INTRODUCTION

The Indian Council of Forestry Research and Education (ICFRE) is the apex body in the national forestry research system to develop a holistic approach towards forestry research through planning, promoting, conducting and coordinating research, education and extension on all aspects of forestry for ensuring scientific management of forests, tree improvement, forestry productivity through scientific and biotechnological researches, bioremediation of degraded land, efficient utilization of forest produce, value addition of forest products, conservation of biodiversity and climate change, effective agroforestry models for various agroecological zones, policy research, environmental impact assessment and integrated pests and disease management.

Objectives of the ICFRE

- To undertake, aid, promote and coordinate forestry education, research and their applications.
- To develop and maintain a National Library and Information Centre for forestry and allied sciences.
- To act as a clearing-house for research and general informations related to forests and wildlife.
- To develop forestry extension programmes and propagate the same through mass media, audio-visual aids and extension machinery.
- To provide consultancy services in the field of forestry research, education and allied sciences.
- To undertake other jobs considered necessary to attain these objectives.

ICFRE has eight regional research institutes and three research centres in different bio-geographical regions of the country to cater to the forestry research needs of the nation. The regional research institutes are located at Dehradun, Shimla, Ranchi, Jorhat, Jabalpur, Jodhpur, Bangalore and Coimbatore and the centres are at Allahabad, Chhindwara and Hyderabad. The activities of these institutes and centres are described in separate chapters of the report. The activities of forestry research, education and extension at ICFRE headquarter are as under :

FORESTRY RESEARCH

Project Formulation Division acts as a nodal agency between ICFRE institutes and donor agencies, for coordination of the Research Projects of ICFRE Institutes/Centres in the identified thrust areas and their submission to various National and International donor agencies as per their funding requirements, coordinates the release of funds to ICFRE Institutes from the donor agencies and evaluates the Project proposals with regards to their suitability in the identified thrust areas. The JFM Programme related issues are dealt by this division like preparation of Training Manual etc.

Twelve International Projects and 126 National Projects are under various stages of implementation. Twenty three International Projects and 7 International Concept Notes have

been submitted for funding to 30 International Donor Agencies.

A Consultancy Project for Haryana Forest Department to prepare Modes Microplans for the JBIC Project on Integrated Natural Resource Management and Poverty Reduction is in progress.

Planning and Programme Division under the Directorate of Research deals with the planning, processing and execution of new research project proposals and review of the ongoing research projects of all the institutes under ICFRE.

During the year 2004-2005, Planning and Programme Division coordinated the Research Advisory Group (RAG) meeting at institute level. All ICFRE Institutes prepared a research plan for their Institutes, after analyzing the forestry scenario in the region and identifying research needs to be addressed by it. This was followed by preparation of research projects by researchers. Finally these projects approved by RAGs were placed before 5th Research Planning Committee (RPC) as per the National Forestry Research Plan (NFRP).

Research Policy Committee (RPC) Meeting was convened on 1st and 2nd May, 2005, under the chairmanship of Shri G.K. Prasad, D.G. ICFRE for according the final approval to the new research proposals submitted by eight research institutes under ICFRE.

The institute wise breakup of new and ongoing projects is as below :

Sl. No.	Name of the Institute	No. of new projects	No. of ongoing projects
1	Forest Research Institute, Dehra Dun	15	51
2	Arid Forest Research Institute, Jodhpur	4	28
3	Himalayan Forest Research Institute, Shimla	3	22
4	Institute of Forest Genetics and Tree Breeding, Coimbatore	8	19
5	Institute of Forest Productivity, Ranchi	3	17
6	Institute of Wood Science and Technology, Bangalore	6	63
7	Rain Forest Research Institute, Jorhat	7	14
8	Tropical Forest Research Institute, Jabalpur	8	33
	Total	**54**	**247**

Planning and Programme Division has also prepared an inventory of Completed Research Projects since the inception of ICFRE. A document "An Inventory of Completed Projects of ICFRE Institutes, 1990–2004" was prepared and being updated continuously. The document is available at the ICFRE website.

Institute wise position of Completed Projects till date is as below :

Name of Institute	No. of Completed Projects
Arid Forest Research Institute, Jodhpur	30
Forest Research Institute, Dehradun	130
Himalayan Forest Research Institute, Shimla	37
Institute of Forest Genetics & Tree Breeding, Coimbatore	29
Institute of Forest Productivity, Ranchi	06
Institute of Wood Science & Technology, Bangalore	58
Rain Forest Research Institute, Jorhat	37
Tropical Forest Research Institute, Jabalpur	54
Total	**381**

Planning and Programme Division coordinated for India's participation in the 22nd session of International Poplar Commission, Santiago, held from 24th November to 2nd December, 2004 and prepared a country paper on "Contribution of Poplars and Willows in Sustainable Forestry and Rural Development in India". Two power point presentations, viz. "Poplar–A Gift for Indian Farmers" and "Dehradun, A Vibrant Venue for IPC 2008" were given by the DG ICFRE.

Planning and Programme Division has also coordinated with all ICFRE Institutes for preparing database on patents and is regularly monitoring it.

Environmental Impact Assessment (EIA) Division deals with the consultancies related to EIA and Environmental Management Plan which are the proven management tools for integrating environmental concerns in development process and for improved decision making. The Division has carried out following works :

Studies were undertaken by team of experts from the ICFRE, Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore and the Forest Research Centre (FRC), Hyderabad to assess the impact of realignment of Tellavagu Nullah (Seasonal Nullah) on flora and fauna–Evaluation studies for the Singareni Colleries Company Limited (SCCL), Kothagudem area, Dist., Khammam (Andhra Pradesh). A detailed report on the impact on flora, fauna and mitigation measures was submitted to the SCCL.

A draft report of final mine closure plan (Eco-rehabilitation plan) for Kudremukh Iron Ore Company Limited, Bangalore, was prepared and submitted for the first time in India as per directives of Hon. Supreme Court by the Council in coordination with Institute of Wood Science & Technology, Bangalore and CWPRS, Pune.

Environmental Impact Assessment, Socio-economic Impact Assessment, Environmental Management Plan and mitigation measures for the Bodhghat Hydro Electric Project (4 x 125 MW) in district Dantewara, Chhattisgarh for the Chhattisgarh State Electricity Board, Raipur was undertaken. Rapid EIA report and draft report on Enumeration, Ecological value, Biodiversity loss of gene pool and Reassessment of need of project-affected people of Bodhghat

Hydro Electric Project were submitted. Comprehensive EIA, SIA and Environmental Management Plan are under progress.

The EIA division of the Council has been entrusted with carrying out the Socio-economic Impact Assessment and cultural survey by the National Thermal Power Project Limited (NTPC), Noida (U.P.) for the proposed Tapovan Vishnugad Hydro Power Project 520 (4 x 130) MW in Chamoli District of Uttaranchal State. The Barrage of the project is proposed to be located on river Dhauli Ganga at village Tapovan. The project is likely to affect 8 villages, viz. Tapovan, Bhengule, Chamoli, Paiya/Chormi, Dhak, Ravigram, Shelong/Jharkula and Animath/Paini of Chamoli district.

Under the programme awarded by the National Afforestation and Eco-development Board of MoEF to the council, the Rain Forest Research Institute, Jorhat carried out the sample check survey of tree planting activities in Darang and Dibrugarh, Assam and reports are being prepared. Studies were undertaken by the TFRI to evaluate the coastal shelterbelt plantation of Bhubaneswar, Orissa and the reports are being prepared. Sample check survey of NAEB plantations was done by the RFRI in South Garo (Meghalaya) and Dimapur (Nagaland).

The Council has been awarded a project by the National Medicinal Plant Board (NMPB), Ministry of Health and Social Welfare, Government of India to evaluate and assess the promotional and commercial schemes provided to various agencies all over the States in India including the Union Territory except for the some of the States in central India. Accordingly, the EIA division of the council has Initiated the work.

Biodiversity and Climate Change (BCC) Division undertakes projects in the areas of Biodiversity and Climate Change. The main activities are :

Recognizing the initiatives taken up by ICFRE and the active involvement of BCC division in Climate Change and Forestry related issues at the national and international level, United Nations Framework Convention on Climate Change (UNFCCC) has awarded the Observer Status to ICFRE. On being awarded the Observer Status, ICFRE can take part in various international meetings of COP/MOP as an independent organization.

'FORCLIMIT–INDIA' (Forests and Climate Change Mitigation Network) collaborative project which was initiated in the year 2002-2003, to address the assessment of mitigation opportunities and potential cost and benefits in selected localities in India, continued in 2004-2005. In phase-I of this project, two case studies in Uttaranchal on Carbon Sequestration Potential under farm forestry and community forestry scenario were completed. Under the US - India FORCLIMIT project, a two days workshop was also organized on "Methodologies in Forestry Mitigation Projects" at India International Centre, New Delhi on 13th and 14th April, 2004. Dr. Prodipto Ghosh, Secretary, Govt. of India, Ministry of Environment and Forest delivered the keynote address and emphasized on faithful partnership on Climate Change issues being developed by the US and India. Besides participation of the project partners viz. US Environmental Protection Agency, Lawrence Berkley National Laboratory (LBNL) of USA, Indian Institutes of Science and Ministry of Environment and Forests, representative from State Forest Departments, various other scientific organizations and NGOs also participated in the workshop.

Dr. Prodipto Ghosh Secretary, GOI, MoEF, delivering key note address on the occasion of inauguration of Workshop on Methodologies in Forestry Mitigations Project

Under EU-India Small Projects Facility Program, BCC Division of ICFRE successfully competed for the award of a project titled *"Beyond Kyoto: EU-INDIA CDM partnership: Promoting stakeholder dialogue and analysis of barriers to forestry mitigation projects"*. The main objective of the project is to initiate stake holder dialogue and capacity building in the CDM and Forestry sector in India. A study on analysis of barriers to CDM forestry projects in India will also be conducted. This project is in partnership with Joanneum Research of Austria and Freiburg University Germany. The total grant awarded from EU is Euros 79, 000. The project also proposes to hold two international workshops to foster the dialogues and partnership in CDM forestry projects.

BCC Division is currently co-coordinating the prospects of revival of preservation plots for benchmarking biodiversity and also updating the ecological process and preserving gene pools of important species/ forest types. In 2004–2005 scientists of various Institutes of ICFRE and the officials of respective SFDs visited the forest areas of several States and Union Territories in order to physically verify the status of the preservation plots created by the Forest Research Institute from 1920 onwards.

A number of states e.g. Andhra Pradesh, Assam, West Bengal, Chhattisgarh, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnatak, Kerala, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu, Uttaranchal and Uttar Pradesh have communicated the existence and maintenance of highly important Preservation Plots for assessing ecological changes occurring in representative areas over a period of time.

Once the status of Preservation Plots is known form all the States, ICFRE will attempt to structure and implement a programme for creation of more plots nation vide in consultation with the State Forest Departments.

FORESTRY EDUCATION

Grant-in-Aid to Universities: Financial supports were provided to the Universities imparting forestry education in the country in order to strengthen the infrastructural facilities of the forestry faculties such as office buildings, laboratories and field equipment, glass houses/ mist chambers, transport and camping equipments, computer centre, mini computer/PC terminals, library, sports, games and other students' amenities. Grant-in-aid has also been provided for enhancing the technical capabilities of the forestry faculties through promoting

workshops/seminars/symposia, participation of teachers in national seminars, symposium, students' study tours, assistance for preparation of teaching manuals, etc. Overall an amount of Rs. 200.00 lakhs was released under grant-in-aid to 11 Universities in 2004-2005 as follows :

Sl. No.	Name of University	Rs. in lakhs
1.	Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan	7.30
2.	Kerala Agricultural University, Main Campus, Trissur	6.50
3.	Forest Research Institute (Deemed University), Dehradun	125.00
4.	H.N.B. Garhwal University, Srinagar	2.00
5.	Birsa Agricultural University, P.O. Kanke, Ranchi	8.00
6.	Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur	7.00
7.	University of Agricultural Sciences, College of Forestry, Sirsi, Dharwad	12.50
8.	C.S.K. Himachal Pradesh Kirshi Vishwavidyalaya, Palampur	9.65
9.	Chandra Sekhar Azad University of Agriculture and Technology, Kanpur	10.05
10.	Allahabad Agricultural Deemed University, Allahabad	7.00
11.	ASPEE College of Horticulture and Forestry, Gujarat Agriculture University, Navsari	5.00
	Total	**200.00**

FORESTRY EXTENSION

Media and Publication Division looks into the extension activities and strategies being adopted by institutes of ICFRE for the dissemination of research findings in forestry sector. This division maintains the monthly account of multifarious activities of ICFRE institutes and keeps MoEF apprised of them through monthly D.O. Letter of D.G., ICFRE. Quarterly Newsletter of ICFRE brings out the latest significant achievements made during the quarter by the ICFRE institutes in all the discipline of forestry. Besides this, work of updation of ICFRE Brochure is in progress. Annual Reports of ICFRE and its institutes are collected, compiled, edited and in the form of ICFRE Annual Report to be placed on the table of the Parliament. Editing, vetting and processing of books, brochures, pamphlets and technical reports of ICFRE institutes by this division is mandatory before final publication. Various draft publications received from institutes were vetted by Media and Publication Division during the year, before final publication.

GENERAL ADMINISTRATION

Forestry Statistics Division carried out following works during the year :

1. Published Forestry Statistics India, 2003.
2. Four issues of Timber/Bamboo Trade Bulletin were published.
3. Statistical assistance was provided to Environmental Impact Assessment Division for its project for Chhattisgarh State Electricity Board.

4. Delivered lectures to FRI Deemed University.
5. Imparted statistical advice to various ongoing projects of FRI.
6. A project funded by Central Statistical Organization, Ministry of Statistics and Programme Implementation, Govt. of India, is being implemented with the help of all ICFRE institutes. An Orientation Programme for the supervisors was conducted at Van Vigyan Bhawan on 27th and 28th January, 2005.
7. Gave Technical Opinion to Punjab Forest Department regarding determination of correct sample size and sample intensity percentage so as to estimate felling from in a particular area.
8. Lectures delivered to ISS probationers.

Information Technology Division under the Directorate of Administration, ICFRE, being a service providing cell caters to all kind of Information Technology needs of the users at ICFRE Headquarters and FRI. The main activities of the cell are training, LAN-WAN support, e-governance and maintenance of hardware. The following are the main achievements :

- Provided inhouse training to the ICFRE and FRI Officers and staff and to the students of FRI Deemed University.
- Maintained different types of servers (10 in number) and other network devices for smooth functioning of LAN and WAN.
- Maintenance of E mail servers and proxy servers to provide round the clock email and internet services to users.
- Hoisting of ICFRE Website (icfre.org) and websites for two other ICFRE-Institutes; http://hfri.icfre.org; http://rfri.icfre.org. In addition to hoisting website on medicinal plants http://marketinfoherbs.icfre.org; and the site of Indian Forester http://indianforester.icfre.org.
- Maintenance of IFRIS (Management Information System) centralized Oracle Database, ensuring FAS / Payroll support to DDO's at ICFRE and FRI.
- Maintenance of a SUN Server, hoisting a TLSM (Total Library Automation Software Management System) Oracle Database of the National Forest Library and Information Centre.
- Providing centralized network antivirus management server takes care of the virus problems round the clock.
- The Cell liaisons between the users and AMC vendors.

MAJOR ACHIEVEMENTS

- FRI, Dehradun obtained VAC-FRI technology for treatment of green bamboo on 14-06-2004.
- Use of *Pseudomonas fluorescence* as root protectant against the infection of *Fusarium solani* was confirmed in the seedlings of Shisham.
- Bamboo-endomycorrhiza system was worked out for the integration of mycorrhiza in boosting the growth and proliferation of *Dendrocalamus strictus*.
- Methods were standardized for production of alpha cellulose and its derivatives from *Lantana camara* for a variety of applications paving thereby a way for management of this obnoxious weed by its utilization into products of commercial importance.
- Reaction conditions were standardized for production of polysaccharide derivatives – graft co-polymers of *Cassia occidentalis*

seed gum with vinyl monomers; water soluble quaternized and cyanoethylated TKP; water soluble carboxymethyl cellulose, and organo soluble cyanoethyl cellulose from cellulose of *Dendrocalamus strictus* bamboo and cotton linters.

- *Ex-situ* conservations of 120 species belonging to 80 generas and 4 families of forest origin from central India have been made in TFRI campus.
- Non-destructive harvesting methods of Kalmegh (*Andrograhic peniculata*) standaridized.
- Multiplied 3,00,00000 wasps of *Trichogramma rosi* and introduced in 200 hectare Teak plantations of Maharashtra and Madhya Pradesh to minimise the out break of Teak defoliator and skeletonizer. It minimised more than 50 per cent annual loss of Teak growth.
- An agroforestry model consisting of tree species (*Tectona grandis, Gmelina arborea* and *Emblica officinalis*) and crop species (soyabean and wheat) has been developed and demonstrated to produce high yield with *E.officinalis*.
- Developing a suitable database on biodiversity.
- Selection of potential mycorrhizas and other beneficial microbes for the reclaimation of bauxite mine spoils.

MAJOR RESEARCH FINDINGS

- A software on forest soil information system for India has been developed by FRI, Dehradun. Data for three hundred soil profiles has been entered from various parts of India. Database is user friendly and data cab be easily entered and retrieved.
- A database for information on seventy species of rare and endangered plants of south India has been developed by IFGTB, Coimbatore.
- Eco-friendly preservatives have been standardized for control of biodeterioration of wood by IWST, Bangalore.
- Development of computer based Forest soil information system for India.
- Molecular cataloguing of 36 plus trees of Teak from 11 states of India and one allied species (*Tectona hamiltoniana* Wall.) endemic to Myanmar using RAPD markers.
- Identified April to July as the best period of adventitious rooting in culm cuttings and side branch cuttings of *Bambusa tulda, B. vulgaris* var. green, *B. multiplex* and *Dendrocalamus membranaceous*.

ICFRE AWARDS FOR EXCELLENCE

Awards

"ICFRE Award for Excellence" for the year 2003-2004 was awarded to Dr. Genda Singh, Scientist, AFRI, Jodhpur for the outstanding work in the discipline of Forestry Research and to Dr. S. Balaji, IFS, Department of Environment in the discipline of Forestry Conservation.

For the outstanding scientific work for the protection of forest seeds, nursery seedlings and plants from various kind of diseases. Dr. Jamaluddin, Scientist-F of TFRI, Jabalpur was awarded the Vishisht Vigyanik Puraskar for the year 2001-2002.

FOREWORD

I am glad that Media and Publication Division of Indian Council of Forestry Research and Education (ICFRE) has brought out Annual Report for the year 2004-2005. This report encompasses the progress of the council during the period under report. Since its inception in 1986 and subsequent attainment of autonomy in 1991, the ICFRE has come a long way in the field of forestry research, extension and education.

The research carried out under the leadership of ICFRE by its eight institutes and three centres spanning through out the length and breadth of India is deep and extensive. With the thrust on new emerging areas such as Environment Impact Assessment (EIA), conservation of biodiversity, global warming, people's participation in forest management, conservation and *ex-situ* cultivation of medicinal plants, the research in ICFRE has attained new dimensions.

Collaboration with various National and International organizations in the field of forestry research is becoming a formidable asset of the council. During the year many senior scientists and research managers from almost all the continents showed greater interest in the activities of the council which is evident from their visits to the council and its institutes. Scientists and officers of ICFRE and its institutes also visited various countries to share the experience in the field of forestry research.

The Council has a clear thinking in the field of extension of research in order to disseminate the achievement of research to the farmers, state forest departments and others stake holders engaged in the forestry sector. Various technologies developed by the institutes of ICFRE are being disseminated to the village level by way of demonstration plots, workshops and seminars etc.

The Council is also helping various universities by way of providing grants-in-aid in the field of forestry education. During the year, Council released Rs. 200 lakhs as grant-in-aid to 11 universities.

By virtue of competent and hardworking scientists, officers and staff, I am sure, the ICFRE will attain excellence in the field of forestry research, extension and education and will keep on working towards attaining the national goal of bringing 1/3rd of geographic area of this great country under forest cover alongwith providing sustainable livelihood to the people who live in and around forests.

(G.K. Prasad)
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C O N T E N T S

ANNUAL REPORT

2004 - 2005

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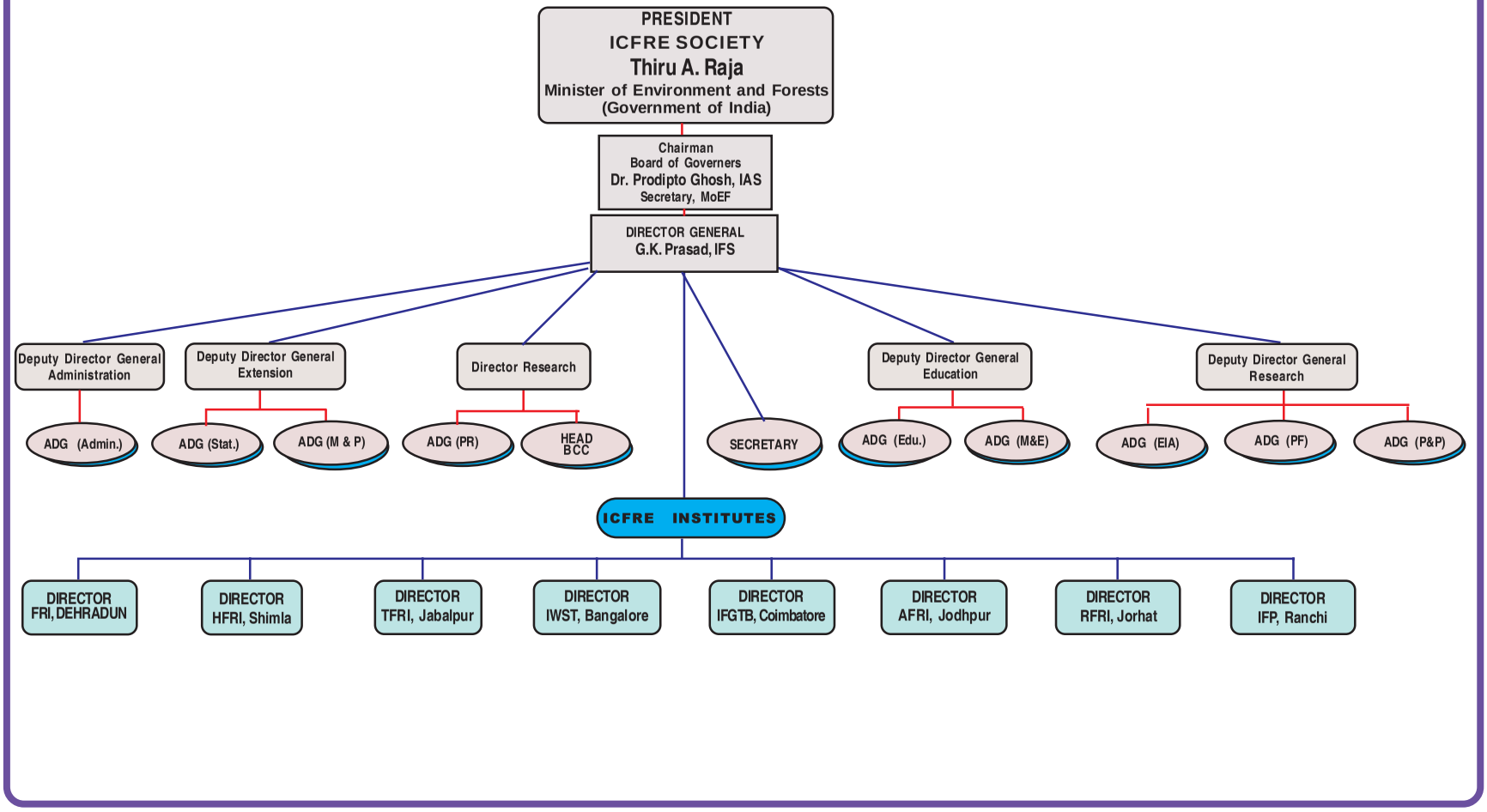
LIST OF ABBREVIATIONS

AFRI	Arid Forest Research Institute
AMF	Arbuscular Mycorrhizal Fungi
APFDC	Andhra Pradesh Forest Development Corporation.
APMP	Alkaline Peroxide Mechanical Pulping
CD-ROM	Compact Disc Read Only Memory
CFR&HRD	Centre for Forestry Research and Human Resource Development
CPT	Candidate Plus Tree
CSF&ER	Centre for Social Forestry Research and Eco-Rehabilitation
CSIRO	Commonwealth Scientific and Industrial Research Organization, Australia
CSO	Clonal Seed Orchard
CTG	Cassia Tora Gum
ESF	Extension Support Fund
FRC	Forest Research Centre
FREE-P	Forestry Research Education and Extension Project
FRI	Forest Research Institute
FRLHT	Foundation for Revitalization of Local Health Tradition
FYM	Farm Yard Manure
GACL	Gujarat Alkali and Chemicals Ltd.
GEF	Global Environmental Facility
GHG	Green House Gas
HFRI	Himalayan Forest Research Institute
HPLC	High Performance Liquid Chromatography
ICFRE	Indian Council of Forestry Research and Education
IFFDC	Indian Farm Forestry Development Cooperative
IFGTB	Institute of Forest Genetics and Tree Breeding
IPM	Integrated Pest Management
IPMA	Indian Paper Manufacturers Association
IPT	International Provenance Trial
IR	Infra Red
IRS	Institute of Remote Sensing
ISSR	Inter Sample Sequence Repeat
IWST	Institute of Wood Science and Technology
KFD	Kerala Forest Department
LAN	Local Area Network

LOSP	Light Organic Solvent Preservative
MPT	Multi Purpose Tree
NABARD	National Agricultural Bank for Agriculture and Rural Development
NFLIC	National Forest Library and Information Centre
NFT	Nitrogen Fixing Trees
NMR	Nuclear Magnetic Resonance
NOVOD	National Oil Seed and Vegetable Oil Development
NRDC	National Research Development Corporation
NWFP	Non-Wood Forest Produce
PFM	Participatory Forest Management
PGD	Post Graduate Diploma
PSB	Phosphate Solubilizing Bacteria
PSIP	Planting Stock Improvement Programe
PT	Progeny Trial
PTG	Primitive Tribe Groups
RAPD	Randomly Amplified Polymorphic DNA
RBD	Randomized Block Design
RCBD	Randomized Complete Block Design
RDBMS	Research Data Base Management System
RFRI	Rain Forest Research Institute
SP	Self Pruning
SPA	Seed Production Area
SPM	Suspended Particulate Matter
SSO	Seedling Seed Orchard
SSPA	Seedling Seed Production Area
TFRI	Tropical Forest Research Institute
TKP	Tamarind Kernel Powder
TLC	Thin Layer Chromatography
TNFD	Tamil Nadu Forest Department
USDA	United States of Department of Agriculture
UV	Ultra Violet
VAM	Vasicular Arbuscular Mycorrhiza
VMG	Vegetative Multiple Garden
WAN	Wide Area Network

ORGANISATIONAL STRUCTURE OF ICFRE



CHAPTER I

FOREST RESEARCH INSTITUTE DEHRADUN

Forest Research Institute (FRI), Dehradun was established in 1906 to organize and lead forestry research activities in the country. The Institute caters in particular to the research needs of the States of Punjab, Haryana, Chandigarh, Uttar Pradesh, Delhi and Uttaranchal. This Institute also has status of Deemed University and at present offers three courses leading to M.Sc. degree and two Post-Graduate Diploma Courses, besides awarding Ph.D. degree in Forestry.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

Project 1: Computerisation of anatomical database of Indian hardwoods for the purpose of their identification [FRI-17/Bot-7/1997-2004]

Findings: An expert system entitled "Wood Anatomy Information System-WAIS" was developed in collaboration with National Informatics Centre, New Delhi. The database consists of all the structural details available so far of 1000 species. Photo-micrographs of 1000 species have also been incorporated under the database.

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 programmes [FRI-192/Bot-31/2002-2005]

Findings: Six clones were screened at multi location Clonal Seed Orchard (CSO) of *Dalbergia sissoo*. The impact of site quality was observed for wood tracts. 15 clones of *Eucalyptus tereticornis* were also analyzed for wood tracts. The impact of juvenile and reaction wood was not found for wood tracts in both the species.

Project 3: Complete elimination of chlorine compounds in bleaching MILOX process [FRI-150/C&P-15/2001-2004]

Findings: Elimination of sulphur and chlorine/ chlorinated compounds from pulping and bleaching of *Eucalyptus tereticornis* using different doses of formic acid sandwiched between different doses of peroxyformic acid treatment in two stages and bleaching adopting in three stages of H_2O_2 sequence under standard condition was achieved.

Project 4: Improved utilization of raw materials for pulp and papermaking including juvenile tree utilization [FRI-129/ C&P-14/1999-2005]

Findings: Roots of *Eucalyptus tereticornis* were chipped and chemical conditions to obtain unbleached grade pulp were optimized. The progress of the project was not satisfactory and processing of roots for papermaking was found to be uneconomical. Thus the project was recommended for termination by Head, Chemistry Division during first six monthly review.

Project 5: Plant growth strategy characterization, diversity and vegetational dynamics of rehabilitated and derelict mined ecosystem in Western Himalaya [FRI 123/ Eco-5/1999-2004]

Findings: Nutritionally poor sites of lime stone mined areas were found to be colonized by the species such as *Rumex hastatus, Wendlandia exserta, Eriophorum comosum* and *Cedrela toona* at lower elevation. In middle elevation, species such as *Coriaria nepalensis, Hypericum* spp., *Eriophorum comosum, Rumex hastatus* and *Debregeasia hypoleuca* were found to be colonizing.

Project 6: Women and NTFP based agroforestry system in Uttaranchal and Western Uttar Pradesh [FRI-235/SF-6/2004-2005]

Findings: Survey of NTFP based agroforestry practices was completed in three Districts, viz. Dehradun, Pauri Garhwal and Pithoragarh in Uttaranchal state and two Districts, viz. Ghaziabad and Meerut in Western Uttar Pradesh. The villagers are collecting non-timber forest products from forest generally for their own use only. They are not cultivating NTFP based plants on significant scale due to lack of knowledge and marketing facilities. If the Government provides all facilities, the villages are ready and keen to cultivate NTFP based trees under agroforestry. The women are actively participating in all type of work related to agriculture/agroforestry.

Project 7: Environmental conservation strategies for land use in the lower western Himalayas : Butterflies as indicators in monitoring environmental changes in urban gradients [FRI-145/FED-9/2000-2005]

Findings: As many as 221 species of butterflies were sampled from the study area lying in the tropical moist deciduous sal forest zone (below 1000 m) of Dehradun valley. Butterflies found here represent 53% of the butterflies diversity found in the Western Himalayas, including 27 species sensitive to environmental changes in natural sal forest habitat. The study noticed a changed butterfly community in areas under different land use patterns (urbanized areas, agriculture land, tea gardens and cantonments) in relation to the original native butterfly diversity existing under sal forest habitats which now occupy 50% of the land in the study area.

Project 8: Parasitic and symbiotic associations of tree species used for harsh sites afforestation [FRI-138/Path-8/2000-2005]

Findings: Disease status in different treatments of Shisham mortality management experiments was evaluated at two Primary Farm Forestry Cooperatives (PFFCs), namely Urarmau and Richaura in the month of September, 2004 and March, 2005. Testing of efficacy of different non-systemic (Captan, Copper-oxychloride, Mancozeb, Thiram and Sulphur, etc.) and systemic fungicides (Bavistin, Benomyl and Ridomil, etc.) was done against leaf spot pathogen, *Colletotrichum gloeosporioides* of Shisham. Root and soil samples from sodic patch, grass and six commonly grown tree seedlings (Azadirachta, Eucalyptus, Pongamia, Psidium, Shisham and Terminalia) were collected and analyzed for mycorrhizal infection and types from field/nurseries raised in Kanaksinghpur and Ramshahpur. The data of these very recently concluded experiments are being processed for final report.

Project 9: Development of computer database for management of strength properties of timber [FRI-237/ FPD (TM) – 44/ 2003-2004]

Findings: Electronic database of available physical and mechanical properties of timber species tested so far since 1911 belonging to 510 records has been prepared. Various calculations of suitability indices and safe working stresses of timber species has been completed and tested.

Project 10: Effect of moisture content on (a) resonance frequency of timber and in turn on dynamic MOE and (b) microwave absorption [FRI-239/ FPD (TM) – 46/2003-2004]

Findings: Testing of wooden samples at 20 different moisture content levels (varying between 95% to 10%) by Vibration non-destructive testing method and conventional destructive method were completed for developing calibration for MOE. The MOE value increases with decrease in moisture content. Testing of samples by microwave absorption method at three different thicknesses (ranging from 0.5 to 1.5 cm) at 20 different moisture contents has also been completed. The data revealed that relationship between microwave absorption and moisture content is non-linear.

Project 11: Evaluation of physical and mechanical properties of *Acrocarpus fraxinifolius* and classification and grading of timber for different end uses [FRI-238/ FPD (TM)– 45/2003-2005]

Findings: All testing has been completed. Data analysis and final report preparation is in progress.

Project 12: Green-dimensioning aspects of Bamboo and Eucalyptus processing [FRI-200/ FPD (WWF)-40/2002-2005]

Findings: The study indicates that the green Bamboo dries faster while working on it. The study also indicates the importance of water curbing – preservative applications while working with green Bamboo. An artisan friendly multipurpose and ecofriendly staining cluster treatments were developed which can be used for handicraft sector for making decorative products from Bamboo. The study also highlights the importance of working with green Eucalyptus at different cutting angles, which helps in rapid air-drying without any appreciable degrade. Further, different finishing treatments were developed on Eucalyptus for surface improvement and weathering trials for three months indicates the reduction in gloss for all the nine different treatments.

Project 13: Contribution of soil minerals for sustainable management of Uttaranchal forest [FRI-240/FSLR-16 /2003-2005]

Findings: The study was carried out in Dhanaulti and adjoining blocks of Jaunpur range, Mussoorie forest division (Uttaranchal). There is mutual relationship between vegetation and soil in the study area, which is governed by climate, aspect and other factors. It has been observed that *Cedrus deodara* forests occur in the soils of Mollisols order whereas *Pinus roxburghii* and *Quercus leucotrichophora* occur in the soils of Inceptisol order. The results of the study revealed that the impact of geology on vegetation is evident in some sites. Observations indicated that *Cedrus deodara* grows well on limestone, dolomite, quartzite and shale whereas *Pinus roxburghii* and *Quercus leucotrichophora* flourishes on phyllite, slate, sandstones, slate shales etc.

Project 14: Development of computer based forest soil information system for India [FRI - 241/ FSLR–17/ 2004-2005]

Findings: Computer based "Forest Soil Information System for India", a programme (software) was developed to feed the forest and soil information. Data of 300 profiles were collected processed, tabulated and entered in the database of the software. Data on forests of different states and union territories were also fed in the database of the software.

Project 15: Introduction of commercially important medicinal plants in the NWFP Nursery, Dehradun [FRI-205/NWFP-10/2003-2005]

Findings: Medicinal plants were collected from Dehradun and adjoining areas and introduced in NWFP Nursery at FRI, Dehradun. The germplasm collected earlier was maintained and multiplied. Studies have been initiated to

propagate high altitude medicinal plants – *Microstylis wallichii*, *Berginia ciliata, Valeriana jatamansi* and *Swertia chirata* by following non-destructive methods at lower elevation (NWFP Nursery, Dehradun). Preliminary observations have revealed that these species can be cultivated at lower elevation.

Project 16: Development of cultivation methods of some commercially important medicinal plants *Desmodium gangeticum* and *Oroxylum indicum* [FRI-204/NWFP-9/ 2002-2005]

Findings: Cultivation trials of *Desmodium gangeticum* and *Oroxylum indicum* under *Eucalyptus* hybrid and *Prunus cerasoides* plantations as well as under open field conditions were finalized.

Project 17: Evaluation of production and quality parameters of seeds from seed production area vis-à-vis natural stands of Chir [FRI-209/Silva-18/2002-2005]

Findings: Only minor differences in terms of germination percentage, mean germination time, seedling survival, growth period etc. were observed on comparison of seeds from cones, from Seed Production Areas (SPAs) and unculled stand outside SPA.

Project 18: 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]

Findings: Proto-type root trainer carrier were designed and developed. Two such carriers fabricated were subjected to field trial but both the root trainer carriers were not found suitable during field trial. The design of the root trainer carrier was modified.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

Project 1: Inventorization and monitoring of biodiversity of threatened wetland sites of Doon valley and surroundings, Uttaranchal [FRI-250/Bot-33/2003-2006]

Status: Floristic surveys in wetland sites of Karwa Pani, Teen Pani, Asan Barrage, Mathronwala, Jaitigaon, Shahjahanpur, Shakumbari Range of Siwalik, Golattapur and Nakaraunda areas of the Doon Valley and surroundings were carried out. Loss of wetlands due to the conversion of the areas for urbanization, road construction, industrialization, and introduction of alien species exotics to the region was observed. Taxonomical evaluation and nomenclature update of 100 species typical of wetland sites were made for systematic accounting.

Project 2: Inventorization of multipurpose trees and shrubs for domestication and their implication in agroforestry for socio-economic upliftment of rural sector of Dehradun [FRI-199/SF-5/2002-2008]

Status: Growth parameters such as height and diameter were recorded for tree species planted in field along with crops. Crop yield was also recorded.

Project 3: To develop propogation technique i.e. micro-propagation of economically important Bamboos - *Arundinaria falcata* and *Bambusa balcooa* [FRI-219/G&TP-10/ 2002-2006]

Status: Axillary bud cultures were continued. Optimal medias were formulated for shoot proliferation from seed explants. *In vitro* shoot multiplication and maintenance carried out on a defined medium. Different types of plant

hormone were tested for the induction of *in vitro* rooting in shoots induced. Somatic embryo were germinated and experimented continued for their further development.

Project 4: Studies on isolation and characterization of polysaccharides of abundantly available seeds of trees/shrubs, leaves, bark and exudate gums [FRI-51/ Chem-1]

Sub-project (vii): Chemical investigation of *Prosopis juliflora* seed polysaccharide (2000–2005)

Status: Partial hydrolysis of *Prosopis juliflora* seed polysaccharide was carried out. Five oligosaccharides have been identified by preparative paper chromatography and their isolation is in progress. Methylation studies of galactomannan polysaccharide was carried out followed by its hydrolysis.

Sub-project (ix): Chemical investigation of *Dalbergia sissoo* leaf polysaccharide (2002-2005)

Status: Methylation of polysaccharide was done by Hakamori's method. Alditol acetate of methylated polysaccharide was prepared after hydrolysis. G.L.C. analysis of methylated polysaccharide in the form of alditol acetate has been carried out. Methylation study of oligosaccharide O-1 is in progress.

Sub-project (x): Chemical modification of Tamarind Kernel Powder (TKP)

Status: Quaternization and cyanoethylation of TKP completed which resulted in production of water soluble quaternized TKP of DS 0.61 and cyanoethylated TKP of DS 0.53 having apparent viscosity of 60 cps (2%) and 2112.5 cps (2%), respectively.

Sub-project (xi): Chemical modification of *Cassia occidentalis* seed gums

Status: Graft copolymerization of *Cassia occidentalis* seed gum with vinyl monomers (acrylamide, acrylonitrile and methylmethacrylate) was completed. Optimized grafted products were also characterized by FT-IR.

Project 5: Phytochemical examination for the utilization of leaves, barks, fruits and roots of Indian forest trees [FRI-53/Chem-3]

Sub-project: Screening of medicinally important plants (i) *Achyranthes aspera,* (ii) *Casearia tomentosa* and (iii) *Clematis roylei* [2002-2006]

Status: Extraction of *Achyranthes aspera* parts with petroleum ether, acetone and methanol to prepare the extracts of different polarity was carried out. Identification of sugars in three saponins isolated earlier was completed. Oleanolic acid was identified as aglycone. Permethylation and preparation of alditol acetates was also done for saponins. Petroleum ether extract of leaves, stem, and roots and methanol extract of seeds and root exhibited significant antioxidant activity. Different extracts of *Casearia tomentosa* bark were prepared. b-sitosterol and another pure compound were isolated from the petroleum ether extract of the bark. Conditions were optimized for the isolation of dye from the bark. Different extracts of *Clematis roylei* were prepared. The alcohol extract exhibited good anti-inflammatory, analgesic, antipyretic and antifungal activities. A pure compound was isolated from the alcohol extract.

Project 6: Chemical modification of cellulose and its industrial uses [FRI-194/Chem-8/ 2002-2006]

Status: Reaction conditions were optimized to produce a *non newtonian* pseudoplastic cold water soluble carboxymethyl cellulose of DS 0.98 having apparent viscosity of 75 cps (1% solution)

from cellulose obtained from *Dendrocalamus strictus* and organosoluble cyanoethyl celluloses of DS 2.2 and 2.5 from the cellulose obtained from *D. strictus* and cotton linters, respectively.

