr. Amit Pandey.*

Status: Diseased inflorescence, leaves and stem were collected. From diseased *Lantana camara* samples fungi viz. *Fusarium* sp., *Alternaria* sp. and *Colletotrichum* sp. have been isolated. *Fusarium solani* was isolated from the cankers on the stem of parthenium.

Leaves of *Lantana camara* showing foliar spots

Project 17: Screening of clones of *Dalbergia sissoo* and *Ecualyptus tereticornis* developed under PSIP of FREEP for disease resistance [FRI-207/Path-13/2002-2007]. *Principal Investigator - Dr. N. S. K. Harsh.*

Status: The root-rot disease by *Ganoderma lucidum* was noticed reaching alarming proportions in CSO of *D. sissoo* at Hissar. The disease is favoured by the root injury caused by harrowing operations. A new root-rot disease caused by *Amauroderma niger* in *D. sissoo* clonal plantation was observed at Paonta Sahib. A new set rot disease of root cuttings of *Dalbergia sissoo* caused by *Fusarium equiseti* has been recorded from Pinjore (Haryana). Dip treatment to roots in 0.1% of Benlate or Bavistin for 15-20 min. can manage the disease.

Project 18: Economic valuation of FRI estate [FRI-208/RS&M-11/2002-04]. *Principal Investigator - Dr. Mohit Gera.*

Status : Data collection for valuation of consumptive use values from secondary sources using Contingent Valuation Methods , Travel Cost Method and Hedonic Pricing Methods has been initiated. Total Willingness to Pay (WTP) for the intangible benefits derived by the society from the estate of FRI was calculated. The estimated mean WTP and total households in the city came to be Rs. 469.62 per annum and Rs. 71,050, respectively. Based on these figures the total WTP for the entire city was found to be Rs. 3.34 crores per annum.

Project 19: Evaluation of production and quality parameters of seed from seed production areas vis-à-vis natural stands of chirpine [FRI-209/Silva-18/2002-2005]. *Principal Investigator - Dr. Manisha Thapliyal.*

Status: About 25-30 cones were collected from 6 trees in each selected sites and length and breadth were measured to study the variation. Weight, length, breadth of seeds were measured, germinated in the laboratory for evaluating their viability and vigour and observations on their growth are being recorded.

EXTERNALLY AIDED PROJECTS

PROJECTS COMPLETED DURING THE YEAR 2002-2003

Project 1: Vegetational survey and inventorization of species in the ridge forests of Delhi [FRI-165/Bot-26/2000-2003/External]. *For technical report contact, Principal Investigator - Dr. H.B. Naithani.*

Findings: Floristic Survey was conducted in the southern and central ridge forest, of Delhi. Taxonomic studies and analysis of the data revealed 43 species as new record for the flora of Delhi.

Project 2: Revision of forest flora of Andaman and Nicobar Islands [FRI-155/Bot.- 21/2000-2003/External]. *For technical report contact, Principal Investigator- Dr. H.B. Naithani.*

Findings: Field tour in different parts of Andaman and Nicobar Islands were undertaken for the finalization of enumerated check list of ligneous flora of the region.

Project 3: To develop technique know-how and process to produce and prepare cellulose (purity>98%) of different DP ranging from 800 to 3000 (4 grades) with brightness >80% ISO. [FRI-154/Chem.6/1999-2002/External]. *For technical report contact, Principal Investigator- Dr. P.L. Soni.*

Findings: Conditions were optimized to produce high DP, high purity and high brightness (>80% ISO) α- cellulose from cotton linter, *Eucalyptus tereticornis*, bamboo and bagasse as envisaged in the project and technology was demonstrated to GACL to their satisfaction. Production of α- cellulose from cotton linter is initiated on commercial scale. The α- cellulose so produced were modified to carboxymethyl cellulose and hydroxylmethyl cellulose by GACL and the quality of the products was at par with product developed with imported α-cellulose.

Project 4: NATCOM Project - India's initial national communication to the UNFCCC [FRI-216/FSLR-14/External/2000-2002]. *For technical report contact, Principal Investigator - Dr. M.N. Jha.*

Findings: FRI has provided information on the carbon content of dominant tree species; change in the biomass due to conversion of different tree species; soil carbon status under different forest cover; round wood and commercial timber harvest and traditional fuel wood consumption to the lead institution *i.e.* Indian Institute of Sciences, Bangalore for onward transmission to the MoEF who is the implementing and executive agency of this project.

Project 5: Central scheme for development of agrotechniques and cultivation of medicinal plants used in Ayurveda, Siddha, Unani and Homeopathy [FRI-173/ NWFP-8/External/1998-2003]. *For technical report contact, Principal Investigator - Dr. P.P. Bhojvaid.*

Findings: Standardized propagation methods of the project species namely *Elaeocarpus ganitrus, Prunus cerasoides, Habenaria intermedia* and *Microstylis wallichii*. Germplasm bank was created for all the species besides detailed trials on harvesting and storage in case of orchid species.

Project 6: Consultancy on status report on availability of medicinal plants, marketing and potential for future growth of medicinal plants in Morni-Pinjore Division [FRI-210/NWFP-11/External/2002-2003]. *For technical report contact, Principal Investigator - Dr. P.P. Bhojvaid.*

Findings: A survey of the project site was conducted and samples of more than 100 medicinal plants were collected and preserved for making herbarium sheets after identification.

Project 7: Evaluation (by volumetric assessment) of the standing crop of Eucalyptus trees and coppice crop in captive plantation in Hempur, District Udham Singh Nagar [FRI-186/RS&M-10/External/2001-2002]. *For technical report contact, Principal Investigator - Dr. N.S. Bisht.*

Findings:.

Total Volume (over bark)	=	17,410.85 m^3
Total pole weight (debarked)	=	1,50,66,431.97 kg
Total firewood weight	=	46,00,837.05 kg

Project 8: Evaluation of Radiata pine from New Zealand [FRI-184/FPD-38 (CW)-External/2002-2005]. *For technical report contact, Principal Investigator - Dr. S.P. Singh.*

Sub-project : Developmental work on appropriate energy efficient drying schedules for *Pinus radiata* suiting to indigenous conditions. *Co-Investigator - Dr. C.N. Pandey.*

Findings: Drying results have shown that Radiata pine wood is very liable to staining, decay and insect attack, have little tendency to surface cracking, splitting and warping. It can be classified as non-refractory wood and may be air seasoned. Prompt conversion after felling, application of prophylactic treatment and rapid drying is recommended.

PROJECTS CONTINUED DURING THE YEAR 2002-2003

Project 1: Conservation of nitrogen fixing plants: A reliable approach for the rehabilitation of degraded sites in Himalayan ecosystem [FRI-161/Bot-22/ External/2001-2004]. *Principal Investigator - Dr. T.C. Pokhriyal.*

Status : Twenty nine genus, forty nine species and more than one hundred nitrogen fixing herb, shrub, climber and trees were identified in Garhwal Himalayas. Maximum number of genera and species were recorded in *Papilionaceae* followed by *Mimosaceae* and minimum to *Caesalpinaceae* among different nitrogen fixing species. Maximum number of plants were recorded in herbs, followed by shrubs, trees and minimum in climbers between 350 to 2,400 m altitudes in the Garhwal Himalayas.