The carboxymethyl cellulose prepared from *Lantana camara* may find application particularly in oil well drilling operations, textile printing and in pharmaceutical preparations where carboxymethyl cellulose of low viscosity is needed. *Lantana camara* seems to be a potential feedstock for producing alpha cellulose and its derivatives for a variety of applications having thereby a way for management of this obnoxious weed by its utilization into products of commercial importance.

Project 7: Study of plant responses to air pollution for air quality monitoring in Dehradun [FRI-231/Eco-11/2003-2006]

Status: Active biomonitoring of air pollutants was performed. Total five bioindicator stations including urban and sub-urban sites, close to streets with heavy and light pollution load were identified and FRI was treated as control site. Anti Pollution Treatment Index (APTI) of five species (*Mangifera indica, Cassia fistula, Eucalyptus* hybrid, *Grevillea robusta* and *Dalbergia sissoo*) was calculated to find out sensitive, indermediate and tolerant species.

Project 8: Bio-ecological studies on the insect pests of Bamboo and their management [FRI-144/FED-8/2001-2006]

Status: Bio-ecological studies on hispine culm borer of Bamboo *Estigmina chinensis* have been completed. The beetle appear in May – June and after mating lay 14-20 eggs on the surface of internodes in groups of 2-5 eggs, incubation period of eggs lasts for 7-10 days, larval period 15-25 days and pupal period recorded was 8-9 days. The pharate beetle thus formed remains in the pupal chamber for rest of the year. Life cycle is annual. The incidence of various insect pests feeding on Bamboo was recorded at four locations (one at New Forest, Two in Kalsi Soil conservation Division. Dharmawala and Shabhawala and one in Dehradun Forest Division, Karwapani).

Project 9: Bio-ecology of insect pests of Paulownia and enumeration of their natural enemies [FRI 196/FED-11/ 2002 – 2007]

Status: Moderate infestation of insect species including *Orgyia postica, Spilarctia obliqua, Helicoverpa armigera, Spodoptera litura, Hyposidra talaca, Euproctis* sp. and *Dasychira* sp. was observed on the foliage of *Paulownia* in nursery and plantations at New Forest, Sahaspur, Devipur (Uttaranchal), Saharanpur (U.P.) and Yamunanagar (Haryana). Larvae of *Acherontia* sp. were observed defoliating at Saharanpur and Devipur only. Chrysoemlid beetles, *Altica* spp., *Miochira gracilis* and *Mimastra cyanura* along with phytophagous pentatomid bugs *Dolycoris* sp., *Erthesina fullo* and *Nezara viridula* were observed feeding on Paulownia leaves. During field surveys in Paulownia nurseries some new lepidopterous larvae were found feeding on the foliage of Paulownia. Larvae fed Paulownia foliage gregariosly and underwent seven moults before pupation. The fully grown larvae measured 8-9 cm in length and total life cycle was 85-122 days. Adult moth was identified as *Eupterote undata* (Lepidoptera : Eupterotidae). This was the first record of the pest on Paulownia.

Studies on the biology of *S. obliqua* was conducted. A mated female on an average laid 1200 eggs, which hatched in 3-4 days. Larva underwent five moults over a period of 32-34 days. Pupal period was of 8-10 days and life cycle was completed in 43-48 days.

Project 10: Integrated pest management of mandate species in nurseries and plantations with special reference to biopesticides and microbial pesticides [FRI-198/FED-13/2002 – 2007]

Status: Seasonal life cycle of many important pests viz. *Plecoptera reflexa, Dichomeris eridantis, Cosmotriche laeta, Apoderus blandis, Orgyia postica* and *Eupterote undata*, on *D. sissoo, Clostera cupreata, Parasa lepida, Bellipa lohor, Eupterote undata, Euproctis* sp., *Hyposidra talaca* and *Neocerura wisei* on Poplar is in progress in the laboratory.

Project 11: Evaluation of *Chrysoperla carnea* for predation potential against the key defoliator of *Dalbergia sissoo* and Populus [FRI-232/FED-15/2003–2006]

Mature and pre-pupation larvae of Shisham defoliator *Plecoptera reflexa*

Status: Survey of *Dalbergia sissoo* and Populus nurseries and plantations was carried out at Chhachrauli Forest Range Haryana, Bahadarabad (Roorkee Range), Kainchiwala, Jhajra Forest Range, Ghamandpur, Barkot Forest Range, Bhaniawala, Lacchiwala Forest Range for the collection of Shisham defoliator, *Plecoptera reflexa* and predator *Chrysoperla carnea*. During the course of survey light to moderate defoliation by *P. reflexa* was observed in the plantation from April to October-November. Eggs of *Chrysoperla carnea* were collected from the field, brought in the laboratory and reared at 27°C. The eggs hatched into alligator shaped larvae. All the larval stages were predatory on eggs and larvae of *Plecoptera reflexa*. Laboratory experiments revealed it as an excellent predator.

Project 12: Upgradation and computerisation of National Insect Reference Collection (NIRC) [FRI-233/ FED-16/2003–2006]

Status: (a) Taxonomy of Parasitic Micro–Hymenoptera : Described five new species of parasitic Hymenoptera, four belonging to family Encyrtidae viz. *Caenohomalopoda longistylata, Metaphycus cassiae, Astymachus felix* and *Cheiloneurella indica* and one belonging to family Braconidae viz. *Spasskia indica*. *Clausenia purpurea* Ishii and *Ooencyrtus corbetti* Ferriere (Hym : Encyrtidae) were reported for the first time from India. *Ooencyrtus corbetti* was recorded from a new host – eggs of *Podontia affinis* (Coleoptera : Chrysomelidae).

Spasskia Belokobylskij was reported for the first time from India and the Oriental region. It is first species under the genus with known host record bred from larvae of *Chlorophorus strobilicola* (Coleoptera : Cerambycidae) infesting cones of *Pinus roxburghii*.

Work on the taxonomy of *Psyllaephagus* spp., which is parasitoids of gall making psyllids and kept unidentified in NIRC, was undertaken. Out of this collection ten have been identified as undescribed species. Taxonomy of encyrtid parasitoids of Diaspidid scales – two species of genus *Neococcidencyrtus*, *Adelencyrtus* and *Coccidencyrtus* was done. These are new species. A new species of *Euderus* parasitising *Alcidodes ludificator* (Curculionidae) a serious pest of *Gmelina arborea* nursery and young plants in the North-East India was described.

(b) Computerization of NIRC: Data of 1500 species was incorporated into the database belonging to families Curculionidae, Cucujidae,

Discomatidae, Dytiscidae, Derodontidae, Elateridae and Cicindelidae of order Coleoptera. Database now contains information of about 3800 species with 21,318 specimens belonging to 8769 localities.

Project 13: Identification and updating of Braconid parasites (Hymenoptera) of major insect pests in National Insect Reference Collection (NIRC) and Doon Valley [FRI-234/ FED-17/2003 –2006]

Status: Work of survey, collection and identification services were provided by NIRC.

Project 14: Management of natural resources as affected by the socio-economics of rural people of Jhajra watershed in Dehradun district [FRI-251/SF-7/2004-2005]

Status: Surveys, collection of data, data analysis and interpretation of data has been completed in all villages.

Project 15: Studies on enhancement of natural durability of Bamboo and plantation grown species with conventional/eco-friendly preservatives [FRI-236/FPD (WP)-43/ 2003-2006]

Status: *Bambusa balcooa* and *Bambusa nutans* were treated with VAC- FRI, Bouchrie diffusion and Wick process with Borax Boric Acid to compare the retentions and performance in field conditions.

A new complex ZiBOC revealed high efficacy against brown and white rot fungus in laboratory. Termite mound test of ZiBOC treated Pine and Poplar samples showed 1-3 % weight loss as compared to control where in Pine and Poplar 13% and 98% weight loss was observed respectively

Neem Oil exhibited high efficacy against brown and White rot fungus in Petri plate bioassays at 15% concentration of crude oil. Methanol and ethanol Neem leaf extractives treated Poplar samples exhibited high efficacy against termites in bottles bioassays as compared to control samples.

Project 16: Exploration of copper lignin complexes for wood preservation and effect of post treatment processes on precipitation or fixation in wood [FRI-252/FPD (WP)-44/2003-2006]

Status: Chir and Mango wood samples were treated with different concentrations of Lignin Copper complex A and B. Chir showed high protection at 0.2% concentration of A and B salt in accelerated field trials whereas Mango wood samples treated were affected mainly by soft rot fungus and slight to moderate infestation by termite and fungus could be seen.

Few formulations viz. calcium hydroxide, copper sulphate, reetha extract, cuprous oxide, sodium fluoride and copper complex A and B were tested at different concentrations against sap fungus in *Poplous deltoides* wood. Comparative study revealed high protection by reetha extract, copper lignin complex A and B and sodium fluoride. 100% of reetha extract 1,2 and 4% of Complex A and B and 4% of sodium flouride extract were found effective.

Black liquor and copper sulphate double spray on Poplar revealed good protection against sap stain fungus at 100% humidity.

Project 17: Evaluation of fertilizers effect on medicinal plants in watershed area for production and productivity [FRI-242/FSLR-18/2003-2005]

Status: Field experiment conducted in Kulhal watershed area of Dehradun Forest Division, Dehradun was maintained. Growth observations (height and tillers) of transplanted plants in fertilizer treated and untreated plots were

recorded. Soil profile study was conducted and samples collected. Representative plants from treated and untreated plots were uprooted, washed and root and shoot biomass recorded. Soil samples for important physico-chemical properties and plant samples for oil content were analyzed. Data were tabulated for statistical analysis.

Project 18: Evaluation of Australian seed sources and families of *Eucalyptus tereticornis* for productivity and genetic improvement [FRI-203/G&TP-9/2002-2006]

Status: Observations with respect to various morphological traits have been recorded of trials established at Midnapur (West Bengal) and FRI campus. The first year growth data of three sites viz. Midnapur, Chiryanpur and FRI campus was analyzed. A significant difference between the families and seed sources was found in respect of various traits. The growth data of all three sites was used to check the provenance x site interaction. A significant interaction was observed for height and number of branches. However, for collar diameter and survival it was non-significant. Linear relationships were also established between the growth traits of different sites and the geographical coordinates of the provenances. Inter provenance controlled crossing was attempted in 15 trees at FRI campus. The parents selected for this hybridization were chosen based on the initial outstanding growth performance from the same trial.

Project 19: Development of protocol for clonal multiplication and germplasm conservation of some medicinal plants [FRI-243/G&TP-14/2003-2007]

Status: Multiplication achieved after sub culturing of *Oroxylum indicum* on to MS medium with BAP. Rooting of *in vitro* grown shoots of *Oroxylum indicum* from epicotyls explants was achieved.

Project 20: Assessment of Shisham die back (decline) in Northern India and its remedial measures [FRI-245/Path-12/ 2003-2008]

Status: The mortality areas were identified on the basis of divisional surveys. Localities with more than 70% mortality were selected in H.P., Haryana, Punjab, Delhi, Uttaranchal, U.P. and Bihar. The pathogenicity trials were conducted taking spores of *Fusarium solani* in a suspension and inoculating one month old seedlings. Nearly 50% seedlings died within 15 days of inoculation whereas the majority died after one month. The pathogen was re-isolated from diseased roots. The seeds of Shisham were collected from healthy trees growing in heavily diseased localities from North Indian states. They were germinated on sterilized soil mixture and inoculated artificially by spore suspension of *Fusarium solani* by root dip method. On the basis of mortality of seedlings they were categorized into 4 groups viz. very resistant, resistant, susceptible and very susceptible. The resistant provenances identified were Rakh Bhuru, Sohagana and Kathu Nangal in Amritsar and Bir Shikargah in Kapurthala, whereas Kangra, Vikas Nagar, Jagadari and Ambala were identified as susceptible provenances. The resistant provenances identified in the pathogenecity trails were further stressed by dipping the roots for 10 days in water. They were extracted and inoculated with *Fusarium solani* spore suspension for 24 hours and then planted in soil in RBD model. Observations were taken regularly and it was observed that 90% of seedlings dried after 30 to 40 days of inoculation. In control plants the mortality was less than 10%. Thus, creating stress conditions could break resistance of seedlings. The experiments with use of *Pseudomonas fluorescence* showed no mortality in control, total mortality in *Fusarium solani* infected seedlings, no mortality in *Pseudomonas*

fluorescence treated seedlings, 80% survival in *Pseudomonas fluorescence* + *Fusarium solani* treated seedlings, 10% survival *Fusarium solani* + *Pseudomonas fluorescence* treated seedlings and 90% survival in a mixed treatment *P. fluorescence* + *Fusarium solani*. The results indicate a positive response of *Pseudomonas fluorescence* if seedlings were given a protective treatment of the bacterium before infection with *Fusarium solani.*

Project 21: Screening for disease resistance in genetic material raised under tree improvement programmes [FRI-207/Path-13/2002-2007]

Status: Screening for disease resistance done in CSOs and SSPAs of *Dalbergia sissoo* at Lacchiwala (Dehradun), Paonta Sahib (H.P.) and Bhitmera (Hissar - Haryana) and for *Euclayptus tereticornis* at New Forest campus. Only two clones No. 194 (Hasanpur Beat, Tulsipur Range, Gonda Forest Division) and No. 255 (Lalpani Beat, Rishikesh Range, Dehradun Forest Division) continued to exhibit resistance against *Ganoderma lucidum* root rot in CSO of *D. sissoo* at Bhitmera, Hissar, whereas No. 80 (Hanumangarh Range, Sriganganagar Forest Division) was found to be the most susceptible clone. In Australian source material of *Eucalyptus camaldulensis* drying up of tips was noticed and a basidiomycetous fungus has been isolated and identified as *Schizophyllum commune*. Pathogenicity tests were confirmed. Die back of leader shoots in *D. sissoo* caused by *Colletotrichum gloeosporioides* was observed in genetic material raised in nursery. Leaf blight disease in *D. sissoo* due to *Colletotrichum gloeosporioides* causes severe necrosis of leaves during the active growing period. Therefore, screening tests were conducted with 20 clones of *D. sissoo* for disease resistance. The causal fungus, *Colletotrichum gloeosporioides,* was isolated and mass culture was prepared. Three clones No. 9, 41 and 66 were found resistant, whereas clone No. 57, 62, 84, 121, 203 and 266 were the most susceptible ones. Screening for diseases resistance was also conducted against *Rhizoctonia solani*, another leaf blight pathogen, which causes severe premature defoliation during the active growing period. All the ten clones exhibited susceptible reaction in the screening tests.

Project 22: Biological control of *Lantana camara* and *Parthenium hysterophorus* by fungal pathogens [FRI-206/Path-12/2002-2007]

Status: *Lantana camara* and *Parthenium hysterophourus* plant samples showing disease symptoms were collected and associated pathogens were isolated. To increase the efficacy of the propagules of *Sclerotium rolfsii* and *Alternaria alternata* on Parthenium, adjuvants viz. APSA 80, Agrowet 101, Indtron AE and shampoo were tested in laboratory conditions. For studying the synergistic effect of herbicides viz. Atrazine, 2,4 D Ethyl Ester, 2,4 D Sodium salt, Paraquat, Glyphosate, Mop up, Lasso and table salts were screened against germination of the fungal propagules of above species. In case of *Alternaria alternata,* the adjuvants were also tested in glass house along with the conidia in tank mix. Different pathogen species viz. *Colletotrichum gleoesporioides, Curvularia lunata, Fusarium solani* and *Fusarium* sp. and two unidentified species were tested on *Lantana camara* in glass house conditions. An unidentified fungal pathogen caused mortality when combined with sub lethal doses of gylphosate in glasshouse experiments.

Project 23: Economics of cultivation of commercially important medicinal plants [FRI- 246/ RSM-14/ 2003-2006]

Status: Relevant literature from various sources was consulted. Surveys were conducted for identifying farmers/growers of medicinal plants in the states of FRI jurisdiction. Data on cost and benefit aspects of cultivation of medicinal plants

were collected for Kalmegh, Tulsi, Satavar, Ratti and Aswagandha from the cultivators of Karnal and Yamuna Nagar districts in Haryana. Cultivators of medicinal plants were also selected in Pithoragarh district and data on cost and benefits of Kuth (*Saussurea costus*), Dolu (*Rheum australe*), Kutki (*Picrorhiza kurroa*) and Salampanja (*Dactylorhiza hatagirea*) were collected from them. Data is being analysed.

Project 24: Development of suitable silvicultural practices for JFM [FRI-180/ Silva– 14/2001-2006]

Status: Data with respect to socio-economic structures and ecological conditions of the protected as well as unprotected forests from two JFM villages of Ramnagar Forest Division have been collected, compiled and analysed. The sampled data of the JFM villages from Uttaranchal are being analysed for preparation of the final report of the project.

Project 25: Working Plan for Reserved Forest of Forest Research Institute Estate [2001-2010]

Status: Data on various parameters constituting inputs and outputs has been collected and documented.

Project 26: Contribution of forestry and human development index of forest dependent community of Jaunsar area [FRI-248/Stat-1/2003-2006]

Status: Secondary and primary data have been collected. Primary data has been collected from 15 villages and preliminary analysis has been done.

NEW PROJECT INITIATED DURING THE YEAR 2004-2005

Project 1: Studies on the termite diversity of Northern India with special reference to species composition in relation to different tree species (Insecta: Isoptera) [2004 – 2007]

Status: Studies were carried out on the unidentified collection in the National Insect Reference Collection and identified 13 species belonging to the families Rhinotermitidae and Termitidae (Isoptera). A new species of the genus Nasutitermes has been identified and details are being worked out. Besides, 89 vials of termites from Goa have been identified and the manuscript with new species and new distributional records was prepared. A key to the identification of the genus Microcerotermes has been updated and revised.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

(Externally Aided)

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]

Findings: A total of 73 generas, 179 species and more than two hundred sixty two NFPs i.e., herbs, shrubs, climbers and tree were surveyed and study areas of Garhwal Himalayan Region (GHR) at the various altitudes during the survey works were identified.

Project 2: Screening and identification of fast growing fuelwood and fodder species for higher biomass projection in Garhwal Himalaya [FRI-162/Bot-23/External/ 2001-2004]

Findings: The three species namely *Grewia optiva, Celtis australis* and *Quercus leucotrichophora* were found the most important fodder tree species having overall acceptability and major demand for planting by the villagers at three studies sites. The villages situated at tropical and sub-temperate climate prefer *Ougeinia oojeinensis*, *Bauhinia* species, *Terminalia*

alata and *Ficus* sp. as fodder species. The most liked fuelwood species were *Morus alba, Melia azadirach, Dalbergia sissoo* and *Toona ciliata* at tropical and sub-tropical climate. However, *Quercus leucotrichophora* were found most valuable and important fuel wood species in temperate areas. The *Alnus nepalensis* was also utilized as a fuelwood by the villagers at temperate altitude. Among all species, the seeds of *Quercus leucotrichophora* showed maximum germination percent and survival at all three nurseries followed by *Bauhinia purpurea, Melia azedarach* and *Ougeinia oojeinensis*. In respect of growth parameters, the maximum height and collar diameter were recorded in *Grewia optiva*, *Leucaena leucocephala* and *Bauhinia variegata* at 640 m altitude. However, at Jarmola (1800 m), maximum height was observed in *Prunus armeniaca* and at Sandra (1200 m) in *Prunus persica*. Maximum number of leaves was found in *Ougeinia oojeinensis* at Dehradun. While, at Sandra and Jarmola, maximum numbers of leaves were recorded in *Prunus armeniaca*. However, at all the three altitudes, *Prunus armeniaca* exhibited maximum number of leaves. Total biomass was observed maximum in *Morus alba* followed by *Ficus glomerata, Leucaena leucocephala* and *Ficus racemosa* at Dehradun however at Sandra, *Terminalia alata* and *Aesculus indica* had the maximum biomass. At Jarmola, *Prunus persica* exhibited the highest biomass followed by *Morus serrata, Populus ciliata* and *Salix alba*. At all the three altitudes, *Quercus leucotricophora* was found to be photosynthetically most efficient followed by *Bauhinia purpurea* and *Grewia optiva*. At all the three altitudes, the maximum Nitrogen content was found in *Prunus persica* at 1800 m and Potassium content in *Toona ciliata* at 640 m, while Calcium and Magnesium content was found maximum in *Celtis australis* and *Toona ciliata* at 640 m altitude. Maximum content of crude protein on dry basis in the leaves of fodder species was found in *Grewia optiva* at 640 m altitude in *Bauhinia variegata* at 1200 m altitude and in *Quercus leucotrichophora* at 1800 m altitude. In all the fodder and fuelwood species, the maximum calorific value (KJ/g dry weight) and Fuelwood Value Index was found maximum in *Toona ciliata* and *Sapindus mukorossi* respectively.

Project 3: Eradication of Lantana by underplanting with Bamboo [FRI/227/Bot-33 /External/2003-2004]

Findings: Studies were conducted to evaluate the physiological potential of Bamboo for suppression and ultimately eradication of lantana in Kandi Areas of Punjab, with a view to developing a silvicultural method for control and eradication of *Lantana camara*. Two species of Bamboo viz., *Dendrocalamus strictus* and *Bambusa bambos* were taken up and the trial was laid at 3 sites in Kandi area of Punjab. Since the project period was very short, no definite conclusion could be drawn.

Project 4: Production of alpha cellulose from *Lantana camara* and its chemical modification for industrial applications [FRI-226/Chem-11/ External/2003-2005]

Findings: Results show that *Lantana camara* can be considered a viable source of a- cellulose. The alpha cellulose yield from *Lantana camara* was 38.76%. It contained 94.8% alpha cellulose, 0.48% ash content, 0.8% lignin, 2.5% gamma cellulose, 1.42%beta cellulose (by difference), 81% brightness, 576 cm^3 gm viscosity and 430 degree of polymerization.

Lantana camara, therefore, has a potential for producing alpha cellulose and its derivatives for a variety of applications paving way for management of this obnoxious weed by its

utilization into products of commercial importance.

Project 5: Impact of disturbances on biodiversity status, resource availability and their management for sustainable development in Kandi areas of Punjab [FRI-228/ Eco-10/External/2003-2005]

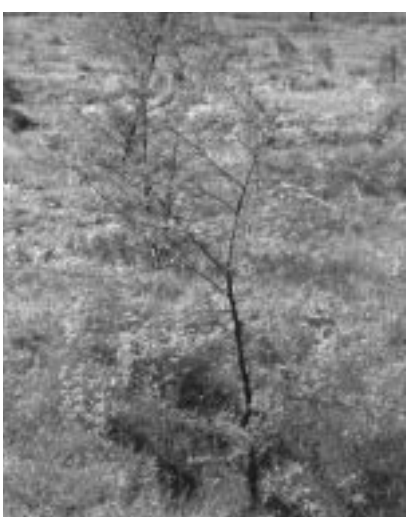
Findings: Ten plant species were identified as new records for the state of Punjab. Low content of nitrogen (0.024%) was recorded in highly disturbed sites which was slightly higher in moderately disturbed (0.034%) and high percentage in least disturbed site (0.04%). Carrying capacity of disturbed sites was recorded quite low (0.1 cow ha^{-1} to 3.3 cow ha^{-1}) than that of protected/natural forests (12.2 cow ha^{-1}).

Project 6: Study on soil/site for optimizing biomass productivity [FRI-229/ FSLR-115/ External/2003-2005]

Findings: Six field experiments were carried out in three types of variations occurring in the Kandi area of Punjab i.e., steep slopes, boulder tract and torrents (*Cho* beds). On the basis of survival, height and collar diameter of 15 species tested in boulder tract (Bhadiyar, Ballachaur Forest Division) *Melia composita*, *Dalbergia sissoo*, *Acacia catechu* and *Tectona grandis* were found more suitable whereas Eucalyptus and *Bauhinia variegata* were found least suitable. *Melia composita*, *Acacia catechu*, *Acacia nilotica, Albizia procera* and *Dalbergia sissoo* were found more suitable and *Bauhinia variegata* was found least suitable, out of the 15 species tested in *Cho* beds (Chaksadhu, Hoshiarpur Forest Division). In the sloppy area of Chakkarh (Pathankot Forest Division) *D. sissoo, M. composita, B. variegata* and *T. arjuna* were found most suitable while Eucalyptus was not found suitable. Vermicompost was found to be the superior source of organic manure in comparison to farmyard manure and compost at all the experimental sites.

Project 7: Consultancy for operationalization of seedling production through clonal technology in Punjab [FRI-171/G&TP-8/ External/2001-2004]

Findings: Consultancy was taken up from Punjab forest department to render expert advise and guidance for the development of macro-propagation facilities, setting up multiplication garden of Eucalyptus, *Dalbergia sissoo* and Poplars. For achieving these objectives three training programmes were conducted. Training was imparted to 196 forest officials of the rank of Range Officers, Foresters and Forest guards on tree improvement, clonal propagation, management of multiplication garden, pathological and entomological aspects in nursery and plantations etc. Technical know how was imparted and two mist chambers were constructed at Hoshiarpur. Multiplication garden of Eucalyptus, *Dalbergia sissoo* and Poplars were established and handed over to the Punjab Forest Department.



Acacia nilotica proved suitable for Cho beds at Chaksadhu, Hoshiarpur

Project 8: Central scheme for development of Agro-techniques and cultivation of medicinal plants used in Ayurveda, Siddha, Unani and Homeopathy [FRI-173/ NWFP-8/ External/2003-2005]

Findings: Cultivation packages for *Elaeocarpus ganitrus, Prunus cerasoides, Habenaria intermedia* and *Microstylis wallichii* were developed. Demonstration plots of *Elaeocarpus ganitrus* and *Prunus cerasoides* were maintained. The flowering and fruiting has been recorded in both these species. The fruit production in *E. ganitrus* per tree basis is being recorded. It has been observed that early fruiting can be initiated through air layered propagated plants.

Project 9: Value assessment of plantations raised by Indian Farm Forestry Development Cooperatives Ltd. in Sultanpur, U.P. [FRI–220/RSM-13/External/ 2003-2004]

Findings: Field works and data analysis were completed and final report is being prepared. Results show that Shisham is the main species having (54.2 %) of the total number of trees followed by Prosopis (12.2%) and Eucalyptus (11.9%). The growth of Shisham is quite slow i.e., almost equal or comparable to the average site quality. The total value of the plantations of all the societies is Rs.10.89 crores. The future yield at 20, 25 and 30 years have also been predicted.

Project 10: Development of community based market information services for medicinal plants of Uttaranchal [FRI-215/RS&M–12/ 2002-2005]

Findings: Eleven issues of "Quarterly Newsletter on Market Information on Medicinal Plants" were published by the institute. It included prices of selected species at Delhi, Ramnagar, Saharanpur and Tanakpur market, price trend analysis of selected species, cultivation techniques of important species and information about the markets as well as annual requirement of certain industries of Uttaranchal.

Project 11: Medicinal and aromatic plants technologies trade and commerce [FRI-284/ Silva-21/External/2004-2005]

Findings: The amount was provided by National Medicinal Plant Board to the Indian Forester for bringing out a special issue on Medicinal and Aromatic plant Technologies Trade and Commerce. The issue was brought out in the month of March, 2005.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Problem of forest regeneration of Sal (*Shorea robusta*) and associates in Dehradun Forest Division with special reference to fire, overgrazing and human interference [FRI-256/ Bot-35/External/2004-2006]

Status: Assessment of regeneration status of *Shorea robusta* (Sal) in three selected localities (Raipur, Lacchhiwala and Barkot Range) of Dehradun Forest Division of Uttaranchal was undertaken and the regeneration was quantified. Soil samples were also collected from all the three locations with special reference to burnt, unburnt, human interference, grazing and control areas for analysis of mineral components. Phosphorus and organic carbon were analyzed in soil samples.

Project 2: 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]

Status: Growth data for height and diameter of different aged plantations of *Acacia catechu*,

Poplulus deltoides, *Melia azedarach*, *Melia composita*, *Acacia nilotica*, *Albizia procera*, *Dalbergia sissoo*, *Eucalyptus* sp., *Morus alba* and *Terminalia arjuna* were collected from the departmental plantation of Ludhiana Forest Division. It comes under agro-ecological region no. 4 (Hot Semi-arid). Soil samples collected from study sites are being analyzed for chemical properties. Data collected in the field is tabulated and computed for further analysis. Climatological data for different ecological zones of Punjab was collected from the Punjab Agricultural University (PAU).

Project 3: Creation of Germplasm Bank of commercially important tree species of Punjab [FRI-178/Bot-28/External/2001-2005]

Status: Preparation of field map of fourteen selected project species for the proper establishment of Germplasm Bank. Seed collection of *Melia composita* from different regions of Punjab, Haryana, Himachal Pradesh and Uttaranchal was done. Seed sowing was done in the nursery of all the progenies of *Melia composita*.

Project 4: Development of suitable propagation technology of three *Terminalia* sp. [FRI-261/Bot-40/External/2003-2005]

Status: Field surveys in FRI Campus, Haldwani and Pant Nagar for distribution and availability of species in Uttaranchal region was carried. Vegetative propagation technology through mature cuttings as well as shoot cuttings in summer season was developed. Rooting in *Terminalia arjuna* has been done successful by using rooting harmones. Seeds of three *Terminalia* sp. were collected and sown. Collection of data on seed length, width, volume, vigour and its analysis are in progress.

Project 5: Micropropagation of Chir pine (*Pinus roxburghii*) and Shisham (*Dalbergia sissoo)* [FRI-222/Bot-13/External/2002-2005]

Status: Somatic embryogenesis was induced successfully from immature zygotic embryos. Somatic embryos were germinated and developed further on defined medium. Axillary bud differentiation was obtained from 20-25 days old seedlings, 10 years old hedges and from 20-25 years old trees. Seedling shoots were also cultured which gave best results. Adventitious bud differentiation was successfully induced on the surface of mature zygotic embryos of chirpine. Study of effect on phytohormones and sucrose was carried out. In *Dalbergia sissoo*, nodal segments were used as explant for *in vitro* multiplication of plants. Nodal segments were surface sterilized and cultured on medium supplemented with different plant hormones. A 90% ex-plant response was obtained.

Project 6: Network program for establishment of demonstrations of Bamboo plantations in Uttaranchal [FRI-257/Bot-36/External/2004-2007]

Status: Nodal segments (3-4 cm long with axillary buds) of *D. asper* were collected from young juvenile shoots of tissue culture raised 5 years old plant and the existing *in vitro* shoot cultures were used. The existing *in vitro* cultures were first multiplied and rooted *in vitro*. Later these tissue culture plants were hardened and acclimatized. Also T.C. plants available in the green house were macro proliferated and multiplied. Within a short period of 5 months 1200 plants were sent for plantation.

Project 7: Development of tissue culture technique for protocol development of *Bambusa balcooa* and *Melocanna bambusoides* [FRI-258/Bot-37/External/2004-2007]

Status: Selection for healthy clumps of *Bambusa balcooa* was done. Media preparation for inoculation of ex-plant and sterilization of ex-plant with different sterlizing agents were carried out and condition for sterilization was perfected. Inoculation of surface axillary buds were done in MS medium supplemented with cylocynin.

Tissue Culture raised plants of Bamboo

Project 8: Enrichment, improvement and development of botanical garden and species specific arboreta of FRI [FRI-260/Bot-39/External/2003-2005]

Status: Misting unit has been set up in the garden. Irrigation facilities are in progress. A number of rare, spectacular and threatened species have been introduced and conserved as live reference materials.

Project 9: Identification, taxonomy, properties and uses of different species of Shoreas of the Malay Peninsula [FRI-191/Bot-30/External/2002-2005]

Status: Variations in physical, gross and microscopic anatomical features of different species of Shorea of Balau group of Malay Peninsula have been studied. Variance ratio (F test) indicated that differences among the wood element dimensions of studied species of Shorea were significant for fibre-length, vessel-length, wall-thickness and fibre- diameter (a=0.05). Identification key in dichotomous pattern has been prepared on the basis of anatomical characters at species level for Balau group of Malay Peninsula. The dichotomy is based on a pair of contrasting characters e.g., presence vs absence of crystals, chambered vs non chambered crystals, presence vs absence of radial canal, maximum and minimum ray height, maximum and minimum ray width, maximum and minimum gum canal diameter, high frequency of vessels vs low frequency of vessels. Differences in quantitative characters are analysed using 't' test for the mean. Besides, features like density and types of gum canals are also used. The occurrence and location of prismatic crystals are found to be of diagnostic value on the species level.

Project 10: Bioconversion of lignocellulosics feed stock into ethanol as biofuel [FRI– 224/C&P-16/External/2003-2005]

Status: Proximate chemical analysis of *Lantana camara* and *Prosopis juliflora* was completed. Acid hydrolysis of *Lantana camara* and *Prosopis juliflora* with H_2SO_4, HCl and H_3PO_4 was performed under different acid concentrations (0.5%, 1.0%, 3.0%, 4.5% and 5.5%). Lignin was separated out from the hydrolyzate. The hydrolyzate was neutralized, purified, decolorized and concentrated. The hydrolyzate was decolorized using activated charcoal. Total sugars were determined using Dinitrosalicylic acid (DNSA) method. The purified hydrolysis product was sent for its bioconversion into biofuel.

Project 11: Chemical screening of the oilseeds of some high oil yielding tree species in the Himalayan region [FRI-223/Chem-9/External/2003-2006]

Status: Seeds of 9 plant species were collected and their fatty oil content and physiochemical properties were determined. Fatty acids from each were isolated by hydrolysis and their methyl esters were prepared.

Project 12: Chemical screening of the oilseeds and development of seed handling practices and plantation trial of some high oil yielding tree species in the Himalayan region [FRI-223/Chem-9/External/2003-2006]

Status: Seed maturation study on *Sapindus mukorossi* was done and November was found to be the suitable time for collection of seeds. The seeds of *Sapindus mukorossi* for raising the nursery stock were collected. To develop the nursery techniques, seeds were also sown in five different media. Observations were taken on germination, height, survival %, etc. at regular intervals. Demonstration Plot of *Sapindus mukorossi* was raised at two sites- 0.69 ha (681 plants) at FRI campus and 2.0 ha (2220 plants) in Compartment 1, Jakhan Block, Barkot range, Dehradun Forest Division.

Seeds of *Prinsepia utilis* were collected from Naagthaath, Haathipaon and Sukhi (Uttaranchal). Seeds were extracted from fruits, dried and subjected to germination test (in different media and temperature) and vigour tests. Nursery stock of about 2500 seedlings of *P. utilis* was raised for plantation.

Putranjiva roxburghii seeds were collected from FRI campus, Pinjore, Chandigarh and Mohali. Seeds were tested for germinability and viability. Seeds from Mohali gave about 93% germination whereas it was only 30% in Pinjore seedlot. Nursery stock of about 4500 seedlings of *Putranjiva roxburghii* has been raised for plantation.

3.7 kg kernel of *Sapindus mukorossi* and 7 kg of seed of *Prinsepia utilis* were supplied to Indian Institute of Petroleum for oil studies, fatty acid profile and machine test. The results show that its oil is suitable for use as a biofuel.

Project 13: Prospecting for botanical pesticides - an All India Coordinated Research Project [FRI-188/Chem-7/External/ 2002-2006]

Status: Eight extracts of three plants species were fractionated by Column Chromatography and 18 isolated fractions were sent for pesticidal screening. Eight fractions were found to be active.

Project 14: Identification, development and utilization of natural dyes from the forest plants of Uttaranchal [FRI-249/Chem-12/ External/2003-2006]

Status: Procurement, installation and commissioning of natural dye pilot plant and four colour fastness determining equipments were completed. Isolation and fractionation of the *Eucalyptus* hybrid and *Populus deltoides* bark dyes were carried out to isolate some pure compounds. The dyes consist of a complex mixture of polyphenols.

Project 15: Utilization of economic potential of parthenium [FRI-262/Chem-13/ External/ 2003-2006]

Sub-project (i): Preparation of alpha celloulose and hand made paper

Status: Experiments were conducted to optimize the conditions (water and alkali hydrolysis, pulping, bleaching with respect to chemical concentration and time) for preparation of alpha cellulose. The product so obtained was studied for its chemical composition (hemicellulose alpha cellulose and ash content).

Sub-project (ii): Preparation of composites from Parthenium

Status: The parthenium lignocellulosic material was isolated and converted into fibres, which

were analysed for physical properties for development of Medium Density Fibre Board (MDFB).

Project 16: Novel chemo-enzymatic technology for the food fibre from Guar/ *Cassia tora* Gums [FRI-225/Chem-10/ External/2003-2006]

Status: Reaction conditions were developed for the depolymerization of *Cassia tora* galactomannan using *Cassia tora* seed enzyme. Enzymes were also isolated from the guar seeds, and depolymerization of Guar, *Cassia tora* and *Cassia occidentalis* endosperm was achieved using guar enzyme. Depolymerization of *Cassia occidentalis* endosperm was also done under acidic conditions.

Project 17: Development of ecorestoration model for iron ore mines of Bihar and Orissa [FRI -179/Eco-9/External/2001-2006]

Status: Plant, soil and rock samples from all the selected sites viz., overburden dumps mined out benches, degraded areas in vicinity of mines and planted overburden dumps were collected and vegetation survey and litter collection was done in the permanent samples plots.

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

Status: The Garden of the Great Arc is situated in main campus of the Survey of India in the Hathibarkala estate in district Dehradun. Project is part of the work undertaken by MECON with funding from Department of Science and Technology. FRI is undertaking plantation and afforestation works in the garden with same theme gardens.

Project 19: Long term impact of monoculture on site productivity and resource conservation [FRI-177/Eco-08/External/2001-2005]

Status: Harvesting of Eucalyptus, Sissoo and Khair was done for biomass estimation and productivity. About 1500 component samples from all these trees were weighed for their fresh weight and dry weight, then powdered for analyzing their nutrient status. About 1000 samples of different plant components have been analyzed for different nutrients. Data entry, tabulation, interpretation and report writing is in progress.

Project 20: Evaluation of Radiata pine from New Zealand [FRI-184/FPD-38 (CW) External/2002-2005]

The study is comprehensive in nature and has been conducted in the following sub-projects:

Sub-project (i): Evaluation of natural durability and treatability under Indian conditions

Status: Natural durability test indicates the *Pinus radiata* to be non-durable in Indian condition. Samples of *Pinus radiata* and *Pinus roxburghii* treated with CCA at different concentration have been installed for field evaluation at Jodhpur and Dehradun.

Sub-project (ii): Evaluating the suitability for general purpose, shuttering, marine plywood and block board

Status: BWR grade plywood, concrete shuttering plywood, marine grade plywood, exterior grade block board and interior grade block board at pressure level of 10.5 Kg/cm^2 and 14.0 Kg/cm^2 do not meet the IS standards. However, in all above categories at pressure level of 17.5 Kg/cm^2 meet the IS standards. MR grade plywood does not meet IS standards at all the three pressures.

Project 21: To establish manufacturing process and market utilization of Eucalyptus wood for value added products for domestic and export market [FRI-185/FPD-39(WS)/ External/2001-2005]

Status: Studies on different sawing methods have shown that the modified quarter sawing gives better recovery (about 65%) after seasoning. The finishing properties of Eucalyptus were found to be comparable to those of Teak including retention. A full sports court covering 1040 sq. ft. area was constructed with flooring strips using tongue and groove jointing as a demonstration of utilization of plantation grown Eucalyptus.

Project 22: Utilisation of Sisal fibre for making composites and handmade paper [FRI-268/FPD-49/External/2004-2006]

Status: Preliminary experiments were carried out to prepare particle boards. Testing of these boards is being carried out as per relevant IS specifications.

Project 23: Biotechnological approaches for improvement of plant species with special reference to pulp and paper [FRI-267/FPD-48/External/2004-2006]

Status: Specific gravity of 20 trees has been determined. Work on chemical analysis has been initiated.

Project 24: Inventory of forest Insects [FRI-218/FED-14/External/2002-2005]

Status: Inventory of forest insect was prepared comprising of 15908 insects species, which include morphological characters, distribution, biology and control belonging to 21 insect orders. Photographs of 4477 insects were also incorporated. HTML files of 1251 insects were prepared.

Project 25: Efficacy testing of the insecticide ACTARA-25WSG against termites [FRI-266/FED-18/External/2004-2007]

Status: M/s Snygenta India Ltd., Mumbai has sent the insecticide ACTARA-25 WSG for testing against termites both in the laboratory as well as under field conditions. Preliminary laboratory studies were conducted alongwith two conventional insecticides Endosulfan 35EC and Chlorpyriphos 20EC for comparison. Endosulfan was found better whereas effectiveness of ACTARA – 25WSG and Chlorpyriphos 20EC was at par.