Project 2: Screening and identification of fast growing fuel wood, fodder species for higher biomass production in Garhwal Himalayas [FRI-162/Bot-23/ External/2001-2004]. *Principal Investigator - Dr. S. Nautiyal.*

Status : The seeds of fuel wood and fodder tree species were collected from superior phenotypes from different areas of Garhwal region. The nurseries are developed at Jarmola, Tons Forest Division, Uttarkashi district for temperate species (approx. 2000 m msl), Sandra, Tons Forest division for sub-tropical species, Uttarkashi district (approx. 1200 m msl), FRI, Dehra Dun for tropical species (approx. 640 m msl).

Project 3: Creation of germplasm bank of commercially important tree species of Punjab [FRI-178/Bot-28/External/2001-2004]. *Principal Investigator - Dr. S. Nautiyal.*

Status: Out of total 14 species, germplasm bank of *Acacia catechu, Dalbergia sissoo* and *Populus deltoides* has been established. 55 progenies of *Azadirachta indica* and 11 progenies of *Terminalia arjuna* have been shifted to Bir Bhadson, Patiala. Data regarding seed traits has been recorded for *Acacia catechu*, *A. nilotica, Melia azedarach*, neem and *Terminalia arjuna*.

Project 4: Long term impact of monoculture of forest tree species on forest and non forest lands in Punjab [FRI-177/Eco-8/External/2001-2004]. *Principal Investigator - Dr. J.D.S. Negi.*

Status: Biomass and productivity was assessed with the help of prediction equations. Maximum biomass and productivity was observed in Farithkot of Muktsar Forest Division. However, these observations are being validated with the help of non-destructive sampling.

Project 5: Development of ecorestoration model for iron ore mines of Bihar and Orissa [FRI-179/Eco-9/2001-2006]. *Principal Investigator- Dr. (Mrs.) P. Soni.*

Status: In the over burden dump sites and in mined out benches, cuttings of *Ipomea* and *Vitex* were planted in rows across the slopes and at the edges, respectively. Mix of locally collected seeds of grasses, herbs, shrubs and tree species were broadcasted on the dumps sites during the monsoon season. Most of the *Ipomea* cuttings are surviving till date. In *Acacia auriculiformis* plantation site, 4 seed combinations of two species each were prepared and broadcasted. Out of the species tried, *Dodonea* and *Pongamia* are performing well. But all these are facing problem of grazing by cattle. At the degraded site, species like mahua, mango, sal, kusum etc were tried in the pits. Although performance is good but facing severe wild boar attack.

Project 6: Evaluation of radiata pine from New Zealand [FRI-184/FPD-38 (CW)-External/2002-2005]. *Principal Investigator - Dr. S.P. Singh.*

Sub-project 1 : Evaluation of physical and mechanical properties for joinery, doors and windows shutters and frames and poles. *Co-Investigator- Mr. V.K. Jain.*

Status: Testing of 2118 specimens in green condition from five logs is done and computation of the collected data was carried out. Testing of 70 specimens meant for shrinkage studies was initiated and is being continued. The condition of the air-dried scantlings was observed and salient points were recorded. 1800 specimens out of 2386 specimens for testing in dry condition were prepared and 1700 specimens were tested.

Sub-project 2: Evaluation of natural durability and treatability under Indian conditions. *Co-Investigator - Dr. Inder Dev.*

Status: Treatability studies of *Pinus radiata* adopting conventional and penetration index method revealed that the heartwood portion excluding the pith showed partial treatment and thus classified as 'c', whereas heartwood juvenile portion showed treatability class as 'b' as per IS: 401. Studies on natural

durability and durability after treatment with CCA and creosote revealed that overall performance of treated samples was good while untreated samples were 50% destroyed at Jodhpur and moderate attack and no attack was observed at Dehra Dun and Chakrata, respectively.

Sub-project 3: Evaluation of wood working, carving and finishing properties under diverse operation. *Co-Investigator- Mr. S.P. Badoni.*

Status: Analysis of data of all the six operations viz. planing, sanding, turning, moulding, mortising and boring is under way. Windsor type, windsor chair has also been made from featured grade material of radiata pine (sawn off cuts) to investigate certain new parameters associated with secondary processing and the results are quite promising.

Sub-project 4: Evaluating the suitability for general purpose, shuttering, marine plywood and blackboard. *Co-Investigator- Mr. S.P. Badoni.*

Status: Veneers of radiata pine were assessed visually and observed free from any significant defects. Moisture resistant grade, boiling water resistant grade and concrete shuttering plywood were prepared and tested for glue shear strength in dry, wet and mycological states as per IS specifications.

Sub-project 5: Evaluation of suitability of *Pinus radiata* as structural timber. *Co-Investigator- Mr. Mohan Lal.*

Status: Work on fabrication, testing and compilation of data in respect of following tests is completed.

(i) Nail strength and composite joints.
(ii) Bolt bearing strength of wood to wood and plywood to plywood in double shear.

Performance study on 310 nos. of wooden single is done. Fabrication, prototype testing and compilation of test results of 4 meter nail jointed timber truss is done. Fabrication, testing and compilation of glue lap joint using UF and PF glue PVA resin and control (solid) in dry and wet conditions in completed.

Project 7: Establishment of manufacturing process and market utilization of Eucalyptus wood for value added products for domestic and export market [FRI-185/ FPD-39(WS)/ External/2001-2004]. *Principal Investigator - Dr. C.N. Pandey.*

Status: Literature was surveyed. Logs of different eucalypts species were procured and converted into planks by different sawing methods viz. Quarter Sawn (modified), Flat Sawn, Quarter Sawn (simple), Balanced Tangential Sawing, True Radial, Plane Sawing in respect of quality and output. Sawn material was air seasoned followed by steam heated klin drying.

Project 8: Qualitative and quantitative improvement of mulberry leaf production by application of chemical and biofertilizers in Doon valley [FRI-189/Path-11/External/2002-2004]. *Principal Investigator- Dr. Y.P. Singh.*

Status: 15 potential varieties of mulberry were screened to capture the seasonal rhythm *vis-à-vis* root infection of arbuscular mycorrhizae, infection types and

rhizosphere spore population. In January 2002, mycorrhizal infection of root was generally low ranging from 35.8 (var. K-2) to 51.7% (var. TR-10). Arbuscules, vesicles extrametrical hyphae were present in the roots. The spore population was reasonably high valuing 14.5 (Var. S-54) to 31.8 spores per 50 ml of soil (var. S-1635).

Vesicles in the root cortex of variety CM (100X)

Project 9: Development of agro-mediculture models for sustainable diversified farming in Uttaranchal and Haryana [FRI-214/NWFP-15/External]. *Principal Investigator - Dr. P.P. Bhojvaid.*

Status: More than 20,000 medicinal plants of different species have been raised in central nursery at FRI, Dehra Dun. The species are *Bacopa monerii, Piper longum, Tinospora cordifolia, Rauwolfia serpentina, Spilanthes acemella, Centalla asiatica, Tribulus terristris, Mucuna prunies, Asparagus racemosus, Ocimum sanctum, Andrographis paniculata, Abelmoschus moschatus, Clitoria terneata, Eclipta alba, Plumbago zeylanica, Cassia angustifolia* and *Acorus calamus*. More than 78,000 plants of the same medicinal plants species have been raised at Damla nursery, Yamunanagar (Haryana). Experimental trials on development of mediculture model are in progress in Uttaranchal and Haryana with different agroforestry species.