Project 26: An interdisciplinary approach to analyze the dynamics of forest and soil degradation and to develop sustainable agro-ecological strategies for fragile Himalayan watersheds [FRI-187/FSLR-13/External/2001- 2005]

Status: The data on hydrological measurements, recorded in the Arnigad Watershed, were sent to task leader, ALTERRA, Netherlands, for incorporation in LISEM model. The village and household level data on socio-economic status were processed and sent to task leader Norway for incorporation in the socio-economic model. Measurements of the tree density, vegetation characteristics, cohesion, soil moisture and random roughness in various micro and macro plots under forest, agriculture and degraded land was carried out and leaf samples from tree, shrub and herb were collected from each field and the Leaf Area Index was estimated. The soil samples were collected from each field and the aggregates were estimated.

Project 27: Micropropagation of promising F1 interspecific hybrids of Eucalyptus and field plantations [FRI-220/G&TP-11/External/2002-2005]

Status: Field plantations of F1 hybrids of Eucalyptus (FRI-5 & FRI-14) were established at seven places. Different media combinations were tried to find out suitable media for establishment of *in vitro* shoot cultures and their multiplication in four hybrids. *In vitro* shoot cultures and multiplication were achieved

through axillary bud cultures of two hybrids FRI-10 & FRI-15. However, two other hybrid experiments are in progress. Fifteen thousand T.C. plants were developed and planted.

Project 28: Analysis of population genetic structure and diversity in Himalayan Pines using molecular markers [FRI-221/G&TP-12/ External/ 2002-2005]

Status: Protocols for genomic DNA isolation from needles of Chir pine (*Pinus roxburghii*), Blue pine (*Pinus wallichiana*), Chilgoza pine (*Pinus gerardiana*) and Khasi pine (*Pinus kesiya*) were standardized.

Project 29: Genetic improvement and production of nursery planting stock of Khair, Shisham and Kikar [FRI-170/G&TP-7/ External/2000-2005]

Status: Clonal seed orchards of three species Khair, Shisham and Kikar (1.0 ha each) were established at Bir Sanur Patiala and Hoshiarpur (Punjab). Vegetative propagation strategies of *Acacia nilotica* (Kikar) and *Acacia catechu* (Khair) were developed and implemented for raising the plus tree ramets for the establishment of their CSOs. Progeny trials of Khair and Kikar comprising families of 40 plus trees of each species were established at Bir Sanur Patiala. Growth assessment of CSO and Progeny Trials are underway. Promising stands of Khair (5.0 ha) and Kikar (5.0 ha) have been finalized as seed stands. The process for the conversion of seed stands into Seed Production Areas is under progress.

Project 30: Development of agro-mediculture models for sustainable diversified farming in Uttaranchal and Haryana [FRI-214/NWFP-15/ External/2002-2005]

Status: Agroforestry based medicinal plant cultivation research plots were established in Haryana and at Dehradun. The planting stock for all the experimental plots was raised at Karnal and Dehradun nurseries. The models were replicated during the second year so as to confirm the results of previous year trials. The cost economics of cultivation of different medicinal plants under different agroforestry and horticultural species have been achieved.

Project 31: Study on inventorisation, assessment of their demand and supply and potential of commercialisation of medicinal plants in South-West Haryana [FRI-269/ NWFP-17/External/2004-2005]

Status: Extensive field surveys in the forest areas as well as non-forest areas of three districts of South-West Haryana viz., Gurgaon, Mahendragarh and Rewari were carried out and medicinal plants occurring in the area were recorded.

Project 32: Studies on interrelationship between production levels and marketing of important forestry species in Punjab [FRI-174/RS&M-9/2000-2005]

Status: Growing stock of Poplar has been worked out in all districts of Punjab. It was observed that the estimated future harvest is decreasing continuously. The reason is the decline in planting of Poplar due to continuous price fall. Some of the reasons for the price fall of poplar were: bulk planting of Poplar in late nineties; land consolidation in U.P.; delay in payment of sugarcane prices in 2002; exploitation by commission agents; fear psychosis among farmers; incidence of insect attack on poplar; inappropriate planting material, and limited diverse uses of poplar wood.

Project 33: Preparation of local volume tables of Khair, Sal, Shisham and Teak [FRI- 255/ RS&M -15/External/2003-2005]

Status: Volume equation for Khair has been prepared and submitted to the U. P. Forest Development Corporation. Local volume tables for Sal, Teak and Shisham are being prepared.

Project 34: Studies on Himalayan Pines [FRI-175/Silva-13/External/1995-2005]

Sub-project 1: Seed testing

Status: Four seed sources of *Pinus roxburghii* had been screened for their water stress tolerance behaviour. Biochemical analysis in context of polyphenol, amino acids and carbohydrate of seven different seed sources of *Pinus roxburghii* have been done. Banding pattern has been achieved and analysis is being done. SDS- PAGE (Poly Acrylimide Gel Electrophoresis) of different seed sources of *Pinus roxburghii* and *Pinus wallichiana* had been evaluated. At present experiment under water stress of seven seed sources of Chir pine at Plant Physiology Glass House are in progress.

Sub-project 2: Seed technology

Status: 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 Chir pine. 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 provenance trial of 56 seed sources has been established at FRI (600 m altitude) and Jarmola (1200 m altitude) in Uttarkashi Forest Division, Uttaranchal. Observations were taken on height, collar diameter, survival (%), bud length, bud breaking etc. of the seedlings. Similar studies on Himalayan high level pine the *Pinus wallichiana* is also planned. Seeds of blue pine from 35 sources that were sown in nursery showed very poor emergence due to the inherent problem of emptiness in the seeds.

Sub-project 3: Nursery and planting technology

Status: The data on the seed and cone characteristics of the three provenances of *Pinus wallichiana* was recorded in 2004 and it was found that cone length is highly variable within a given tree; more than 99 per cent of the variation in this character is attributable to the tree factor. Technique for rapid extraction of seeds from cones of *Pinus roxburghii* was developed.

Sub-project 4: Investigation on diseases of Blue pine (*Pinus wallichiana)*

Status: Compilation of data for the preparation of a brochure was completed, which included the importance and utility of mycorrhizae in Blue pine, the seed mycoflora associated with it and the achievements obtained till now with scanned photographs. Preparation of MMN medium, subculturing of the mycorrhizal fungus associated with *Pinus wallichiana* as well as *Pinus roxburghii* from the fruiting bodies collected during the field tour to Dhanaulti, pure cultures were prepared and maintained by sub-culturing. Synthesis experiment was terminated in December. Three species namely Geastrum, Coenococum and Thelophora showed efficient results. Seed mycoflora of three provenances namely Devrana, Nelong and Gangnani were studied. Erupting fungal colonies were pure cultured in test tubes for further experimental work. They were then identified using monographs and keys. Germination % age was observed. Collection of mycorrhizal soil samples of blue pine was conducted. Isolation of mycorrhizal roots from the collected samples is in progress.

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Evaluation and standardization of the methods employed in identity of the medicinal plants employing woods of Himalayan and sub-Himalayan tract [FRI-276/Bot-41/External/2004-2007]

Status: Started in January, 2005.

Project 2: Impacts of tourism on environment of Roopkund and Pindari areas of Nanda Devi biosphere reserve of Uttaranchal [FRI-280/Eco-15/External/2004-2007]

Status: Project has been initiated in December, 2004. Relevant literature has been compiled.

Project 3: Ecorestoration studies in Uranium Mines [FRI-265/Eco-19/ External/2004-2008]

Status: Project was prepared to undertake ecorestoration studies in Uranium Mines of Jaduguda (Jharkhand). This project has been proposed to develop ecologically and economically viable restoration model for the restoration of environmentally sensitive Uranium mill tailings.

Project 4: Restoration of biodiversity in the hills of Kujapuri Siddhapeeth following Badrivan restoration approach [FRI-264/Eco-13/External/2004-2007]

Status: Monsoon and winter plantation of various native fodder and horticulture species was done in and around the Kujapuri temple and in village community and private lands. Monitoring of growth and survival of planted species was carried out. Vegetation and soil analysis was also done. Socio-economic survey in two villages located nearby Siddhapeeth was also concluded. Awareness campaigns about protection and conservation of plant diversity were organized in the villages.

Project 5: Demand and supply of medicinal plants and produce grown/found in Haryana [FRI-291/NWFP-18/External/2004-2005]

Status: Project initiated in March, 2005 with the objective of assessing the demand and supply of medicinal plants in the state of Haryana.

Project 6: Study of pathogenic and molecular variability in *Fusarium solani* causing Shisham (*Dalbergia sissoo*) Wilt. [FRI-272/Path-17/External/2004-2007]

Status: The isolates of *Fusarium solani* were collected from Dehradun, Haldwani and Sultanpur. A total of 80 isolates were collected and purified.

Project 7: Researches on natural decay resistance of juvenile timbers like poplars – DST sponsored project [FRI-283/Path-18/External/2004-2007]

Status: Wimco Seedlings Ltd., Rudrapur was visited and modalities were worked out for procuring authentic material of poplar for testing. Four samples of different clones of poplar were procured and are being prepared for testing.

Project 8: Studies on fungal infestation, mycotoxin elaboration and induced biochemical changes associated with edible oilseeds of forest origin [FRI-270/Path-15/External/2004-2007]

Status: Seed samples of *Buchanania lanzan, Juglans regia, Prunus armeniaca* and *Shorea robusta* were collected from different regions of Uttaranchal under field and storage conditions. The incidence of mycoflora was studied and an exhaustive list of mycoflora associated was prepared. The fungi isolated were screened for their mycotoxin producing potential. Natural

contamination of mycotoxins in fresh and stored samples was also carried out. Statistical analysis of the results was carried out to analyze the effect of season and source on incidence of mycoflora and natural occurrence of mycotoxin contamination.

Project 9: Evaluation of microbial status of organic farming [FRI-271/Path-16/External/ 2004-2006]

Status: Selection and collection of soil and root samples of different crop category like cereals, vegetables, medicinal plants and horticulture in different seasons (Kharif and Rabi) was carried out. Collection of soil and root sample in different growth phase of crops was done. Screening of different beneficial microbes from different crops and physico-chemical analysis of soils under different crops were carried out.

Project 10: Study and preventive measures of dying phenomenon of *Acacia nilotica* and *Dalbergia sissoo* in Haryana [FRI-286/Path-19/External/2005-2006]

Status: Project initiated in March, 2005.

Project 11: Networking forest plantations in a crowded world: Optimizing ecosystem services through improved planning and management strategies funded by E.U. under ECCP [FRI-288/RCS-1/External/2005-2007]

Status: The principle objective of the project is to establish an expert network on forest plantation and management between leading universities and research institutes in densely populated countries. The initial kick-off workshop between participating institutes viz. FRI, Freburg University, Germany and Alterra, Netherlands took place from 15th to 18th March, 2005 in Dehradun.

Project 12: Development of mechanism for computation and forecast of growing stock in strip forests of Haryana taking into account the year wise plantation and survival of relevant species [FRI-289/RCS-2/ External/2005-2006]

Status: Project initiated in March, 2005.

Project 13: Development of Technological package for the production and quality evaluation of seeds of important medicinal plant [FRI-285/Silva-22/ External/2004-2007]

Status: After extensive literature survey, a calendar was prepared on the habit, habitat, distribution, flowering, fruiting and germination etc. of 100 medicinal species.

RESEARCH ACHIEVEMENTS

Name of state	No. of Projects completed in 2004-2005	No. of ongoing Projects in 2004-2005	No. of Projects initiated in 2004-2005
Uttaranchal	8	18	3
Uttar Pradesh	2	2	—-
Haryana	—-	1	4
Punjab	2	4	—-
Others	16	35	8

EDUCATION AND TRAINING

Training organized

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

1. Wood Seasoning
2. Management of NWFP for Sustainable Development
3. Bamboo Silviculture and Utilisation
4. Inventory and Status Survey of the Herbal Wealth in the Cold Desert Region of the Indian Himalayas
5. Nursery and Plantation Technology
6. Plywood Manufacture
7. Development of Green Belts
8. Agroforestry
9. Classification and Grading of Timber
10. Seed Technology
11. Eco-restoration of Wastelands
12. Economics and Valuation of Forests and Forests Products
13. Training progamme for ISS Probationers
14. Joint Forest Management
15. Recent Forestry Practices for Maximizing Agroforestry Returns
16. Commercial Utilisation and Value Addition of NWFP
17. Compulsory training of IFS Officers on Management of NWFP for Sustainable Development

Training received

1. Dr. V.K. Varshney attended laboratory training on "Aromatherapy creations and formulations" at Institute of Natural and Modern Cosmetech, Faridabad from 27th and 28th October, 2004.
2. Dr. Ashok Kumar, Scientist-C attended a training programme on "ISO 14000 : 1996 Environmental Management System Lead Auditors Training Course" from 22nd to 27th November, 2004 conducted by the Division of Biodiversity and Climate Change of the Indian Council of Forestry Research and Education, Dehradun.
3. Dr. Ashok Kumar, Scientist-C of this division attended a training on bio-safety issues related to transgenic crops at the G. B. Pant University of Agriculture and Technology, Pantnagar, U.S. Nagar from December 27, 2004 to January 01, 2005 on different aspects including current scenario of development of transgenic plant, quarantine and controlled movement methods for ensuring biosafety, IPR for transgenic and the transfer of transgenics from lab to land.
4. Shri H. P. Singh, Scientist-B got training on "EMS Auditor training Course, ISO 14002" from 23rd to 27th November, 2004 at ICFRE, Dehradun.

LINKAGES AND COLLABORATION

Linkages were developed with following institutes/agencies:

National

1. Burean of Indian Standards (BIS) during MSCD meeting at BIS, New Delhi attended by Sh. V.K. Jain, Head, Forest Products Division on 29th March, 2005.
2. CSIR during finalization of CSIR funded multi-disciplinary and multi-institutional project tiled "Biotechnological approaches

for improvement of plant species with special reference to pulp and paper".

3. TIFAC & DST were developed during participation in ASEAN-India Workshop on "Management of Technology Innovation" from 12th and 13th January, 2005, attended by Dr. Vimal Kothiyal, Scientist – E.

4. Department of Forestry, HNB Garhwal University while collection of sample for CSIR funded project.

5. Soil Conservation Research and Training Institute, Kaulagarh, Dehradun.

6. NCL, Pune, Lucknow Univerity, Osmania University, JK Paper Mills, ITC Bhadrachalam, NBRI Lucknow, CIMAP Lucknow, KFRI, Kerela.

7. Wood and wood products manufacturer and user industries, important among them are NTPC Talcher, BIS New Delhi, Northern Coal Fields Ltd. Singrauli, Delhi Development Authority, Polyplex Ltd., Thailand.

8. The farmers/trainees regarding Bamboo strength properties and Bamboo box manufacturing during the short term training courses titled "Bamboo Silviculture Practice and its Utilization" organized by PLO and Extension division.

9. The State Forest Deptt of Uttaranchal for field planting of *Sapindus mukorossi* in 2.00 ha area in Jakhan Block, Barkot Range, Dehradun Forest Division and also for ongoing JFM project and for Monitoring and Evaluation of Panchayat land plantations made by Pauri Forest Division.

10. Jhansi Forest Division for Monitoring and Evaluation of AOFP project of Jhansi Forest Division.

11. Haryana Forest Department for making Micro-Plans under JFM project.

12. National Informatic Centre, New Delhi for development of Computer software for wood identification.

13. Bolani Ore Mines (Steel Authority of India), Keonjhar, and Orissa. Also working in collaboration with Department of Atomic Energy under the project "Ecorestoration Studies in Uranium Mines".

14. Meteorological data used by Uttaranchal Irrigation Deptt., IMA and researchers.

International

1. European Union (EU) through a Research Project on "Interdisciplinary approach to analyze the dynamics of forest and soil degradation and to develop sustainability agro-ecological strategic fragile Himalayan watersheds" which is in progress.

2. Material transfer agreement was signed with Prof. Angel Concheiro, Department of Pharmacy and Pharmaceutical Technology, University of Santiago de Compostela, Spain for characterization of hydroxypropyl derivatives of cellulose.

3. Lund University, Sweden for M.Sc. Thesis.

PUBLICATIONS

Book

"Anatomy of Indian Bamboos" by Dr. Laxmi Chauhan and Dr. Mohinder Pal.

Quarterly Newsletter

"*Market Information on Medicinal Plants*". Four issues of the Newsletter were published by FRI, Dehradun during 2004-2005 and disseminated to various end users.

CONSULTANCIES

- Installation of steam-heated kiln at J & K Handicrafts Srinagar (J&K Handicrafts Corporation) funded by J&K Handicrafts (S&E) Corporation, Srinagar, Jammu and Kashmir for a period of 3 years. The consultancy amount is Rs. 16.5 Lakhs. The installation has been completed and staff of J&K Handicrafts has been trained in kiln operation.
- Installation of solar kiln at IMPCL factory premises, Mohan (IMPCL funded) by IMPCL, Mohan, Almora Dist., Uttaranchal for a period of 2 years. The consultancy amount is Rs. 3,37,200. This project is for installing a solar kiln for M/s IMPCL, Mohan and maintaining it for 1 year. The woodworking and procurements of materials are nearing completion and the kiln will be installed shortly.
- Greening of Delhi: Forest and Tree Crop Management. The work is in progress.
- Inspection and testing of timber for Cooling Tower at TTPS funded by NTPC, Talcher, Orrisa for period of 12 months. The consultancy amount is Rs. 12.0 Lakhs. The work is yet to start, as it is dependent on the requirements of time scheduling of NTPC.
- Consultancy/supply of strength properties of Teak to M/s Lcitiff Sons, Mumbai and revenue of Rs. 5, 000/- was earned.
- V.K. Jain visited factory of Polyplex Cor. Ltd, at Thailand from 16th to 21st September., 2004 to provide consultancy on wooden pallets and revenues of Rs. 46,000/- was earned.
- IRCON International Ltd., Gurgaon had requested Director, FRI to ascertain the cause and extent of damage by termites to the IRCON building constructed two years back. The site of the building was visited, assessed the damage, collected the termites responsible for the damage. The technical report was submitted.
- Consultancy was given to M/s ABC Paper Mill, Hosiarpur (Punjab) against a consultancy fee of Rs. 2000/-.
- Consultancy for operationalization of seedling production through clonal technology in Punjab by Punjab Forest Department.
- Large number of samples received from different industries and organization tested. Total fee received Rs. 27.29 Lakhs.
- About 400 wood samples has been examined and identified and revenue for about 19.50 Lakhs earned.

Patents Obtained/Filed

1. VAC-FRI Technology for treatment of green Bamboo Patent filed through NRDC No. 962/DEL/2004 on 14.06.2004.

CONFERENCES/MEETINGS/ WORKSHOPS/SEMINARS/ SYMPOSIA/EXHIBITIONS

National

1. A paper entitled " Impact of Protection on *Cryptomeria japonica* ecology in Wet temperate zone of Darjeeling Himalaya was presented by Dr. Nirmal Ram in National symposium on Exotics in Indian Forestry, organized by Department of Forestry, Punjab Agricultural University, Ludhiana.
2. A paper entitled " Impacts of tourism on hydroecological parameters of sal plantation

in the forest hills of Darjeeling, Himalaya" was presented by Dr. Nirmal Ram in a National Seminar on tourism and Himalayan Biodiversity organized by Government P.G. College, Uttarkashi from 4th and 5th March, 2005.

3. Chandra, Veena Invited to deliver a special lecture on Threatened Biodiversity of Medicinal Plants IUCN RED LIST CATEGORIES Ver 3.1 in National symposium on Emerging Technologies and their Application in Assessment, Conservation and Management of Threatened Wild Medicinal Plants and their Habitats.

4. Dayal, R. Glycosides from some forest plants. Paper presented (invited) in XIX Carbohydrate Conference held at FRI, Dehradun from 1st to 3rd December, 2004.

5. Goyal, Puja, Kumar, Vineet and Sharma P. Carboxymethylation of Tamarind Kernel Powder. Paper presented in XIX Carbohydrate Conference held at FRI, Dehradun from 1st to 3rd December, 2004.

6. Gupta, Sangeeta attended 'National Workshop of ENVIS Centers and Nodes' held at Wildlife Institute of India, from 25th to 27th June, 2004.

7. Gupta, Sangeeta attended National Seminar on 'Bio-resources awareness and Management of solid waste' held at Jhansi.

8. Jha, M.N. attended Biodrainage Project Meeting at AFRI, Jodhpur from 19th to 22nd August, 2004 as special Invite. He also participated in international conference on "Multipurpose trees in the Tropics: Assessment, growth and management" held at Jodhpur in November, 2004; National Workshop on "Sacred grove a minibiosphere helping in conservation of flora and fauna held at Coimbatore and EU NETFOP Project meeting with European collaborators held at Forest Research Institute, Dehradun from 14th to 18th March, 2005.

9. Jha, M.N. Attended National Workshop on "Forests and Water Conservation Myths and Realities" as a delegate at FRI, Dehradun from 8th to 10th June, 2004.

10. Jha, M.N. attended Workshop on "Methodologies in Forestry Mitigation Project" from 13th and 14th April, 2004- as delegate.

11. Kholiya, Deepak attended National Seminar on "Tourism Education and Contemporary Issues (26th and 27th March, 2005) organised by Kurukshetra Univ. at Kurukshetra from 26th and 27th March, 2005 and presented a paper "Dwarahat-Khajuraho of Kumaun Himalaya" by Deepak Kholiya, Laxmi Rawat and Preeti Joshi.

12. Khullar, Ritu; Gupta, P.K.; Varshney, V.K.; Naithani, S.; Bhatt, Amit and Soni, P.L. Carboxymethylation of cellulose isolated from *Lantana camara* and cotton linters, and their rheological behaviour. Paper presented in XIX Carbohydrate Conference held at FRI, Dehradun from 1st to 3rd December, 2004.

13. Kothiyal, Vimal Attended a ASEAN-India Workshop on "Management of Technology Innovation" organized by TIFAC & DST at New Delhi from 12th and 13th January, 2005.

14. Kumar, Vineet, Sharma, P. and Soni, P.L. MPTS management by sustainable utilization and value addition: A futuristic approach. Paper presented in Multipurpose Trees in the Tropics: Assessment, Growth and Management held at AFRI, Jodhpur from 22nd to 25th November, 2004.

15. Naithani, S. Paper and Paper Chemical Additives. Paper presented (invited) in XIX Carbohydrate Conference held at FRI, Dehradun from 1st to 3rd December, 2004.

16. Nautiyal, S. Attended National Symposium on Exotics in Indian forestry, held at PAU Ludhiana (Punjab) from 15th to 18th March, 2005.

17. Nautiyal, S. Attended International conference on Multipurpose tree in the Tropics: Assessment, Growth and Management from 22nd to 25th November, 2004, held at Arid Forest Research Institute, Jodhpur.

18. Pande, P.K. attended IUFRO workshop at AFRI, Jodhpur.

19. Poster presentation on "Biomass estimation of Eucalyptus hybrid at different localities of Punjab" by Laxmi Rawat, R.K. Luna, S.K. Kamboj and JDS Negi in National Seminar on "Exotics in Indian Forestry" held at PAU Ludhiana from 13th to 18th March, 2005.

20. Rana, Vikas; Bhatia, Himani; Gupta, P.K. and Soni, P.L. Medicinal plant polysaccharides: structure and function relationship". Paper presented in XIX Carbohydrate Conference held at FRI, Dehradun from 1st to 3rd December, 2004

21. Rashmi and Dayal, R. Antioxidant activity of *Achyranthes aspera*. Paper presented in XIX Carbohydrate Conference held at FRI, Dehradun from 1st to 3rd December, 2004.

22. Rawat, Laxmi and Kholiya, Deepak attended National seminar on "Tourism and Himalayan Biodiversity from 4th and 5th March, 2005 at PG College Uttarkashi and presented a paper on "Impacts of tourism on floral diversity (roadside plants) of Mussoorie hills" by Sapna Madan and Laxmi Rawat.

23. Rawat, Laxmi attended International seminar on "Ecotourism-Global Issues and Challenge" organised by Kurukshetra Univ. at Kurukshetra from 28th to 30th March, 2005 and presented a paper "Consequences of tourist activities on floral diversity of Dwarahat, Kumaun Himalaya" by Deepak Kholiya, Laxmi Rawat and Preeti Joshi.

24. Rawat, Laxmi attended International Workshop on "Ecotourism Planning and Management in Protected Areas" from 28th February, 2004 to 3rd March, 2005 at Mussoorie organised by Centre for Mountain Tourism and Hospitality Studies, HNBGU Srinagar and presented a paper on "Impacts of tourist activities on Environment of Mussoorie" by Laxmi Rawat and Sapna Madan.

25. Rawat, Laxmi attended National workshop on "Forests and Water Conservation-Myths and Realities" from 8th to 10th June, 2004 and presented a paper 'Effects of pollution on water quality of some streams of Doon valley" by Laxmi Rawat, P. K. Pandey, P. S. Chauhan and Kanchan Pangtey.

26. Rawat, Laxmi attended National workshop on 'Resource dynamics in watershed management -Emerging Challenges and Options" from 23rd to 25th June, 2004 organised by GBPIHE&D Almora and presented a paper 'Impacts of forests on environment".

27. Soni, P. participated in National seminar on "Anthropogenic Stress on Environmental And Sustainable Development" from 17th and 18th December, 2004 at and Nagar Nigam Mahila Mahavidyalya, Kanpur.

28. Soni, P. participated in a National seminar on "Forests and People" from 29th and 30th July, 2004 at Belgaum, Karnataka.

29. Soni, P.; Rawat, Laxmi and Vasistha H.B. got training in ISO 14001 Lead Environmental Auditors from 23rd to 27th November, 2004 provided by BIS.

30. Soni, P.L. Novel chemo-enzymatic approach to prepare dietary fibre from galactomannan. Paper presented (invited) in XIX Carbohydrate Conference held at FRI, Dehradun from 1st to 3rd December, 2004.

31. Srivastava, Rajeev K. was invited by MOEF as an expert member to attend a meeting on Conservation of Biological Diversity.

32. Srivastava, Rajeev K. was invited by MOEF for attending a core group meeting on NBSAP held in New Delhi.

33. Tripathi, A.K. attended an "Interactive workshop on water conservation" organized by National Institute of Hydrology. Roorkee from 13th and 14th April, 2004.

34. Varshney, V.K. and Sharma, Pradeep attended a one day seminar on Texture analysis organised by M/s Scientific and Digital Systems, New Delhi on 19th January, 2005.

35. Varshney, V.K. Chemical modification of cellulosic material isolated from Bamboo, lantana and cotton linters. Paper presented (invited) in XIX Carbohydrate Conference held at FRI, Dehradun from 1st to 3rd December, 2004

36. Vasistha, H.B. presented a paper on "Landslides: Strategy for their sustainable management in the Himalayan region" Acharya Narendra Dev Nagar Nigam Mahila Mhavidyalaya, Harsh Nagar, Kandpur from 17th and 18th December, 2004.

AWARDS

National

- Dr. Rajeev K. Srivastava, Head, Silviculture Division was awarded "Brandis Award" for best paper on Silviculture.
- Dr. Mohit Gera, IFS from RS&M Division received the ICFRE Award of Excellence in Forestry Research.
- Dr. P.L. Soni awarded Life Time Achievement award for his notable contributions in the field of Carbohydrate Chemistry by ACCTI in XIX Carbohydrate Conference held at FRI, Dehradun from 1st to 3rd December, 2004.
- Dr. (Mrs.) P. Soni, Dr. Laxmi Rawat and Dr. H.B. Vasistha successfully completed Lead Auditors Course and received certificate from Marsden International, UK.
- Dr. Salim Ali, National Wildlife Fellowship Award 2001 was given to Shri Arun P. Singh, Scientist-D, Entomology Division, FRI, ICFRE, Dehradun by the Ministry of Environment and Forests Government of India for carrying out the study entitled, "Ecology of woodpeckers in borer infested sal forest of Dehradun valley, the lower western Himalayas".

Workshops and Exhibitions

National Technology Day at FRI Dehradun on 11th May, 2004

During the day long celebrations the technologies developed by the institute were demonstrated to the general public. Besides this there was free entry to all six Museums for visitors.

World Environment Day at FRI and Ranger's College, Dehradun on 5thJune, 2004.

Workshop on "Forest and Water Conservation – Myths and Reality" at FRI, Dehradun from 8th to 10th June, 2004.

Hon'ble Minister of Environment and Forests, Govt. of India planting a sapling on 3rd August, 2004 on Van Mahotsava

Celebration of Van Mahotsava at FRI, Dehradun on 3rd August, 2004.

Celeberation of Hindi Saptaha at FRI, Dehradun from 13th to 17th September, 2004.

Vigilance Week at FRI, Dehradun from 1st to 6th November, 2004.

Platinum Jubilee Celebration of FRI building, Dehradun from 7th and 8th November, 2004.

XIX Carbohydrate Conference at FRI, Dehradun from 1st December to 3rd December, 2004.

Celebration of National Science Day at FRI, Dehradun on 28th February, 2005.

National Science Day was celebrated on 28th February, 2005. A film show was also organized for the school children and general public in the Convocation hall. Forest Research Institute also participated in the National Science Day at Anthropological Survey of India, Kaulagarh Road, Dehradun.

World Consumer Rights Day at DAV College, Dehradun on 15th March, 2005.

World Forestry Day at FRI, Dehradun on 21st March, 2005.

World Forestry Day was celebrated on 21st March, 2005. On this occasion the institute organized an exhibition in the Information centre. Beside this the research activities carried out by the institute were also shown to the general public including villagers and school children. The exhibition was inaugurated by Shri B.S. Sajwan, IFS, Deputy Director General (Extension).

DISTINGUISHED VISITORS

6.4.2004	Mr. Ulrich Podewils, Director, Daad, India.
2.4.2004	Yusuf Noristani, Minister of Irrigation, Water Resources and Environment of Afghanistan.
27.7.2004	Shri Sharad Pawar, Union Agriculture Minister, Govt. of India.
28.7.2004	Shri G.R. Mussafir, Speaker, Himachal Pradesh Assembly.
3.8.2004	Thiru A. Raja, Hon'ble Minister of Environment and Forests Govt. of India.
23.8.2004	Shri Hans Raj Josan, Forest Minister Punjab, Chandigarh.
28.8. 2004	Shri Sangay Ngedup, Minister of Agriculture, Bhutan.
13.9.2004	Thakur Ram Lal, Forest Minister (H.P.).
11.10.2004	Shri Namo Narayan Meena, MoS (E & F), Govt. of India.
11.10.2004	Shri Bhairon Singh Shekhawat, Vice President of India.
6.11.2004	Mr. Grene Watos, New Zeeland High Commissioner.

16.2.2005	Visit of Honorable guests from New Zealand to review the work progress of Radiata Pine by FRI.
22.2.2005	IUFRO Team members visited the museums and held meeting at FRI.
22.3.2005	Lt. Gen. K.K. Khanna, AVSM, Commandant IMA, Dehradun

FOREST RESEARCH INSTITUTE (DEEMED UNIVERSITY)

Forest Research Institute, Dehradun was conferred the status of 'Deemed University' by the Ministry of a 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 study newly introduced in the country, such as Forestry Economics and Management, Wood Science and Technology, Environment Management, Plantation Technology, Biodiversity Conservation to man responsible positions in forestry research, wood based industries and plantation activities, the Deemed University has 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 and 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 in Post Graduate Diploma Courses and 24 in M.Sc. Admission to these courses is made on the basis of candidate's performance in All India competitive Entrance Test.

During the year 90 students were admitted in all to the above five courses. At present total strength of the students in all courses in 89.

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

Besides regular lectures programme and dissertation/project work on specific topic relevant to their course, students were sent to one month industrial attachment to different industries/organizations. Local excursion, short and long study tours and training were also organized during the academic session.

Extra Curricular Activities

1. Students of FRI DU participated in the workshop on Intellectual Property Rights Awareness held on 19th and 20th April 2004, FRI DU.
2. Students of M.Sc. Environment Management course II semester attended a seminar on

"Woman's Role in Disaster Management" organized by Rotary Club Dehradun on 19th June, 2004.

3. Annual Sport meet was held from 4th to 7th December, 2004 at FRI, Dehradun.

Students Welfare Activities

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

Special Lectures

Dr. E.M. Wil from the World Cultural Council, Mexico addressed the student of FRI Deemed University on 23rd April, 2004.

Ph.D. Programme

Research is an essential function of a national institute like Forest Research Institute Deemed University and increasing emphasis is being given to this important aspect of academic pursuit. Highly qualified Foresters/Scientists and talented Research Scholars have continued to be active in the 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 436 Research Scholars have been registered including registration 62 Research Scholars in the current year. During the year, 42 Research Scholars have been awarded Ph.D. Degree.

Placement

The students passing out of the FRI Deemed University also have the facility of placements through placement coordinator. The campus interviews are arranged every year for students of all the disciplines.

Following is the placement detail of our students for last two academic years :

Year	Course	No. of students	No. of campus interview organized	No. of students selected
2002-04	M.Sc. Wood Science & Technology	19	7	12
2002-04	M.Sc. Forestry	24	4	8
2002-04	M.Sc. Environment Management	22	4	4
2002-04	PGD in Biodiversity Conservation	9	1	1
2002-04	PGD in Plantation Technology	11	1	2
	Total	**85**	**17**	**27**
2003-05	M.Sc. Wood Science & Technology	25		
2003-05	M.Sc. Forestry	23		
2003-05	M.Sc. Environment Management	23	1	
2003-05	PGD in Biodiversity Conservation	9		
2003-05	PGD in Plantation Technology	9		
	Total	**89**	1	**6**

NATIONAL FOREST LIBRARY AND INFORMATION CENTRE

The National Forest Library and Information Centre (NFLIC) is richest in document collection South and South-East Asia and 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, a total of 27,580 books were loaned to the users for outside reading. Besides, 56, 118 books and journals were consulted inside the library.

The NFLIC subscribed to 93 foreign and 113 Indian periodical titles at a cost of about Rs. 35.49 lakh. It also received 400 periodical titles gratis.

The NFLIC has been selling ICFRE publications through its Book Depot. During 2004-2005, it sold 796 books and 22 cassettes/ VCDs and earned a revenue of Rs.1, 10,1019/-.

The Ministry of Environment and Forests, Govt. of India established an ENVIS Centre on Forestry at NFLIC. The Centre, during the year launched its website containing plethora of information on forestry viz. bibliographical databases entitled: Indian Forestry Abstracts, Joint Forest Management, *Prosopis juliflora* and Grey Literature on Forestry; content pages of Indian as well as foreign journals; forest cover in the country state wise and then district wise; detailed information of different forest species; details of forthcoming conferences, seminars, etc. Besides, the Centre also published *ENVIS Forestry Bulletin's* special issue on Mangroves; and *Forestry News Digest* regularly.

CHAPTER II

INSTITUTE OF FOREST GENETICS AND TREE BREEDING COIMBATORE

The Institute of Forest Genetics and Tree Breeding (IFGTB) was formed in April, 1988 under the Indian Council of Forestry Research and Education (ICFRE), an autonomous Council of the Ministry of Environment and Forests, Government of India, by up-gradation of the Forest Research Centre (FRC), Coimbatore under the Forest Research Institute and College, Dehradun. Several organizations and schemes viz., Forest Soil-cum-Vegetation Survey (FSVS), Coimbatore, Disease and Insect Survey (DIS), Coimbatore, Indo-Danish Project on Seed Procurement and Tree Improvement (IDPSPTI), Tropical Pines Research Centre (TPRC), Kodaikanal, Eucalyptus Research Centre (ERC), Ooty and Environmental Research Station (ERS), Ooty were also merged with the FRC to form the Institute.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

Project 1: Development of protoplast regeneration system in Eucalyptus [IFGTB/RP-7/2002-2005]

Findings: Protoplasts were isolated from *in vitro* grown leaves and embryogenic suspension cultures obtained from the cotyledons. Seven days old suspension cells were harvested for protoplast isolation and the cell were digested with the digestion solution containing 0.4 M mannitol, 0.33 % cellulase, 25.0 mg macerozyme R10, 3.0 mM MES (2-N morpholino ethane sulfonic acid), 7.0 mM $CaCl_2$. $2H_2O$ having pH 5.8. After washing with Artificial Sea Water (ASW), the isolated protoplasts were grown on MS medium, B5 medium and KM8p medium as Alginate bead culture, suspension culture and on agarose solidified medium.

Yield of protoplasts from suspension culture was 2.95 $X10^6$ protoplast/g.f.wt and *in vitro* leaves produced 1.2 X 10^6 protoplast/g.f.wt. Protoplast viability immediately after isolation was 65 ± 7 % in suspension cultures and 47 ± 4% in *in vitro* leaves. After 3 days of culture as suspension in KM8p medium, based on the maintenance of the spherical shape and cell wall regeneration, 45 and 20 % viability was recorded in the case of suspension culture and *in vitro* leaves derived protoplasts, respectively. No cell wall regeneration was recorded in alginate beads. Plating efficiency (micro calli formation) of the two protoplast sources was determined as 14 and 7 %, respectively. The micro calli when transferred to medium containing BA and Kinetin showed pink coloured callus and the morphological features were very similar to embryogenic callus.

Project 2: Impact assessment of intensive silvicultural practices on seed production in seed orchards/seed production areas in South India with reference to Teak [IFGTB/RP-9/1999-2003]

Findings: In the identified Seed Production Areas (SPAs) in Tamil Nadu (Sengampatti, Coimbatore and Seechalay Valley, Top slip) and Kerala (Pandupara Malayattoor and Cherupuzha, Nilambur), the fertilizer treatments and biofertilizer treatments were given to individual trees in the trial plots. The initial flowering in SPAs was observed. Information on seed

production in the SPAs of previous years was collected. The results showed that biofertilizers treated trees were better in terms of flowering and seed yields.

Project 3: Afforestation and productivity studies on problem soils of Tamil Nadu [IFGTB/RP-10/1999-2005]

Findings: Under this Project the problem soils of ACC Madukkarai and Magnesite mine spoils of Burn Standard, Salem have been reclaimed by planting tree species viz. *Acacia auriculiformis, Casuarina equsetifolia, Cassia fistula, Delonix regia, Eucalyptus tereticornis, Azadirachta indica* (Neem), *Muntingia calabora, Syzygium cumini* (Naval), *Leuceana leucocephala* (Subabul), *Ailanthus excelsa, Cassia samea, Samanea saman* and *Grevillea robusta* (Silver oak). About 5000 plants each at the Burn Standards mines, Salem and at the ACC mine dumps, Madukkarai have been planted.

Performance of these species and survival are satisfactory. Techniques for immediate air pollution control as well as for accelerated amelioration of completely nutrition-free soil dumps adopted in the Madukkarai area, Coimbatore have produced good results. Good quantity of litter fall in the trial plantations indicates very satisfactory soil amelioration at the site of experiments. Plantation trials have reduced the pollution problem in and around the factory premises to a great extent. Growth rate of species planted is very good. Due to this drifting of sand by wind has been controlled giving relief to the nearby villagers. Applications of biomanure and biofertilizers have resulted in satisfactory performance under adverse soil conditions.

Project 4: Studies on productivity of *Acacia mangium* plantations in Kerala [IFGTB/RP-16/2000-2005]

Status: The present study was carried out to assess performance and productivity of Mangium under different planting configurations in farm fields in various agro-climatic zones of Kerala. Among eight agroclimatic zones existing in Kerala, Mangium is grown mostly in southern, high altitude and northern zones. The mean annual increment (MAI) in terms of gbh was greater in high altitude zone (9.6 cm) than in northern (9.3 cm) and southern (8.0 cm) zone. MAI in terms of height was 1.99, 1.92 and 1.78 m in southern-northern and high altitude zones, respectively. Comparative studies on productivity of *Acacia mangium* in homesteads and block plantations have shown that the diametrical growth was greater under homestead plantation (gbh 94.5 cm) when compared to block plantation (gbh 81.2 cm) within the same locality in Kerala.

Project 5: Studies on mycorrhizal fungi (biofertilizers) and their application in nursery and field [IFGTB/RP-25/2002-2007]

Findings: Investigation on VAM fungi associated with *Casuarina equisetifolia* and *Eucalyptus globulus* revealed the association of different species of VAM belonging to four genera viz., Acaulospora, Gigaspora, Glomus and Scutellospora .

An ectomycorrhizal fungus, *Thelephora ramarioides,* was recorded for the first time in association with *Casuarina equisetifolia* and *C. junghuhniana* under field conditions; 100 per cent distribution of this ectomycorrhiza was observed in the plantations of *C. equisetifolia* while it was recorded to be 80% in *C. junghuhniana* plantations.

Investigation on distribution of Ectomycorrhizal (ECM) and Endomycorrhizal (VAM) fungi revealed the occurrence of different ectomycorrhizal fungi viz., *Amanita muscaria, Laccaria fraterna, Lycoperdon perlatum,*

Scleroderma citrinum and *Suillus brevipes* in Eucalyptus plantations of Nilgiri Hills, Tamil Nadu. Among these, the species *L. fraterna* and *S. citrinum* were found distributed in all the plantation sites. The association of these species with *E. globulus* in India is reported for the first time.