Project 10: Genetic improvement and production of nursery planting stock of khair, shisham and kikar [FRI-170/G&TP-7/External/2002-2005]. *Principal Investigator - Director, Forest Research Institute.*

Status: Established progeny trials of *Acacia catechu* (2 ha) comprising 40 families and *Acacia nilotica* (5 ha) comprising 10 families. Evaluated already established trials for their growth performance. Standardized air layering technique in *A. nilotica*. Experiments were conducted on rooting of cuttings of *A. nilotica* var. *indica* using juvenile and mature shoot cuttings. In mature shoot cuttings, 20% success in rooting was achieved using 5000 ppm IBA. These were planted during the month of May, 2002.

Project 11: Consultancy for operationalisation of seedling production plantlets through clonal technology in Punjab [FRI-171/D&GTP-8/PFD Project /External]. *Principal Investigator - Mr. D.P. Uniyal.*

Status: The work was concentrated on technical know how and training to the staff of Punjab Forest Department on various activities related to the project. Under demonstration, hedge garden of *Eucalyptus tereticornis* comprising 24 clones were established at Hoshiarpur. Imparted training on clonal technology of *Eucalyptus* and *D. sissoo,* root trainer technology, planting stock improvement, insect and pest management and control in nursery. The existing facilities viz. mist chamber, shade house were upgraded.

Project 12: Studies on interrelationship between production levels and marketing of important forestry species in Punjab [FRI-174/RSM-9/Extenral/2000-2005]. *Principal Investigator - Dr. N.S. Bisht.*

Status: Fifty two markets (out of total 105 markets) in Amritsar, Bhathinda, Fatehgarh Sahib, Roopnagar, Hoshiarpur, Nawansahar, Jallandhar, Ludhiana, Kapurthala, Mansa, Sangrur and Patiala were surveyed and data collected for estimation of total supply and demand of wood. For estimation of production level in non-forest area, enumeration work in 67 villages (out of total sample of 252 villages in both extensively and intensively plantation area) have been completed and for khair, in Kandi area, felling permits issued and quantity extracted, during last ten years have been collected.

Project 13: Studies on Himalayan pines [FRI-175/Silva-12/1996-2004/USDA]. *Principal Investigator - Mr. A.K. Rana.*

Status: A first ever wide ranging provenance trial of low level Himalayan pine, (*Pinus roxburghii* Sarg.) has been laid out at two sites under the USDA funded project titled "Studies on Himalayan Pines." Seeds have been sampled from 56 sources from the states of U.P., H.P., J & K, West Bengal/Sikkim and Arunachal Pradesh covering the entire range of distribution of chir pine in India. Field planting has been done with 3380 seedlings in a replicated design in an area about 4 ha within the FRI campus at 640m and at Jarmola in Singtur range, Tons Forest Division in Uttaranchal at about 1600 m. The aim of the study is to explore the nature and extent of variation in wide range of population of chir pine in some prominent characters and relate them to adaptability and growth. In order to achieve this object studies have been carried out to find out source variation in cone, seed and seedling characteristic of chirpine. Different morphological traits, germination behaviour and nursery performances of the seed have been recorded and genetic variability estimated. Significant amount of genetic variation has been observed in different characters of cone, seed and seedling. A similar study on Himalayan high level pine the *Pinus wallichiana* is underway. Seeds from 8 sources have been collected in the year 2002- 2003. Overall 46 seed sources have been sampled.

A field trial was laid out of bare root seedlings of *Pinus roxburghii* that have been produced using tools and technique developed under this project. The survival of bare root seedlings is 77% compared to 65% obtained during the previous year, but it is still much below the level of 95% survival, which is achievable with the use of containerized seedlings. Study of cone and seed characteristics of *Pinus roxburghii* showed that cone fresh weight, cone dry weight and cone length are under high genotypic control while considerable

within-tree variation was found for cone diameter, seed weight per cone and no. of seeds per cone. Cones of *Pinus wallichiana* were also collected for laying out provenance trial.

Canker development on chir pine seedling

Sub-project 1: Studies on stem rust of chir-pine. *Co-Investigator-Dr. A. N. Shukla.*

Status: Survey has been completed and areas of maximum disease incidence were identified. Symptoms developed on chirpine seedlings following artificial inoculation by *Cronartion himalayense* after a year. Artificial inoculation of seedlings and development of symptoms is a very specific process which has been achieved for the first time. This will help in identification of resistant provenance / seedlings against stem rust.

Inoculation of chirpine seedling with *Cronartium himalayense*

Seeds of chir pine were collected from 32 localities and they were germinated in root trainers during June 2001. The seedlings were inoculated with germinating telial columns of *Cronartium himalayense* on the freshly cut apical portion in Oct. 2002. They were incubated at 98% RH for 48 hours. The infection on the needles was observed from the next month of inoculation. Further work regarding development of cankers on the stem is being monitored.

Sub-project 2: Investigation on mycorrhizae in chir pine. *Co-Investigator-Mr. P.S. Rawat.*

Status: Five mycorrhizal isolates namely *Cenococcum geophilum, Gestrum fimbriatum, Russula* sp., *Amanitopsis* and *Boletus* sp. were tried for synthesis in chirpine seedlings. *Cenococcum geophilum* performed better among five fungi tried for synthesis. Blue pine samples collected from six seed sources of Himachal Pradesh were analyzed for mycorrhizal characterizations. Maximum number of mycorrhizal roots and type of mycorrhizae were recorded in Sanaba seed source. Seed collected from six seeds sources were examined for incidence of mycoflora. *Aspergillus niger* was found to be dominating in most of the seed sources except Harsil. A survey was conducted to find out the cause of mortality in *Pinus wallichiana* in Uttarkashi division. The causal organism identified as *Arceuthobium minutisimum*.

Sub-project 3: Screening and identification of drought resistant provenances of Himalayan pine species. *Co-Investigator - Dr.S.Nautiyal.*

Status : Seven seed sources of *Pinus roxburghii* viz. Ranikhet, Chopal, Rajouri, Solan, Kunihar, Chamba and Ramnagar have been screened for their water stress tolerance. Chopal and Ranikhet seed sources were found to be most droughts tolerant while Rajouri and Chamba to be most drought sensitive. Sixty seed

sources of *P. roxburghii* grown at three altitudes viz. 600 m, 1200 m and 1800 m were screened for their photosynthetic efficiency. Agustmuni (Uttaranchal) seed source was found to be photosynthetically most active seed source while Nagra (Assam) seed source was found to be poorest at photosynthesis. Seed studies on twenty different sources of *P. wallichiana* were carried out and genetic variation in various seed parameters had also been evaluated. All the seed parameters including seed length, seed width, seed thickness, seed weight and volume were found to be highly heritable at 5% level of significance. Seed weight parameter showed height value of heritability

NEW PROJECTS INITIATED DURING THE YEAR 2002-2003

Project 1: Developing bio-climatic indices for important species existing under agroforestry and departmental plantations for different agro-climatic zones of Punjab [FRI-217/Bot-32/External/2002-2005]. *Principal Investigator - Mr. V.R.S. Rawat.*

Status: Preliminary field surveys and subsequent field visits were made for growth data collection of plantation species. Collected soil samples are being analysed for pH, organic matters and composition.