Salt tolerance capacity of two isolates of the ectomycorrhizal fungus *Pisolithus tinctorius* under laboratory conditions tested with salts like sodium chloride, sodium sulphate and sodium citrate at five different concentrations revealed that both the isolates are salt tolerant. However, there was a gradual reduction in growth and biomass as the salt concentration increased. The isolates were able to grow maximum in sodium sulphate and sodium chloride as compared to sodium citrate.

Effect of dual inoculation of both the ecto and endo mycorrhizae (VAM + *P. tinctorius*, VAM + *L. fraterna* and VAM + *S. citrinum)* on the growth enhancement of *Casuarina junghuhniana* and *Eucalyptus camaldulensis* seedlings under glass house condition was studied and it was found that the inoculated seedlings of both the tree species had better plant height, collar diameter and shoot and root biomass than the uninoculated (control) seedlings.

Project 6: Developing a suitable database on biodiversity [IFGTB/RP-27/ 1999–2004]

Findings: Information on nomenclature, habit, habitat, ecology and phenology of about 70 species of Rare, Endangered and Threatened (RET) plants of Southern India was collected from various sources in a designed format to develop a basic database for easy retrieval of information. This information was incorporated in nine different tables (prepared in MS Access) *viz*. basic details, bibliography, description, habit, habitat, phenology, propagation, species and utilization. The database developed has various retrieval options and will be a valuable tool for those who are interested in research and conservation of RET plants.

Project 7: Variability studies with special emphasis on physiology, biometry and biochemistry in selected tree species for tree improvement [IFGTB/RP-4/2000-2005]

Findings: Variability studies were undertaken in 76 clones of *Casuarina equisetifolia* and 59 clones of Eucalyptus (*E. tereticornis*-16nos. and *E. camaldulensis*- 43 nos.). In Casuarina, the crown length exhibited the highest degree of variation followed by Diameter at Breast height (DBH) or collar diameter (CDM) among all the primary characters (total height, DBH, CDM, crown length, cladode length, cladode diameter and number of primary branches). Diameter at breast height showed higher degree of variation than total height. Number of primary branches, cladode length, cladode diameter and total height showed narrow difference between the values of Phenotypic Coefficient of Variation (PCV) and Genotypic Coefficient of Variation (GCV) indicating that these traits were less influenced by environment. Volume index and crown length recorded high values for broad-sense heritability coupled with high values for GCV and genetic gain indicating that these traits had considerable genetic variability, thus offering good opportunity for improvement through selection. All the clones of Casuarina and Eucalyptus were graded based on point grading, a method where both quantitative and qualitative traits were used for assessment. Based on the physiological studies, 12 Casuarina clones and 5 Eucalyptus clones were identified for semi-arid locations. These clones exhibited superior growth with favourable physiological characteristics including high photosynthesis, carboxylation efficiency and water use efficiency. Mahalanobis' D^2 statistics

and Tocher's clustering method was used to study the genetic divergence in clones of Casuarina and Eucalypts. Based on these studies 20 Casuarina clones and 10 Eucalyptus clones were identified for future tree improvement programmes. Observations recorded on shoot length, root length, collar diameter, shoot fresh weight, shoot dry weight, root fresh weight, root dry weight, biomass index and total biomass, from an experiment to elucidate the difference in growth performance between seedlings and rooted cuttings derived from randomly selected female clones of Casuarina grown in the clone bank showed that seedlings performed better than rooted cuttings during the study period of 3 years. The within variability estimated using coefficient of variation was also less in seedlings in around 60 per cent of the cases. Biochemical/ molecular/anatomical studies were conducted to understand the characteristics of the juvenile and adult tissues of Casuarina. Total phenol content and peroxidase activity exhibited an increasing trend with maturity, whereas chlorophylls, total crude proteins and DNA content recorded a decreasing trend. However, the protein profiles (obtained from 4 different positions from lower to upper positions within a tree) when studied using SDS-PAGE technique, did not show any variation. Among the various anatomical parameters, pith diameter and thickness of phloem tissue varied among the stem cuttings obtained from the four positions. Seventy-three clones of *C. equisetifolia* were screened for salt tolerance in a field experiment at Tiruchirapalli, Tamil Nadu. Based on growth and physiological parameters nine clones were identified for planting in sodic-soils.

Project 8: Development of database on tree improvement of mandatory species [IFGTB/ RP-28/2001-2004]

Status: Forms and reports are being designed and improved. Tree improvement information from secondary sources has been updated. Plus trees/SSO/CSO/SPA etc. have been finalized.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

Project 1: Genetic variability and selection in natural population of *Artocarpus* sp. [IFGTB/RP-1/2000-2005]

Status: Seeds of *Artocarpus hirsuta* were collected from Seed Production Area (SPA) Chalakkudy, Kuzhathpuzha and Palode. Seedlings were raised in the nursery and growth data were recorded. To understand the genetic structure of populations, genetic variability within and between populations, isozyme characterization is being done with three enzymes namely, esterase, Aspartate Amino Transferase (AAT) and peroxidase. The starch gels revealed two loci for AAT, 4 loci for esterase and 2 loci for peroxidase.

Project 2: Evolving clonal propagation technology for Teak to improve productivity [IFGTB/RP-2/2000-2005]

Status: Forty selected superior trees of Teak from different parts of Kerala have been clonally multiplied and assembled in the Institute. The clonal trial of Teak established at Panayankode, Nilambur (Kerala) was evaluated one year after planting which showed superior growth performance. The height and collar girth of different clones varies from 1.8 to 2.6 m and 8.9 to 13.0 cm, respectively one year after planting. A comparative Teak trial with improved planting stock of selected clones and CSO seedlings has been established at Tirunelveli (Tamil Nadu). The seed production in Teak plantations at Nilambur (Kerala) and Mudumalai (Tamil Nadu) was studied. There was no correlation between the

size of the tree and seed production in Teak. It was found that climatic and edaphic factors influence seed production in Teak.

Project 3: Genetic improvement of *Eucalyptus tereticornis* through controlled hybridization and molecular characterization [IFGTB/RP-3/ 2002-2005]

Status: *Eucalyptus tereticornis* is a major industrial species planted widely in plains of Tamil Nadu. Inter-specific controlled pollination has been carried out in *E. tereticornis* with high altitude species such as *E. pellita, E. alba, E. grandis* and *E. urophylla* having better stem form as pollen parents to produce full sib families and thereby improve productivity. Three full-sib trials of these combinations have been established at Sadivayal and Kolapakkam (Tamil Nadu) and Panampally (Kerala). An early evaluation indicates that *E. tereticornis* x *E. pellita* is performing better in terms of establishment, height and girth.

Project 4: Enhancing productivity in *Casuarina* sp. through inter-provenance and inter-specific hybridization [IFGTB/RP-30/ 2003-2008]

An outstanding family of *Casuarina equisetifolia*

Status: Twenty outstanding clones each of *Casuarina equisetifolia* and *C. junghuhniana* sub-sp. *timoresnsis* were selected and vegetatively propagated in a hybridization garden. Flowering phenology of male and female clones was studied for levels of overlapping between them. Pollen storage techniques for the two species for making available pollen for controlled pollination were standardized. Crossing between clones belonging to different provenances and species were carried out and fruit set were obtained. Open-pollinated progenies from a hybridization orchard were assessed for growth and form traits in field tests.

Project 5: Estimation of gene diversity and enhancing seed production in seedling seed orchards of Eucalyptus, Casuarina, Acacia and Teak [IFGTB/ RP-31/2003-2008]

Status: Fertility studies were taken up in Casuarina and Eucalyptus orchards established at different locations. More than 80% of the trees in *C. equisetifolia* orchards were fertile in both coastal and inland sites. In C. *junghuhniana*, the coastal orchard had twice the proportion of fertile trees than that of inland. The orchards established in coastal environment had less fertility variation in both species. To improve the flowering in Eucalyptus four treatments, namely, high N (500 g Urea per tree), NPK, Pollarding, Paclobutrazol application (as soil drench) were given in the seed orchards at Pudukottai and Panampally. It was found that only the Paclobutrazol application had significant effect on fertility of trees where 60% of trees flowered as against 10% in control and 13% each in high N and NPK application.

Project 6: Genetic transformation of Eucalyptus and Casuarina to enhance salinity tolerance [IFGTB/RP-6/2002-2005]

Status: Regeneration methods amenable for genetic transformation of *Eucalyptus tereticornis*

clones and seedlings were optimized. Shoot morphogenesis and rhizogenesis in *Casuarina equisetifolia* were obtained. A case of somatic seedling was observed in Casuarina. Co-cultivation studies are in progress for introduction of Osmotin gene into explant tissues of *Eucalyptus tereticornis*. Selection media for screening Kanamycin tolerant cell lines of *Casuarina equisetifolia* were deduced. Protein profile studies carried out in a highly salt tolerant *Casuarina equisetifolia* clone showed accumulation of a 41 kDa polypeptide on the fourth day after 340 mM (2%) NaCl stress. Withdrawal of salt stress on the 18 day resulted in immediate reduction in the levels of this polypeptide.

Project 7: Isolation of somaclonal variants of *Casuarina equisetifolia* for salinity tolerance [IFGTB/RP-8/2002-2007]

Status: Response of callus to varying concentration of NaCl was carried out. Callus obtained from two clones CP3501 and CP4403 were subcultured in solid media containing NaCl at 1,2 and 3%. After 15 days of exposure, 100 % mortality was observed in both the clones for 3% salt treatment. Treatments with 1% and 2% NaCl had resulted in mortality in the range 30 and 70%, respectively, in both the clones. 1% and 2% NaCl can be used for in vitro screening for salt tolerance. Callus multiplication from various clones are in progress for screening and biochemical studies.

Project 8: Selection of potential mycorrhizas and other beneficial microbes for the reclamation of bauxite mine spoils [IFGTB/RP-10a/2002–2005]

Status: This project is implemented at Bauxite mine spoils at Yercaud, Salem District, Tamil Nadu, where The Madras Aluminum Company has undertaken the open cast bauxite mining. Normally to ameliorate the mine spoils, topsoils are spread on the mine spoils before planting tree species because topsoil is having good structure, water holding capacity and beneficial microbes like VAM fungi, which are very essential for plant growth. These qualities are lacking in the mine spoils because of removal of topsoil during mining. In this study the suitable tree species like *Acacia auriculiformis, Casuarina equisetifolia, Eucalyptus camaldulensis* and *E. tereticornis* were grown in bauxite mine spoils under nursery conditions and inoculated with cultured VAM fungi *(Glomus aggregatum)* and other beneficial microbes like Rhizobium and Phosphobacterium.

The studies from these nursery experiments revealed that the VAM fungal inoculation and other beneficial microbes improved the seedling quality in terms of biomass and growth as well as ameliorate the bauxite mine spoils by increasing soil aggregation. The VAM and other beneficial microbes inoculated seedlings were transplanted at bauxite mine spoils and after transplantation the seedlings growth and survival rates were monitored. The VAM fungi and other beneficial microbes inoculated seedlings showed 100% survival rate. Their growth is also significantly higher than the control seedlings. The Rhizobium inoculated seedlings also showed good performance in terms of height and survival in *A. auriculiformis*. In *Eucalyptus* spp., the inoculations of VAM + Phosphobacterium are found better than other bio- fertilizer treatments in terms of growth. Growth of suitable tree species grown in bauxite minespoil amended with vermicompost was found to be better than that of control seedlings. In *C. equisetifolia* the inoculations of VAM and Frankia are found more suitable as they improved the seedlings growth compared to that of control seedlings on bauxite mine spoils. Further, application of compost in the bauxite mine spoils improved the nutrient status whereas

inoculation of VAM fungi mobilized the nutrients to the plants.

The periodical monitoring for the past 10 months on the growth and survival of the planted seedlings showed that the seedlings are all performing well in their growth and survival particularly *E. camaldulensis, C. equisetifolia* and *A. auriculiformis*. The soil analysis showed that the status of N P and K nutrients was improved in the rhizosphere of those tree seedlings. The VAM fungi were also recovered in the rhizosphere of *E. camaldulensis, C. equisetifolia* and *A. auriculiformis*. These studies indicate that the bauxite mine spoils are being reclaimed through VAM fungi and other beneficial microbes associated with planted tree species. Further, the indigenous species such as *Phyllanthus emblica, Albizia lebbeck*, and *Dalbergia latifolia* were inoculated with cultured VAM fungi and other beneficial microbes such as VAM fungi, Rhizobium, Azospirillum and Phosphobacterium bauxite mine spoils at nursery conditions and transplanted at bauxite mine spoils, Yercaud.

Project 9: Study on market dynamics relating to important Non Timber Forest Produce in Tamil Nadu [IFGTB/RP-19/2002-2006]

Status: This study was conducted in various Large Agricultural Multi-Purpose Societies (LAMPS) in Tamil Nadu. The study shows that the profit margin of the private trader ranged from 20 per cent to as high as 471% (17% to 85% profit to LAMPS). The sale price realized by the private traders was far higher than the LAMPS' due to processing, grading, value addition etc. Only 30-35% of wholesale price reached the gatherers (Rs. 4/kg for gatherers' sale price and Rs. 25/kg is the consumer's price in honey). Information on NTFP's vis-à-vis socio-economic status of local tribal people was also gathered and the study is under progress.

Project 10: Identification, isolation, evaluation and mass production of native fungi for the management of Teak and Casuarina stem borers [IFGTB/ RP-21/2002-2007]

Status: Seventy soil samples collected from various forest areas of Western Ghats and coastal area of Sirkali of Tamil Nadu were subjected to insect bait method and one more new isolate of Entomo-Pathogenic Fungus (EPF) was trapped and isolated. Of the rest 8 unidentified isolates of EPF three were identified to the species level. Pathogenicity of the rest 7 of the 12 isolates trapped from the soil samples was tested on the test insect *Galleria mellonella* and confirmed the pathogenicity.

Ten of the 12 EPF isolates trapped from the soil and 3 isolates isolated from insect cadavers were tested for their pathogenicity and bioefficacy on the two species of the targeted insect pests, *Sahydrassus malabaricus* and *Indarbela quadrinotata* and found 4 (Konni, Nilambur Thadiyankudisai (2)) of the 10 isolates trapped from soil and 2 of the 3 isolates isolated from the insect cadavers pathogenic and effective in controlling the targeted pests *S. malabaricus* and *I. quadrinotata* causing 100% larval mortality with in 3-7 days.

Project 11: Testing of promising plant derived chemicals against key pests (Component: Bioactive compounds from *Acacia nilotica* (Babul) against the major defoliators of forestry tree species) [IFGTB/RP-22/2000-2005]

Status : The target of the project is to develop methods for the identification of antifeedant and insecticidal compounds of *A. nilotica*. Therefore, the efficacy of extracts of different tissues of *A. nilotica* was evaluated against the important defoliators of Teak and Pongamia. Testing of biopesticidal properties of hexane, methanol and ethyl acetate extracts of *A. nilotica* laves, flower,

pods, seeds and twigs was done at different doses ranging from 0.04 to 1.25 per cent on *Hyblaea puera, Eutectona machaeralis* and *Tephrina pulinda* at different developmental stages. Of these, Hexane extract exhibited toxic effect at the concentrations ranging from 0.32 to 1.25 per cent and induced 60-83% larval mortality due to larval weight loss, antifeedancy (40-87%), ovicidal (40-85%) and pupal mortality (10-67%) of Teak defoliators.

Project 12: Testing and evaluation of selected existing control methods for key diseases of *Casuarina* spp. with reference to blister bark and root-rot [IFGTB/RP-24/2002-2007]

Status: The second proposed field trial of *Casuarina junghuhniana* at Karikalampakkam (Pondicherry) was established for developing integrated methods of management of blister bark or stem wilt disease caused by *Trichosporium vesiculosum* and root-rot disease caused by *Ganoderma lucidum*. Periodical observations were made to record incidence of the targeted diseases in the said as well as already established trial of *C. equisetifolia* at Panampally field research station. Both biofertilizers (VAM and ECM) and bio-control agents (*Trichoderma* spp.) were mass produced and maintained for further application in the field. Biofertilizers (VAM and ECM), bio-control agents (*Trichoderma* spp.) and fungicide (bavistin/Indofil M-45) were applied to the saplings of *Casuarina equisetifolia* and *C. junghuhniana* in the field.

Roots and rhizosphere soil samples were collected from the root zone of *Casuairna equisetifolia* at Panampally at regular intervals. The samples were anlaysed for recording the colonization of both ECM and VAM fungi in the roots. It was observed that all the root samples had VAM fungal colonization and maximum percent colonization was observed in VAM treated plant roots. Rhizosphere soil samples were processed and recorded for the distribution of VAM spores and the results revealed that VAM fungal spores were found in all the rhizosphere soils. Among different VAM fungi recorded, the genus Glomus was found maximum in most of the soil samples screened.

Periodical observations made to record the incidence of the disease problems on the saplings of *Casuarina equisetifolia* and *C. junghuhniana* in the trials laid at Kerala and Pondicherry revealed incidence of no major disease.

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

Project 1: Natural regeneration studies on important trees in Silent Valley National Park, Kerala [IFGTB/RP-32/2004-2009]

Status: Information on plant species of Silent Valley National Park was collected from relevant literature. After scanning the literature, the following tree species were selected for the study. Various maps of the study area were also collected and tentative sampling locations identified.

Species selected: *Aphanamixis polystachya, Actinodaphne bourdillonii, Aglaia anamallayana, Agrostistachys meeboldii, Artocarpus heterophyllus, Bischofia javanica, Calophyllum polyanthum, Canarium strictum, Casearia wynadensis, Cassine glauca, Cinnamomum malabatrum, Cinnamomum sulphuratum, Cryptocarya bourdilloni, Cullenia exarillata, Dimocarpus longan, Drypetes elata, Elaeocarpus munronii, Elaeocarpus tuberculatus, Epiprinus mallotiformis, Erythroxylum mooni, Euonymus angulatus, Ficus nervosa, Garcinia gummi-gutta, Garcinia morella, Gomphandra tetrandra, Heritiera papilio, Holigarna arnottiana, Holigarna nigra, Hopea glabra, Hydnocarpus alpina, Lepisanthes*

tetraphylla, Litsea floribunda, Mangifera indica, Mastixia arborea, Meliosma pinnata, Mesua nagassarium, Myristica dactyloides, Neolitsea scrobiculata, Neolitsea zeylanica, Nothapodytes nimmoniana, Nothopegia beddomei, Olea dioica, Palaquim ellipticum, Persea macrantha, Prunus ceylanica, Symplocos racemosa, Syzygium laetum and *Toona ciliata.*

PROJECTS COMPLETED DURING THE YEAR 2004-2005

(Externally Aided)

NIL.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

(Externally Aided)

NIL.

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Evaluation of breeding efficiency and genetic gain in seedling seed orchards of Eucalyptus and Casuarina in South India [IFGTB/EF-RP-4/2002-2005]

Status: Five seedling seed orchards of Eucalyptus and four of Casuarina in different locations were investigated for breeding efficiency and genetic gain. Unpedigreed orchards maintained higher diversity than pedigreed orchard even with low fertility as many unrelated trees contribute to seed production. Fertility was generally low in most orchards except in an unpedigreed orchard of *E. camaldulensis* located at Panampally in Kerala state where 45% of the trees contributed effectively in seed production. There was no significant correlation between tree height and fertility. Two genetic gain trials of seed orchard seeds that were established for each genus in different locations were evaluated which showed superior growth.

Project 2: Estimation of gene diversity and drift pattern in natural stands and plantations of forest tree species in South India [IFGTB/EF-RP-6/2003-2006]

Status: Fertility differences between clones were estimated in a 25 years old Clonal Seed Orchards (CSO) of Teak in South India. Clones selected from Karulai and Nilambur were more fertile than those from Thunakadavu and Sungam. A single clone, SBL 1 produced 68% of flowers and 56% fruits in the orchard. KLK1 (22%) and KLN2 (7%) were the other major seed bearers. Initial studies on reproductive output have also been undertaken in plantations of neem, tamarind and sandal.

Project 3: Evaluation of reproductive success in seed orchards of Teak in India [IFGTB/EF-RP-8/2003-2006]

Status: Studies on flowering and fruiting phenology, quantification of flower and fruit production by individuals and extent of seed filling were continued for the second flowering year. X-radiography technique for non-destructive evaluation of seed filling in Teak drupes was standardized. Collection and identification of principal pollinators were carried out. The abundance, frequency and pollination efficiency of different pollinators were evaluated.

Project 4: Full sib production in selected high yielding Tamarind clones of Tamil Nadu [IFGTB/EF-RP-14/2003-2006]

Status: A study on reproduction was conducted in 40 Tamarind clones located at eight places in

six agro-climatic zones of Tamil Nadu. Based on flowering intensity and open pollination fruit set patterns, 10 clones were chosen for control pollination studies. Crossing schedules were carried out in TNPKM1 x TNR401, TNVEP412 x TNR402, TNPKM407 x TNR402, TNHAS9 x TNR401, TNR401 x TNPKM401, TNR402x TNPKM401 and TNA5 x TNR401 at Anthiyur and Vaigai Dam Forest Research and Extension Centres. Seedlings of the above combinations were raised in the nursery for full sib testing.

Project 5: Fingerprinting of economically important clones of Eucalypts and Casuarinas [IFGTB/EF-RP-2/2000-2005]

Status: Simple Sequence Repeat (SSR) marker in *Casuarina equisetifolia,* was developed and transferability of Eucalyptus SSR markers to Casuarinaceae family was evaluated. Sequences and SSRs were identified in *C. equisetifolia.* All the three categories of SSRs (di, tri and penta nucleotide repeat motifs) were identified. Primers were synthesized for four repeat motifs and were used for fingerprinting of *C. equisetifolia* clones. The SSR targeting $(GCT)_5$ showed allelic variation within the Casuarinaceae family and the sequence was submitted to National Centre for Biotechnology Information, USA. This is the first report of development of co-dominant SSR marker in the family Casuarinaceae.

Project 6: Genome evaluation and characterization in Casuarinas and Eucalyptus for improving productivity and conservation [IFGTB/EF-RP-5/ 2002-2005]

Status: Species-specific markers were developed for four *Eucalyptus* sp. (*E. grandis, E. camaldulensis, E. citriodora* and *E. urophylla*), two *Casuarina* sp. (*C. junghuhniana* and *C. glauca*) and two *Allocasuarina* sp. (*A. littoralis* and *A. heugeliana*). The genetic diversity existing between and within the species populations were also estimated using Inter Simple Sequence Repeat (ISSR) markers.

Project 7: Identification of broad spectrum antifungal protein from elite medicinal plants for control of plant pathogens [IFGTB/EF-RP-7/2003-2006]

Status: A broad spectrum, non race specific and constitutively expressed antifungal protein from the leaves of *Acorus calamus* was identified. The protein with molecular weight of 13.9 KD showed significant inhibitory activity against the hyphal extension of pathogens like *Trichosporium vesiculosum, Macrophomina phaseolina* and *Fusarium moniliforme*. The protein was characterized as basic and intracellular in expression showing functional homology to bacterial chitinase.

Project 8: Refinement of *in vitro* multiplication protocol for *Bambusa nutans* and *Dendrocalamus giganteus* [IFGTB/EF-RP-17/2004-2007]

Status: Sterilization protocol for nodal segments from mature genotypes of *Dendrocalamus giganteus* was standardized and aseptic culture from the mature explants of *Dendrocalamus giganteus* and *Bambusa nutans* were established. Shoot multiplication was achieved in *Bambusa nutans*.

Project 9: Performance of micro and macro propagated planting stock of selected five commercially important Bamboo species [IFGTB/EF-RP-18/ 2004-2007]

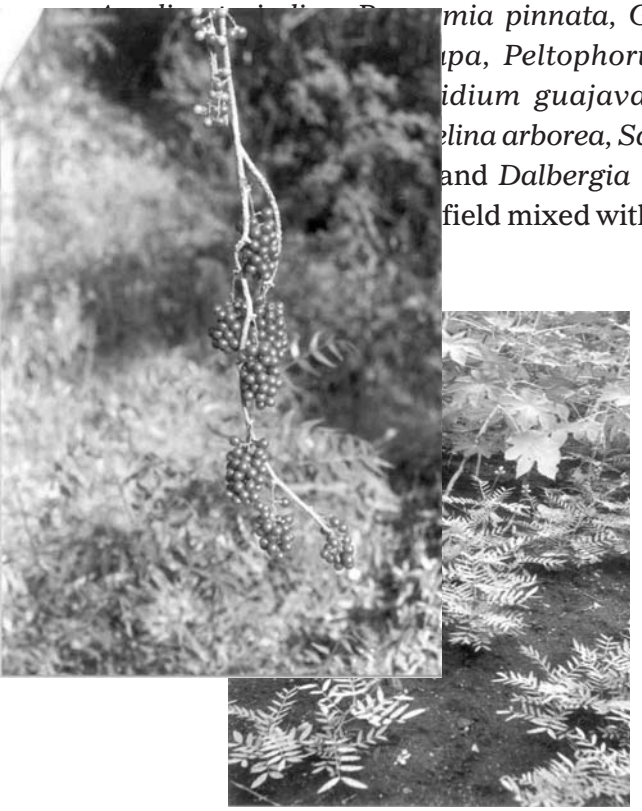
Status: Three hectares of demonstration trial of tissue culture raised Bamboo species viz. *Bambusa bambos, Dendrocalamus strictus* and *Pseudoxytenenthera stocksii* was established at Veerapandi No. 4, Coimbatore. A germplasm bank of different species of Bamboos was established.

Project 10: Selection and clonal propagation of commercially important medicinal plants [IFGTB/EF-RP-19/2004-2007]

Status: Potential areas for collection of medicinal plants have been identified. Work has been initiated to find rooting ability of selected medicinal plants.

Project 11: Utilisation of fly ash in agriculture and forestry [IFGTB/EF-RP-12/ 2003-2006]

Status: The significant contributions of this project is propagating vegetation (both forestry and agricultural species) on fly ash dykes in their saline and non-saline environment. Utilizing different quantities of fly ash enhanced the yield of some of crops viz. Paddy, Sweet potato, Ginger, Turmeric, Tapioca, Banana, Green gram, Black gram, Ground nut, Bean, Sunflower, Castor, Senna, and Jatropha. The forestry species viz. *mia pinnata, Gravelia* *ıpa, Peltophorum* sp., *idium guajava, Ficus* *elina arborea, Samanea* and *Dalbergia latifolia* field mixed with varied



Cultivation of Senna and Castor with fly ash

Project 12: Germplasm conservation and establishment of seed stands for production of quality seeds and seedlings [IFGTB/EF-RP-9/2003-2006]

Status: Under the selection programme several new CPTs viz. *Aegle marmelos*-11, *Asparagus racemosus*-12, *Emblica officinalis*-6, *Gymnema sylvestre*-15, *Oroxylum indicum*-2, *Rauwolfia serpentine*-5, *Saraca asoca*- 8, *Strychnos potatorum*-3 and *Tinospora cordifolia*-9 were identified and assembled in the germplasm bank. Seed handling techniques were standardized for *Aegle marmelos, Asparagus racemosus, Embelia ribes, Emblica officinalis, Oroxylum indicum, Strychnos nux-vomica* and *Tinospora cordifolia.* About 2000 seedlings of *Emblica officinalis,* 11000 seedlings of *Aegle marmelos* and 1000 seedlings of *Saraca asoca* were raised. Nursery raising of *Aegle marmelos* using seeds is successful. It is advisable to dibble seeds directly in polybags

Heavy fruiting in *Tinospora cordifolia*

(8 x16 cm) instead of raising initially in mother beds and later transplanting. This is to avoid transplantation shock which otherwise drastically reduces the plant survival percentage. Success rate is high in vegetative propagation of *Gymnema sylvestre* when stem cuttings are placed with at least one node inside the planting medium. Pretreatment studies on *Embelia ribes* showed that the seeds possess mechanical dormancy. Storing *Oroxylum indicum* seeds at 20°C significantly improved the germination. Soaking *Tinospora cordifolia* seeds in 1000 ppm GA3 for 24 hours was found to improve germination upto 67%. Studies on effect of fruit maturity of *Tinospora cordifolia* on seeds germination showed that seeds of ripe (dark red) fruits germinate well. Ambient condition for storage of seed of this species is the 31 ± 2 ºC.

Project 13: Characterization of tropical and temperate forest seeds with reference to seed storage behaviour [IFGTB/EF-RP-10/2003-2006]

Status: Seeds of about 15 species present in different forest types were collected and tested for their tolerance to liquid nitrogen. The seed moisture content and drying rate of a range of species growing in different forest types were studied. Desiccation and temperature tolerance studies in *Persea macrantha* seeds collected from different forest types of South India was carried out. Seeds of *Strychnos nux-vomica* were collected and studied for seed maturity, storage and germination requirements. Seeds of *Pithecellobium dulce* were studied for seed storage behaviour. Seed storage behaviour of *Symplocos cochinchinensis* is in progress.

Project 14: Establishment of agroforestry models with medicinal plants and trees for conservation, propagation and utilization [IFGTB/EF-RP-16/2004-2007]

Status: About 30,000 seedlings of various species of medicinal importance like *Aegle marmelos, Withania somnifera, Ocimum sanctum, Azadirachta indica, Pongamia pinnata* and *Cassia angustifolia* etc. were raised in the nursery for establishment of agro forestry plantations as well as for distribution to farmers. Agroforestry plantations with medicinal plants and trees have been established in seven farm fields with *Aegle marmelos, Azadirachta indica, Pongamia pinnata, Gymnema sylvestre* and *Emblica officinalis*.

Project 15 : Evaluation of superior planting stock of *Acacia mangium* in agroforestry systems at different eco-climatic zones of Kerala and Tamil Nadu [IFGTB/EF-RP-11/ 2003-2006]

Status: Seeds were collected from identified superior trees of Mangium in Panampalli, Kerala as well as from Theni, Tamil Nadu. About 2000 seedlings were raised in the nursery. Four farm fields in southern zone (in Trivandrum and Pathnamthitta District) and one in central zone (in Palakkad District) were identified in Kerala for evaluation of superior planting stocks of Mangium under agroforestry systems. Similarly, three farmlands in southern zone (in Theni District) and two fields in western zone (in Coimbatore District) were identified in Tamil Nadu for raising agroforestry plantations. About 1000 seedlings of superior trees origin were planted out in six fields each having plot size of approximately one acre (five fields in Kerala and one in Tamil Nadu).

Project 16: Development of integrated pest management package for forest nursery insect pests of some economically important tree species [IFGTB/ EF/RP-13/2003-2006]

Status: Regular surveys carried out at various nurseries maintained by the State Forest Departments of Tamil Nadu, Pondicherry and

Kerela revealed the incidence of insect pests like defoliators and sap suckers in nursery seedlings. Major pest problems recorded were defoliation on *Tectona grandis, Azadirachta indica, Sapindus emarginata* and *Pongamia pinnata* by *Myllocerus* sp. Other major defoliation problems recorded on seedlings were by *Hyblaea puera* and *Eutectona machaeralis* on Teak, *Papilio demoleus* on *Limonia acidicima, Nephopteryx eugraphella* on *Mimosops elengi* and *Eligma narcissus* on *Ailanthus excelsa*. A Pest Calendar for nursery seedlings is prepared and updated. Influences of biotic and abiotic factors on pest build up were studied.

Project 17: Exploitation of mycorrhizal systems in the Nilgiris Biosphere Reserve Area [IFGTB/EF-RP-15/2004-2007]

Status: Different Forest Ecosystems such as Natural Forests (Tropical Wet Evergreen Forests, Shola-Grassland Ecosystem) and Man-made Plantation Forests were selected and surveyed at regular intervals for investigating the status of mycorrhizal diversity in the Nilgiri Biosphere Reserve Areas of the Nilgiri Hills, Tamil Nadu state. Data on occurrence and distribution of different mycorrhizal fungi such as Ectomycorrhizal (ECM) and Endomycorrhizal (AM) fungi in various forest ecosystems like grasslands, man- made plantations (*Acacia* spp., *Cupressus* spp., *Eucalyptus* spp. and *Pinus* spp.) in the Nilgiri Hill areas of South India were collected at a regular intervals.

Different species of AM fungi belonging to three genera viz., Acaulospora, Gigaspora and Glomus were recorded. ECM fungi like *Amanita muscaria*, *Inocybe* spp., *Laccaria fraterna*, *Lycoperdon* sp., *Rhizopogon* spp., *Russula* spp., *Suillus* spp. and *Scleroderma* spp. were recorded from different study sites under various host trees.

Project 18: Ecorestoration for Tsunami devastated coastline of Andaman Group of Islands [IFGTB/EF-RP-20/2004-2007]

Status: Project has been initiated and seeds of *Cauarina equisetifolia* were collected for raising seedlings.

RESEARCH ACHIEVEMENTS

Name of State	No. of Projects completed in 2004-2005	No. of on-going Projects in 2004-2005	No. of Projects initiated in 2004-2005
Tamil Nadu	6	26	5
Kerala	5	20	5
Pondicherry	2	7	1
Andaman & Nicobar	1	1	1

EDUCATION AND TRAINING

Training organized

1. Tissue culture techniques for genetic engineering for M.Sc. student from Bharathidasan University for 4 months.
2. Summer Project Training on Mycorrhizal biofertilizers techniques – isolation, identification, multiplication and application on May, 2004, for Ph.D. Scholar from University of Mumbai, Mumbai.

3. Importance of bioferetilizers in agriculture and forestry – isolation, identification, mass production and application of different kinds of biofertilizers in nursery and field on 15th May, 2004 for 40 participants of Attappadi Hills Area Development Society (AHADS), Department of Rural Development (Government of Kerala), Agali, Kerala State.

4 Training on various themes of forestry from 19th to 21st October., 2004 for the farmers, NGOs and Forest Department staff of Pondicherry.

5. Cultivation of medicinal plants on 21st October, 2004 for the farmers of Pondicherry.

6 Forest Seed Management on 26th October, 2004 for Forest officers of Kerala State at KFRI, Peechi.

7. Training on Seed handling – collection, processing, storage techniques and pretreatments on 30th October, 2004 for Field officers of Attappady Hills Area Development Society (AHADS), Agali.

8. Molecular Pathology on 10th December, 2004 for Government college teachers during refresher course in Botany at PSGR Krishnammal College for Women, Coimbatore.

9. Biofertilizer and disease management in nursery/ plantation on 15th December, 2004 for Forester trainees at Southern Forest Rangers College, Coimbatore.

10. Nursery/plantation pests and their management on 17th December, 2004 for Forester trainees at Southern Forest Rangers College, Coimbatore.

11. Employment opportunities for biologists and a glimpse of bio-pesticides on 31st December, 2004 for Students of Zoology, ANJA College, Sivakasi.

12. Integrated pest management in forest nurseries and plantations on 20th January, 2005 for the serving forest officers of various state forest departments during Refresher Course at State Forest Service College, Coimbatore.

13. DNA finger printing and plant microbial interaction on 22nd March, 2005 for participants of the refresher course in Microbial Bio-technology at Bharathiar University, Coimbatore.

14. Agroforestry and inter-cropping patterns suitable for Tamil Nadu on 16th and 17th February, 2005 for the officials of the Tamil Nadu State Forest Department at SFRC, Coimbatore.

15. Chemical ecology in host selection by phytophagous insects and its role in IPM on 23rd February, 2005 for trainees of Recent Advances in HPR course at Tamil Nadu Agricultural University, Coimbatore.

16. Insect offence and plant defense on 18th March, 2005 for Zoology students of Avinashilingam Deemed University, Coimbatore.

17. Disease problems and their management in nurseries and plantations from 17th to 29th March, 2005 for trainees of the TAP training course at Southern Forest Rangers College, Coimbatore.

18. Insect pests of forest nurseries and plantations and their management from 17th to 29th March, 2005 for trainees of the TAP training course at Southern Forest Rangers College, Coimbatore.

Training received

National

1. Shri C. Bhuva-Neswaran attended training on Capacity building of CBOs for participatory development, National Institute of Rural Development (NIRD), Hyderabad from 26th April to 1st May, 2004.

2. Shri Kannan C.S. Warrier attended training on Participatory planning and management of natural resources for sustainable livelihoods, National Institute of Rural Development (NIRD), Hyderabad from 23rd to 28th August, 2004.

3. Shri C. Kunhikannan and D. Rajasugunasekar attended training on ISO 14001 Environmental Management System Auditor Course (IEMA Approved), ICFRE, Dehradun from 23rd to 27th November, 2004.

4. Shri D. Rajasugunasekar attended training on Sample survey to estimate rates and ratios of timber and non-timber forest products in India, ICFRE, Dehradun from 27th to 29th January, 2005.

5. Shri T. Gunasekaran attended training on Combating desertification, Forestry Training Institute, Jaipur from 7th to 11th February,2005.

6. Shri S. Saravanan attended training on Participatory planning and management of agroforestry under IWDP for sustainable development, National Institute of Rural Development (NIRD), Hyderabad from 28th February to 5th March, 2005.

7. R. Vivekanandan, Maria Dominic Savio, M. P. Che-zhian and R. Kamalakannan attended training on Plant Genetic Resources, data bases and their application in Agriculture, Centre for Plant Molecular Biology, Tamil Nadu Agriculture University, Coimbatore from 27th to 31st March, 2005.

International

1. Shri V. Sivakumar, Scientist-C attended training on Characterization of tropical and temperate forest seeds with reference to seed storage behaviour, Swedish University of Agricultural Sciences, Umea from May, 2004 to August, 2004.

2. Dr. Mohan Varghese, Scientist-D attended training on Estimation of gene diversity and drift pattern in natural populations and plantations of forest tree species in South India, Swedish University of Agri-cultural Sciences, Umea from May, 2004 to July, 2004.

LINKAGES AND COLLABORATION

Mr. John Fryer and Dr. John Davidson of ACIAR (Australia) visited the Institute from 2nd to 5th May, 2004 to review the progress of the collaborative project – Domestication of Australian trees. The officials visited the Pannampally and Karunya field stations of IFGTB and seed orchards and genetic trials of Australian species.

PUBLICATIONS

Published in Journals

National

1. Das, Gupta, Modhumita and Gurumurthi, K. (2005). Isolation of antifungal proteins from leaves of *Acorus calamus*. *The Biome News*, Vol.6, No.1.

2. Gurudev Singh, B. and Warrier, R.R. (2004). *Tinospora cordifolia*. *Indian Forester*, 130(9): 1806.

3. Hegde, Maheshwar; Mohan, V., Manokaran, P. and Palanisamy, K. (2004). *Alternaria* Leaf Blight Disease on *Artocarpus* seedlings - A

New Record. *Indian Forester,* 130(11): 1339-1342.

4. Hegde, Maheshwar, Ramteke, P. K. and Subramanian, K. (2004). Genetic Variation and interse correlation of seedling characteristics in Teak (*Tectona grandis* L.). *Indian Journal of Forestry*, 27(1): 19-24.

5. Jacob, J.P., Murugesan, S, Balu, A. and B. Sunitha. (2004). Organic pest control methods against some insect pests of forest trees. *My Forest,* 40(3): 209-216.

6. Mohan, V. and Manokaran, P. (2005). Control of Leaf Rust of *Terminalia chebula* caused by *Uredo terminaliae*. *Indian Forester,* 131(1): 115-17.

7. Murugesan, S. (2004). Biopesticidal effects of different tissues of *Acacia nilotica* (Babul) extracts on *Tectona grandis* (Teak) pests. *Ad. Plant. Sci.,* 17(1): 203-206.

8. Murugesan, S. (2004). Induced defence research and potential application of induced defenses in forestry. *Indian Forester*, 130(11): 1227-1234.

9. Narayanan, C. and Nicodemus, A. (2005). Incidence of wilt (blister bark) disease of *Casuarina junghuhniana* in India. *Indian Forester,* 131: 257-258.

10. Nicodemus, A. and Jacob, J.P. (2004). Bird pollinators of Teak. *Newsletter for Birdwatchers*, 44: 68-69.

11. Rajagopal, K., Buvaneswaran, C., Subramanian, V. and George, M. (2005). Nutrient cycling in young Teak plantation: I- Restitution of nutrients through litter and rain-wash. *Indian Forester*, 131(2): 221-228.

12. Saravanan, S. (2004). Functions of Large Agricultural Multipurpose Societies (LAMPS) in marketing of Non-timber forest products in Vellore district of Tamil Nadu – A case study. *Journal of Non -Timber Forest Products*, 11(2): 94-98.

13. Saravanan, S. and Buvaneswaran, C. (2004). A socio-economic analysis on cultivation of a potential medicinal plant – *Coleus forskohlii*. *Journal of Economic and Taxonomic Botany,* 28(3): 729-733.

14. Saravanan, S., Buvaneswaran, C. and Nautiyal, Raman (2004). Growth performance of Teak (*Tectona grandis*) in farmlands under different agro-climatic zones of Tamil Nadu. *My Forest*, 40(3): 227-234.