Project 2: Identification, taxonomy, properties and uses of different species of *Shorea* of the Malay Peninsula [FRI-191/Bot.-30/2002-2004/External (CSIR)]. *Principal Investigator - Dr. P.K. Pande.*

Status: Selection of Xylarium samples for Red Meranti Group is done. Microscopic and maceration data for 30 samples have been collected and the statistical analysis is initiated.

Project 3: Prospecting for botanical pesticides - An all India coordinated research project [FRI-188/Chem-7/External/2002-2003]. *Principal Investigator - Dr. Rameshwar Dayal.*

Status: Plant material of 20 plant species selected for the project were collected from different locations and the petroleum ether, chloroform and 25% water - methanol extracts of each were prepared and sent for their pesticidal screening to three laboratories identified for the testing. Extractives of three plant species exhibited biological activity against malaria mosquito (*Anopheles* sp.) while eight plant extractives were found to be active against 3rd instar larvae of *Spodoptera litura* and five against adult female red spider mites.

Project 4: Value assessment of plantation raised by IFFDC Ltd. in Sultanpur district of U.P. [FRI-220 / RSM-13 / External / 2003 2004]. *Principal Investigator - Dr. N.S. Bisht.*

Status: Training was imparted to the IFFDC staff for collection of field data. A format was standardized to record the growth data for volume and value assessment of the plantations. Field demonstration was also given for stratification of population, selection of sample plots, enumeration of trees, selection of sample trees and related measurements of volume and weight.

Project 5: Technological dossier-cum-manual on packages of practices for propagation and cultivation of bamboos. [FRI/RSM/2003]. *Principal Investigator- Dr. N.S. Bisht.*

Status: A technological dossier-cum-manual on seven important bamboo species in India viz; *Bambusa balcooa, B. nutans, B. tulda, Dendrocalamus asper, D. giganteus, D. hamiltoni* and *D. strictus* is being prepared. The first draft has been discussed with TIFAC committee headed by Shri S.K. Pandey, IFS (Ex-D.G. Forests, GOI). Final draft on *Dendrocalamus strictus* is ready.

Project 6: Environmental performance audit for sal assisted natural regeneration areas of Uttar Pradesh [FRI/RSM/External]. *Principal Investigator- Dr. N.S. Bisht.*

Status: This is a time bound consultancy project started form February 2003 and to be completed by May 2003. Field works for data collection are in progress.

Project 7: Environmental performance audit for sal assisted natural regeneration areas of Uttaranchal [FRI/RSM/External]. *Principal Investigator - Dr. N.S. Bisht.*

Status : This is a time bound consultancy started form February, 2003 and the project is to be completed by May, 2003. Field works for data collection have been competed and draft report is under preparation.

Research achievements

Name of state	No. of projects completed in 2002-03	No. of ongoing projects in 2002-03	No. of projects initiated in 2002-03
Uttaranchal	3	8	3
Uttar Pradesh	3	-	2
Punjab	1	4	1
Haryana	2	1	-
Other	16	18	20

Technology assessed and transferred

The know-how for the preparation of compost from plant biomass was transferred to M/s Anubhav Agro Tech, Yamuna Nagar by charging a license fee of Rs. 60,000/.

Education and trainings

Trainings organised

1. The following short term training courses were organised in which officials of Govt. of India, State Forest Departments, Public Sector Undertaking and representatives from various industries participated.

   - Agroforestry
   - Development of Green Belts

- Management of Forest Herbarium and Arboreta
- Field Identification of Timber
- Biodiversity Conservation
- Cultivation and Utilisation of Medicinal Plants
- Ecotourism Planning and Management
- Ecorestoration of Wastelands

2. International training on 'Sustainable NTFP management for rural development' from 9 to 12, November, 2002 and 12 participants from various countries attended.
3. One week compulsory training course on "Management of NWFP for sustainable development" for IFS officers from 25-29, November, 2002.
4. Training-cum-Workshop of "Natural Tree Furniture" for master craftsman from 10-20, December, 2002 in which 25 artisans/craftsman participated.
5. Two days study tour/training programme for ISS probationers from 30 and 31, December, 2002.
5. Compulsory training course on "Biodiversity Conservation" for IFS officers from 6 to 10 January, 2003.
7. Customised training course on "Environmental Management" for officers of U.P. Forest Department from 4 to 8, March, 2003.
8. Customised training course on "Nursery and Plantation Technology" for Jawans of Eco-Task Force from 24 to 28, March , 2003.
9. Training on pencil making by hand tools in Sindhu Darshan Mela, organized by ITBP at Ladakh.

Publications

Books

1. Indian Woods their identification, properties and uses, VI, 2002.
2. Indian Woods their identification, properties and uses, I (Revised), 2002.

Research papers

1. Agarwal, Manisha; Gupta, Sangeeta; Chauhan, Luxmi and Painuly, Veena (2002). 'Perforated ray cells in *Pistacia terebinthus*- A new record for Anacardiaceae'. *Indian Forester*, 128 (5).
2. Ahmad, M. and Mishra, R. K., (2002). Potential of biological control in forest pest management, *ENVIS Forestry Bulletin*, 2 (1): 14 - 18.
3. Ahmad, M.; Ahmad, M. J.; Mishra, R. K. and Khan, H. R. (2002). Egg parasitoid, *Trichogramma* and its host range in India. *IndianForester*, 128 (4): 412-420.

4. Ahmad, M.; Ahmad, M. J.; Mishra, R. K. and Sheel, S.K. (2002). Super parasitism by *Trichogramma poliae* in the eggs of *Clostera cupreata* (Lepidoptera: Notodontidae) and its effect on offspring. *J.Trop. For. Sci.* (Malaysia), 14 (1): 61-70.

5. Ahmad, M.; Mishra, R. K.; Ahmad, M. J. and Pandey, R. (2002). Defoliation capability of poplar defoliator, *Clostera cupreata* Butler (Lepidoptera: Notodontidae), *Indian Forester*, 128 (12): 1360-1366.

6. Ahmad, M.; Mishra, R. K.; Gupta, Hemant and Ahmad, M. J. (2002). New fungal disease of poplar defoliator, *Clostera cupreata* Butler (Lepidoptera: Notodontidae). *Indian J. Forestry,* 25 (1): 79-81.

7. Bhojvaid, P.P. (2003). Medicinal plants based forest management: problems and prospects. *Indian Forester*, 129(1): 23-37.

8. Bisht, Prabha, Sharma, V.K. and Uniyal, D.P. (2002). *In vitro* clonal Propagation of mature Eucalyptus F_1 Hybrid (*E. citriodora* Hook x *E. torelliana* F.V. Muell., *Indian J. Forestry,* 24 (4):

9. Chaudhari, D.C.; Manmohan and Dobriyal, J.R. (2002). Non Wood Forest products resources in economy of Uttaranchal. An initial study. *International Journal of Forest Usufructs Management,* 3 (1 &2):49-62.

10. Chauhan P.S.; Kumar, Rakesh and Negi, J.D.S. (2002). Foliage water loss pattern in Sal (*Shorea robusta* Gaertn. f.) and its associates under stress. *Indian Forester*, 128 (6): 655-659.

11. Chauhan, Y.S. and Pokhriyal, T.C. (2002). Effects of Nitrogen and *Rhizobium* inoculation treatments on some growth parameters in *Albizia lebbeck* L. Benth seedlings. *Indian Forester,* 128(3): 316-322.

12. Chauhan, Y.S. and Pokhriyal, T.C. (2002). Nodulation and nitrogen fixation as influenced by *Rhizobium* and Mycorrhizal inoculation in *Albizia lebbeck* L. Benth. *Annals of Forestry,* 10 (2): 243-251.

13. Dayal, Ram; Chaudhari, D.C.; Chand, Sumer; Swaroop, Satya and Singh, Munney (2002). Ornamental trees for avenue plantation *In:* Non timber forest products of India (eds. S. Nautiyal and A.K. Kaul).

14. Dayal, Ram; Chaudhari, D.C.; Singh, B.P. and Prasad, Amba (2002). Two lesser-known medicinal plants, 10(11).

15. Dubey, Y.M. and Jain, V.K. (2003). Dielectric Constant of Some Indian Timbers at Different Moisture Contents. *J. of Timb. Dev. Assoc. (India)*, 49, (1 - 2).

16. Gera, M. and Ginwal, H.S. (2002). Preliminary observations on field trial of root trainer raised seedlings. *Indian Forester*, 128 (1): 19-26.

17. Gupta, Sangeeta; Kulshresta, S.P. and Chauhan, Luxmi (2001). An expert system for wood anatomy research, image display and wood identification. *Indian Forester,* 128(8).

18. Gupta, Sangeeta; Kulshresta, S.P. and Chauhan, Luxmi (2002). 'Wood Anatomy Information System (WAIS) - A computerised package for wood Identification'. *Journal of International Association of Wood Anatomist (IAWA),* 22 (4).

19. Hayat, M. and Singh, S. (2002). Description of a new genus and two new species with record of a known species of *Encyrtidae* (Hymenoptera: Chalcidoidea) from the Andaman & Nicobar Islands, India. *Entomon,* 27 (2): 161- 168.

20. Hayat, M. and Singh, S. (2002). Two little known genera of *Encyrtidae* (Hymenoptera: Chalcidoidea) from India with description of two new species from Assam. *Entomon,* 27 (3): 1 8.

21. Hayat, M.; Singh, S. and Basha, M.C. (2002). Description of a new species of *Rhytidothorax* (Hymenoptera: Encyrtidae) from India. *Zoos' Print Journal*, 17 (6): 795- 796.

22. Kalia, Shamila and Harsh, N. S. K. (2002). *Euproctis lunata* Walk. (Lepidoptera : Lymantridae) a new host of *Aspergillus flavus* Link. *Asian Jour. Life Sci.*, 1:7-10.

23. Kalia, Shamila; Singh, Charan and Pandey, V. P. (2002). *Dasychira mendosa* Huebner (Lepidoptera: Lymantridae) - a report of new pest on *Cedrus deodara* Roxb. G. Don in Himachal Pradesh. *Indian Forester,* 128 (3): 358.

24. Kambo, A.S. and Pandey, C.N. (2002). Performance evaluation of newly developed solar-cum-dehumidification kiln. *J. of Timb. Dev. Assoc. (India),* 48 (3-4): 20-23.

25. Katwal, R.P.S. and Soni, P.L. (2002). Agarbathi prospects and perspectives. *Indian Forester*, 128, (12) 1281-1287.

26. Kaur, S.; Dayal, R. and Varshney, V. K. (2002). A comparative study of volatile constituents of different parts of *Shorea robusta*. *Indian Perfumer*, 46(1) : 55-57.

27. Kazmi, Sarfrazul Islam and Chauhan, Neena (2002). *Chalcid parasitoids* (Hymenoptera: Chalcidoidea) of *Hypsipyla robusta* (Moore) (Lepidoptera: Pyralidae), A serious pest of Cedars and Mahogany. *Oriental Insects*, 37:261-275.

28. Khali, D. P. and Rawat, S.P.S. (2002). Studies on The moisture adsorption behaviour of chemically modified wood using the Brunnauer-Emmett-Teller Theory, *J. of Timb. Dev. Assoc. (India)*, 48 (3-4): 41-46.

29. Lal, Ram; Dobriyal, P.B.; Nautiyal, S.N. and Dev, Indra (2002). Dip treatment of five hardwood species for joinery timber. *J. of Timb. Dev. Assoc. (India)*, 48(3-4), 24-28.

30. Mishra, A.; Mishra, L.; Sharma, C.M. and Sharma, S.D. (2002). Community structure and growing stock variation on different aspects of dry semi-evergreen *Shorea robusta* forest cover type of Garhwal Himalaya. *Annals of Forestry,* 10(2): 228-232.

31. Negi, J.D.S. (2003). Dom sal. A nature's gift for disturbed sal forest. *ICFRE Newsletter,* 2 (3): 6.

32. Negi, J.D.S. and Chauhan, P.S. (2002). Green House Gases (GHGS) Mitigation Potential by Sal (*Shorea robusta* Gaertn. f.) Forest of Doon Valley. *Indian Forester*, 128 (7): 771-778.

33. Negi, J.D.S.; Shah, Dhirendra; Kukreti, Pooja; Negi, Mridula; Basera, H.S.; Kamboj, S.K. and Chauhan, P.S. (2002). An ecological assessment of sal mortality in Uttaranchal. *Annals of Forestry*, 10 (2): 193-2003.

34. Negi, Mamta; Singh, Ravindra and Jain, P.P. (2002). Studies on Non-traditional oilseeds, *Journal of Non-Timber Forests Products*, 9 (1/2): 64-66.

35. Negi, Mamta; Singh, Ravindra and Jain, P.P. (2002). Studies on Non-traditional oilseeds, *MFP NEWS*, 12(3): 8-9.

36. Pande, P.K.; Negi, J.D.S. and Sharma, S.C. (2002). Plant species diversity, vegetation composition, gradient analysis and regeneration behaviour of some tree species in a moist temperate Western Himalayan Forest Ecosystem. *Indian Forester,* 128(8): 869-886.

37. Pandey, C.N.; Joshi, Neeraj and Kandpal, R.P. (2002). Silver oak- A promising species for bentwood furniture. *Wood News*, 12(1).

38. Pandey, A.; Harsh, N.S.K. and Suresh Chandra (2002). A new stem canker disease of poplar in Doon Valley. *Indian Forester*, 128:1033-1036.

39. Pandey, C.N.; Joshi, Neeraj and Swaroop Chetan (2002). Embossing on wood-An alternative technique to wood carving. *J. of Timb. Dev. Assoc. (India)*, 48(3-4): 24-28.

40. Pangty, Kanchan and Rawat, Laxmi (2002). Pollution tolerant species for green belts. *MFP News*, 12 (Jan-March) No. 1: 9-10.

41. Pant, B.C.; Singh, S.P.; Gupta, Sachin and Sharma, C.M. (2002). Working qualities of some Indian timbers-Part X, *Indian Forester*, 128(9):1021-1032.

42. Phartyal, S.S.; Thapliyal, R.C.; Koedam, N. and Godeforid, S. (2002). *Ex-situ* conservation of rare and valuable forest tree species through seed-gene bank. *Current Science*, 83:1351-1357.

43. Raina, A.K.; Jha, M.N. and Pharasi, S.C. (2002). Accumulation of carbonates and clay movement in sodic soils of eastern Uttar Pradesh, India. *Indian Forester,* 128(6): 635-640.

44. Rawat, Laxmi and Bisht, M.S. (2002). The lowest July rainfall in Doon Valley in past 72 years. *Indian Forester*, 128 (12): 1375.