15. Warrier, K.C.S. (2004). Kavukal – Jaiva Vaividhyathinte Kalavarakal (Language: Malayalam) (meaning Sacred groves – The treasure house of Biodiversity). *Kumkumam,* 39(11): 22-23.

16. Warrier, K.C.S. (2004). Nammude Kavukal (Language: Malayalam) (meaning: Our Sacred groves). *Matruvani*, 20(14): 30-31.

17. Yasodha R.; Kathirvel M.; Sumathi R., Gurumurthi, K. and Nagaraju, J. (2004). Clonal identification of *Casuarina equisetifolia* using DNA polymorphisms generated by PCR with arbitrary primers. *NFT News*, 7(1): 5-6.

18. Yasodha R.; Sumathi, R. and Gurumurthi, K. (2004). Micropropagation for quality propagule production in plantation forestry. *Indian Journal of Biotechnology*, 3: 159-170.

International

1. Ghosh, M.; Thangamani, D.; Thapliyal, M., Yasodha, R. and Gurumurthi, K. (2004). Isolation of *Andrographis Paniculata* leaf protein with antifungal property. *Acta Phytopathologica et Entomologica Hungarica*, 39(4): 377- 381.

2. Ghosh, M.; Thangamani, D.; Thapliyal, M., Yasodha, R.; and Gurumurthi, K. (2004). Purification of antifungal protein against blister bark pathogen of *Casuarina equisetifolia*. *Acta Botanica Croatica,* 63(2):75-81.

3. Karthikeyan, A., Muthukumar, T. and Udaiyan, K. (2004). Response of tea (*Camellia sinensis* (L.) O. Kuntze) to arbuscular mycorrhizal fungi under plantation nursery conditions. *Biological Agriculture and Horticulture,* 22 (4): 305-319.

4. Varghese, M.; Lindgren, D. and Nicodemus, A. (2004). Fertility and effective population size in seedling seed orchards of *Casuarina equisetifolia* and *C. junghuhniana*. *Silvae Genetica,* 53(4-5): 164-168.

5. Warrier, R.R.; Sivakumar, V.; Anandalakshmi, R.; Vijayachandran, S.N., Mahadevan, N.P. and Gurudev Singh, B. Improving storability of *Bambusa arundinacea* (Retz.) Wild. Seeds. *Journal of Bamboo and Rattan*, 3(4): 375-382.

6. Zhang, Y., Murugesan, S. and Nair, M.G. (2004). Novel Lipid-Peroxidation and Cyclooxygenase-Inhibitory Tannins from *Picrorhiza kurroa* Seeds. *Chemistry and Biodiversity,* 1: 426-441.

Papers Presented in Seminars

1. Buvaneswaran, C. and George, M. (2004). Performance of *Acacia mangium* in plantations and homesteads under various agro-climatic zones of Kerala. Paper presented in the *IUFRO International Conference on Multi-purpose trees in the tropics – Assessment, Growth and Management* held at Arid Forest Research Institute, Jodhpur from 22nd to 24th November, 2004.

2. Buvneswaran, C. (2005). Nutrient dynamics under Teak based agro-forestry systems. Paper presented in the *Workshop on Agro-forestry for Attappady Wastelands* at AHADS, Agali, Palakkad, Kerala on 8th and 9th January, 2005.

3. Kunhikannan, C. (2004). Botanical garden, IFGTB. In: *Working Document, National Workshop on Information management of biodiversity resources in Botanic Gardens of India* at NBRI, Lucknow, conducted from 6th to 10th September, 2004.

4. Kunhikannan, C. (2004). Traditions, rituals and biodiversity in sacred grove of *Karakkakavu*, Kasargod district, Kerala state: A case study - presented in the *National Workshop on Strategy for Conservation of Sacred Groves* held at IFGTB, Coimbatore from 27th and 28th May, 2004.

5. Kunhikannan, C., Rao, Rama N. and Bisen, S.S. (2004). Diversity of Plant Communities in Dry Deciduous Forests of Tadoba National Park, Chandrapur, Maharashtra, India. In: *XIV Annual Conference of IAAT and National Seminar on New Frontiers in Plant Taxonomy and Biodiversity Conservation* held at Thiruvananthapuram, Kerala from 29th to 31st December, 2004.

6. Narayan Lalit; Kumar Anil; John, Anil V. and Surendranathan, A. (2005). Prospect of growing Senna (*Cassia angustifolia*) in soils mixed with fly ash. Paper presented in National Symposium on *Emerging Technologies and their Application and Management of Threatened Wild Medicinal Plants and their Habitats* from 23rd to 25th February, 2005 at State Forest Research Institute, Jabalpur (M.P).

7. Maria Dominic Savio, M. and Singh Gurudev, B. (2004). Plus tree selection in tree borne oil seeds. Presented during ICAR sponsored Winter School – short course on *Strategies for improvement and utilization of Tree Borne Oilseeds* conducted at the Forest College and Research Institute, TNAU, Mettupalayam from 20th to 30th September, 2004.

8. Maria Dominic Savio, M. and Singh, Mudit Kumar (2004). The role of multipurpose trees in saving the forestry resources of Andaman and Nicobar Islands. Souvenir cum Abstracts of *IUFRO International Conference on Multipurpose trees in the Tropics: Assessment, Growth and Management* held at Arid Forest Research Institute, Jodhpur from 22nd to 25th November, 2004. pp. 173.

9. Mohan, V. (2004). Diversity of mycorrhizal fungi and their role as biofertilizers in forestry. Presented in MoEF sponsored National Workshop on *Biodiversity Resources Management and Sustainable use* held at Centre for Biodiversity and Forest Studies, School of Energy, Environment and Natural Resources, Madurai-Kamaraj University, Madurai from 11th to 15th October, 2004.

10. Mohan, V. (2004). Role of mycorrhizal fungi as biofertilizers in agriculture, horticulture and forestry. Presented in UGC sponsored National Conference on *Current trends in Biological Scenartio* at PG and Research Department of Botany Vellalar College for Women, Erode, Tamil Nadu on 11th and 12th August, 2004.

11. Mohan, V. (2004). Selection of disease resistant phenotypes of the multipurpose tree species, *Casuarina equisetifolia* in South India. Presented in the *IUFRO International Conference on Multipurpose Trees in the Tropics: Assessment, Growth and Management* held at Arid Forest Research Institute (Indian Council of Forestry Research and Education), Jodhpur – 342 005, Rajasthan, India from 22nd to 25th November, 2004.

12. Mohan, V. (2004). Studies on the status of arbuscular mycorrhizal fungi in association with some important medicinal plants. Presented in UGC sponsored National Symposium on *Rural and Ethnomedicinal Plant Remedies – Conservation and Utilization (Ayush Remedies)* held at Kongunadu Arts and Science College, Coimbatore from 23rd to 25th September, 2004.

13. Mohan, V. (2005). Distribution of Mycorrhizal Fungi and their Effect on Growth Improvement of Forest Trees in Nursery and Field". Presented in the Workshop on *Agroforestry for Attappady Wastelands Potential and Prospects* at Attappady Hills Area Development Society, Agali, Govt. of Kerala, Kerala, India on 8th and 9th January, 2005.

14. Mohan, V. (2005). Mycorrhizal biofertilizer technology – A tool for forestry improvement. A lead paper presented in 4th *National Level Biological Congress on Biotechnology – A Boon to Humanity* held at Department of Biological Science, Muthayammal College of Arts and Science, Rasipuram, Nammakkal District, Tamil Nadu, India on 28th and 29th January, 2005.

15. Mohan, V. (2005). Role of mycorrhizal fungi as biofertilizers in agriculture, horticulture and forestry. A lead paper presented in the State Level Seminar on *Important Microbes: Present and Future Scenario* held at

Department of Microbiology, Karpagam Arts and Science College, Coimbatore – 641 021, Tamil Nadu, India on 9th March, 2005.

16. Murugesan, S. (2005). Plant natural products, induced defense and their potential application research in forest IPM. Presented in the National Seminar on *Insect Growth Regulators and Natural Products in IPM* organized by UGC and KSCSTE at St. Joseph's College, Calicut on 11th January, 2005.

17. Nicodemus, A., Varghese, M. and Nagarajan, B. (2004). Selection of *Casuarina junghuhniana* Miq. provenances for multiple end uses in India. Paper presented in the IUFRO International conference on *Multipurpose Trees in Tropics: Assessment, Growth and Management* held at AFRI Jodhpur from 22nd to 25th November., 2004.

18. Palaniswamy, K. (2004). Clonal technology for Teak for production of quality planting stock to improve productivity. Paper presented in *XIII ICFRE Society Meeting* at Ministry of Environment and Forests, New Delhi on 2nd November, 2004.

19. Rekha R., Warrier; Anandalakshmi, R.; Sivakumar, V. and Gurudev Singh, B. (2005). Conservation of medicinal plant diversity through cultivation and utilisation. In: International Conference on *Modern Trends in Plant Sciences — Role of Biodiversity in Conservation* (ICPSBC-05), Amravati University, Amravati, India from 19th to 21st February, 2005.

20. Saravanan, S. and George, M. (2004). *Casuarina equisetifolia* – A potential multi-purpose tree species for agroforestry systems in Tamil Nadu. Paper presented in the *IUFRO International Conference on Multipurpose trees in the tropics – Assessment, Growth and Management* held at Arid Forest Research Institute, Jodhpur from 22nd to 24th November, 2004.

21. Subramanian, K.N., Sasidharan, K.R and Venkatasubramanian, N. (2004). Floristic Diversity of Iringole Kavu, Eranakulam District, Kerala State. Presented in the National Workshop on *Strategy for Conservation of Sacred Groves* held at IFGTB, Coimbatore from 27th and 28th May, 2004.

22. Yanjun Zhang, Murugesan, S. and Nair, Muraleedharan G. (2004). Triterpenoids and lignans from *Picrorhiza kurroa* seeds. Paper presented in *2004 – International Congress on Natural Products Research* from 31st July to 4th August, 2004, Phoenix, Arizona, USA.

Brochures / Reports

1. George, M. and Buvaneswaran, C. (2004). Final report on *Greening the Islands of Lakshadweep and environment protection* – Submitted for incorporation in the State Development Report of Lakshadweep.

2. Gunasekaran and Maria Dominic Savio, M. (2004). Final report on the *Role of Panchayati Raj Institutions in Lakshadweep Administration* (modified). Submitted to the Planning Commission, Government of India, pp. 94.

3. Gurudev Singh, B. (2004). Report on *Lakshadweep Islands – Biodiversity Conservation and Sustainable Use*. Submitted for incorporation in the State Development Report of Lakshadweep, pp. 84.

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CONSULTANCIES

- Technical Advisory Consultancy for enhancing productivity of forest plantations was provided to West Coast Paper Mills, Dandeli (Karnataka).
- Technical consultancy was offered to Andhra Pradesh Forest Department on implementing breeding programmes for native and introduced tree species.
- Consultancy service were provided to Singareni Collieries Company Limited, Kothagudem, Khammam District Andhra Pradesh for the study of the changes likely to occur with the diversion of R.F on flora and fauna in the area of 11.96 ha of forest land sought for realignment of Tellavagu nallah - a seasonal stream.
- A technical consultancy was given to Kudremukh Iron Ore Company Ltd., Kudremukh in preparation of Final mine closure plan along with Eco-restoration plan.

CONFERENCES/MEETINGS/ WORKSHOPS/SEMINARS/ SYMPOSIA/EXHIBITIONS

Organized

Organized a National Workshop on *Strategy for conservation of Sacred Groves* sponsored by the Ministry of Environment and Forests (MoEF), Government of India on 27th and 28th May, 2004 at the Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore. The workshop was inaugurated by Dr. Kulaindaivel, Chancellor, Avinashilingam Deemed University, Coimbatore and attracted more than 110 participants. 48 papers were presented.

Attended

National

1. Consultative Workshop on Propagation and Cultivation of Bamboo on 30th and 31st July, 2004 at G.B. Pant University of Agriculture, Uttaranchal.

2. Consultative Meeting for formation of umbrella project on LKTS from 16th to 18th August, 2004 at ICFRE, Dehradun.

3. Workshop on Regional cooperation on conservation of biodiversity hot spots of the Indian sub-continent and taxonomy databases for conservation on 30th August, 2004 organised by ATRI and UAS, Bangalore

4. Workshop on Information management of bio-diversity (plant genetic) resources in Botanic Gardens of India from 6th to 10th September, 2004 at NBRI, Lucknow.

5. National Workshop on Conservation of Sacred Groves from 16th to 18th September, 2004 organised by KFD, Kozhikode.

6. Interaction Workshop on Participatory Forest Management and Genepool Conservation Areas on 20th September, 2004 at High Range Circle Office, KFD, Kottayam.

7. ICAR sponsored Winter School short course on Strategies for improvement and utilization of tree borne oil seeds from 20th to 30th September, 2004 at Forest College and Research Institute, TNAU, Mettupalayam.

8. Workshop on Advanced Techniques in Plant Biotechnology on 22nd September, 2004 at J.J. College of Arts and Science, Pudukottai.

9. Seminar on State Development Report for Lakshadweep from 12th and 13th October, 2004 organised by IAMR at Kavaratti, Lakshadweep.

10. 5th Annual Discussion Meeting on Dimension of Molecular Entomology on 27th November, 2004 organised by Prof. T.N. Anantahakrishnan, Emeritus Professor at Chennai.

11. XIV Annual Conference of IAAT and National Seminar on New frontiers in plant taxonomy and biodiversity conservation from 29th to 31st December, 2004 at Tropical Botanical Garden and Research Institute, Thiruvananthapuram.

12. National Seminar on Healthy Environment for the next generation from 2nd to 4th December, 2004 at Loyola College, Chennai.

13. Workshop on Agroforestry for Attappady Wastelands: Potentials and Prospects on 9th January, 2005 at Attappady Hill Area Development Society, Agali, Palakkad.

14. ICAR National Symposium on SYMBIOHORT from 10th to 12th January, 2005, Kerala Agricultural University, Thrissur.

15. Round Table Consultative Meet on Bamboo Location Trial on 15th and 16th January, 2005 at G.B. Pant University of Agriculture, Uttaranchal.

16. Annual Research Seminar of Salim Ali Centre for Ornithology and Natural History on 17th January, 2005 at SACON, Coimbatore

17. Symposia on Microbial and Plant Biotechnology from 17th to 19th February, 2005 at Loyola College, Chennai.

18. Seminar on State Development Report, Lakshadweep on 23rd February, 2005 at IAMR Campus, Narela, Delhi.

19. National Symposium on Emerging Technologies and their management of threatened wild medicinal plants from 23rd to 25th February, 2005 at State Forest Research Institute, Jabalpur.

International

1. IUFRO International Conference on Multipurpose Trees in Tropics: Management, Growth and Assessment jointly organized by IUFRO and ICFRE from 22nd to 25th November, 2004 at Arid Forest Research Institute, Jodhpur.

AWARDS

Best Poster Award was given for the poster on *Protoplast isolation and Regeneration in Eucalyptus camaldulensis* (R. Yasodha, R. Sumathi and P. Malliga) at National Symposium on *Microbial and Plant Biotechnology* held at Loyola College, Chennai from 17th to 19th February, 2005.

DISTINGUISHED VISITORS

Thiru A. Raja, Hon'ble Union Minister, Ministry of Environment and Forests, Govt. of India visited the Institute on 25th January, 2005.

MISCELLANEOUS

- Mrs. V. Bhanumathy, LDC won the *Gold medal in Chess* during *XIII All India Sports Meet* held at Raipur, Chhattisgarh from 28th December, 2004 to 1st January 2005.
- A lecture on *Origin, Genesis and Functions of Judiciary in India* was delivered by Shri B. Mohan, B.A., B.L., Attorney, Coimbatore. The programme was jointly organized by Indian Institute of Public Administration (IIPA) and IFGTB on 24th March, 2005 at IFGTB,
- A total of 640 visitors visited the Institute during April, 2004 to March, 2005. It includes the students of various educational institutions, NGOs, industrialists, academicians etc. The research activities were explained to them by arranging visits to laboratories, botanical garden, modern nursery, vegetative multiplication garden, Gass Forest Museum etc. and they were provided with relevant technical information on Forestry. Pamphlets and handouts were distributed to the visitors. ICFRE and IFGTB publications were made available for sale.
- Participated in the radio programmes organized by AIR, Coimbatore on various forestry related topics and a special radio feature on *IFGTB's research activities with special reference to Agroforestry* was presented.

Service Rendered

- Plants and plant products slated for export were examined and subjected to the appropriate quarantine measures and 643 Phytosanitary Certificates were issued to various organizations and individuals.
- Queries relating to the pests and disease problems and bio-fertilizers received from the State Forest Departments, farmers and NGOs were attended and provided appropriate solutions.

Gass Forest Museum

- Collection management, upkeep and maintenances, visitor's service and educational service were undertaken. A total of 7073 peoples visited the museum during the year.

Maintenance of Seed Bank

- Seeds of various important species viz. *Jatropha curcas, Azadirachta indica* and *Tectona grandis* were collected from

different localities of Tamil Nadu and Kerala. Seeds of *Acacia auriculiformis, A. mangium, Casuarina equisetifolia, C. junghuhniana, Eucalyptus camaldulensis* and *E. tereticornis* were supplied to other divisions of the Institute, SFDs, Industries, NGOs and other user agencies. Ten kg seeds of *Jatropha curcas* collected from Tamil Nadu and Kerala were supplied to Union Territory of Lakshadweep.

- Seed testing for viability, seed count, purity were conducted and provided the test results to various clients and researchers.

Library and documentation

The Library has a collection of 8100 books, 35 Indian journals, nearly 250 number of back volumes, other research reports, Seminar Proceedings, tour reports and non-subscribed periodicals received as complimentary and resource sharing of library documents.

CHAPTER III

INSTITUTE OF WOOD SCIENCE AND TECHNOLOGY BANGALORE

The Institute of Wood Science and Technology (IWST), Bangalore formed in 1988, is mandated to conduct research on Wood Science and Technology as its national objective and focus on important forestry research needs of the states of Karnataka, Andhra Pradesh and Goa at regional level. Taking into consideration the expertise available and contributions made, the Indian Council of Forestry Research and Education (ICFRE), Dehradun has assigned the Institute the status of Centre for Advanced Studies in the areas of Improved Utilisation of Wood; Mangroves and Coastal Ecology and Research on Sandal. The direction of research being carried out at IWST is in consonance with and in response to the aims of National Forest Policy in the areas of utilisation of timber and non-timber products and for increasing productivity. The Institute mainly aims to develop sustainable strategies for use and production of wood and other forest products.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

Project 1: Assessment of wood quality (Anatomical) of 8-10 years old *Acacia auriculaeformis* and *Acacia mangium* hybrids [IWST/WPU/X-08-2002-2004]

Findings: Data on anatomical and physical properties of 8 years old *Acacia auriculaeformis* and *A. mangium* hybrids was generated for the first time. Statistical analysis of specific gravity and anatomical data revealed wood quality of *Acacia auriculaeformis* is more uniform than *Acacia mangium* hybrid. Both the hybrids were found as good as *Acacia auriculaeformis* and *Acacia mangium* for usage as solid wood products and for paper and pulp. However, the wood of *Acacia mangium* hybrid showed wooly nature, which may cause problems during processing.

Project 2: Development and popularization of packing boxes of plantation grown timbers from South India for Horticulture produces [IWST/WPU/ X-09/2003-2005]

Findings: Five packing boxes each having external dimensions of the box 45X30X30 cm for 20 kg load for horticulture produce were fabricated using *Acacia auriculaeformis* and *Eucalyptus tereticornis* clone wood.

Project 3: Studies on forced air drying of plantation grown timbers [IWST/WSP/X-01/ 2002-2004]

Findings: The forced air drying method was found superior to natural air drying method in case of all the species tested.

The moisture contents of planks of different species after drying in case of these two methods were as follows :

The technique was found superior to existing technique in respect of uniformity in drying as well as economy of drying.

Moisture contents as %

Name of species	Natural air drying	Forced air drying
Albizzia lebbek	16.61	6.79
Grevillea robusta	15.60	9.26
Eucalyptus tereticornis	23.35	14.12
Azadirachta indica	17.87	15.87
Casuarina equisetifolia	19.07	15.82
Hevea brasiliensis	16.63	16.57

Project 4: Development of alternative preservatives of more economic value and schedules for their incorporation in wood [IWST/WSP-009/2000-2005]

Findings: Eco-friendly wood preservatives were prepared from plant extractives like Cashew Nut Shell Liquid (CNSL) and Neem oil by incorporating copper ions. *Hevea brasiliensis* specimens were treated with these preservatives by employing three different methods namely brushing, dipping and pressure processes. The treated samples along with control specimens have been evaluated for their efficiency against termite (field test) and fungi (Laboratory). The periodic observations show that the formulated preservatives increased the durability of the timber against termites and fungi. Pressure treated specimens were found better than dip treated ones. Copperised neem oil and copperised CNSL gave complete protection against termites wood rotters. Neem oil and CNSL treatments also showed better performance but could not bring complete protection against termites and decay fungi.

Project 5: Evaluation of ammonia based preservatives against Indian termites [IWST/WSP/2002-2005]

Findings: Specimen treated with ammonia based wood preservatives performed better compared to those treated by CCA which in turn performed better than control.

Project 6: Effect of temperature, humidity and pH on CCB fixation in wood [IWST/WSP/X-11/2003-2005]

Findings: Samples of *Bombax ceiba*, *Albizia falcataria* and *Samanea saman* (size: 25 mm^3) were prepared and treated with 6% CCB solution to evaluate the effect of temperature, humidity and pH on CCB fixation. All the Samples have been analysed for Cu, Cr and B content. It is observed that Cu and Cr leached more at low pH value.

Project 7: Studies on drying behaviour of timber used for handicrafts [IWST/WSP/X-20/2003-2005]

Findings: The effectiveness of anti-shrink chemicals namely common salt (50% w/v solution), Urea (60% w/v solution) and brush coating of linseed oil was assessed on *Artocarpus hirsutus, Gmelina arboria* and reed *Ochlandra trawanca*. Both urea and salt solution were found to be very effective in controlling any surface or end cracks in the wood samples. In case of *Ochlandra trawanca* reed, treatment reduced the drying rate and restricted any drastic shape deformation and cracking during the early stages of drying. However with the prolonged drying, the treated samples deformed to the same magnitude as untreated reeds.

Project 8: Natural products evaluation of extractives of plant origin for biological and pharmacological activity-*Nothapodytes nimmoniana* and *Garcinia indica* [CFP-003/ 2000-2005]

Findings: Fruits of *Garcinia indica* and wood of *Nothapodytes nimmoniana* on extraction with methanol yielded 24 % and 2.7% extracts, respectively. The above extracts on pharmacological evaluation were found to exhibit anti-inflammatory property.

Project 9: Role of biofertilizer in ecorestoration of problematic site like mine reject soil in Goa [IWST-28/WBD-3/2000-2005]

Findings: Planting work of biofertilizers treated plants was successfully completed in three places of mine reject areas in Goa state with the help of Goa Forest Department. Survival percentage, mortality rate and growth data was collected for these seedlings. *Acacia auriculiformis* and *Casuarina equisetifolia* performed better than other three species in both growth and survival percentage.

Project 10: Studies on entomofauna of mangroves of Karnataka, Goa and Andhra Pradesh [IWST-24/WBD-7/2000-2005]

Findings: Studies on the insect diversity in the mangroves of the coastal Karnataka, Goa and Andhra Pradesh was completed. Mangroves at Vishakhapatnam and Kakinada were surveyed for observations on the incidence of different groups of insects. From both coasts, 200 species were authentically identified with the help of ZSI, IRI and FRI, Dehradun. Checklist of insects belonging to different orders, which were collected from east and west coast have been prepared.

Project 11: Control of biodeterioration of wood with the help of eco-friendly preservatives and bioactive substances on staining and decay fungi under terrestrial conditions [IWST-13/ WBD-8 /1997-2005]

Findings: Pure culture of wood rotters, stain and plant pathogenic fungi were maintained in virulent condition. Significant protection of rubber wood was achieved against wood rotters by the application of *Dalbergia latifolia* extract, copperised CNSL and Neem oil. Encouraging results were obtained in the bio-assay studies with seed oils and metabolites of microorganisms like *Trichoderma viridae, Pencillium spinolosum* and *Bacillus coagulensis* against wood decay fungi.

Project 12: Bio-systematic studies on parasitoid complex of Sandal coccids and their utilization in biological control [IWST/ WBD/2002-2005]

Findings: Identification of the hymenopteran parasitoids has been completed. Data on the population dynamics of the host and its parasitoids has also been obtained. Results indicate that there are several species of promising parasitoids that could be exploited for biological control of the coccid pests.

Project 13: Development of modern nursery techniques for propagation of important species of Goa – *Terminialia tomentosa, Xylia xylocarpa, Myristica fragrans, Bambusa arundinaceae* and *Dendrocalamus strictus* [IWST/TIP/ 001/2000-2004]

Findings: Nursery protocol for five important species was standardized. In all, three experiments were laid for each species. The best combination was based on overall growth, health and economics of nursery production. Nursery gestation period was 5 months in case of all

species except *Myristica fragrans* which was 8 months.

Project 14: Studies on micropropagation field evaluation and conservation of *Pseudoxytenanthera stocksii (Oxytenanthera stocksii*) – Threatened species [IWST/TIP/002/2000-2005]

Findings: Refined protocol for the rapid and mass *in vitro* cloning of *P. stocksii* from the explants of the Candidate Plus Clump (CPC) through axillary shoot proliferation was developed. High rate of multiple shoot (4-6 shoots, explant) was induction obtained in MS liquid medium with NAA 0.1 – 0.25 mg/l + BAP 2.0 – 2.5 mg/l. Shoot multiplication rate was 5-6 fold in MS liquid medium with PGRs within 4 weeks period. Among the various auxins, NAA proved the best auxin and about 95 per cent *in vitro* and *ex vitro* rooting could be obtained within 3 weeks period. Plantable plantlets of 4-5 tillers with miniature rhizome developed within 3-4 months period. Based on the protocol, 2000 plants were produced and provided for the field planting. Survival rate was 100 per cent in field after six months of the micropropagated plants at Gottipura.

Project 15: Variation in photosynthesis in clones of Sandal and Eucalyptus [IWST/TIP/X-28/2003-2005]

Findings: The study material comprised of clonal material of Sandal and Eucalyptus with an aim to document the variation existing with reference to photosynthetic gas exchange parameters. Significant variation has been observed across various accessions for gas exchange parameters like; stomatal inductions, intercellular carbon dioxide concentration, transpiration rate, photosynthetic rate and instantaneous water use efficiency. This preliminary data would provide base line information for further breeding programme in these two species.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

Project 1: Evaluation of wood quality parameters of plantation grown *Eucalyptus citriodora* for different end uses [IWST/WPU/X-09/2002-2005]

Status: Five trees of *E. citriodora* were procured from Yesalur range, Sakaleshpura, Hassan District. Fibre length, fibre diameter, lumen diameter, vessel diameter and vessel element length were measured from macerated material for three trees. Micro slides were prepared for five trees at 4 different radial positions and 3 vertical positions. Physical and mechanical properties in green condition were completed for all the five trees. Retention of shape was determined from its shrinkage values. The suitability of this timber for handicraft was carried out by subjecting it to various working quality operations in collaboration with handicrafts department and its performance for any defect was under observation. Tests on compression parallel and perpendicular to grain in air-dry condition were completed.

Project 2: Assessment of wood quality of *Simarouba glauca* for its timber value [IWST/WPU/X-10/2003-2005]

Status: Studies on shrinkage (longitudinal, radial, tangential and volumetric) behaviour and mechanical properties under green conditions were completed. Data on fibre length, fibre diameter, lumen diameter, vessel element length, vessel diameter and vessel frequency of stem wood and branches of all the trees were collected.

Project 3: Evaluation of culm quality before, during and after flowering in bamboo (*Bambusa bambos, Dendrocalamus strictus,* Melocana and *Ochlandra* sp.) [IWST/WPU/X-14/2003-2006]

Status : Within culm variation in starch content by gravimetry from base to top has been completed in flowered and non-flowered *Bambusa bambos*. Growth stresses study was completed. Relevant anatomical data pertaining to within culm variation in fibre length, fibre diameter, fibre lumen diameter, double wall thickness, vessel element length, vessel diameter from 1 to 10 internodal positions have been studied. No consistent pattern has been observed in any of the parameters. Histo-anatomical studies were made in relation to starch content, total proteins and phenolics in a culm of *Bambusa bambos* while flowering. Testing has been completed for different physical (specific gravity and shrinkage) and strength properties (static bending – MOE and MOR, compression parallel to grain) in green condition on non-flowered and during flowering stages of *Bambusa bambos* and non-flowered stage of *D. strictus*.

Project 4: Assessment of wood quality of *Tectona grandis* (Teak) clones from Thithimathi (Karnataka) and Andhra Pradesh [IWST/WPU/X-15/ 2003-2006]

Status : Data analysis was carried out for the physical properties - specific gravity and shrinkage properties (volumetric, radial and tangential) from green to oven dry condition from bottom, middle and top positions of logs of the Haliyal and Thithimathi clones. From the observations, it is seen that Thithimathi clones have higher standard specific gravity as compared to Haliyal clones. Both these values are found much lower than the standard Teak values. Volumetric shrinkage values of these two were found comparable but much higher when compared with the standard Teak values. Volumetric shrinkage values of these two were found comparable but much higher when compared with the Standard Teak values. Testing of strength properties – static bending, compression parallel and perpendicular to grain hardness, shear, tension in green condition were completed and data being analysed. Testing of nail and screw holding power in green condition is being carried out.

Project 5: Studies on fracture mechanics in solid wood and wood composites using acoustic emissions [IWST/WPU/X-16/2003-2007]

Status : Compression tests were carried out on small block samples of Teak wood, *Eucalyptus citriodora*, *Acacia auriculaeformis* and *A. mangium* hybrid in longitudinal, radial and tangential directions at different UTM cross head speeds. The fracture patterns of these samples when compressed in longitudinal direction have shown a characteristic appearance. The fracture band was found to run perpendicular to the grain on the radial face and obliquely on the tangential face having an angle of 60°-70° along the grain direction. This fracture band was found to be about 1 – 2 mm wide and fibres in these bands have been observed as buckled and continuous. It was found that Teak wood is generally exhibit more fracture toughness in LT plane than in LR plane.

Project 6: Use of sonic and ultrasonic testing techniques to evaluate wood strength of plantation species - A non-destructive test method [IWST/ WPU/ X-17/2003-2005]

Status: Testing was carried out on wood materials of *Simarouba glauca* and *Acacia auriculaeformis* to study the effect of density, principal grain directions, moisture content and sample sizes on ultrasonic velocity. The preliminary tests showed that ultrasonic velocity along the longitudinal direction is greater than transverse ones (radial/ tangential directions) and decreases with increasing moisture content (Y25%), while least effect of density of test samples on ultrasonic velocity was noticed. Dynamic modulus of

elasticity of above mentioned three species and *Eucalyptus citriodora* were determined at different moisture content below fibre saturation point using Elastosonic instrument (NDT method).

Project 7: Evaluation of treatability of selected refractory species [IWST/WSP/2002-2006]

Status: *Eucalyptus* hybrid was procured from IWST Campus specimens of the 3 different sizes 30 cm x 10 cm x 2.5 cm, 30 cm x 10 cm x 5 cm and 30 cm x 10 cm x 10 cm were prepared from the logs and kept for ponding for 1, 2 and 4 months. These were consecutively kept for diffusion process with two different preservatives for 1, 2 and 4 weeks along with control. These specimens were subjected to penetration tests. Chemical analysis is in progress.

Project 8: Analytic studies on Viscoelastic behaviour of wood and tree biomechanics [IWST/WSP/X-06/2002-2005]

Status: Viscoelastic behaviour was studied using four element model, consisting of one Maxwell body (having one spring and one dashpot in series) and Kelvin body (having one spring and one dashpot in parallel). Irreversible deformation, delayed and instantaneous elastic behaviour are explained through this model. Dashpot of Maxwell body which describes the viscous flow and irreversible creep was related to the slow movement of woody constituents like cellulose, Hemicelluloses and lignin under the influence of external load. Spring of the Maxwell body describing instantaneous elastic behaviour was represented by crystalline portion of the cellulose. Kelvin body with spring and dashpot in parallel was linked with delayed elasticity which resulted from cross linking of woody constituents.

Project 9: Studies on fibre formation in wood [IWST/WSP/X-07/2002-2005]

Status: Relationship between microfibril angle and fiber properties was analysed in terms of stress transformation from fibre orientation to microfibril direction. Mechanism of fibre formation in wood was explored from the point of view of self-assembly of cellulose into large scale fibres producing structures. Cellulosic microfibrils can be arranged in parallel throughout the thickness or can change direction from layer to layer due to their liquid crystalline nature.

Project 10: Studies on the gas permeability of secondary species of timbers [IWST/WSP/2003-2008]

Status: Samples of *Acacia auriculiformis* of 22 mm x 22 mm x 22 mm size which had attained last stage of conditioning (about 9% moisture content) are being studied for permeability in axial, radial and tangential directions.

Project 11: Polymerization filled composites [IWST/WSP/2003-2006]

Status: Composites of HDPE and Wood fibres were prepared using "polymerization filling" technique in S.S. high pressure stirred autoclave. The design of autoclave system was standardized. Effect of monomer concentration and time on polymerization was studied. It was found that with appropriate pretreatment of support, presence of cellulosic filler does not adversely affect the kinetics of polymerization. The polymerization was carried out at a pressure of 5 bar of ethylene and very high catalyst efficiencies (~3,000kg of PE/mol of TM/hr) were recorded. Most importantly, no reactor fouling was observed even at very high solid content (upto 40%) in the slurry. The study demonstrated that highly filled composites can be prepared by filler supported catalyst system using cellulosic materials as fillers. Also slurry reactors which are used commonly in industry for manufacture of

polyethylene can be used conveniently for production of cellulose filled HDPE composites.

Project 12: Chemical induction of heartwood in Sandal [CFP-001/2000-2006]

Status: Sandal plants were injected with 8th dose of heartwood stimulant chemicals viz. Paraquat and etherel. Different parameters like girth, height etc were recorded. The effect of these two chemical was found significantly higher than that of control. Further observations are being taken.

Project 13: Development of colouring reagents based on enzyme-substrate reaction for differentiating oil yielders of Sandal in field [IWST/CFP/ X-12/2002-2007]

Status: Modified colour reaction using guaiacol substrate is giving encouraging results for categorizing Sandal plants of varied oil contents.

Project 14: Impact of disturbance on canopy insect biodiversity: an assessment of forest health [IWST/WBD/2003-2007]

Status: Structure of canopies were sampled using the standardized canopy access techniques, thermal fogging technique. Arthropod samples have been drawn during monsoon, post-monsoon and pre-monsoon periods from disturbed and undisturbed forests. Monsoon collections have been sorted to recognizable taxonomic units and data on the diversity of different taxa analysed. The post-monsoon samples of undisturbed forests and monsoon samples obtained from rubber plantation have also been sorted. The samples are being classified to the level of species by several taxonomists across the country.

Project 15: Studies on Teak heartwood borer *Alcterogystia (cossus) cadambae* moore and its management [IWST-29/WBD-9/2000-06]

Status: Studies on bio-ecological aspects of the pest were completed at Gunjavati area (Yellapur division). Studies on the life cycle of the pest was conducted in the laboratory and the seven instars have been found. For management of the pest nematodes, *Bacillus thurigiensis* and Neem products were tested in the *in vitro* conditions and preliminary trials on the applications were conducted in the Teak plantations of Haliyal and Yellapur divisions of North Kanara Circle. Nematodes and B.T. applications were found effective.

Project 16: Ecorestoration of degraded mangrove habitat along Goa coast [IWST-2/ WBD-1/2000-2005]

Status: Project has been kept in abeyance for administrative reasons.

Project 17: Studies on durability of selected Indian secondary timbers against marine wood biodeterioration agents in the marine environment along Karwar coast (Karnataka) [IWST-30/WBD-10/2000-2005]

Status: Project has been kept in abeyance for administrative reasons.

Project 18: Species, provenance and clonal test trials on *Casuarina* spp. in North Andhra [IWST/WBD-Marine/X-004/2003-2008]

Status: Ten clones of *Casuarina equisetifolia* were collected from Regional Forest Research Centre, Rajahmundry. Regular maintenance of plantations was carried out. Growth data of clones was recorded.

Project 19: Ethnobotanical studies of Godavari valley in Andhra Pradesh [IWST/ WBD Marine/X-04/2002-2007]

Status: Intensive field surveys were undertaken and ethnobotanical data was collected from the agency areas of Polavaram and Rampachodavaram of East and West Godavari Districts. Ethnobotanical data on 123 plant

species were collected from Kondareddy, Koya and Kondakammara tribes of Godavari Valley. Herbarium was made and documented for the collected species. Identification of 70 plant species was completed. Five rare and endangered wild plant genetic resources of botanical and ethnobotanical importance, namely, *Dioscorea bulbifera, Ensete glaucum, Musa balbisiana, Piper betle* and *Zingiber zerumbet* were collected from the Godavari valley of Andhra Pradesh and introduced for *ex situ* conservation.

Project 20: Community involvement in coastal forestry through periodical returns by value added produce [IWST/WBD-Marine/ X-24/2003-2008]

Status: Nursery of *Eucalyptus citriodora* was raised and plantation was taken up in the three hectare of selected area. Plantation was done in 2 m x 2 m spacing in block planting and five rows of *Casuarina equisetifolia* were planted all around the block to serve as windbreaker and shelterbelt. Casualty replacement was done in all 3 ha areas. Clipping of terminal shoot of *E. citriodora* was undertaken to facilitate production of higher quantity of herbage and essential oil in addition to periodic maintenance.

Project 21: Environmental impact of leachates from Copper-Chrome-Arsenic (CCA) wood preservative under marine condition [IWST/ WBD-Marine/ X-23/2003-2006]

Status: Test stakes were treated with CCA wood preservative. End penetration test was carried out to assess preservative retention in panels.

Project 22: Studies on recruitment and metamorphosis of marine woodborer larvae [IWST/WBD-Marine/X-22/2003-2008]

Status: Two species of algae, namely, *Chaetoceros* sp. and *Isochrysis* sp. were procured and maintained in Guillard's f/2 medium. Experiments on the influence of algal species on the recruitment of teredinid woodborer larvae on wood surface and subsequent metamorphosis were carried out. Generations of teredinid woodborers were reared and maintained in the laboratory for use as stock for larval production. Running seawater system was regularly maintained for larval rearing.

Project 23: Inventory of coastal plant communities of north Andhra region [IWST/ WBD -Marine/X-25/2003-2006]

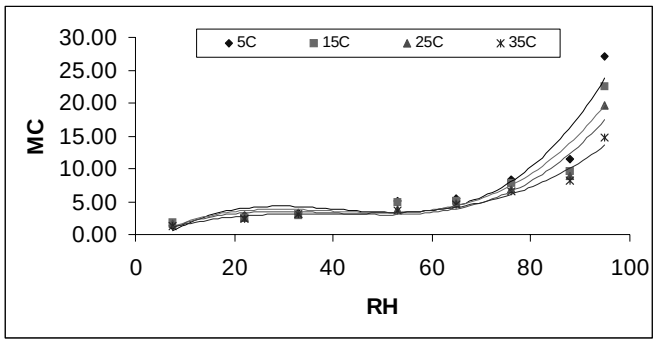
Status: Intensive field surveys were undertaken along the coastal areas of Srikakulam, Vizianagaram and Visakhapatnam Districts. Several mangroves, halophytes, hydrophytes, xerophytes and psammophytes were collected. An excellent sand binder, namely, *Pupalia lappacea* var. *orbiculata* was collected for the first time from coastal areas of Andhra Pradesh. 383 plant specimens were collected and made into herbarium. Of the total collections, 174 plant specimens were identified. Ethnobotanical data were collected wherever available.

Project 24: Standardization of protocol for viability testing and prolonging the viability and vigour of *Santalum album* seeds in storage [IWST/ TIP/2003-2005]

Status: Experiments were laid to study the effect of different storage conditions, viz. temperature and moisture content on viability of Sandal seeds. The seeds stored at 5°C and 15°C having 2.5% moisture content retained 50% viability after one year.

Periodic change in moisture content at different relative humidities at 5, 15, 25 and 35°C was recorded to study the effect of different RH on the equilibrium moisture content. Adsorption isotherms were developed. The isotherm obtained was validated using BET theory and the

primary and secondary water level at different RH and at each temperature was obtained.



Adsorption isotherm for the seeds of Sandal at different temperatures and relative humidities.

Project 25: Seed studies of some of the economically important species of Western Ghats [IWST/TIP/2003-2006]

Status: *In situ* regeneration studies carried out for *Myristica fragrans*, revealed that the seeds germinated within 15 days, which otherwise took 90 to 120 days for germination under laboratory and nursery conditions.

Variability, storage and desiccation studies were carried out for seeds of *Dysoxylum malabaricum* and *Garcinia gummigutta*. *Garcinia gumigutta* seeds were desiccated at different temperatures and were periodically tested for viability. After 21 days, the seeds desiccated at 15°C, retained 50% viability.

Seed predation studies in *Dysoxylum malabaricum* revealed that 30% of seeds were infested by fruit fly of family Tepritidae, which has been reported for the first time in this species.

Project 26: Genetic screening of *Jatropha curcas* – an important biofuel species of dry areas [IWST/TIP/2003-2006]

Status: Seeds of 24 different provenances as well as clonal propagules (cuttings) from 7 districts of Karnataka (Kolar, Uttara Kannada, Haveri, Tumkur, Bidar, Shimoga and Karwar), which are considered natural habitat of *J. curcas* were collected. Estimation of oil contents is in process.

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

Project 1: Characterization and identification of imported timbers available in the timber markets and sea ports [IWST/WPU/X-43/2004-2007]

Status: Started in September, 2004. Data collection is in progress.

Project 2: Development of seasoning schedules for plantation timbers using dehumidification based drying [IWST/WSP/X32]

Status: Drying behaviour of plantation grown timbers in a desiccant based dehumidifying wood drying system is in progress. Drying of *Eucalyptus tereticornis* timber from mature and juvenile trees were studied. The wood from mature trees was slow to dry as compared to juvenile wood. In a specific drying conditions, it took 20 days to dry mature timber (mostly heartwood) to 12% moisture content from 40% moisture content. However juvenile wood (mostly sapwood) could be dried to 17% moisture content from an initial 90% moisture content within 15 days. The moisture loss rate in timber from young trees was nearly 8% per day at the initial stages. More importantly, about 90% of the dried boards were without any significant degrades like surface checking, end cracking and warp.

Project 3: Influence of pretreatment techniques on the treatability of hardwood species grown in Karnataka [IWST/WSP/X-33/2004-2007]

Status: Efforts are being made to procure *Eucalyptus grandis* from State Govt. organisation.

Project 4: Studies on natural durability of treated and untreated timbers of secondary species [IWST/WSP-X-34/2004-2007]

Status: Timber species of *Lophopetalum wightianum*, *Lagerstromia lanceolata* and *Artocarpus heterophyllus* were treated by Full Cell process with CCA preservative for four different levels of absorption: 4,8,12 and 16 Kg/m^3. The treatment schedule for all these species for different loadings of absorption was developed. Highly refractory *Artocarpus heterophyllus* specimens were treated for higher absorption levels by giving alternate pressure and vacuum. Treatment with CCB preservative is in progress.

Project 5: Woodfibre plastic composite foams with improved cell morphology by continuous process [IWST/WSP/X37]

Status: A series of polystyrene wood fibre/wood flour composite materials having 10, 20, 30, 40 and 50% of wood (by weight) were prepared. All the experiments were performed in a co-rotating twinscrew extruder. The polystyrene blended with process additives was fed through the main inlet hopper of the extruder. The wood fibres were fed to the side feeder at a predefined rate using another volumetric feeder. After approximately 10 min, when steady state conditions were reached, the pure PS feed was changed to mixture of PS, compatibilizer and processing additives. Vacuum venting was used to remove the residual moisture and volatiles, which were produced during WPC production. The product was recovered by guiding the molten extrudate into a standard cold water stranding bath. The cooled strands were subsequently chopped into pellets, dried and stored in sealed plastic bags. Foaming experiment is to be carried out.

Project 6: Performance and evaluation of selected bamboo species treated by modified Boucherie process [IWST/WSP/X44/2004-2006]

Status: Freshly felled three species of Bamboo, viz. *Dendrocalamus strictus, Pseudooxytenanthera stocksii* and *Bambusa arundinacea* bamboo culms with branches and leaves were collected. Eight per cent solution of three preservatives viz. CCA, CCB and Boran (Boric acid) were prepared. Two culms of each species were treated with each preservative for six hours by Boucherie process. Immediately after the treatment the same culms were treated with 2% solution of CCA, CCB and Borax for four hours for the uniform distribution of the preservative chemical. After the treatment the branches of the treated culms were removed. These culms were kept for drying in shade for fixation of preservatives. Treated and dried bamboo culms were cut into small pieces of 30 cm length having at least one node. One small ring adjacent to each sample (2.5 cm length) from bottom, middle and top portions were removed for the analysis. Six samples from each culm with one control sample were buried such that half portion is below and half portion above the ground in the test yard for their durability test. Chemical analysis was carried out. The results of the analysis showed that the absorption of the chemical are more in the bottom portion and least in the top portion in all bamboo species.

Project 7: Gender identification of *Garcinia indica* and *Simarouba glauca* using isoenzyme studies and assessment of fruit characters, yield and market potential of *Garcinia indica* in Karnataka state [IWST/ CFP/X-39/ 2004-2006]

Status: Literature was surveyed for *Garcinia indica* and *Simarouba glauca*. Male and female plants of *Garcinia indica* and *Simarouba glauca* were marked in Kodagu district and GKVK campus, Bangalore, respectively, for undertaking isoenzyme study. Isoenzyme studies by PAGE technique on *Simarouba glauca* are in progress.

Preliminary results are encouraging and needs further confirmation with more number of samples. A questionnaire has been prepared for conducting market survey and data are being collected.

Project 8: Studies on the sucking pest complexes of Sandal and their management [IWST/WBD/X-13/2004-2007]

Status: Insect pest survey was conducted in Sandal Clonal Seed Orchard raised at Sri Venkateshwara University campus. So far 15 sucking pests belonging to eight families were identified down to species level. Study on the life history of the spiralling whitefly *Aleurodicus dispersus* Russell on Sandal from August to September, 2004 indicated that it takes 49.25 days from egg to adult. The males lived for 6.33 days and female for 7.66 days.

Project 9: Role of Fungi biodeterioration of timber under marine conditions [IWST/ WBD/X-35/ 2004-2007]

Status: Bacteria, actinomycetes and fungi from infested wood samples collected from Visakhapatnam coast were isolated. Characterization of biodegrading activity of isolates is in progress.

Project 10: Investigations on the resistance of commercially available bamboo species in Karnataka against insect borers and termites [IWST/WBD/X-45/2004-2008]

Status: Two commercially available Bamboo species, viz. *Bambusa bambos* and *Dendrocalamus strictus* have been taken up for this study. The adult borers collected from these bamboos are being cultured to test them on bamboos. Durability tests of treated and untreated bamboo stakes procured from the wet zone are being carried out against termites in the field.

Project 11: Studies on Productivity and Management of *Tectona grandis* (Teak) in Agroforestry practices in Karnataka and Andhra Pradesh [IWST/TIP/X-38/2004-2007]

Status: Few preliminary studies were initiated on assessing growth performance and productivity of farm Teak planted in farmlands in Devanahally taluk, Bangalore Rural district, Karnataka and in Tirupathi, Chittor district, Andhra Pradesh under an UNDP project executed 10 years back. The growth performance (height and gbh) of the Teak planted on farm bunds was distinctly superior as compared to block plantations. Wood samples from felled Teak trees were collected and samples were prepared for testing wood properties as per standard procedure for evaluation of wood quality parameters relating to physical and mechanical properties. Data is also being compiled on socio-economic parameters through semi-structured questionnaires among beneficiary farmers.

10 years old block plantations in study area

10 years old Teak on farm boundary in study area

Project 12: Productivity and interaction studies in *Acacia* hybrid based agroforestry practices in Karnataka [IWST/TIP/X-40/ 2004-2009]

Status: A trial on agroforestry with *Acacia* hybrid has been laid out on a farmland near Kolar, adopting 10 m x 2 m spacing to study its performance/productivity and tree crop interactions in agroforestry. During first year, Tomato and Ragi were cultivated in the interspaces and the observations are in progress.

Project 13: Screening clonal propagation, *ex-situ* conservation and genetic improvement of *Pongamia pinnata* [IWST/ TIP/X-36/2004-2007]

Status: Study was conducted to see the effect of different growth regulators and their concentrations on cuttings of *Pongamia pinnata*. Among the growth regulators, IBA performed better in terms of rooting percentage, root length, number of leaves and survival percentage of rooted cuttings. Similarly, the cuttings treated with IBA @ 2000 ppm performed the best for early rooting greater root length, shoot length and number of leaves.

The seeds collected from different plus trees of *Pongamia pinnata* in Central Northern Silvicultural zones of Karnataka were sown in the sand bed for germination studies. The seeds collected from 15 plus trees of northern silvicultural zone performed better in terms of high germination percentage.

Project 14: Evaluation of genetic variability and mating system analysis of *Aegle marmelos* Corr. and *Feronia elephantum* Corr. using isoenzyme markers [IWST/TIP/X-42/ 2004-2007]

Status: For evaluation of genetic variability, fruits and leaf samples of *Aegle marmelos* were collected from six different genotypes at Ramakrishna Ashram, Mysore. Fruits and leaf samples of *Feronia elephantum* were collected from ten different trees in Savanadurga reserve forest. Six clones from the clonal seed orchard at Mudugere, Karnataka state forest department were also collected. Data were recorded on morphological characters, viz. shape and weight of fruit and number of seeds per fruit, presence or absence of thorns, size and shape of leaf, number of pinnules per pinnae, petiole length and size of pinnules. Morphological variation was distinct between the clones. Three isoenzymes, viz. peroxidase, esterase and malate dehydrogenase were standardized and studied for 6 genotypes of *Aegle marmelos*. In case of *Feronia elephantum* esterase, polyphenol oxidase and peroxidase were standardized.

Variation in fruit & leaf size of *Aegle marmelos*

Project 15: Comprehensive tree improvement program for *Gmelina arborea* in Karnataka – Phase I- Progeny trial [IWST/TIP/X-41/ 2004-2007]

Status: Fifty seeds of each of 49 families of *G. arborea* obtained from the RFRI, Jorhat were sown for germination. Out of these, seeds of 14 families only germinated with low germination percentage.

Project 16: Carbonisation of selected fuelwood and Bamboo species [IWST-34/WE-1/2004-2005]

Status: Samples of different age groups ranging from 3 to 6 years of *Eucalyptus* hybrid and *Acacia auriculaeformis* were procured. Measurements of basic density of wood and bark and wood/bark ratio for different ages and heights of the tree were carried out. Variation in calorific value of the *Eucalyptus* hybrid with age (3 to 6 years) and height (bottom to top) of the tree was studied. It was found that calorific value does not significantly vary with age and height.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Bio-invasion, SPS measures and import of wood and wood products into India [2003–2004]

Findings: Survey of six ports, viz. (Mangalore, Tuticorin, Kandla, Mumbai, Calcutta and A&N Islands have been completed to study the bioinvasion of insects and fungi through wood import. Insects and fungi collected were identified. The final report is submitted.

Project 2: Introspection into the phytosanitary procedures for storage of forest seeds in Karnataka [2003–2004]

Findings: The insect infestation levels in the seeds of different forestry species stored in government and private storages were assessed. The insects were identified and preserved. Package of practices for the phytosanitary measures to be adopted in tree seed storages have been recommended. Final report has been submitted.

Project 3: Field incidence and management of major pests of Neem and Pongamia in Karnataka [2003–2004]

Findings : Survey work in Bangalore and adjoining districts was conducted to study pest status and the damaging levels of different pests of Neem and Pongamia. The important pests and their field incidence was documented. Management of the leaf and fruit gall of Pongamia in the field conditions have been standardized based on field trials with insecticides/acaricides. The detailed checklist was prepared for insect pests of Neem and Pongamia. Final report is submitted.

Project 4: Estimation of demand and supply of fuelwood and other available biomass in three districts of eastern plains of Karnataka [2003-2004]

Findings: Survey of two districts in Karnataka (Kolar and Tumkur) was carried out and data was collected from these districts were compiled and analyzed with respect to (i) per capita fuelwood consumptions in villages and (ii) distribution of the fuelwood and other biomass consumption pattern according to land holding of the farmer, economic status of the farmer and distance from forest. Estimated per capita consumption of fuelwood in rural areas of Tumkur and Kolar districts of Karnataka were 1.79 and 1.63 kg/day, respectively, whereas per capita consumption in urban areas was 0.13 kg/day for each of the districts. In urban areas, per capita fuelwood

consumption decreases with increase in the population of town. It was found that agriculture waste forms an important source of fuel in rural areas. Dependence on forest is much less than was envisaged. Source of fuelwood is farm forestry and trees on roadside, bunds and marginal land. Biogas use is still very less despite cattle population. Project completed and final report has been submitted to Karnataka Forest Department.

Project 5: Weathering of wood surfaces [2002-2005]

Findings: Study on effect of irradiation on photodegradation of wood surfaces of *Hevea brasiliensis* and *Pinus roxburghii* showed rapid colour changes, reduction in lignin content and increased concentration of chromophoric groups. Overall colour changes were linearly correlated with decay of lignin and formation of carbonyl groups during weathering. The rate of photodegradation increased with the intensity of irradiance source and radial surfaces were found to discolor faster than tangential faces. Presence of extractives in *Acacia auriculaeformis* and *Pterocarpus marsupium* increased rate of discoloration and rate of photodegradation at the short exposure period. Esterification of wood with benzoyl chloride was found very effective at inhibiting photodiscoloration and photostabilizing wood polymers. Photostability of wood surfaces of rubber wood and Chir pine esterified with acetic anhydride, maleic anhydride and phthalic anhydride (PA) was assessed. Acetylated wood showed good stability. Maleic anhydride was partially effective in suppressing photodegradation whereas phthalic anhydride was not effective at all. A method of chemical modification of solid wood blocks using fatty acid chlorides synthesized from fatty acids (Octanoic and lauric acid) was developed. Rubber wood specimens esterified by Octanoyl chloride showed good dimensional stability and consistent Anti-Swelling Efficiency (ASE). Project has been completed and Final Technical Report of the project has been submitted to CSIR, New Delhi.

Project 6: Analysis of existing agroforestry practices – A study in Bellary district of Karnataka [2004]

Status: A study was undertaken to analyze socio-economic factors influencing existing agroforestry practices in semiarid regions covering Bellary district of Karnataka. Three regions; viz. rainfed region, mining region and irrigated region were selected to represent distinct ecological features. The data was collected from respondent farmers covering 12 villages in the three regions using a semi-structured questionnaire.

Crop species cultivated, tree diversity and patterns of plants were found to vary with agro-ecological regions. Analysis of existing agroforestry models reveals that majority of the respondents were practicing agri-silviculture model, followed by agri-horticulture and least practiced model was silvi-horticulture. Analysis of the association between independent variables and adoption of agroforestry reveals that variables like, education, income, material possession, social, mass media, extension, contact and environmental awareness had significant association with the adoption of agroforestry, while family size, farm size, number of animals owned and management orientation had no association with adoption level of agroforestry practice.

Project 7: Assessment of fruit characters in *Garcinia cambogia* and gender identification of economically important forestry species using isozyme studies - *Garcinia cambogia* and *Myristica fragrans* [2003-2004]

Findings: Three methods of gender identification have been developed : (i) using isozyme studies (Laboratory method), (ii) based on peroxidase enzyme activity – Laboratory method and (iii) a simple, less expensive and user-friendly colour reaction (a field method to be used by forester/ farmer/common man).

Market dynamics study of the fruits of *Garcinia cambogia* has been made in the districts of South canara, Hassan, Kodagu. A field kit has been developed to undertake gender identification work. Three demonstration programmes (Chikkamagalur, Hassan and Uttar Kannada Forest Divisions) were conducted in connection with gender identification to forest officers, farmers. Information on morphological characters have been gathered from the local people and forest department personnel and efforts are being made to distinguish male and female plants by studying the morphological characters on a large number of individuals in the forest.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Investigations on lesser known aspects of mangrove biodiversity and ecology in the states of Goa, Karnataka and Andhra Pradesh [2004- 2008]

Status: Survey of mangroves in Vizagapatnam and Kakinada (Koringa Wildlife Sanctuary) was conducted to study the occurrence, distribution and intensity of insects on the different species of trees which are true halophytes and also mangrove associates. The major tree species encountered were Avicennia, Rhizophora, Sonneratia and Ceriops etc. Defoliators, fruit borers and also wood borers were encountered.

Project 2: Establishment of Advanced Wood Working Training Centre at IWST

Status: Advanced Wood Working Training Centre has been established at IWST jointly by IWST and Italian Trade Commission in March, 2003. Training courses under three modules are being conducted. Eight hundred trainees have been trained in 48 modules.

Project 3: Characterization and quantitative analysis of decayed wood by Fluorescence and Fourier Transform Infrared (FTIR) spectroscopy [2003-2006]

Status: Lignin modification in *Pinus sylvestris* L. (Scots pine) and *Fagus sylvatica* L. (beech) wood decayed to different weight losses by the brown-rot fungus *Coniophora puteana* was investigated by FTIR. Polysaccharide components of wood were selectively degraded as decay progressed. Polysaccharide to lignin ratios estimated using FTIR correlated well with lignin contents determined by acetyl bromide method. Samples of softwood (*P. roxburghii* and *A. pindrow*) and hard wood (*H. brasiliensis* and *B. ceiba*) were exposed to brown-rot (*P. melia* and *T. palustris*) and white-rot (*C. hirsustus* and *C. versicolor*) fungi up to 15 weeks. *H. brasiliensis* and *B. ceiba* samples showed a significant weight loss (maximum up to 45 %) by all these fungi. FTIR spectra were measured from wood samples decayed by brown rot *T. palustris* and relative changes in lignin/carbohydrates ratio as a result of decay were determined. A progressive increase in lignin content relative to carbohydrate was evident from increases in the relative height of lignin associated bands and a corresponding decrease in the intensities of carbohydrate bands in Rubber wood and *B. ceiba*.

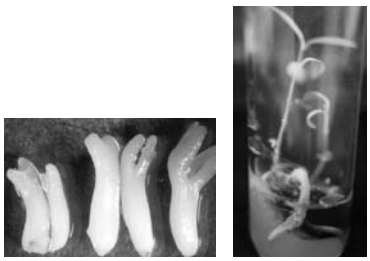
Project 4: Refinement of protocols for rapid clonal propagation of Sandal and Red sanders; Demonstration of field performance and evaluation of genetic fidelity [2003-2006]

Status: Shoot initiation cultures of five clones of Sandal were established. Medium, growth hormones, additives, pH, agar-agar, sucrose concentrations, inoculum density and sub culturing period for shoot multiplication in Sandal were standardized. Leaching and browning problems were overcome in shoot initiation cultures in red sanders. Five genotypes shoot initiation cultures in red sanders were established. Shoot multiplication rate was high (4 fold) in Sandal as compared to red sanders (2-3 fold) in 6 weeks period. Studies (auxins and media) on *in vitro* and *ex vitro* rooting in Sandal were conducted and a maximum of 50 per cent rooting was achieved in 5-6 weeks period from mature trees.

Medium, PGRs, additives, incubation conditions for embryogenic callus induction and further multiplication were standardized.

Protocol for the isolation, purification, quantification of DNA and PCR reactions for molecular markers studies of micropropagated plants of Sandal and Red sanders were standardized.

In vitro cloning of Sandal



Somatic embryo induction and germination in Sandal

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Bio-composites from Engineered Natural Fibres

Staus: Mechanical properties, measured in tensile, flexural and impact tests, demonstrated that the fibres used in this work act as effective reinforcing agents for PP. Addition of wood fibres, at all levels, resulted in more rigid and tenacious composite. Tensile strength of composites increased by almost 45%, whereas an 85% increase in flexural properties was observed. Modulus of elasticity increased by almost 200%. However, impact energy and percentage of elongation decreased with increase in wood content.

Project 2: Community ecology of a detritus systems. Insects and fungi associated with fallen trees in the Nilgiri Biosphere Reserve [2004-2007]

Status: Permission from PCCF (Wildlife) has been obtained for the surveys and studies in the Nagarhole National Park (Nilgiri Biosphere Reserve) and survey work has started. Various species of logs in different stages of deterioration were selected from three landscape elements viz. moist deciduous forests, dry deciduous forests and Teak plantations. An emergence trap has

been designed for the collection of insects emerging from the fallen logs in the study area.

Project 3: Studies on the Entomofaunal diversity and their interactions in selected provenances of Sandal [2004-2007]

Status: Floral composition in all the selected provenances of Sandal including trees, shrubs and herbs was collected, identified and documented. Entomofauna of all selected Sandal provenance was also documented. So far 66 species of insects in Bangalore provenance, 48 species in Thangali, 32 species in Mandagadde, 41 species in Chitteri, 43 species in Javaddis and 40 species in Munnar could be identified.

Project 4: Revision of subfamily Ponerinae (Hymenoptera:Formicidae) in India with special emphasis to western ghats [2004-2007]

Status: Ponerinae fauna were taken as loan from Forest Research Institute Museum and studied. Key to the Indian subfamilies of the family Formicidae is being revised. Survey was conducted in Goa and ponerinae were collected. A checklist of type species distribution list for Indo-Australian and Oriental species is prepared in order to determine genus distribution pattern. Key to the genus Platythyrea is revised.

Project 5: Investigations on the mechanisms of success of *Mytilopsis sallei* (Recluz) in managing toxic load arising out of biodeterioration control measures [2005-2008]

Status: The project was approved for funding for a period of 3 years by the Department of Science and Technology, Government of India. Release of first installment of the grant is awaited.

Project 6: Development of protocols for rapid and mass clonal propagation of *Bambusa pallida* Munro. and *Phyllostachys bambusoides* [SIEB/ET/ JUCC/ 2004-2007]

Status: As a source of material for *in vitro* cloning studies, offset cuttings of *Bambusa pallida* were collected from Chesa (Arunachal Pradesh and Jorhat, Assam). Whereas, in for *Phyllostachys bambusoides*, cuttings and vegetatively propagated plants were collected from Y.S. Parmar University, Solan (Himachal Pradesh) and Chesa (Arunachal Pradesh). Shoot initiation cultures were established in both the species. Studies on explant, media and PGRs for shoot initiation in both the species were conducted. Maximum 6-8 shoots/explants were obtained from nodal shoot segment of *B. pallida* in MS liquid medium with PGRs. Initial shoot multiplicate rate was 3-4 fold in *B. pallida* in 4 weeks period. In *P. bambusoides* severe leaching and browning of the shoot at sub-culturing (shoot multiplication) stage was encountered.

Project 7: Field performance of micro and macropropagated planting stock of selected five commercially important Bamboo species [2004-2007]

Status: Offset cuttings of 25 Candidate Plus Clumps (CPCs) of *Dendrocalamus strictus*, 20 CPCs of *Pseudoxytenanthera stocksii* from Sirsi Forestry College (UAS, Dharwad), Sirsi and 3 CPCs of *B. bambos* from TNAU., Coimbatore for the establishment of germplasm garden were collected. Germplasm garden of seven species of bamboo (*B. bambos, D. strictus, D. asper, P. stocksii, Ochalendra travencorica, Guadua angustifolia* and *Phyllostachys bambusoides*) in 0.4 ha at Gottipura (Karnataka) and five genotypes cultures of *B. bambos* and *D. strictus* and further multiplied for *in vitro* rooting and production of plantlets was established. In *P. stocksii* cultures of five CPCs material were established and multiplied. Based on the protocols, 2000 plants of *P. stocksii*, 500 plants of *B. bambos* and 100 plants of *D. strictus* were produced.

RESEARCH ACHIEVEMENTS

Name of State	No. of Projects completed in 2004-2005	No. of on-going Projects in 2004-2005	No. of Projects initiated in 2004-2005
Andhra Pradesh	1	4	1
Karnataka	1	3	6
Goa	2	1	-
General	12	18	10

EDUCATION AND TRAINING

Education

1. Shri A.G. Koppad, Asstt. Professor, University of Agricultural Sciences Dharwad, College of Forestry, Sirsi was awarded Ph.D. degree for his thesis entitled "Studies on effect of *in-situ* moisture conservation techniques and fertilizers on early growth and wood properties of *Tectona grandis* (Teak)" by FRI Deemed University, Dehradun.

2. Shri E.V. Anoop, Asstt. Professor (Wood Science), Kerala Forest Research Institute, Peechi, Thrissur, presented his pre-submission synopsis on the thesis entitled "Studies on anatomical variation in the juvenile wood of acacias grown in Kerala for provenance trials" for his Ph.D. degree under FRI Deemed University, Dehradun.

3. Two research scholars have been registered for their Ph.D. degree in forestry under FRI, Deemed University, Dehradun.

4. Four researchers from the W. B. D. Division (A. K. Dubey, B. Raji, K. V. Jamuna, B. Tharakanadha and R. Veeranna) were awarded Ph. D degree of the FRI Deemed University, Dehradun.

5. P. Sarasija presented the Ph.D. Synopsis seminar on the topic 'Diversity, Community, Structure and Ecology of insects occurring on fallen trees in Nilgiris Biosphere Reserve. Mrs. Hemalatha presented her Ph.D. synopsis seminar on "Tannin-microbe interactions in the biodegradation of the litter of *Acacia nilotica*".

6. Two M.Sc. Microbiology students from Oxford College of Science, Bangalore and three M.Sc. Microbiology students from Narayan Guru College, Coimbatore have completed their Project work in the Institute during December to February, 2005. M.Sc. students from Vishakapatnam, Andhra Pradesh, Ramaiah College, Bangalore visited the Pathology lab to learn microbial aspects of wood.

Training

1. Compulsory training on IPR in Forestry Issues for the in-service IFS officers from 13th to 17th December, 2004.

2. One week training on Wood Seasoning and Technology for the representatives of Wood Based Industries from 29th November to 3rd December, 2004.

3. Training on Timber Joinery for the officials of Naval Dockyard, Visakhapatnam from 24th to 28th January., 2005.

4. Training in Classification and Grading of Timber to the in-service officials of Customs House, Tuticorin from 21st to 23rd March, 2005.

LINKAGES AND COLLABORATION

1. Linkages developed with State Forest Department, Karnataka, Andhra Pradesh Forest Department, Goa Forest Department, Bangalore University, Bangalore, University of Agricultural Sciences, Bangalore, University of Agricultural Sciences, Dharwad, Indian Institute of Science, Bangalore, College of Forestry, Sirsi, Kerala Agricultural University, Vellanikara, Thrissur, Acharya Institute of Technology, Bangalore, FRLHT, Bangalore,

2. One operational DBT project in collaboration with KFRI, Peechi and IFGTB, Coimbatore on "Field performance of micro and macropropagated planting stock of selected five commercially important bamboo species"

CONSULTANCIES

1. Testing services were rendered to different users from Industry, Government Departments, Police, Vigilance, CBI, Defence, Railways, Construction industry, NGOs and Private sectors on 1. Timber Identification 2. Moisture content 3. Strength property determination 4. Technical information on use of wood and wood products.

2. Analytical service was rendered to Police Department, Forest Department and public in analysis of essential oils from Sandalwood samples. A number of technical inquiries on utilization of various non-wood forest products from Government Departments and public were attended to and advice given.

3. Enquiries from Larsen and Tourbo, Pondicherry regarding the timber decay problems were attended.

4. The test report on the bioefficacy of TERMINATOR 'A' and 'E' against termite and borer was prepared and submitted to the Pidilite Industries, Mumbai.

5. The presence of pathogens on timber from M/s. Chambal Fertilisers and Chemicals Limited was assessed.

6. Services were rendered to the Karnataka forest department in finding out the causal organism and suggesting the remedial measures for the entomological and pathological problems of the plantations and other forest tree species (*Tectona grandis* and *Shorea talura* etc.).

7. Efficacy of some commercial preservatives was tested for their resistance against termites, borers and pathogens.

8. The institute along with other experts of ICFRE Institutes undertook an consultancy of *Final mine closure plan for KIOCL iron ore mine* at Kudremukh and submitted the final draft plan on "Biological Eco-rehabilitation Plan for Kudremukh iron ore mine".

CONFERENCES/MEETINGS/ WORKSHOPS/SEMINARS/ SYMPOSIA/EXHIBITIONS

Organized

1. A one day demonstration programme on Treatment of Bamboo Through Sap

Displacement Method at Virajpet (Karnataka), Kodagu District on 17th July, 2004. A total of 400 participants attended the programme.

2. A demonstration programme on gender identification of dioecious forestry species (*Garcinia cambogia* and *Myristica fragrans*) in the field to the staff of forest department/ local farmers at following places.

   a) Balehonnur, Shrungeri forest ranges (Koppa Forest Division) and Kerekatte wildlife range (Kudremukh Wildlife Forest Division) from 21st and 22nd July, 2004

   b) Sakaleswapur, Hassan ranges in forest division and Bisle forest area in Mercara Forest Division of Karnataka state during September, 2004.

Participated

1. Institute participated in "Bio-2004" organized by Vision Group on Technology from 11th to 13th July, 2004 at Palace Grounds, Bangalore. The theme of the event was Biotechnology for a billion people.

2. The Institute participated in Krishimela organized by University of Agricultural Sciences, Bangalore at GKVK from 5th to 7th November, 2004. About 165 stalls were put up in the mela. The Institute exhibited furnitures made from secondary wood species like, *Acacia auriculiformis* and *Eucalyptus tereticornis* etc. Seedlings reared though tissue culture techniques were also on display, chemical aspects of wood were also highlighted. Shri Srinivas Gowda, Honourable Agricultural Minister of Karnataka inaugurated the exhibition and visited IWST stall too. A total of 60,000 visited the mela.

3. Meeting of BIOSPORA was organized by Karnataka Biotechnology Development Council, Bangalore on 1st October, 2004 at the Institute of Wood Science and Technology.

4. Dr. K.S. Shashidhar, Shri Suresh Gairola and Shri Pankaj Aggarwal attended workshop on "Perspective in IPR" organized by Government Science College, Bangalore on 28th January, 2005.

AWARDS

Dr. K. K. Pandey, Scientist-E was granted a "*Ron Cockcroft Award*" *(RCA)* for attending the *International Research Group on Wood preservation (IRG-35)* meeting held in Ljubljana, Slovenia from 6th to 10th June, 2004.

DISTINGUISHED VISITORS

1. Shri N. Vittal, IAS (Retd.), Former Chief Vigilance Commissioner, Govt. of India visited the Institute on 25th June, 2004.

2. Dr. Alex Valcke, President IRG (2000-2004) and Mr. Joran Jermer, Secretary General, IRG visited the institute and held a meeting regarding IRG 36 arrangements on 13th July, 2004.

3. Mr. Antonio Armellini, Ambassador of Italy, Dr. Andrea Bonardi, Secretary General of Indo-Italian Chamber of Commerce and Industry, Mumbai, Mr. Rafaelle Langella, Head, Economic and Commercial Section, Embassy of Italy and Dr. Vittorio Mecozzi, Trade Commissioner, Italian Trade Commission, Mumbai has visited the Institute on 31st August, 2004.

4. Mr. Brue Mattinsow, ITC Preferring Farming, Australia and Mr. David Wettenhall,

Business Development Manager, WA, CSIRO (Forestry and Forest Products) visited the Institute on 21st October, 2004.

MISCELLANEOUS

1. A Fortnight long celebration was organized for National Science Day from 28th February to 13th March, 2005 by the Institute. Poster presentation competition was conducted among the children of the Institute's staff. Prizes were distributed to the winners.

2. National Science Week was celebrated by the Institute.

3. The Information Technology Cell of the institute developed a website for 36th Annual Meeting of International Research Group on Wood Protection held from 24th to 28th April, 2005 at Bangalore, India.

CHAPTER IV

TROPICAL FOREST RESEARCH INSTITUTE JABALPUR

Tropical Forest Research Institute (TFRI), Jabalpur is the central regional Institute of ICFRE since 1988. The Institute caters to the forestry research needs of four states of central India, viz. Madhya Pradesh, Chhattisgarh, Maharashtra and Orissa. Thrust areas of research in the Institute relate to non-wood forest products, rehabilitation of mined areas and other stress sites, development of agroforestry models, planting stock improvement, developing tissue culture protocols for species of central Indian forests, and control of forest diseases and pests. During the recent years, TFRI has established excellent liaison with state forest departments, NGOs working in the field of forestry and allied areas, universities imparting education in forestry and forest based industries.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

Project 1: Social and livelihood analysis of dependence of tribal people on forests [015/ TFRI-2000/Econ-23/2000-2005]

Findings: Vegetational survey in Korku dominated forest areas of M.P. showed that 38 plant species were used by the Korku tribes for food, fodder, oil and medicine.

Training on lac cultivation

Vegetation survey

Maror Phalli in Hoshangabad

Safed Musli in Teak forest

Project 2: Economic evaluation of NTFPs in tribal belt of Madhya Pradesh [044/TFRI-2002/Agro-2(9)/2002-2005]

Findings: Data from weekly markets in nine districts, viz. Mandla, Betul and Chhindwara, Damoh, Neemuch, Shivpuri, Sheopur, Umaria and Shahdol of M.P. regarding five important NTFPs was collected and analysed.

Project 3: Collection of ethnobotanical data from various tribes of Central India [006/ TFRI-97/Bot–7/2000-2005]

Findings: Ethnobotanical data was collected on Gond tribes from Madhya Pradesh and Chhattisgarh state. Herbal medicines used for cure of diseases such as Asthma, Jaundice, Arthritis, Malaria, Paralysis, Diabetes, Headache and Diarrhea along were recorded. Sixty ethnobotanical uses of various plants of forest origin were documented. Ten traditional herbal healers were contacted and interviewed for documentation of information on ethno-medicinal uses of vegetation in tribal culture. The social structure, customs and traditions of tribal were recorded from 10 localities.

Project 4: Impact of eco-restoration on degraded forests [TFRI-2000/Ecol-20/2000-2005]

Findings: Comparative studies were conducted in degraded forests protected by VFCs through JFM, adjacent in protected and natural forests in M.P., Chhattisgarh and Orissa and the impact of eco-restoration was observed by vegetation studies, soil characteristics and socio-economic parameters. The involvement of local people in the protection activities, particularly, in control of grazing, is reflected in increase of regeneration of the dominant tree species and the ground flora.

Project 5: Ecological and economic evaluation of Teak monoculture and mixed plantation [032/TFRI-(2000)2001/Ecol-2(5)/2000-2005]

Findings: The effect of Teak plantations, monocultures and mixed plantations of different ages at Behrai Range of Balaghat Division (Seoni) on the soil was studied. It was observed that soil characteristics such as nutrient status and physico-chemical characteristics have changed compared to control with aging plantations.

Project 6: Mass multiplication of *Trichogramma* spp. and their efficacy against key pests of Teak forests [TFRI-2000/Ento–24/2000-2005]

Findings: An experiment was conducted to optimise quantity of food (maize) for the development of an ideal host of *Trichogramma* spp. It was found that 300 gms of grinded maize is the optimum food quantity for the healthy development of 300 larvae of *Corcyra cephalonica*. The parasitisation caused by *Trichogramma brasiliensis*, *T. raoi* and *T. chilonis* at different temperatures and Relative Humidity (RH) showed that a temperature of 27 ± 1° C and RH of 80 ± 5 % was best for maximum (95 %) parasitisation. Studies conducted on parasitisation by *Trichogramma brasiliensis* on the eggs of *Corcyra cephalonica,* found that maximum parasitisation occurs within three days of oviposition. Chilling the freshly laid eggs of host insect *C. cephalonica* at –8° C is proved best for maximum parasitization. Field efficacy of five *Trichogramma* spp., viz. *T. brasiliensis*, *T. chilonis*, *T. japonicum*, *T. pretiosum* and *T. raoi,* has been carried out against Teak leaf skeletonizer, *Eutectona machaeralis*, by releasing the parasitoids @ 1.5 lakh ha^{-1} or lakh/ha. *T. chilonis* proved best among five species, showing about 52.63% protection of skeletonization in Teak followed by 48.25% in *T. raoi*. Field dispersal of *T. chilonis*, *T. japonicum*, *T. brasiliensis* and *T. pretriosum* showed that the wasps of *T. chilonis*, *T. japonicum, T. brasiliensis* and *T. pretiosum* move up to 50, 45, 40 and 40 metres horizontally respectively and 10 metres vertically within three days of introduction.

Project 7: Investigation into the nature of inheritance and breeding of *Tectona grandis* (Teak) [TFRI-2000/Gen-21/2000-2005]

Findings: Analysis of variance revealed highly significant differences among 30 families tested for height, girth, NRA, conductivity and stomatal conductance. Out of six characters NRA showed highest heritability values of 29 and 51 % at individual tree and family mean basis respectively.

Project 8: Studies on differential adventitious rooting response *vis-a-vis* clonal propagation of economically important forestry species [038/TFRI-2001/Gen-2(4)/2001-2005]

Findings: Physiological and biochemical changes at different stages of adventitious rhizogenesis in semi-hardwood and sprout cuttings of *Gmelina*

arborea were investigated in auxin-treated and non-treated condition. Profound changes in endogenous biochemicals occurred during the process of adventitious root formation in shoot cuttings. All biochemicals exhibited change in the first 24 hours, indicating consequential processes, which influenced subsequent rhizogenesis in treated cuttings. The results indicate two possible phases of adventitious rhizogenesis in these cuttings the initial phase requiring low endogenous moisture with elevation of endogenous phenols and peroxidase activity and later phase demanding higher endogenous moisture with minimal endogenous phenols and peroxidase activity.

Adventitious rooting in IBA –treated cuttings of *G. arborea*: Left- semi-hardwood cuttings; Right- sprout cuttings.

Project 9: Evaluation of various NWFP species for saponins potential and their value addition [TFRI/NWFP/2000-18/2000-2005]

Findings: Saponin glycosides from *Chlorophytum borivillianum* tubers were isolated and estimated. Physico-chemical properties of isolated saponins were determined. The biological activities of saponin glycosides against insects pest of stored seeds were also assessed.

Project 10: Establishment of Advance Centre of NWFP [TFRI/NWFP/2000-19/2000-2005]

Sub-project 1: Germplasm collection, conservation, domestication and commercial cultivation of threatened species of medicinal plants in India. Species: *Terminalis chebula, Celastrus paniculatus*, *Madhuca longifolia* and *Commiphora vitatae*

Findings : Germplasm of *Terminalis chebula, Celastrus paniculatus* and *Commiphora vitatae* from M.P. and Chhattisgarh and *Madhuca longifolia* from Maharashtra were surveyed and collected. Germination studies, chemical analysis and establishment of demonstration plots of selected species were carried out at TFRI campus, Jabalpur.

Sub-project 4: Qualitative and quantitative variations in Tree borne Oil Seeds. Species: *Schleichera oleosa* (Kusum), *Garcinia indica* (Kokam), *Mesua ferrea* (Nagkeshar) and *Actinodephane hookeri* (Pisa)

Findings: Seeds of *Schleichera oleosa* from different forest areas in M.P. and Chhattisgarh, *Garcinia indica* from Sindhudurg and Ratanagiri, *Mesua ferrea* and *Actinodephane hookeri* from Pune, Maharashtra were collected. Total carbohydrate, oil contents, protein contents and other physico-chemical properties of seeds of selected species were estimated. Established demonstration plots of selected TBO's in TFRI campus, Jabalpur.

Sub-project 5: Standardization of methodologies for extraction and value addition of NWFP providing sustenance to tribals [TFRI/NWFP/2000-19(5)/2000-2005]

Findings: Starch from the rootstock of *Curculigo orchioides* was extracted, purified and quantified. Total starch in the extracts of

Curcuma angustifolia and *C. orchioides* was estimated. Viscosity and X ray diffraction studies were done in starch of *C. angustifolia* and *C. orchioides*. Solubility and swelling power in the starch of *C. orchioides* were estimated. The volatile oil, resin and impurities were extracted and quantified in the resin sample of *Gardenia gummifera* (Dikamali). Heavy metals (lead and arsenic) in vegetable dye of *Butea monosperma* and *Woodfordia fruticosa* were estimated

Project 11: Investigation of methodologies for determination of elapsed period after felling of Teak and Bamboo [47/TFRI-2002/NWFP-1(7)/2002-2005]

Findings: Teak logs of varying girth classes from Kalpi Forest Depot, Mandla District and Bamboo samples of *Dendrocalams strictus* and *Bambusa arundinacea* from Balaghat and TFRI Jabalpur, M.P. were collected. Crude fibre, ash, moisture content, cellulose, hemicellulose, hollocellulose and lignin contents in Teak and Bamboo samples were estimated. Insect attack, fungal infestations, physical characteristics, silvicultural character and anatomical characteristics of selected Teak logs, stumps and Bamboo clumps were studied for determination of elapsed period.

Project 12: Development of germplasm bank of biofertilizers and field application of effective strains on important tree species [046/TFRI- 2002/Path-1(6)/2002–2005]

Findings: Cultures of VAM fungi were supplied for trial to Forest Development Corporation, Nagpur for application in Teak, *Gmelina arborea*, *D. sissoo* and Bamboo plantations. Cultures of VAM fungi and Azospirillum were supplied to the Institute of Forest Productivity, Ranchi. Root colonization by VAM fungi were studied in 25 different species of Bamboos planted at Amravati.