45. Rawat, Laxmi and Dabral, B.G. (2002). Forest influences vis-à-vis soil and water conservation. In: Forest conservation and management-challenges of the millennium.

46. Rawat, M.M.S. and Thapliyal, R.C. (2002). Endogenous rhythm in seed germination of *Dendrocalamus strictus*. *Seed Science & Technology*, 31: 21-27.

47. Sharma, Brij Raj; Kumar, Vineet and Soni, P.L. (2002). Ceric Ammonium Nitrate-Initiated Graft Copolymerization of Acrylamide onto *Cassia tora* Gum. *J. Applied Polymer Science*, 86 -3250.

48. Sharma, Brij Raj; Kumar, Vineet and Soni, P.L. (2003). Cyanoethylation of *Cassia tora* Gum. Starch/Starke, 55 - 38.

49. Sharma, Brij Raj; Kumar, Vineet and Soni, P.L. (2003). Graft Copolymerisation of Methyl methacrylate onto Guar gum Using Ceric Ammonium Nitrate-Nitric Acid as Redox Initiator. *Journal of Macromolecular Science*, Part A, *Pure and Applied Chemistry*, 40:49-60.

50. Sharma, S.K.; Verma, S.K. and Uniyal, D.P. (2002). A preliminary study on the Air-layering in *Acacia nilotica* (L) DEL. var. *indica*. *Indian Forester*, 128 (12): 1376-1378.

51. Shukla A.N.; Tandon, Kavita and Pandey, Rajiv (2002). Associated mycoflora and its control by the use of plant extracts on the seeds of *Acacia catechu*. *Indian Journal of Forestry*, 25 (1): 42-52.

52. Shukla, A. N. (2002). Mortality of *Dalbergia sissoo* in India. *Indian Forester*, 128: 1209- 1215.

53. Shukla, A.N. (2002). Comparative performance of exotic strains of Shiitake *Lentinus edodes* (Breark) Sing. on saw dust bags logs. *Journal of NonTimber Forest Products*, 9(2): 16-21.

54. Singh, A. P. (2002). Butterflies of the Ban-oak forests. *Sanctuary ASIA*. 22 (1): 38-41.

55. Singh, A. P. (2002). New and significant birds records from Dehra Dun valley, lower Garhwal Himalayas, India. *Forktail*, (U.K.) 18: 10151-153. *In. National Journals*.

56. Singh, A. P. (2002). Relative natural resistance of newly introduced *Populus deltoides* clones in India against defoliator *Clostera cupreata*. *Indian Forester*, 128 (3): 307-312.

57. Singh, A.P. and Pandey, R. (2002). Natural resistance of *Populus deltoides* clones selection to defoliator *Clostera cupreata* in northern India: Relative pupal weight as an easier criteria for accurate evaluation. *Journal of Applied Entomology*, 126 (9): 475-480.

58. Singh, Dhan, Vasistha, H.B. and Pandey, Rajeev (2002). Role of agroforestry interventions in development of mined degraded watershed of Doon Valley. *Indian Journal of Forestry*, 25 (1): 7-20.

59. Singh, Neerja and Pokhriyal, T.C. (2002). Nitrogen fixation and nodulation behaviour in relation to seed source variations in *Dalbergia sissoo*. *J. Trop. Forest. Sci.*, 14(2): 198-206.

60. Singh, Punam Kumari and Harsh, N.S.K. (2002). Aflatoxin in *Aegle marmelos* (Linn.) Corre ex. Roxb. *Indian Forester*, 128:1248-1253.

61. Singh, Punam Kumari; Harsh, N.S.K.; Khan, S.N. and Pandey, Rajeev (2002). Mycotoxins infestation in *Buchanania lanzan* and *Pinus gerardiana* seeds. *Indian Forester*, 128:421-431.

62. Singh, S. and Hayat, M. (2002). New species and new record of *Microterys* (Hymenoptera: Chalcidoidea: Encyrtidae) from northern India. *Oriental Insects*, 36: 405- 421.

63. Singh, S.; Barman, H.K. and Barthakur, N.D. (2002). Pathogenicity of entomogenous fungi on *Calopepla leayana* (Coleoptera: Chrysomelidae), a major insect pest of *Gmelina arborea*. *Annals of Forestry*, 10 : 351- 355.

64. Singh, S.; Barman, H.K. and Barthakur, N.D. (2002). Integrated insect pest management of *Gmelina arborea* in *Gmelina arborea:* A Technology Mission (eds. Kumar A., Singh, A.N. Kalita, R.K. and Prasad, K.G.), *RFRI publication,* 13.

65. Singh, S.B. and Bhatnagar, Sanjeev (2002). Response of *Acacia nilotica* to nitrogen and phosphorus in water logged sodic soil. *Indian Forester,* 128(5): 545-550.

66. Singh, S.P.; Singh, J.P. and Rawat, S.S. (2002). Particle boards from *Ailanthus excelsa*, *J. of Timb. Dev. Assoc.(India)*, 48(3&4) : 5-8.

67. Singh, S.P.; Singh, J.P. and Rawat, S.S. (2002). Particle boards from *Prosopis juliflora. J. of Timb. Dev. Assoc. (India)*, 48(1-2).

68. Singh, V.; Dayal, R. and Bhandari, R. S. (2002). Antifeedant activity of essential oil of *Vitex negundo* leaves against *Sitotroga cereallela. SHASHPA,* 9 (1):71-75.

69. Sood, K.G.; Rawat, G.S.; Sharma, C.M. and Nautiyal, A.M. (2002). Transportation of plants in hills- A comparative study. *Indian Forester*.

70. Tripathi, A.K.; Tripathi, S. and Banerjee, S.K. (2002). Air quality status and its impacts on nitrate reductase, superoxide dismutase and peroxidase activities of plants in Lime kiln area. *Indian Forester*, 128 (9): 995-1008.

71. Uniyal, D.P.; Sharma, V.K. and Prasad, M. (2002). Cone attributes as indices of seed maturity in Blue pine (*Pinus wallichiana* - A.B. acks). *Annals of Forestry,* 10 (2): 268-272.

72. Uniyal, D.P.; Verma, S.K.; Sharma, S.K. and Sharma, V.K. (2002). Provenance variation in specific gravity of wood of chirpine (*Pinus roxburghii* Sarg). *Indian Forester,* 128 (12): 1295-1301.

73. Uniyal, K.K.; Dubey, Y.M. and Jain, V.K. (2003). A Note on Thermal conductivity of wood at different moisture contents. *J. of Timb. Dev. Assoc. (India)*, 49 (1- 2).

74. Vasistha, H.B. and Kumar, Om (2003). Intangible benefits of forests in terms of environmental conservation soil erosion and flood control. In: Non timber forest products of India, (eds., Nautiyal S. and Kaul, A.K.). Jyoti Publisher and Distributors, Dehra Dun.

75. Viswanath, S.; Singh, R.P. and Thapliyal, R.C. (2002). Seed germination patterns in a Himalayan moist temperate forest. *Tropical Ecology*, 43(2):265-273.

Conferences/meetings/workshops/ seminars /symposia

1. A workshop on Natural Tree Furniture was organized from 10th to 22nd December, 2002 in collaboration with I.I.T., New Delhi at FRI, Dehra Dun.

2. Agrawal, Manisha and Gupta, Sangeeta (2003). Wood microstructure of *Indian Rhus* (Anacardiaceae) with special remarks on their systematic position. Presented at 90th Indian Science Congress, Bangalore.

3. Bhojvaid, P.P. (2002). Forestry intervention for restoration of degraded natural resources in Shiwalik hills, in India Sustainable Mountain Agriculture. September, 27-29, Academy of Administration, Nainital, India.

4. Bhojvaid, P.P. (2002). Issues in resource inventory of NWFP species in India. Paper presented in *Consultative workshop on resource Inventory of NWFP* species in India. Forest Survey of India, 26-27, August, New Delhi, India.

5. Bhojvaid, P.P. (2002). The roots of sustainable forest management in India and south Asia. Paper presented in International Conference on The Environmental History of Asia, 4-7 December, JNU, New Delhi.

6. Bhojvaid, P.P. (2003). Medicinal plants based Agroforestry models: A strategy for income generation and biodiversity conservation. *Agroforestry in 21st Century*. February 11-14, 2003. Punjab Agricultural University, Ludhiana, India.

7. Bhojvaid, P.P. (2003). Research issues and technological innovations for JFM: ICFRE's perspective Paper presented in National Workshop on research issues and technological innovations for JFM. 3-4 February, Forest Research Institute, Dehra Dun.

8. Bhojvaid, P.P. (2003) Research issues in NWFP based forest management through JFM. Paper presented in National Workshop on research issues and technological innovations for *JFM*. 3-4 February Forest Research Institute, Dehra Dun.

9. Bhojvaid, P.P. (2003). International conventions and NWFP trade: Implications on biodiversity conservation. Paper presented in the IUFRO Division 5 Conference. March 11-15, Forest Research Centre, Rotorua, New Zealand.

10. Gupta, P.K. and Gupta, S. (2003). UV-VIS Studies as an aid to wood identification presented at 90th Indian Science Congress, Bangalore, 3-7, Jan., 2003.

11. Gupta, P.K. and Soni, P.L. (2002). *Prosopis juliflora* - a potential source of seed-gum in paper presented in XVII Carbohydrate Conference at CFTRI, Mysore, 21-22, Nov., 2002.

12. Gupta, S.; Sharma, P. and Soni, P.L. (2002). Optimization of conditions of synthesis of carboxy methyl derivative from *Cassia occidentals* seed gum in Paper presented in XVII Carbohydrate Conference at CFTRI, Mysore, on 21-22, Nov.,2002.

13. Gupta, Sangeeta and Chauhan, Nisha (2003). Wood Microstructure of Indian *Zanthoxylum* (Rutaceae). Presented at 90th *Indian Science Congress*, Bangalore, 3-7 Jan., 2003.

14. Jha, M. N.; Rana, A.K.; Sexena, Alok, and Gupta, M.K. (2003). Degraded Forests in India and Carbon sink with special reference to Madhya Pradesh. Paper presented in National seminar held at T.F.R.I., Jabalpur on 15th-16th, January, 2003.

15. Jha, M.N and Gupta, M.K (2002). Soil nutrient status and economic return under farming and agro forestry land use. Paper presented in National workshop on "Agroforestry-prospects and Challenges" at IFGTB, Coimbatore on 22 Nov., 2002.

16. Jha, M.N., Singh, S.B., Sharma, S.D. and Gupta, M.K. (2003). Prospects of carbon sink expansion in problem soils through peoples participation in U.P. Paper presented in FORSPA-Bangkok sponsored National Workshop held at ICFRE on Feb 3-4th, 2003.

17. Kaur, S.; Varshney, V.K. and Dayal, R. (2003). Chemical constitutents of *Shorea robusta* bast and leaves. 90th Indian Science Congress, Bangalore , 3-7, Jan.

18. Kumar, D. (2002). Programme for genetic improvement of Poplar in India. Paper presented in National Workshop on " Agroforestry for sustainable cropping systems" at GBPUAT, Pantnagar, Nov., 13, 2002.

19. Kumar, V.; Sharma, B.R. and Soni. P.L. (2003). Carbamoyethylation of *Cassia tora* seed gum. 90th Indian Science Congress, Bangalore, 3-7, Jan., 2003.

20. Negi, Krishna and Gupta, Sangeeta (2003). Wood microstructure of *Indian Swietenia* (Meliaceae) with special remarks on their ecological variations. Presented at 90th Indian Science Congress, Bangalore 3-7, Jan., 2003.

21. Pandey, C.N.; Indra Dev, Jain; V.K.; Badoni, S.P. and Singh, S.P. (2003). Value Addition to Wood Products through Joint Forest Management, paper presented in Workshop on Technological Innovations and Research Advancements for Application in Joint Forest Management, held between 3-4, February 2003 at ICFRE, Dehra Dun.

22. Pokhriyal, T.C., Nautiyal, S. (2003). National Workshop on "Technological Innovations and Research Advancements for Application in Joint Forest Management held at Forest Research Institute, Dehra Dun w.e.f. 3rd -4th, February, 2003.

23. Pokhriyal, T.C.; Singh, Himmat; Rawat, Vijay; Parandiyal, A.K. and Kumar, Pankaj (2002). Introduction of Nitrogen fixing plants : A sustainable approach for the plantation forestry programmes. International Conference for Plant Physiology.

24. Saxena, Vishaka and Gupta, Sangeeta (2003). Wood microstructure of *Indian Euonymus* Celastraceae). Presented at 90th Indian Science Congress, Bangalore 3-7, Jan., 2003.

25. Sharma, B. R.; Kumar, V. and Soni, P.L. Chemical modification of *Cassia tora* gum: cyanoethylation at XVII Carbohydrate Conference at CFTRI, Mysore, 21-22 Nov., 2002.

26. Singh, S.P. and Pandey, C.N., attended workshop on Challenges of Hill Architecture IIA, Doon Convention on 1-2 June, 2002, at Dehra Dun.

27. Singh, S.P., attended workshop on Landslide Hazard Zonation Meeting at UA Secretariat, Dehra Dun on 25 Oct., 2002.

28. Singh, S.P., Badooni, S.P., Pandey, C.N. and Indra Dev, attended curriculum workshop for Diploma Course in Wood Technology at TTTI, Chandigarh from 28-30 May, 2002.

29. Singh, V.; Dayal, R. and Bartley, J.P. Chemical constituents of *Vitex negundo* leave. National symposium on Advanced Instrumental Methods of Analysis at D.A.V. (P.G.) College, Dehra Dun, June 7-8, 2002, p. 36.

Consultancies

Consultancies were provided on following topics for the amount mentioned against them.

- Impact Assessment of Assisted Natural Regeneration (ANR) of Sal operations in Uttaranchal (Rs. 7, 10,000).
- Environmental audit of sal ANR areas in Uttar Pradesh (Rs. 3, 00,000).
- To draw up the revised working plans for forests of the Andman & Nicobar Islands (Rs. 1, 00,000).
- Enabling Activities for India's Initial National Communication (Rs. 3, 00,000).
- Operationalisation of seedling production (Plantlets) through clonal technology in Punjab (Rs. 6,60,000).
- Vanaspati van scheme of Morni-Pinjore Forest Division (Rs.3,02,000).
- Different aspects of wood processing technology was given to different organizations, industries, etc. (Rs. 20,500).
- MOU was signed to provide consultancy regarding Establishment of a seasoning plant for the seasoning of walnut wood with J&K Handicraft Corporation (Rs.13,75000).