Project 13: Studies of population structure dynamics and efficacy of existing silviculture systems for management of Teak forests in the Central India with respect to carbon sequestration [023/TFRI-2000/Silvi-15/2000-2005]

Findings: This study was carried out in Mandla Range of Mandla Forest Division by selecting sites in Teak forests under clearfelling and selection-cum-improvement silvicultural systems. Data regarding population structure, regeneration, growth / yield, etc. were collected by laying out sample plots. Soil samples from different sample plots under the silviculture systems for Teak forests were collected and analyzed for pH value, % organic carbon and available NPK in Kg/ha. Information regarding extraction/ removal of timber, firewood, etc. has been obtained from Madhya Pradesh Forest Department. Data regarding growth, yield and carbon sequestration is being analyzed.

Project 14: Standardization of macro-propagation protocol for mass multiplication of Bamboo species [042/TFRI-2002/Silvi-3 (5)/2002-2005]

Findings: Seasonal variation in adventitious rooting in culm and culm-branch cuttings of different Bamboos, viz. *Bambusa tulda*, *B. vulgaris* var. green, *Dendrocalamus membranaceous* and *Bambusa nana* was studied. The most favourable period of year for adventitious rhizogenesis in culm and side-branch cuttings of *Bambusa tulda*, *B. vulgaris* var. green, *B. nana* and *Dendrocalamus membranaceous* has been identified. The efficacy of auxins and non-auxin growth regulators for induction and growth of adventitious roots was also studied. Most effective treatments for each species have been identified as IAA (*Bambusa tulda* and *B. vulgaris* var. green), IBA

(*Dendrocalamus membranaceous*), and Boric acid (*B. nana*). Evaluation of three types of culm-cuttings (full, half and strip) has been made for adventitious rooting under influence of the best growth regulator for each species. Graded doses of both growth regulators have also been tested in each species in the best season.

Project 15: Standardization of seed handling and storage techniques for important tree species of central India [041/TFRI-2002/Silvi-2(4)/2002-2005]

Findings: Seeds of *Acacia catechu* (Khair) and *Pterocarpus marsupium* (Bijasal) were collected from Jabalpur/ Bhandara and Bijadandi range respectively. Various parameters of seeds, viz. purity percentage, weight of 100 seeds, number of seeds per kg., initial moisture content, germination percentage, were determined. Pre-treatment studies revealed that cold water soaking for 24 h. improves the germination of seeds of both the species. Viability of *Acacia catechu* seeds declined after six months storage.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

Project 1: Development and standardization of management practices for most promising existing agroforestry system in Central Narmada Valley and Satpura Plateau agroclimatic region [043/TFRI-2002/Agro-1(8)/2002-2006]

Status: An agroforestry model consisting of 21 month old plants of *Tectona grandis, Gmelina arborea* and *Emblica officinalis* as tree component was established. The inter-spaces between the trees were grown with soybean (Kharif season) and wheat (Rabi season). Among the tree species *E. officinalis* showed the best height performance (1.85 m) followed by *G. arborea* (1.5 m) and *T. grandis* (below 1m). Yield of soyabean was maximum under *E. officinalis* (470 gm/sq.m) followed by *G. arborea* (370 gm/sq.m) and *T. grandis* (320 gm/sq.m) as compared to sole crop (430 gm/sq.m). The wheat yield was not significantly different under the three tree species.

Project 2: Management of insect pests of forest nurseries in Central India [045/TFRI-2002/Ento-1(5)/2002-2006]

Status: *Holotrichia* sp. (White grubs) was found major insect pest of Teak seedlings in Maharashtra. Teak defoliator and skeletonizer were found major pests in Madhya Pradesh. Termites were major pests in Maharashtra and Orissa attacking seedlings of Teak and Khamer. Endocel @ 0.04% proved most effective against eggs of white grubs. Two commercial available biopesticides; Biopro super (*Bacillus thuringiesis*) and Bioseal super (*Metarhizium anisopliae*) were evaluated against the Teak defoliators. A new insect was recorded which damages Teak roots and was identified as *Myllocerus discolor*. Feeding behaviour of this borer is being studied in details.

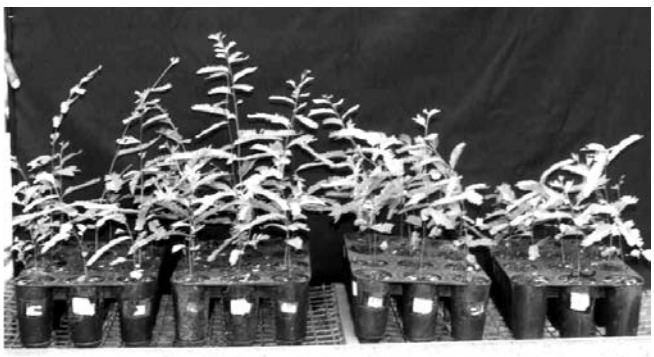
Project 3: Development of a decision support system for predicting suitability of important forestry species in various climatic conditions in central India [059/TFRI-2003/Misc-IT-1(1)/2003-2006]

Status: Field information on 15 identified tree species was collected.

Project 4: Integrated management of diseases of seeds, nurseries and plantations [035/TFRI - 2001/Path-4(5)/2001–2006]

Status: Fungi associated with Teak fruits were recorded and their role in abortiveness of its fruits was studied. A new fungus, *Cephaliophora irregularis,* was found to be a dangerous pathogen of Teak fruit. Effect of Trichoderma and PSB was studied for control of *Macrophomina phaseolina,*

which is known as charcoal root rot of Casuarina. Effects of soil solarization, VAM, Trichoderma application on germination and survival of *Acacia nilotica* seedlings were evaluated. Maximum germination and survival was found in solarized and Trichoderma applied nursery bed.



Effect of different Biofertilizers on Aonla 1. PSB 2. Azospirillum, 3. VAM and 4. Control

Project 5: Germplasm conservation and investigation on inheritance pattern of *Gmelina arborea* [040/TFRI–2002/Gen–1(5)/ 2002-2007]

Findings: Systematic surveys were undertaken in forest areas of Chhattisgarh and Maharashtra states to identify and mark candidate plus trees, which would form the base materials to start the breeding programme. Total 46 Candidate Plus Trees (CPTs) were selected and marked from 8 locations.

Open pollinated seeds and bud grafts of 88 phenotypically superior trees were collected for establishing breeding population and germplasm bank. Data collected from progeny trial was subjected to analysis of variance followed by estimation of General Combining Ability (GCA) and other genetic parameters. Analysis of variance revealed significant differences amongst the families for growth characters, viz. height and girth. Heritability values for height and girth were 5.59, 21.22, 19.02 and 44.01 % at individual tree and family mean level, respectively. Genetic gain estimates for these two characters were 9.14 % and 26 %. Twelve parents showed positive GCA for girth and 11 parents exhibited positive GCA for height. CPT No. 6 and CPT No. 63 showed maximum GCA for girth and height respectively.

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

Project 1: Ecological rehabilitation of limestone mined areas of Madhya Pradesh [065/TFRI-2004/Ecol-1(6)/2004-2007]

Status: Suitability of different tree species on limestone mined overburden spoils mixed with FYM (1:1) was studied in pot culture. Growth observations recorded after seven months of planting showed that *Leucaena leucocephala* recorded the highest score in respect of height, collar diameter and biomass followed by *Nyctanthes arbortristes*. *Albizia procera* recorded the minimum score. In control treatments using pure limestone mined overburden spoil, almost no seed germination or growth of seedling was observed.

Project 2: Screening populations of *Dalbergia sissoo* for tolerance to salt and water stress using physio-morphological and biochemical criteria [067/TFRI-2004/Gen-2 (8)/2004-2007]

Status: Open pollinated seeds (half-sib) of *Dalbergia sissoo* were collected from 30 healthy and vigorously growing trees. Seeds of 5 half-sib families (FRI/DS/006, FRI/DS/007, FRI/DS/011, FRI/DS/014 and FRI/DS/015C) were also obtained from Dehradun. Experiments have been designed for evaluation of germination potential and changes in endogenous level of biochemicals

in half-sib families as influenced by various regimes of NaCl induced salinity stress.

Project 3: Studies on inheritance pattern of selected wood traits in *Tectona grandis* L. (Teak) [068/TFRI-2004/Gen-3(9)/2004-2007]

Status: The project envisage to gather information on pattern of inheritance of wood traits in Teak, which would be used to formulate breeding strategy for improving its wood quality. Wood parameters such as wood specific gravity, earlywood and latewood per cent, fibre or vessel length/diameters, grain pattern and colour of wood in progenies of half-sib families will be studied using samples collected from progeny trials of Teak laid out in central Indian states.

Project 4: Chemical investigations on biologically active chemicals of forest species and their utility for pest control [069/TFRI-2004/NWFP-1(9)/2004-2007]

Status: *Jatropha curcas* seeds from Barha and TFRI Campus, Jabalpur were collected. Extraction was made from *J. curcas* seeds for isolation of toxic biochemicals.

Project 5: Evaluation of wild edible plants of central region for polysaccharides and other food value [070/ TFRI/2004/NWFP-2(10)/ 2004-2007]

Status: Tubers viz. *Alpinia galanga, A. calcarata, Kaempferia galanga, Costus speciosus* and *Crinum defixum*s were collected from NWFP Nursery. Phenols, carbohydrates, cyanogens, tannins, free amino acids, proline, P, K, Na in these species tubers were estimated.

Project 6: Studies on bacterial and viral diseases of Teak, Gmelina and Albizia and their management [066/TFRI/2004/Patho-1(8)/2004–2007]

Status: Samples of diseased seedlings of Teak and Gmelina from Mandla, Balaghat and Jabalpur forest nurseries were collected. Isolation of *Pseudomonas solanacearum* was confirmed and identified in most of the samples. Predisposing factors for disease development were also recorded.

Project 7: Evaluation of management systems and level of community participation under Joint Forest Management (JFM) [071/TFRI-2004/Silvi-1(6)/2004-2007]

Status: Compartment No. 560/563 of Maihar Range of Satna Forest Division is being managed under Joint Forest Management by Madhya Pradesh Forest Department and Udaipur Village Forest Committee under people protected area approach. The project work will evaluate the approach for better management of the forests.

Project 8: Studies on the role of Actinomycetes in controlling root diseases of *Tectona grandis* and *Albizia procera* [072/ TFRI-2004/Patho–2(9)/2004– 2007]

Status: Soil samples from different forest divisions were collected and screened for Actinomycetes population by dilution plate method. Some of the actinomycetes forms were isolated in PDA medium for detail studies.

Project 9: Seed physiology of the tropical forest species with special reference to their maturity and storage [076/TFRI-2004/Silvi-2(7)/2004-2009]

Status: Germination percentage was found to increase with simultaneous treatment with sulphuric acid and Gibberelic acid in *Rauvolfia tetraphylla*. Seeds of *R. tetraphylla* are desiccation tolerant up to 5% moisture content, hence likely

to be of orthodox category. Maturation study on *Mimusops elengi* is continued.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Improving infrastructure facilities for *ex-situ* conservation of rare/threatened plants in the Botanical Garden, TFRI, Jabalpur [037/TFRI-2001/BD-1(MoEF)(3)/ 2001-2005]

Cinnamomum tamala (Tej Patta)

Piper nigrum (Kali mirch)

Gnetum ula Brong.

Findings: The germplasm of 120 species belonging to 80 generas and 40 families of forest origin of central India have been collected and maintained in the botanical garden.

Project 2: Screening and identification of Teak of Madhya Pradesh for resistance against major insect pests [034/TFRI-2001/ Ento-1(MPCST)(4)/ 2001-2004]

Findings: Feeding potentiality of Teak defoliator and leaf skeltonizer on 5 Teak clones (3 trials) and progeny of 30 clones of Madhya Pradesh Teak was studied and leaf water contents of contributory leaves measured. Defoliation impact of major insect pests on 135 Teak clones of Madhya Pradesh in TSO, Behrai (Seoni) was measured.

Project 3: Productivity enhancement through people's participation – a follow-up action [054/TFRI-2003/Ext-1(FF)/2003-2005]

Findings: The long term and short term needs and expectations of the members of VFCs were documented through PRA exercises. Planting materials viz. Jatropha seeds (30 Kg) and seedlings 2000 Nos. at Barbati VFC and seed of Dinanath Grass (100 Kg) in Kukarikheda and

Richai VFC were distributed. Four and half hectare pasture for Barbati VFC was developed. Micro-plans for the VFCs of Moiyanala, Barbati, Richhai and Kukarikheda were prepared.

Project 4: Entomological survey of Kanha National Park [058/TFRI/2003/ Ento-I(MFD) (6)/2003-2004]

Findings: Periodical surveys of 5 different ranges of the Kanha National Park were conducted from July, 2003 to June, 2004. About 250 species were sampled from which nearly 200 species were identified, described and documented.

Project 5: Introduction of egg parasitoid, *Trichogramma* spp. to prevent growth loss in Teak plantations due to defoliator, *Hyblaea puera* Cramer and skeletonizer, *Eutectona machaeralis* (Wlk.) [062/TFRI-2003/Ento-2 (MPFD)(7)/ 2003-2004]

Findings: Wasps of indigenous egg parasitoid, *Trichogramma raoi* were multiplied in insectory and uniformly introduced @ 1.25 lakh wasps per hectare in 100 hectare Teak plantations in compartment Nos. 249 and 242 of Bijadandi and Kalpi ranges under West Mandla Forest Division from July, 2004 to November, 2004 in 4-5 instalments. Releasing of wasps proved effective in minimizing the skeletonized leaves of Teak as compared to non-introduced sites in the month of November.

Project 6: Introduction of egg parasitoid, *Trichogramma* spp. to prevent growth loss in Teak plantations of FDCM due to Teak defoliator, *Hyblaea puera* Cramer and skeletonizer, *Eutectona machaeralis* (Wlk.) [064/TFRI-2003/Ento-03 (FDCM) (8)/2003-2004]

Findings: A total of 100 hectare Teak plantations raised by Maharashtra Forest Development Corporation Ltd. were surveyed for identification of natural enemies of Teak defoliator and skeletonizer. To suppress the incidence of these pests, an egg parasitoid, *Trichogramma raoi*, which was missing in plantations was introduced uniformly @ 1.25 lakh wasps per hectare in 3-4 installments after pre monsoon showers. Releasing higher number of wasps in September resulted maximum protection of Teak leaves from the attack of skeletonizer.

Project 7: Analysis and valuation of common Bamboo under Sawran Jayanti Gram Swarojgar Yojana (SJGSY) [075/TFRI-2004/ Agro-1(MPFD) (11)/ (October 2004-December 2004)]

Findings: Five districts, viz. Satna, Shahdol, Sidhi, Panna and Chattarpur were selected for the study. Field work has been completed. Reports for Shahdol, Sidhi and Satna have been completed and are under preparation for the remaining two districts.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Studies on cataloguing the genetic variability in Teak species using molecular markers [052/TFRI-2003/Gen-1(DBT)(6)/ 2003-2006]

Status: DNA fingerprinting of 48 plus trees of *Tectona grandis* and one of *T. hamiltonii* were investigated using RAPD (Random Amplified Polymorphic DNA) markers. There was specific fingerprint of each plus tree commensurate with RAPD markers. RAPD markers were also used to study the genetic relatedness among the plus trees. Nei's gene diversity index for plus trees ranged between 0.141 and 0.499 with a mean of 0.345. *Tectona grandis* maintained genetic

distance from *T. hamiltonii*. A screening of Inter Simple Sequence Repeat (ISSR) primers, obtained from University of British Columbia, Canada with respect to Teak genomic DNA was conducted. Genomic DNA of Teak populations from four central Indian states has been extracted for RAPD/ISSR analysis. A reference library of RAPD fingerprints for the plus trees has been established. This information will serve as a reference source of RAPD profiles for each plus tree.

Project 2: Standardization of production technology of some important medicinal plants under tropical climate of Madhya Pradesh [55/CFRHRD/ 2003/2003-2006]

Status: Major active ingredients, viz. Ascorbic acid, Gallic acid and other phenolic acids were estimated in the Aonla fruits. Method for estimation of active ingredients, e.g. Reserpine and andrographolide in Sarpagandha roots and Kalmegh was standardized. Germplasm of Aonla, Sarpagandha, Kalihari, Gurmar, Giloe and Kalmegh were collected from different parts of Madhya Pradesh Seedlings/plantlets were raised and transplanted in the field. Cultivation techniques were standardized for Sarpagandha and Gurmar. Non-destructive harvesting technique of Kalmegh was standardized.

Project 3: Taxonomy and documentation of fungi occurring in forests of Madhya Pradesh and Chhattisgarh [061/TFRI–2003/Path–1(CSIR)(7)/2003– 2006]

Status: Surveys were conducted in forest areas of Pipariya, Tamia, Delakhari, Pachmarhi, Choorna, Bori, Mandla, Balaghat, Katni, Damoh, Sagar, Motinala and Supkhar, Madhya Pradesh. Total 231 fungi specimens were collected and 121 fungi identified, out of them 30 fungi confirmed upto species level. 259 isolates were recorded from 71 soil samples. Cultural characteristics of 56 soil fungi belonging to various families were conducted. Illustrations of 53 fungal generas have been drawn.

Project 4: Developing coalition approach to non-timber forest produce for better livelihoods of tribal communities of Madhya Pradesh [053/TFRI-2003/Agro (1) DFID (10)/ 2003-2005]

Findings: In this project there were 4 partners i.e, TFRI, State Institute of Rural Development, Tarun Sanskar, Jabalpur and Livelihood Solutions, New Delhi and coalition approach was introduced to four Self Help Groups (SHG). All these SHGs consisted of tribal women, who depend on Mahua for their livelihood. Main problem relating to Mahua was that of distress sale, repurchasing Mahua from traders at higher price during lean season and storage. Groups were imparted capacity building trainings. They were given seed money to procure Mahua from collectors, which they will be, using in lean season. Stored Mahua will be sold to others also. Mahua was stored in traditional bins in each member's house.These bins were lined with plastic sheets so that Mahua is protected from moisture.

Apart from Mahua, which is seasonal, Palas (*Butea monosperma*) trees are found in large number in this area, which is a good host for lac insect. To enhance tribal people incomes, SHG members were provided training in lac cultivation. 700 trees were inoculated with lac insects.

PROJECTS INITIATED DURING THE YEAR 2004-2005

(Externally Aided)

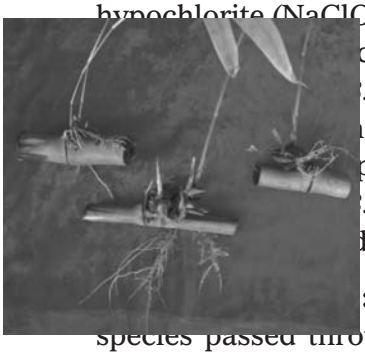
Project 1: Studies on refinement and scaling up of existing micropropagation and macropropagation technologies for *Bambusa nutans* and *B. tulda* [063/TFRI-2004/Gen-1/ DBT (7)/2004-2007]

Status: Survey for selection of superior clumps: Survey for selection of superior clumps of *B. nutans* and *B. tulda* was undertaken during November-December, 2005 at different places of Orissa for use in micropropagation experiments. *B. tulda* was collected from Ghatikia, Barbeta, Angul and *B. nutans* from Angul and Sambalpur.

Micropropagation

Collection of explants: The nodal segments (explants) of *Bambusa tulda* and *Bambusa nutans* were collected from the bambusetum and NWFP nursery of the institute. Collection of both the species was done from three clumps.

Explant sterilization of *B. nutans* and *B. tulda* was standardized for culture establishment in two seasons, i.e. rainy (July) and winter (November) employing three concentrations (0.05%, 0.1% and 0.2% for the duration of 10 min) each of mercuric chloride ($HgCl_2$) and sodium hypochlorite (NaClO). The 0.2% $HgCl_2$ was found



c culture establishment (*B.*
. tulda- 90%) and bud break
d *B. tulda*- 53%) in July and
otic culture establishment (*B.*
. tulda- 53%) and bud break
d *B. tulda*- 53%) in November.

: The cultures of both the species passed through 10 subculture cycles of 15 days for *Bambusa nutans* and 10 days for *Bambusa tulda* maintaining a maximum multiplication rate of 4.5 and 3.5 fold, respectively on MS liquid medium supplemented with 3 mg l^{-1} BA and 0.5 mg l^{-1} IAA. However, some of the cultures of *Bambusa tulda* started exhibiting yellowing and death after 5th subculture cycles and deteriorated by 7th subculture cycles. Inclusion of 50-100 mg l^{-1} glutamine and/or 50-100 mg l^{-1} ascorbic acid with NAA did not check yellowing. The proliferated cultures of both species will be used for setting experiments for optimization of shoot multiplication and induction of adventitious rhizogenesis. Presently, 831 clusters of *Bambusa nutans* and 96 clusters of *Bambusa tulda* are being regularly maintained. Each clusters contains 10 shoots in *B. nutans* and 3 shoots in *B. tulda*.

Macropropagation: The effect of seasonal variation on adventititous rhizogenesis in culm and culm-branch cuttings of *B. nutans* and *B. tulda* was investigated in rainy (July) and winter (November) season. The best adventitious rhizogenesis was recorded in auxin-treated *B. nutans* culm-cuttings of rainy season (55.6%). In the same season 25.6% root induction occurred in treated culm-branch cuttings. In spite of some sprout development, no rooting was noticed in *B. tulda*. Overall the pattern was: culm-cuttings > culm-branch cuttings and rhizogenesis in rainy season and winter season was same in case of *B. nutans*.

Adventitious rhizogenesis in *B. nutans*. a. Cuttings in mist chamber, b. Culm-cuttings and c. Culm-branch cuttings.

An experiment has been laid out to study the adventitious rhizogenesis in three types of culm cuttings (full, split and strip) of each species and to study the effort of 16 treatments comprising of four different concentrations of auxins (IBA and NAA) and non-auxins (boric acid, coumarin and thiamine).

Project 2: Screening of indigenous species of *Trichogramme westwood* and *Trichogrammetoidea girault* (Hymenoptera: Trichogrammatidae) from central India and their utilization against important forest insect pests [077/TFRI-2005/Ento-DST-1(9)/2005-2008]

Status: The project has been initiated recently.

Project 3: National network on integrated development of Jatropha and Karanj [73/TFRI-2004/NWFP-3 (NOVOD)(11)/2004-2007]

Status: *Jatropha curcas* seeds were collected from various agroclimatic regions of M.P. and were analyzed for fatty oils. Jatropha seeds from various provenances were sown in beds and poly bags to raise seedlings for multilocational trails.

Project 4: Study of Sal mortality in forest divisions of Chhattisgarh [074/TFRI-2004/Patho-3(CGFD)(10)/2004-2005]

Status: Project inception report has been submitted to Chhattisgarh Forest Department. Survey in east Raipur and Udanti Forest Division has been conducted and the samples from Sal mortality area have been collected.

EDUCATION AND TRAINING

Trainings organized

1. Two weeks training programme in biochemistry was organized for M.Sc. Students of R.D. University.
2. Two weeks training programme in biotechnology was organized for B.Sc. Students of Govt. Science College, Jabalpur.
3. Training programme was organized for SFD Officials at four locations, viz. Baihar, Motinala, Bajag and Amarkantak Range of Madhya Pradesh for effective catching of beetles of Sal heartwood borer.
4. Training progamme was organized for M.Sc. students in biotechnology and biochemistry.
5. Three days training programme on improving forest productivity through technological means was organized for field executives of Maharashtra Forest Department from 17th to 19th February, 2005.
6. One week compulsory training course was organized for IFS officers on New Approaches to biodiversity conservation from 31st January to 4th February, 2005.
7. One day training programme was organized for the members of VFC at Kukarikheda on 1st March, 2005 for Lac cultivation.
8. One day training programme was organized for the members of VFC at Richhai on 22nd March, 2005 for Mushroom cultivation.
9. Two days training programmes were organized on cultivation of Jatropha and Karanj for the farmers at Satna, Mandla, Lakhnadon, Balaghat and Narsinghpur.
10. Training was imparted to women and youth of Kanwar tribe on Cultivation of Lac and Medicinal Plants at Bilaspur, Korba and Katghora on 18th March, 2005.
11. Training was imparted to members of village society of Gotegaon (Narsinghpur) on Potential of Jatropha and Karanj in Agroforestry from 29th and 30th March, 2005.

12. Training was imparted to forest officials on Agroforestry Systems at Department of Rural Development, Chhindwara.

13. Training was imparted to members of village society of Satna, on Potential of Jatropha and Karanj in Agroforestry from 11th and 12th March, 2005.

LINKAGES AND COLLABORATION

1. A collaborative project entitled Developing coalition approach to non-Timber Forest Produces for better livelihoods of tribal communities of Madhya Pradesh funded by DFID was implemented.

2. Replied more than 10 public queries pertaining to various issues like availability of medicinal plants, diseases, pests and insect problems etc.

Pamphlets

1. Pamphlets containing information about divisions of TFRI - 250 Nos.

2. Booklet containing the cultivation of Jatropha and Karanj - 500 Nos.

CONSULTANCIES

1. Consultancy given to Regional Manager, Tribal co-operative Marketing Federation, Ministry of Tribal Affairs, Jagadalpur for cultivation of Safed musli at Jagadalpur from 20th and 21st November, 2004.

2. Evaluated coastal shelterbelt plantation in coastal districts of Orissa.

3. Analyzed soil samples from SAIL (Funding Agency: SAIL, Kolkata).

CONFERENCES/MEETINGS/ WORKSHOPS/SEMINARS/ SYMPOSIA/EXHIBITIONS

1. Director, TFRI and one scientist participated in IUFRO International Seminar on Multipurpose Tree Species from 22nd to 25th November, 2004 held at AFRI, Jodhpur, (Rajasthan).

2. Director, TFRI and two scientists attended International Symposium on Microbial diversity: Challenges, opportunities and relevance in new millennium organized by Society for Basic and Applied Mycology (SBAM), R.D. University, Jabalpur from 19th to 21st November, 2004.

3. Dr. R.K. Verma, Scientist-D participated in 26th Annual Conference of ISMPP and National Symposium on Advances in Fungal Diversity and Host Pathogen Interaction from 7th to 9th October, 2004 held at Department of Botany, Goa University, Taleigao, Goa.

4. Dr. Nidhi Sharma, SRF, CSIR Project attended International Symposium on Microbial diversity: Challenges, opportunities and relevance in new millennium organized by Society for Basic and Applied Mycology (SBAM), R.D. University, Jabalpur 19th to 21st November, 2004 presented a Poster Presentation on "Fungal diversity in the forests of Satpura" (by R.K. Verma, Nidhi Sharma, K.K. Soni and Jamaluddin).

5. Dr. Jamaluddin and Dr. V.S. Dadwal attended a National Symposium on Conservation and Management of Threatened Medicinal Plants, was held from 23rd to 25th February, 2005 at SFRI, Jabalpur and presented two research papers.

6. Shri Avinash Jain, Scientist-D, attended Advanced EMS Auditing Course for Quality and Environmental Professionals accredited by the Institute of Environmental Management and Assessment (IEMA) at ICFRE, Dehradun from 23rd to 27th November, 2004.

7. Shri S.P. Tripathi, IFS attended National workshop on refined criteria and indicators on sustainable forest management held from 10th and 11th March, 2004 at IIFM, Bhopal.

8. Dr. A.K. Pandey, Scientist-E presented a paper entitled Medicinal Plants in Madhya Pradesh: Potential and Constraints in National Interactive Meet on Scope and opportunities in research and business of medicinal and aromatic plants from 29th and 30th October, 2004, Central Institute of Medicinal and Aromatic Plants, Lucknow.

9. Dr. A.K. Pandey, Scientist E presented a paper Role of Tropical Forest Research Institute in Research and Development of NWFPs. Regional Workshop on Non Wood Forest Products at Raipur, from 3rd and 4th November, 2004.

10. Dr. A.K. Pandey, Scientist-E presented a paper Sustainable development of Aonla (*Phyllanthus emblica* L.) through non destructive harvesting practices in the International Conference on multipurpose trees in the tropics : Assessment, Growth and Management from 22nd to 25th November, 2004, Arid Forest Research Institute, Jodhpur.

11. Dr. A.K. Pandey, Scientist-E attended National symposium on emerging technologies and their application in assessment, conservation and management of endangered wild medicinal plants and their habitats from 23rd to 25th February at SFRI, Jabalpur and presented a paper.

12. Jamaluddin and Chawdhry, P.K. (2004). Management of nursery diseases of multipurpose tree species in central India. In: *IUFRO International Seminar on Multipurpose Tree Species* from 22nd to 25th November, 2004 held at AFRI, Jodhpur.

13. Dadwal, V.S. and Jamaluddin (2004). Diversity of diseases in agroforestry tree species in central India. Presented in Symposium on *Microbial Diversity: Challenges and Opportunities / Recent trends in Plant Sciences* held at R.D. University, Jabalpur from 19th to 22nd November, 2004.

14. Kulkarni, N. and Joshi, K.C. (2004). Role of ecofriendly insect control methods in plant conservation. Paper presented in National Workshop on *Regional Strategy for Conservation of Plants*, held at Tropical Forest Research Institute, Jabalpur from 26th and 27th February, 2004.

15. Rai, Rajiv and Nath, V. (2004). Glimpse on herbal medicinal plants conserved in Sacred Groves, Deogudi by Gond tribals of Central India. National Workshop on Strategy for Conservation of Sacred Grove. IFGTB, Coimbatore.

16. Rai, Rajiv and Nath, V. (2004). Tribal concepts of Conservation and Sustainable Utilization of Multipurpose tree species of medicinal value in Central India. International Conference on Multi purpose trees in the tropics from 22nd to 25th November, 2004, AFRI, Jodhpur.

17. Rai, Rajiv and Nath, V. (2005). Plants used by indigenous inhabitants in stress sites of Madhya Pradesh (India). International

Conference on Suitable Crop Production in tree Enviroments: Management and Genetic Option from 9th to 12th February, 2005. JNKVV, Jabalpur.

18. Rai, Rajiv and Nath, V. (2005). Medicinal and Aromatic plant product –oil used in ethnomedicine by Gond tribe in Central India. National Seminar on Medicinal and Aromatic Plants- Biodiversity, Conservation, Cultivation and Processing, IGKVV Raipur, CG from 26th and 27th February, 2005.

19. Rai, Rajiv (2005). Floristic diversity of herbal medicinal plants documented in tribal pockets of Madhya Pradesh. National Symposium on emerging Technologies, and their application, in Assessment, Conservation and Management of Threatened wild medicinal plants and their habitat from 23rd and 24th February, 2005, SFRI, Jabalpur, p. 14.

20. Sah, A.K.; Argal, A.; Singh, R.B., Dilraj, I.T.K. and Berry, N. (2004). Production of fodder crop under 5 MPTs. Paper accepted in IUFRO International Conference on Multipurpose Trees in tropics: Assessment, growth and management held at AFRI, Jodhpur held from 22nd to 25th November, 2004.

21. Participated in state level Krishi Vigyan Mela at JNKVV, Jabalpur from 3rd and 4th October, 2004.

22. Participated in Gramin Mela at Xavier Institute of Development Action and Studies (XIDAS), Jabalpur from 3rd to 5th December, 2004.

23. Participated in state level trade fair Van Mela at Bhopal from 8th to 10th December, 2004.

24. Participated in exhibition at JNKVV, Jabalpur on the occasion of an International Conference on Sustaible crop production in stress environment: management and genetic options from 9th to 12th February, 2005.

25. Participated in two days National Symposium on Emerging Technologies and their application in Assessment, Conservation and Management of Threatened wild medicinal plants and their habitat from 23rd and 24th February, 2005, organized by SFRI, Jabalpur and presented two research papers.

26. Participated in Herbal Mela 2004 from 10th to 13th December, 2004 organised by Madhya Pradesh, MFP Federation, Bhopal and delivered information on use of herbal medicines in cure of ailments.

27. Participated in Van Mela 2005 from 17th to 20th March, 2005 organised by DFO, Jabalpur to document information from vaidyas of Seoni, Mandla , Katni, Chhindwara, Jabalpur and Anuppur (Shahdol) for recording information on herbal medicines and their formulation.

AWARDS

1. Dr. Jamaluddin, Scientist-G, Head of Forest Pathology and Group Coordinator (Res.), Dr. K.K. Soni, Scientist-D and Dr. V.S. Dadwal, Scientist-B, Forest Pathology Division, TFRI were awarded Award of excellence in Forestry Research by ICFRE, Dehradun for 2003.

2. Dr. Jamaluddin, Scientist-G has been awarded Vishist Vaigyanik Puraskar from the Ministry of Environment and Forests, Govt. of India.

3. Dr. Jamaluddin, Scientist-G and Dr. V.S. Dadwal, Scientist-B awarded Brandis

Prize for the year 2004 by the Society of Indian Forester.

DISTINGUISHED VISITORS

Dr. D.N. Tiwari, Vice Chairman, Chhattisgarh State Planning Board visited this institute from 12th and 13th September, 2004 and held a discussion with officers and senior scientist of TFRI on various aspects of Jatropha.

MISCELLANEOUS

Museum development: Digital photograph (30" x 20") with lamination on various activities of extension have been prepared for museum - 5 Nos.

Meetings, RAG, CTA's etc.

1. Pre RAG – in-house meeting held at Tropical Forest Research Institute, Jabalpur in the last week of July, 2004.
2. 14th RAG Meeting held at Tropical Forest Research Institute, Jabalpur on 12th and 13th August, 2004. Members and a few special invitees participated from all 4 states under the jurisdiction of Tropical Forest Research Institute.

Important activities during the year

1. Celebrated World Environment Day on 5th June, 2004 with relevant programmes.
2. Celebrated Van Mahotsav on 27th July, 2004 in which about 200 seedlings of various species have been planted in TFRI, Jabalpur.
3. Celebrated Wildlife week from 1st to 7th Oct., 2004 along with relevant programmes.
4. About 2000 seedlings of Jatropha have been planted at Barbati village of Madhya Pradesh under Ford Foundation follow-up-action.
5. About 100 Kg seed of Dinanath Grass was distributed to the members of VFC at Richhai and Kukarikheda.

CHAPTER V

RAIN FOREST RESEARCH INSTITUTE JORHAT

The Rain Forest Research Institute (RFRI) was established at Jorhat, Assam in the year 1988. The main objectives of the Institute are Conservation of Biodiversity resources of North-East States, Eco-restoration of degraded forests and management of shifting cultivation practice, development of technology for sustainable utilization of forest resource – Bamboo and rattan, genetic improvement and propagation of important tree species of North-East Region, afforestation and silviculture management, management of pests and disease in forestry and technology transfer to user groups.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

Project 1: Management of seed and soil borne diseases of *Gmelina arborea* and *Dipterocarpus retusus* in nursery [RFRI/FP-05/2000-2004]

Findings: Major nursery diseases of *G. arborea* have been identified. Control strategies have been evolved to minimize the losses to seed and seedlings of *G. arborea* by fungal pathogens.

Work on seed and seedling diseases of *Dipterocarpus retusus* is a pioneering one and have been reported and described for the first time. User-friendly protocol has been developed for the management of seed and seedling pathogens of *D. retusus*.

Project 2: Development of VAM as biofertilizer for some economically important forest plant species of Assam and Arunachal Pradesh [RFRI/FP-07/2000-2004]

Findings: Diversity and dynamics of VAM fungi in a cafeteria plantation of 20 fuelwood species have been assessed. The range of percent root colonization significantly varied from *L. nitida* (10.67%) to *A. lebbek* (29.17%) and *S. saman* (29.33%). The study of seasonal variation of VAM spore population associated with twenty species revealed that the spore population started increasing from February and reached the maximum in the month of June.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

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

Status: Survey, selection and collection of productivity data of different land use systems in Nagaland is in progress. Cost benefit ratio of settled and jhum cultivation, Kadam and Teak plantation in Nagaland. Soil nutrient status of Pineapple, Teak and Bamboo plantations of Silonjan, Karbi Anglong were evaluated.

Settled Cultivation

Pineapple Cultivation

Project 2: Growth, Biomass and energy production potential of selected energy plantation species [RFRI/ SC-7/2003-2006]

Status: Field trials were set in the Naharoni Field Station and frequent field visits were made for collection of growth data of different fuel wood species. Sample trees were harvested and biomass estimation was completed. The calorific value of different fuel wood species was also determined. Three promising species were identified based upon their growth parameters and high energy value.

Mallotus albus (Promising Fuel wood species)

Project 3: Ecological studies on Dipterocarp forest of Gibbon Wildlife Sanctuary of Assam [RFRI/EE-04/2003-2006]

Status: Ecological assessment of Dipterocarp forest with reference to distribution, abundance rarity and profile sketch of evergreen forest is being carried out in Gibbon Wildlife Sanctuary. Enumeration of tree species was carried out in natural, plantation and disturbed sites of the area. Preliminary data showed that thick canopy cover and biotic interference are responsible for poor regeneration of Dipterocarp.

Project 4: Genetic improvement of *Pinus kesiya* (Khasi pine) [RFRI/TI-08/ 2002-2005]

Status: Evaluation and monitoring of established Seed Production Areas is in progress. Thirty three plus trees were selected in the state of Meghalaya. Seed from plus trees were collected and progenies of the same were raised to establish Seedling Seed Orchard. Seed and cone parameters of different plus trees were estimated. A new record of presence of cone clusters in Khasi pine was also recorded.

Plus Tree Khasi pine

Cone Clusters

Project 5: Stability test of various progenies and clones for different characters in *Gmelina arborea* [RFRI/TI-10/2003-2006]

Status: Evaluation and monitoring of National and regional progeny trials is in progress. Collection of seed from seed orchards and supply to different institutes for gap filling has been completed. The growth data of progeny trials has also been recorded.

Project 6: Reclamation of highly eroded site at Cherrapunjee, Meghalaya [RFRI/SM-04/ 2003-2006]

Status: Experimental area was replanted during May, 2004 with *Alnus nepalensis* and *Exbucklendia populania*. The growth and survival data were taken. The survival percentage of *Exbucklendia populania* and *Alnus nepalensis* was found to be 98.09 % and 96.87 %, respectively. After six months of plantation it was observed that in case of *Alnus nepalensis* the treatment combination $P_2W_1M_0F_1$ shows better growth while for *Exbucklendia populania* $P_1W_1M_1F_1$ gives the highest growth.

Replanted seedlings

Project 7: Studies on distribution dynamics of Bamboo and Canes and their *ex-situ* conservation [RFRI/EE-03 / 2004-2007]

Status: *Ex-situ* conservation of 3 Bamboo species was completed. Identification of different Bamboo species based on morphology is in progress. Recording of growth data and maintenance of propagules / new culms is in progress.

Project 8: Germplasm collection, conservation and mass multiplication of selected medicinal plants of North-East India [RFRI/EE-05/2003-2006]

Status: Collection and *ex-situ* conservation of five different selected species (*Bacopa monnieri*, *Andrographis paniculata*, *Plumbago zeylanica, Plumbago indica* and *Asparagus racemosa)* of medicinal plants have been completed at RFRI campus. Identification of plant species and maintenance of collection is in progress.

Project 9: Germplasm evaluation of selected Bamboo species for various end uses [RFRI/ SM-03/2003-2006]

Status: Clonal trial in split plot design was established. Growth data of six month seedlings and 11 months old trials at Naharani Research Station has been collected. 15 Plus clumps of *Dendrocalamus hamiltonii* were tried for rooting. Improved planting stock of *Bambusa balcooa*, *B. nutans*, *B. tulda* and *Dendrocalamus hamiltonii* has been maintained. About 3200 ramets and the periodic management works are being carried out at regular intervals.

Project 10: Capacity building of village level committee for efficient forest resource management through JFM [RFRI /CFE-01/ 2002-2006]

Status: Resource survey of area was conducted in order to identify the local problems and based on the problem ranking through PRA, micro - plan modules have been developed. Scientific remedial measures were suggested so as to overcome certain problems. Layout design has been prepared for Agroforestry models on the basis of species preference of local communities. Bamboo treatment technique was demonstrated in 6 villages of the Island to generate technical awareness among farmers and to encourage them to use treated Bamboo for greater longevity.

Project 11: Studies on yield and quality traits of fragrant products from selected humid-tropical aromatic plants [RFRI/ CFE-02/2002-2005]

Status: Information regarding harvesting, post-harvesting, extraction and storage practices being adopted by farmers, NGOs and entrepreneurs were collected. Leaf samples from the plants under different maturity stages were analyzed for oil content. Organoleptic characteristics, moisture content and fresh to dry weight ratio of different leaf samples were evaluated. Effect of drying mode of Patchouli leaves on the recovery of oil was studied and appropriate drying method was suggested. TLC fingerprinting for Patchouli leaves was carried out to evolve phyto-chemical parameters for authentication of the leaf raw material even in dried and powdered form.