Testing

Samples received from different industries and organizations were tested (Rs.16,33,650/-).

Exhibitions/ Meetings

1. World Forestry Day at FRI Dehra Dun on 21st March, 2003.

World Forestry Day 21st March, 2003

2. World Environment Day at FRI, Dehra Dun on 5th June, 2002
3. Hindi Saptah at F.R.I Dehra Dun from 23rd to 27th September, 2002.
4. Participated in the Exhibition on Climate Change at New Delhi from 23rd October to 3rd, November, 2002.
5. Bamboo Exhibition at Lachiwala on 8th and 9th, June, 2002.
6. Van Mahotsava at F. R. I., Dehra Dun on 9th, July, 2002.
7. Vigilance week at F. R. I, Dehra Dun from 31st October to 6th November, 2002.

Aamwala 11th May, 2002

National Technology Day Aamwala
11th May, 2002

8. World Day to Combat Desertification and Drought at F. R. I., Dehra Dun on 17th June, 2002.
9. Exhibition at ITBP mela at Seemadwar, Dehra Dun on 3rd May to 5th May, 2002.
10. National Technology Day at village Aamwala, Sahaspur Block, and Dehra Dun on 11th May, 2002.
11. Organized a workshop on "Natural Tree Furniture" from 10th to 22nd December, 2002.

Natural tree furniture

12. Organized the National Workshop on "Joint Forest Management" on 3rd and 4th, February, 2003.

13. Participated in the "National Science Day" Exhibition at Wadia Institute of Himalayan Geology, Dehra Dun on 28th February, 2003.

14. Participated in the Health Mela organized by Indian Medical Association at Rangers College ground, Dehra Dun on 6th October, 2002.

15. Presented material along with photographs showing the advantage of treated wood in increasing carbon-locking diplayed at Trade Fair, New Delhi.

Awards

- Brandis award for the outstanding research paper was given for "Moisture distribution pattern in the soil under different tree plantations" to M.N. Jha, M.K. Gupta, B.M. Dimri and H.S. Bedwal published in April, 2001 issue of *Indian Forester.*

- Dr. Mukhtar Ahmad was awarded National Vishisht Vaigyanik Puraskar (Min. of Environment & Forests) in recognition of his outstanding contribution in the field of Forest Entomology: Biological control of insect pests.

- A.K. Raina, M.N. Jha and S.C. Pharasi won award S.K. Seth prize for the outstanding research Paper "Forest soil: vegetation relationship in Mussoorie Forest Ddivision (Uttaranchal)" by published in August, 2001 issue of *Indian Forester.*

- Ms. Sarika Gupta, Research Scholar won the best poster award of Rs. 1000/- alongwith the certificate in XVII Carbohydrate Conference at CFTRI, Mysore, 21-22 Nov., 2002.

Distinguished visitors

1. Mr. Peter Price, Mr. N. Ravindran and Mr. Pankaj Agarwal from New Zealand and M/s Ace Global (P) Ltd, New Delhi visited FRI on 17th September, 2002 to review the progress made in the sponsored project on Radiata pine.

2. Parliamentary committee under the chairmanship of Honourable Dr. Alladi P. Raj Kuwar, M.P. Rajya Sabha, visited the institute on 14th September, 2002.

3. His excellency the Governor of Arunachal Pradesh Shri Arvind Dave visited the Institute on 5th September , 2002.

4. Shri Babu Parmanand, Hon'ble Governor of Haryana visited the Institute on 30th May, 2002 .

5. Shri Bhagat Singh Koshyari, Hon'ble Ex-Chief Minister of Uttaranchal visited the Institute on 18th April, 2002.

6. Shri D.P. Gharutlahare, Hon'ble Minister of Forest Department., Govt. of Chhattisgarh visited the institute on 26th June, 2002.

7. Shri Partap Singh Bajwa, Hon'ble Minister for PWD, (Govt. of Punjab) visited the institute on 28th October, 2002.

8. Smt. Shabana Azimi, M.P., Rajya Sabha and Shri Javed Akhtar, Poet, visited the institute on 10th December, 2002.

FOREST RESEARCH INSTITUTE (DEEMED UNIVERSITY)

Forest Research Institute, Dehra Dun 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 6.12.1991. After the conferment of Deemed 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 forestry newly introduced in the country such as Forestry Economics & Management, Wood Science & Technology and Environment Management, Plantation Technology, Biodiversity Conservation it provides technical know how/support to men in responsible positions in forestry research, wood based industries and plantation activities. Deemed University has also been fostering pioneering research in specialized areas under Ph.D. Programme.

Academic courses and admissions

The FRI (Deemed University) has been offering the following academic courses on a regular basis:

1. M.Sc. Forestry (Economics & Management)
2. M.Sc. Wood Science and Technology
3. M.Sc. Environment Management
4. Post Graduate Diploma in Plantation Technology
5. Post Graduate Diploma in Biodiversity Conservation.

The M.Sc. courses are of two years duration whereas Post-graduate Diploma Courses are of one year duration. The intake capacity of each course is 15. Admission to these courses is made on the basis of a candidate's performance in All-India competitive Entrance Test. During the year 82 students were admitted in all to the above five courses.

Ph.D. programme

Research is an essential function of a National Institute like the Forest Research Institute (Deemed University) and more 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 frontier 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, which the Institutes and established Research Centers have, the research activities under Ph.D. Programmes have increased manifolds. At present 386 Research Scholars have been registered including registration of 56 Research Scholars under Ph.D. programme in the current year. During the year 18 Research Scholars have been awarded Ph.D. Degree.

National Forest Library and Information Centre

The National Forest Library and Information Centre (NFLIC) is the heart of all academic and research activities of the Forest Research Institute. The NFLIC has been providing all 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, 455 selected books on different aspects of forestry and allied subjects were purchased at a total cost of Rs.8.13 lakh. Additional 1,973 books were received as gratis. Thus a total of 2428 books were added to the collection during the year making the total document collection of the library 161, 084. Realizing the importance of scientific periodicals in advanced level of research, the NFLIC subscribed 147 foreign and 83 Indian periodicals. Besides, it also received 350 periodical titles as gratis. For providing efficient and effective retrospective search and current awareness, the NFLIC subscribed CAB CD, and Tree CD bibliographical databases on CD ROM format. These databases were accessible on ICFRE intranet. The binding of books and periodicals is an essential library activity. For increasing their shelf life, during the year a total of 1,000 sets of books and periodicals were got bound at a total cost of Rs.48,850/-. For reading outside the premises of the NFLIC, a total of 22,346 documents were issued to the users during the year. The NFLIC has started compiling *Indian Forestry Abstracts*: an abstracting service wherein the articles, having bearing on forestry, published in the Indian periodicals are selected and their bibliographical details along with abstract are entered into the database. This service has been made accessible on the ICFRE intranet. The NFLIC has been selling books and other publications of the ICFRE through its Book Depot. During the year, it earned a revenue of Rs.122,213/- by selling 931 books and 18 VHS cassettes. The NFLIC has been running an ENVIS Project on Forestry. Under this project, 12 issues of a monthly Forestry News Digest were published by scanning 14 daily newspapers in Hindi and English languages received in the NFLIC. Two issues of the ENVIS Forestry Bulletin, a half yearly publication, were also published.