Extraction of Patchouli oil

Testing Effect of containers on shelf oil life

Patchouli leaves

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

Project 1: Genetic improvement and clonal propagation of *Dipterocarpus retusus* [RFRI/TI-11/2004-2007]

Status: In view of early flowering and fruit setting in some progenies, the study of floral behaviour and fruit setting of different progenies was undertaken to explore the possibility of getting abundant seed to conserve this threatened species. Significant variation was observed in different progenies for flowering and fruit setting. The period of flowering ranged from June to January with flowering mean duration of 105 days. In all the progenies, fruiting was recorded from 1.63 to 14.28 per cent. In the first flush of flowering in some progenies, less than 0.08 per cent fruit setting was observed.

In progenies performance evaluation, significant variation was observed among all the progenies for different traits. Clonal propagation trials are in progress to develop a suitable protocol of the species.

Flower and Fruit Drop

Project 2: Development of an eco-friendly strategy for the management of *Calopepla leyana* Latr., a serious pest of *Gmelina arborea* (Roxb.) [RFRI/FE-11/2004-2007]

Status: *Beauveria bassiana* and *Metarrhizium anisopliae* are identified as natural enemies of *Calopepla leayana* from different insect groups. Entomopathogenic fungi was found effective against both larval and adult stages of *C. leayana*. Bakery waste/desolate bread was identified as one of the suitable substrate for the mass production of *B. bassiana*.

Pathogenic effect of *Beauveria bassiana* on *Calopepla leayana*

Project 3: Development of Patchouli based viable agroforestry models for North-East region of India [RFRI/CFE-04/2004-2007]

Status: 4000 plantlets of Patchouli were raised through vegetative multiplication in root trainers. Alley cropping trials with leguminous crops was laid. Laying of *on-station* and *on-farm* agroforestry trials is under progress.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

(Externally Aided)

Nil.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Assessment of biological diversity of various ecosystems and to establish methods for conservation in the Kaziranga

National Park of Assam [RFRI/EP-05/2003-2006]

Status: Quantitative structure, population dynamics of forest communities and grassland productivity has been analysed in the Kaziranga National Park. Three communities were identified in woodland species. Richness was found higher in semi- evergreen forest area of the park.

Grassland enumeration and biomass study has indicated the distinct characters of tall and short grass community.

Data collected reveals the presence of endangered species, rare orchids and rattan species for the first time in Kaziranga National Park, Assam.

A rare ground orchid (*Zeuxine affinis*) in Kaziranga National Park

Savannah Forest (Kaziranga National Park)

Calamus nambereinsis an endemic and endangered rattan from (Kaziranga National Park)

Project 2: Contribution of N_2 fixing plants on improvement of abandoned fallow in shifting cultivation [RFRI/EP-04/2003-2006]

Status: Better enhancement of chemical properties of soil due to addition of *Crotolaria pallida* was recorded. Available NPK was higher after the application of *Crotolaria pallida* followed by *Sesbania bispinosa* and *Cajanus cajan* respectively. Economic analysis is under progress.

Project 3: Indigenous knowledge of Angami tribe in sustainable management of biodiversity in Nagaland, India [RFRI/EP-03/2003-2006]

Status: Documentation of resource use pattern such as medicinal, fodder, wild edible plant, dye and gum etc. has been completed. The important medicinal plants used by this tribe has been listed. Angami tribe use different indigenous techniques for preservation of dry food and also crop in field.

Drying technique of foodstuff

Project 4: Conservation of productive land and promising flora of Majuli Island in Bramhaputra river [RFRI/EP-05/2003-2006]

Status: Problem ranking of the area has been done through PRA exercises. Micro-plan has been prepared to conserve productive soil and promising flora to enhance productivity and resource conservation through PRA methodology.

Resource survey of the area has been under taken and 150 medicinal/promising plants were inventorized.

Project 5: Control of soil and riverbank erosion in Majuli through Bamboo based vegetative embankment [RFRI/EP-07/2004-2007]

Status: The project site has been demarcated and treatment area has also been stratified into four zones as per the technical programme. 12 Kissan Nurseries were established and Village Level Committees (VLCs) in all the five villages were formed. More species suitable for the vegetative embankment were identified. For establishment of Bamboo based soil erosion, control riverbank protection structures, various designs like Water Current Deflector, Bank Wall, etc. have been prepared and finalized to be established at the site based on the erosion pattern.

Project 6: Validation, testing and locational trial of micro/macro-propagated planting stock Bamboo species in North-Eastern India [RFRI/EP-08/2005-2008]

Status: With the consultation of TERI lay out and package of practices for Bamboo locational trails in all the seven North-Eastern states has been prepared.

Project 7: Financial assistance for improvement of infrastructural facilities in Botanical Garden/Centres of *ex-situ* conservation at Rain Forest Research Institute Jorhat, Assam [RFRI/EP-09/2003-2006]

Status: Construction of shade cum poly house, orchidarium and installation of irrigation facilities has been taken up. Twenty species of rare Orchids of North-East region have been collected.

Ex –situ conservation of Orchids of North-East

Shade cum poly house constructed under MoEF funded project for development of botanical garden at RFRI

RESEARCH ACHIEVEMENTS

Name of State	No. of Projects completed in 2004-2005	No. of on-going Projects in 2004-2005	No. of Projects initiated in 2004-2005
Assam	2	17	3
Meghalaya	-	6	1
Manipur	-	4	-
Tripura	-	5	-
Nagaland	-	4	-
Mizoram	-	3	-
Arunachal Pradesh	-	3	-

TECHNOLOGY ASSESSED AND TRANSFERRED

One site training programme on Compositing and Vermi-composing was organized at Majuli from 1st and 2nd April, 2004 for Kissan Nursery holders.

Three training programme on different aspects of Bamboos were organized at RFRI for the Foresters and Forest Guards of Assam and Arunachal Pradesh.

EDUCATION AND TRAINING

Dr. A. N. Singh, Scientist-C and Dr. K. Panneer Selvam, Scientist-B of this Institute participated in the training-cum-workshop on *"Advanced Environmental Management Systems, Auditor Training Course (IEMA Approved)"* from 23rd to 27th November, 2004 at ICFRE, Dehradun.

LINKAGES AND COLLABORATION

The linkage and collaboration were established with SFDs of Noth-East States and other research organizations like G.B. Pant, NMBA, MoEF, DBT, DST, NEC and NGOs working in the field of forestry and forestry research.

PUBLICATION

Abstracts

1. Kaushik, P.K. and Tripathi, Y.C. (2004). Microplan Modules for Community Based Management of Biological Embankment Programme, *IInd International Conference on Scour and Erosion (ICSE–2)*, from 14th to 17th November, 2004, Singapore.

2. Kaushik, P.K.; Pandey, B.K. and Tripathi, Y.C. (2004). Medicinal Plant Based Agroforestry for Tackling Raw Material Crisis in Herbal Drug Industries, *2nd Global Summit on Medicinal and Aromatic Plants*, organized by Century Foundation in New Delhi from 25th to 29th October, 2004.

3. Kaushik, P.K.; Pandey, B.K. and Tripathi, Y.C. (2004). Participatory Approach to Watershed Management in India, *National Conference on Resource Conserving Technologies for Social Upliftment*, organized by Indian Association of Soil and Water Conservations at Central Soil and Water Conservation Research and Training Institute, Dehradun from 7th to 9th December, 2004.

4. Pandey, B.K.; Kaushik, P.K. and Tripathi, Y.C. (2004). Medicinal Flora of Majuli Island – An Ethnobotanical Appraisal, *2nd Global Summit on Medicinal and Aromatic Plants*, organized by Century Foundation in New Delhi from 25th to 29th October, 2004.

5. Pandey, B.K.; Tripathi, Y.C. and Kaushik, P.K. (2004). Soil Stabilization and River Bank Protection through Bamboo Based Biological Embankment Around Majuli Island, VIIth *World Bamboo Congress 2004*, from 27th February to 4th March, 2004, New Delhi.

6. Singh, J. and Bora, I.P. (2004). Scared Groves of Meghalaya – status, floristic composition and conservation strategies National Workshop on Strategy for conservation of scared groves, ogranized by I.F.G.T.B., Coimbatore from 27th and 28th May, 2004.

7. Singh, Ombir and George, M. (2005). Conservation of genetic resources of non-mulberry host trees in Northeast India. *In Workshop on Strategies for non-mulberry Germplasm maintenance* from 10th and 11th March, 2005. Organized by Central Muga Eri Research and Training Institute, Central Silk

Board, Ministry of Textiles, Govt. of India, Lahdoigargh, Jorhat, Assam, pp. 37-44.

8. Singh, Ombir and Mahanta, N. Genetic Improvement of Khasi pine (*Pinus kesiya*) in North-east India. Abstract accepted in 2004 in IUFRO Conference on *Forest Genetics and Tree Breeding in the Age of Genomics* at South Carolina, USA.

9. Tripathi, Y.C. and Pandey, B.K. (2004). Socio economic and Environmental Impact of Biological Embankment at the Eroding Bank of Majuli Island in Brahmaputra River, *IInd International Conference on Scour and Erosion (ICSE–2)*, from 14th to 17th November, 2004, Singapore.

10. Tripathi, Y.C.; Kaushik, P.K and Pandey, B.K (2004). Modern Phytomedicines – Paradigm of Ancient-Modern Concordance, *2nd Global Summit on Medicinal and Aromatic Plants*, organized by Century Foundation in New Delhi from 25th to 29th October, 2004.

11. Tripathi, Y.C.; Kaushik, P.K. and Pandey, B.K. (2004). Bamboo Identification – A Morphological Consideration. *VIIth World Bamboo Congress 2004*, from 27th February to 4th March, 2004, New Delhi.

12. Tripathi, Y.C.; Kaushik, P.K. and Pandey, B.K. (2004). Conservation of NTFPs for Efficient Forest Management, *National Conference on Resource Conserving Technologies for Social Upliftment*, organized by Indian Association of Soil and Water Conservations at Central Soil and Water Conservation Research and Training Institute, Dehradun from 7th to 9th December, 2004.

13. Tripathi, Y.C.; Pandey, B.K. and Kaushik, P.K. (2004). Riverbank Erosion – Bioembankment, *VIIth World Bamboo Congress 2004*, from 27th February to 4th March, 2004, New Delhi.

Technical Bulletins

Meena, C.R.; Tripathi, Y.C. and Saikia, D. (2004). Positive response to selection for flowering in *Dipterocarpus retusus-Future prospects*. Submitted to ICFRE, Bulletin, Newsletter, 2004.

CONSULTANCY

R.F.R.I. successfully completed the consultancy on evaluation of Afforestation and Tree Planting activities in Dimapur District of Nagaland, sponsored by National Afforestation and Eco-develpment Board (NAEB), Ministry of Environment and Forests (Govt. of India) under Integrated Afforestation and Eco-development Projects (IAEP) on January, 2005.

CONFERENCES/MEETINGS/ WORKSHOPS/SEMINARS/ SYMPOSIA/EXHIBITIONS

Organised

1. R.F.R.I., Jorhat organized a meeting on Planting stock of Bamboo species on 14th December, 2004. The meeting was sponsored by Department of Biotechnology (DBT), Govt. of India.

2. 6th Research Advisory Group Meeting was held in the premises of RFRI on 15th February, 2005.

3. Vigilance Awareness Week was celebrated at RFRI from 1st to 6th November, 2004. During the celebration essay competition was organized on the topic "Necessity of Vigilance to upgrade research in RFRI" and also a seminar held on topic " Why vigilance is in Research ?"

Attended

1. Dr. Y.C. Tripathi, Scientist-E, attended NMBA sponsored Round Table Meet on Bamboo Location Trial held at G.B. Pant University of Agriculture and Technology Pant Nagar from 15th and 6th January, 2005.

2. Dr. Y.C. Tripathi, Scientist-E, attended Expert Group meeting for evaluation of projects held at DBT, New Delhi on 8th February, 2005.

3. RFRI participated in Scientific Exhibition cum Technology Demonstration in Farmer Festival at Assam Agricultural University, Jorhat from 2nd to 4th March, 2005.

4. RFRI participated in exhibition held during Kaziranga Centenary Celebration from 11th to 17th February, 2005.

5. Dr. M. George and Dr. Ombir Singh participated in *Strategies for nonmulberry germplasm maintenance* from 10th and 11th March, 2005 organised by Central Muga and Eri Research and Training Institute, Lahdoigarh, Jorhat.

6. Dr. Tilak Hazarika, Asstt. Librarian R.A. Gr. II attended the National Seminar organized by the Media Trust, Assam on *Building up of a National Information-cum-Achieve Centre for the North-East India* held at Guwahati from 2nd and 3rd November, 2004 and presented paper on *Role of media in larnessing sustainable management of environment and forests in North-East India.*

7. Dr. Tilak Hazarika, Asstt. Librarian R.A. Gr. II attended the XXI IASLIC National Seminar held at Kolkata from 31st December, 2004 to 3rd January, 2005 and presented a paper on *Information input for rural development in agricultural and forest services : an assessment.*

DISTINGUISHED VISITORS

Shri V.S. Oberio, Advisor, NMBA (TIFAC), visited on 14th December, 2004.

CHAPTER VI

ARID FOREST RESEARCH INSTITUTE JODHPUR

Arid Forest Research Institute (AFRI), situated at Jodhpur in Rajasthan, is one of the Institutes under an autonomous council under the Ministry of Environment and Forests, Indian Council of Forestry Research and Education (ICFRE). The main objective of the Institute is to carry out research in forestry in order to develop technologies to enhance bio-productivity and to conserve biodiversity in the arid and semi-arid region of Rajasthan, Gujarat and Dadra & Nagar Havelli.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

Project 1: Provenance trial on Arid Zone species [AFRI-16/FGTB-3/1992-2005]

Findings: Neem : Provenance trial of Azadirachta established in 1992 using 39 seed sources showed that provenance from Palanpur (Gujarat), Jaiselmer (Rajasthan), Amrawati (Maharashtra), Jhansi (U.P.) and Gandhinagar (Gujarat) performed better than others. Palanpur provenance was found best in performance.

Rohida: The provenance trial of *Tecomella undulata* which was planted in the year 1992 with 13 seed sources from Rajasthan. Sunderpur Bir (Sikar) provenance was found superior in growth with a height of 3.81 m followed by Nagaur 3.55 m and Goshala 3.39 m. The girth was maximum in case of Barmer (Chotan) 30.73 cms followed by Nagaur 29.13 cms and Bhinslana 29.00 cms.

Shisham: Provenance trial for *Dalbergia sissoo* was laid out in August, 1995 from the seeds sent by FRI, Dehradun. During the year 2005 best performance has been recorded for height in Etawah 8.07 m followed by Pilibhit 7.81 m, Allahabad 7.35 m, Pratapgarh 6.14 m and Kasganj 6.13 m. In case of girth, Pilibhit has shown the best result with 77.00 cms followed by Lalitpur 46.99 cms, Allahabad 45.30 cms and Pratapgarh 45.00 cms.

Project 2: International Neem Network Provenance trial [AFRI-17/FGTB-2/1995-2005]

Findings: The International provenance trial on Neem was initiated by the FAO Neem Network and the seeds were exchanged between the participating countries during 1995. The field trials carried out during the July – August, 1996 at Jodhpur, Jaipur, Palanpur, Jabalpur, and Coimbatore, with 18 provenances including the control one. At present the trial is continuing only at Jodhpur, Jaipur and Coimbatore. The provenance which performed better in terms of height and girth are Ramanaguda (IND), Sagar (IND) and Jodhpur (IND) in trial-I and Sunyani (GHA), Myne (MYN) and Multan (PAK) in trial-II.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

Project 1: Studies on the role of trees in reclamation of waterlogged area and their impact on soil [AFRI-29/FEDD-6/2002-2006]

Status: An experiment was conducted in the year 2002 to screen suitable plants for waterlogged area in Indira Gandhi Nahar Priyojna (IGNP). Seedlings of 8 species, viz. *Eucalyptus camaldulensis*, *E. fastigata, E. grandis, E. rudis, E. saligna, Casuarina cunninghamiana, C. glauca*

and *Corymbia tesselaris* were planted on raised bunds. Observation on growth and survival was recorded periodically. Among the species planted better growth was recorded in *E. camaldulensis* and *E. rudis*. Though survival was very high in *Casuarina cunninghamiana* and *C. glauca* but due to high biotic pressure the species could not put up best growth.

Project 2: Litter dynamics and soil changes during stand development in plantation forest [AFRI-30/FEDD-5/2002-2006]

Status: An experiment was laid out in the year 2002 to study litter dynamics and soil changes at various stages of plantation in Indira Gandhi Nahar Pariyojna (IGNP). Four age groups and six species were selected for the study. 76 litter plots of 10 m x 10 m area were laid in plantations of *Eucalyptus camaldulensis, Acacia nilotica, A. tortilis, Tecomella undulata, Prosopis cineraria* and *Dalbergia sissoo* at Nachna, Sada and Ramgarh area along IGNP. Tree height and girth at breast height (GBH) were recorded for trees inside the plot. Monthly litter collection for study is continued. Litters are separated into different components and dry weight is recorded. Annual litter production (kg/ha) from different trees in IGNP area indicated highest accumulation under *E. camaldulensis* followed by *Dalbergia sissoo*.

Project 3: Identification and screening of some suitable nitrogen fixing species of dry region for their utilization in improvement of soil fertility and biomass [AFRI-41/FEDD–6 /2003-2007]

Status: Out of 10 species tested *Rhynchosia minima, Mimosa hamata, Mucuna pruriense* and *Crotolaria burhia* species indicated better soil status and therefore selected for multiplication and testing in the field for further investigation.

Project 4: Screening different phenotypes of *Dalbergia sissoo* and *Acacia nilotica* for their tolerance to salinity and sodicity [AFRI-42/ FEDD-7/2003-2007]

Status: Highest survival (30%) and growth in height (16.12 cm) of *Acacia nilotica* was recorded in phenotype collected from *Harethar* and *Lakhani*. The survival and growth of *Dalbergia sissoo* phenotype was very poor because of high salinity level. Salinity of experimental site was in the range of 8.80 – 10.88 dSm^{-1}. Soil pH and organic carbon were 7.66 – 8.86 and 0.23-0.28%, respectively.

Project 5: Provenance trials on *Acacia nilotica* and *Ailanthus excelsa* [AFRI-18/ FGTB-3/ WB/1995-2005]

Status: *Acacia nilotica*: Provenance trial was laid out in the year 1992 with 28 provenances collected from different states of India. The trial has been affected by the prolonged drought conditions in the state. The data on growth parameters have been recorded and best performing provenances for height are Shivpuri 3.26 m followed by Manikpur 3.20 m, Gurgaon 3.17 m, Hastinapur 3.13 m and Haldwani 3.13 m. The best performing provenances for girth are Makdampur 30.33 cms followed by Parlekhmundi 29.42 cms, Shivpuri 29.17 cms, Gurgaon 29.05 cms and Jhabua 28.32 cms.

Provenance trial of *Acacia nilotica*

Ailanthus excelsa: Provenance trial was laid out using seeds collected from 13 different seed sources. The provenance trial was laid out at two different sites at Jaipur and Jodhpur. This trial has been affected by the prolonged drought and low humidity conditions prevailing in the state. The data collected during this year showed that the Varanasi (3.95 m) was the best followed by Sonbhadra (3.59 m), Kazipeth (3.50 m), Mirzapur (3.41 m) and Pinjore (3.40 m). The best performing provenances for girth are; Sonbhadra 53.2 cms followed by Kazipeth 52.59 cms, Mirzapur 47.07 cms, Pinjore 46.62 cms and Varanasi 44.54 cms. The best performing provenances in terms of height at Jaipur are Bikaner (4.78 m), Jaipur (4.75 m), Varanasi (4.70 m) and Pinjore (4.48 m).

Project 6: Multilocational trials of Eucalyptus and Dalbergia clones [AFRI-31/ FGTB-7/2002-2006]

Status: A multilocational trial of *E. camaldulensis* and *D. sissoo* clones was established in August, 2003 at four different locations, viz. Dessa, Kheralu, Gandginagar and Rajpipala in Gujarat State. The objective of these trials was to evaluate and select superior clones of *D. sissoo* and *E. camaldulensis* on the basis of their growth performances.

A total of 30 clones of *D. sissoo* and 35 of *E. camaldulensis* were used for establishing multilocational clonal trials.

Project 7: Micropropagation of an important medicinal plant of the arid and semi-arid regions – Commiphora [AFRI-32/FGTB-8/ 2002-2006]

Status: Work on callus induction, multiplication and somatic embryogenesis was in progress.

Project 8: Genetic improvement of *Tecomella undulata* [AFRI- 33/FGTB-9/ 2002-2005]

Status: Based on survey conducted for availability of Candidate Plus Trees (CPTs) in different areas, 30 CPTs in the irrigated tract of IGNP canal area from the plantation raised in 1987 and 35 CPTs in the unirrigated areas in the farmers field were selected. The data has been recorded for the total height, clear bole, d,b,h, and the colour of the flower. The tree bears yellow, deep red and orange colour of flowers.

Project 9: Screening of high oil and Azadirachtin in Neem [AFRI-34/FGTB-10/ 2002-2005]

Status: Twelve hectares of progeny trials of summer and winter flowering CPTs were carried out at AFRI, Jodhpur and high Azadirachtin and high oil containing CPTs at Govindpura, Jaipur are being maintained.

Project 10: Identification of mortality factors of *Prosopis cineraria* and development of suitable management strategies [AFRI/2001-2005]

Status: It has been examined that the mortality problem primarily arose due to cumulative effects of indiscriminate and successive lopping followed by a secondary infestation of three species of root and shoot borers viz., *Aeolesthes holoserecea* Feb, *Derolus iranensis* (discicollis) Gahan and *Hypoeschrus indicus* Gahan. The affected samples reveal the presence of three highly infective species of fungi imperfectii group viz., *Alternaria* sp., *Phoma* sp., and *Botryodiploidia* sp., which cause the dieback disease in mature trees of Khejri as a result of which the tree starts drying from the top. Among other contributory factors to the problem are : continuous depletion of water table in Rajasthan owing to increasing number of tube-wells, low rain fall, change in soil property and agricultural practices and over maturity of trees.

A field experimental trial for the management of Khejri mortality has been laid out at Basuwa in Sikar district during January, 2004 in order to test the relative efficacy of different treatments for the management of infected Khejri trees. The experiment was laid out in Randomized Block Design (RBD) with seven treatments. The treatments were taken with different combinations of fungicides, insecticides and growth regulators. The lopped branches were pasted with AFRI paste (a modified chaubattia paste). The diseased samples were analysed in the laboratory and a *Colletotrichum* sp. was isolated and identified.

The most effective root treatment comprises Chloropyriphos 20 EC (300 ml) + Bavistin (300 gm) + Leader (400 ml) in 200 lt of water whereas the potential shoot treatment contains linseed oil (2 lit) + copper carbonate (1 kg) + red lead (1 kg) + Monocrotophos (2 ml).

Project 11: Studies on improving tree productivity of *P. cineraria* through VAM/ Biofertilizers [AFRI-36/Silvi-8/2002-06]

Status: VAM population studies showed that maximum number of propagules were isolated from agro forestry plantation of *P. cineraria* at Sikar and minimum from Churu. Work is in progress.

Project 12: Ethnomedical property of phyto-pathogenic fungi: screening and isolation of therapeutic products [36A/AFRI/FPD/2003-2006]

Status: Fomes species, *Aspergillus ochraceous*, *A. niger* and *A. flavus* were screened for antimicrobial activity study. These pathogenic fungi were isolated from infected trees of *Prosopis cineraria*. The results showed inhibitory action against *Fusarium* sp. The shaked culture of the *Aspergillus flavus* showed two compounds with inhibitory activity against pathogenic fungi. Further analysis is in progress.

Project 13: Studies on seed quality improvement in respect of various tree species of arid and semi-arid areas [AFRI-35/ Sil-7/2002-2007]

Status: Seeds of *Dalbergia sissoo* and *Ailanthus excelsa* collected during the last year were stored at various moisture and temperature levels and were tested for moisture and germinability. It was observed that the variability of both types of seeds reduced significantly. Neem seeds collected and tested showed that physiologically mature green, green yellow and yellow fruits showed >90% germination. During storage, green yellow seeds performed better. Seeds of *Prosopis cineraria* collected by SFD, Rajasthan from four Agro-Climatic Regions (ACRs) are under seed testing. 100 seeds weight varied from 3.87 to 4.42 g while variation in germination % was from 73% to 91%. Black coloured seed of *Commiphora wightii* gave 45% germination while white coloured showed only 5% germination.

Project 14: Market survey on selected species in selected markets [AFRI-24/ FRME-1/1994]

Status: The data regarding prices of various forest products, viz. timber and fuelwood. Bamboo were collected from the markets of Jaipur and Ahmedabad on quarterly basis.

Project 15: Stand dynamics of some important tree species of Gujarat [AFRI-25/ FRME-2/2001-2006]

Status: Annual measurements were carried out in 36 sample plots of *E.* hybrid and 22 of *Acacia nilotica* laid out in Gujarat State. Data processing and plot computations have been completed which include information on stems/ha, BA/ha,

Dominant height, average height and quadratic mean diameter of the trees in the plots, volume/ha etc. The MAI in respect of total wood volume (ob), for *E.* hybrid and *A. nilotica*, ranged from 0.77 to 32.14 m^3/ha/year and 0.60 to 10.71 m^3/ha/year, respectively, depending upon age, density and site. The dominant heights in the stands varied from 5.8 m to 34.1m for *E.* hybrid and from 4.6 m to 21.1 m for *A. nilotica* depending upon site quality and age. Annual height and diameter increments and form factor for the stands have also been calculated. Preliminary total wood volume equations (over-bark and under-bark) were developed for both the species using combined variable model for estimating total volume yield in the stands. Finally total wood and merchantable volume equations for *A. nilotica* was constructed and validated.

Project 16: Screening of exotic and indigenous plant species for their performance on salt affected soil with different management project [AFRI-6/FRME-4/1997-2003]

Status: A total of seven experimental trials exist at the salt affected area of Gangani in Jodhpur district laid out in different years (from 1997 to 2003) out of which Experiment 1 and 4 were concluded in 2003. Experiment 2, 3 and 6 were concluded in the year 2004-2005.

Experiment 2: *Salvadora persica* is a preferential halophyte, evergreen multipurpose tree, however, its slow growing nature resists its cultivation. An experiment was initiated on saline alkali sandy loam soil with eight treatments comprising of four levels of nitrogen (0, 9, 18 and 27 g of N) and two levels of gypsum (0 and @ 100% soil GR) application in a randomised block design. Results of sixth year of plant growth and biomass yield indicate that despite deficient rainfall conditions survival from 85.2 to 66.7%, was recorded in different treatments. Treatments positively influenced the growth and application of nitrogen in combination with gypsum gave better results as compared to application of nitrogen only. T_6 (gypsum + 9 g N) was the best treatment attaining 207 cm of height and 212 cm of crown diameter, which was 38% and 24% more than the untreated plants. Crescent shaped drainage trenches for individual plants helped in plant establishment and growth as it served the dual purpose of leaching of salts and water harvesting as well. The site has shown substantial improvement in soil status (reduction in soil pH and electrical conductivity and improvement in percent organic carbon content) during the study period. Growth of *S. persica* promoted the natural regeneration, dominated by halophytes, the number of plant species increased gradually. *S. persica* has the potential to make the barren salt affected area productive.

Experiment 3: *Acacia ampliceps* was planted with and without gypsum in September, 1998 on highly degraded soil. Species suffered with some casualties (more on shallow soil area) due to deficient rainfall. The overall percent survival was found as 55.4 (-5%) for control and 65 (-6%) for gypsum treated trees on deeper soil as compared to 45 (-13%) for control and 35.2 (-26 %) for gypsum treated trees on shallow soil area. *Acacia ampliceps* performs very well on deep saline-alkali soils (soil depth 60 cm to 75 cm minimum).

Experiment 5: An experimental trial of *Acacia amnicola* was laid out in August, 2000 with three planting treatments (double ridge mound S_1, elevated slope planting S_2 and simple bund planting S_3) with full gypsum requirement G_1 and control G_0. Treatment combinations were $T_1 = S_1G_0$, $T_2 = S_2G_0$, $T_3 = S_3G_0$, $T_4 = S_1G_1$, $T_5 = S_2G_1$, $T_6 = S_3G_1$. In spite of severe drought survival was maintained at 48 months of age which survival varied from 80.6% to 61.4% in different

treatments. Gypsum application positively influenced the dry biomass yield, ranging from 4% in DRM, 19% in Bund and 42 % on SRM. Cut biomass estimation in *A. amnicola* trial was determined and data analysis is under progress. Complete flowering and seed setting was observed in *A. amnicola*. Percent protein content was estimated in dried leaf (13.6–15.8%) and branch (8.1–10.8%) of various treatments.

Experiment 6: Trial was laid with three salt tolerant species namely, *Atriplex lentiformis*, *A. stocksii* and *Sueda nudiflora* and three planting techniques. *Sueda nudiflora* adapted well to the dry land stress and salt conditions. It was the best species recording nearly 100% survival, attaining maximum growth and biomass in all the three planting treatments (Double Ridge Mound (DRM), Circular Dished Mound (CDM) and control) followed by *Atriplex lentiformis*. *Atriplex stocksii* was poorest performer.

Experiment 7: A trial with two tree species, *Acacia colei* and *Azadirachta indica* was laid with three treatments of planting in August, 2001. No change in survival (from 24-36 months) was recorded and good survival was maintained in DRM (69.0%) followed by CDM structure (46%) and control (23.8%).

Experiment 8: A new experimental trial was laid in August 2003 with two fodder species namely *Ziziphus mauritiana* (Ber) and *Colophospermum mopane*. The trial was laid with two levels of gypsum (0 and 100% soil G.R.) and three doses of nitrogen (0, 9 and 18 g of N in the form of urea) on two modes of planting (control and circular dished mound). *C. mopane* registered 95% survival on CDM and 90% in control after one year of planting, while it was 81 and 72% for *Z. mauritiana*. Growth data recorded at 18 months showed that Ber recorded better overall average height (61 cm to 39 cm) while crown diameter was more for *C. mopane* (52 cm to 47.5 cm). In case of Ber, 10 and 16% more height and crown diameter was recorded on CDM as compared to control, while for mopane no difference in height and 10% more crown diameter was recorded. Nitrogen application increased both height and crown diameter (16%) for Ber. In case of mopane influence was on crown diameter only (15%).

Project 17: Quantitative estimation of biologically active secondary metabolites in some of the arid zone medicinal plants to ascertain correct harvesting time [AFRI-15/NWFP-4/2002-2005]

Status: The yield of petroleum ether and methanol extractives of flowers of *Calotropis procera* collected in three seasons viz., monsoon, winter and summer was determined. It was found that the yield was highest in monsoon and lowest in summer season. The yield of fractionated extracts of methanol extract showed that in case of petroleum ether, benzene and chloroform fractions, the yield was higher and in case of acetone and methanol fractions the yield was lower in monsoon season as compared to winter season. In case of ethyl acetate fraction, the yield was almost the same.

Project 18: Studies on post harvest technologies on non-traditional, under-exploited locally available timber species for suitability to handicraft and other small scale Industries [AFRI-37/NWFP-5/2002-2006]

Status: Wood logs of *Acacia tortilis* (Israili babool), *Prosopis cineraria* (Khejri) and *Prosopis juliflora* (Vilayathi babool) have been taken from experimental fields of AFRI. The logs have been sawn and treated with preservatives, 2% CCA and 2% chloropyriphos solution under pressure

of 80 psi. Moisture has been brought down to 10-12% in kiln seasoning chamber and further seasoned under natural condition. The plantation-grown wood exhibiting better shelf life compared to control. Value-added products like sofa set and utility boxes have been made out of treated wood.

Small handicraft items like pen/pencil stand have been made from treated and seasoned wood of *Acacia tortilis*, *Prosopis cineraria* and *P. juliflora* for display in fairs/ exhibitions to popularise the utilisation of lesser-known species with value addition.

Furniture from treated wood

Furniture were made from preservative treated (CCA and Chloropyriphos) under pressure treatment plant and seasoned wood of all the three plantation of lesser known timber species viz. *A. tortilis*, *P. juliflora* and *P. cineraria*.

Project 19: Survey of sandal population in Rajasthan and Gujarat states and evaluation of heartwood content and oil content [AFRI-44/NWFP-6/ 2003-2007]

Status: The oil content in sandal wood trees of Rajasthan varied from 0.9 to 3.0 %. The heartwood content was found better in naturally grown trees than trees grown on agricultural/ farmlands.

Project 20: Transfer of technology on forestry through training and demonstration [AFRI-38/SF-1/2002-2006]

Status: An Extension and Interpretation Centre has been established which was inaugurated by the DG, ICFRE on 04.07.2004 during his visit to the institute.

Project 21: Identification of key indicators and suitable strategies for sustainable Joint Forest Management in Gujarat and Rajasthan [AFRI-39/JFM-1/2002-2006]

Status: Survey works on collection of information pertaining to socio-economic status and present status of Joint Forest Management committee is in progress. So far, 125 JFM village committees (85 Rajasthan and 40 Gujarat) have been covered and the sampling survey have been completed. The committee members and villagers were interviewed and information regarding JFM Committees was collected.

Project 22: Development of suitable multi-tier farm-forestry models in IGNP command area [AFRI-39/JFM-1/2002-2006]

Status: Site at 155 RD Charanwala branch in IGNP area has been finalized. Seedling of silviculturally important species were raised at AFRI Model Nursery. Further actions will be taken after chalking out the details with Rajasthan Forest Department.

Project 23: Standardization of nursery practices in respect of selected species suitable for arid and semi-arid region [AFRI-33/ Silvi-5/DRDA/2002-2006]

Status: Planting stock required by various research divisions for undertaking different experimental trials during the year have been raised and supplied.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

(Externally Aided)

Nil.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Development of silvipasture model for *Maru Gaucher Project* suitable for arid and semi-arid region of Rajasthan [AFRI-45/ Silvi-9/MGP/ 2003-2006]

Status: Technical guidance to two gram panchayats for execution of silvi-pasture rehabilitation of oran/gauchar being undertaken by them under the centrally sponsored 'Maru Gauchar Yojna' on an area of 16 ha. at each of the two villages was provided.

Project 2: Development of suitable models for urban aesthetic forestry suitable for arid and semi-arid region of Rajasthan [AFRI-28/Silvi-4/UIT/ 2001-2006]

Status: Experimental avenue plantation raised during the year 2001-02, 2002-03 and 2003-04 have been maintained during the year.

Project 3: Raising of arboretum cum botanical garden for native flora of Rajasthan [AFRI-34/Silvi-6/2002-2006]

Status: Plants belonging to 82 native tree species of Rajasthan have been maintained and an improved shade house with underground water tank was constructed.

Project 4: Survey and silvicultural management practices for commercially exploitable medicinal plants of arid and semi-arid areas of Rajasthan [AFRI-35/Silvi 8/MPB/ 2002-2005]

Status: Over 210 species of medicinal plants are being traded in 18 districts of Rajasthan. *Emblica officinalis* has maximum demand followed by *Cassia angustifolia*. Total quantity of medicinal plants traded in Rajasthan is more than 7,30, 000 kg. Jaipur tops among the surveyed districts with 40% trading of medicinal plants followed by Jodhpur (22%), Ajmer (16%), Udaipur (10%) and Chittorgarh (4%). Other districts amount 8% of trade. Germplasm bank has been established with 150 medicinal plants. Field trials/cultivation trials on *Commiphora wightii* (Guggal), *Aloe vera* (Guarpatha), *Catharanthus roseus* (Sada Bahar), *Withania somnifera* (Aswagandha), *Ocimum sanctum* (Tulsi) and *Asparagus racemosus* (Shatavari) are in progress.

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Ecological and environmental assessment in the on-shore area of RJ-ON-90/2 block, Rajasthan

Status: Literature on floral diversity, faunal diversity, nesting place and migration paths of wildlife were collected from various sources. Field visits were carried out and interactions were made with the villagers and staff of forest department. Based on the literature survey and people interactions, a preliminary report was prepared.

Project 2: Study of characteristic features pertaining to bio-drainage potential of some selected tree species

Status: The project has been initiated at three sites.

Project 3: Capacity building and eco-sensitization of farmers and rural poor for development and sustainable management of life supporting systems

Status: The training programme for the Panchyat Raj Institutions (PRI) functionaries i.e Village Sarpanch, Up-Sarpanch, Panch, BDO's, Gram Sevaks, Gram Sabha members and farmers etc. of the 10 Desert districts, in two phases has been prepared. The project period is over two years.

RESEARCH ACHIEVEMENTS

Name of State	No. of Projects completed in 2004-2005	No. of on-going Projects in 2004-2005	No. of Projects initiated in 2004-2005
Rajasthan	2*	24	3
Gujarat	-	3	-
Common to both Rajasthan and Gujarat	-	6	-

* Project concluded during 2003-2004 but report submitted by PI during 2004-2005.

TECHNOLOGY ASSESSED AND TRANSFERRED

1. Preparation of AFRI paste and its application to the affected Khejri trees has been demonstrated through training programmes of the farmers and through imparting training to the agricultural officers.
2. Indigenous and exotic species, *Atriplex lentiformis* and *Acacia amliceps* were screened for afforestation technology on salt affected lands. Seeds of the species and afforestation technology were supplied to State Forest Department of Gujarat and Rajasthan.
3. VAM production facility was developed at TRC, Gandhinagar, State Forest Department, Gujarat. Demonstration for preparation of VAM inoculum containing five different combinations of species of VAM fungi, viz. *Glomus fasciculatum*, *G. microcarpum* and *G. aggregatum* including consortium inoculum was given to the field officers.

EDUCATION AND TRAINING

Attended

International

1. Dr. Tarun Kant has been awarded one year Post Doctoral Fellowship from 16th August, 2004 to 15th August, 2005 under Biotechnology Overseas associateship 2003-2004, Govt. of India, Dept. of Biotechnology at the Department of Plant Sciences, University of Cambridge, U.K.
2. Shri N. Ravi, R.O. attended Third Country Training Programme on genetic conservation of indigenous species for

breeding purposes at Yogyakarta, Indonesia from 6th to 19th March, 2005.

Organised

1. Organized 10 nos. of 3 days training programme on Capacity building and eco-sensitization of farmers and rural poor for development and sustainable management of life supporting systems from 23rd August, to 6th October, 2004 for the PRI functionaries i.e Village Sarpanch, Up-Sarpanch, Panch, BDO's, Gram Sevaks, Gram Sabha members and farmers etc. of the 10 Desert districts in Phase-I at AFRI in 10 batches of 40 each of PRI functionaries and forest field staff in 4:1 ratio. In total 437 participants comprising of 269 PI Functionaries, 1 BDO, 89 Gram Sevak and 79 Forest officials including 8 womens attended the training programme.
2. As a multidisciplinary approach of watershed management, inputs on nursery and plantation techniques, biofertilzers, agroforestry models, moisture and soil conservation techniques, horticulture, on animal husbandry, pasture management were given by the resource persons from both within the institute and outside.
3. Three students each from three Universities imparted one month training in tissue culture and biotechnology.

LINKAGES AND COLLABORATION

National

1. National Bureau of Plant Genetic Resources, New Delhi
2. Tata Energy Research Institute, New Delhi
3. Central Arid Zone Research Institute, Jodhpur
4. National Botanical Research Institute, Lucknow
5. Rajasthan Forest Department
6. Gujarat Forest Department
7. Ayurvedic units

International

1. Asia Pacific Association of Forestry Research Institutions (APAFRI), Malaysia.
2. Centre for International Forestry Research (CIFOR), Indonesia.
3. International Union of Forest Research Organizations (IUFRO).
4. The Guangdong Forest Research Institute, Longdong, Guangzhdou, P.R. China.

PUBLICATIONS

Chapters in books

1. Srivastava, K.K. and Tripathi, Y.C. (2004). Potential of phytochemical in controlling pathogenic mycobionts. In: D. Reddy, B.P. Dabral, Vinai Singh and K.K. Sood (eds.). *Forest conservation and Management in challenges of the millennium*. pp. 594-612.
2. Srivastava, K.K.; Ahmed, S.I. and Thangamani, D. (2004). Biostresses on arid and semi-arid tree plantations and their possible management strategies. In the Dr. K. Bagchee Memorial Book on Forest Pathology to be published by Forest Pathology Division, FRI, Dehradun.
3. Tomar, U.K.; Sharma, N.K.; Parveen and Emmanuel, C.J.S.K. (2003). Literature review on clonal propagation of important arid zone species. In: B.B.S. Kapoor (ed) *Advances in Resource Management,* Madhu Publication, Bikaner, pp. 70-98.

Research Papers in Scientific Journals

International

1. Chaudhuri, K.K.; Singh, G. and Bala, N. (2004). Traditional knowledge and technological innovations for productivity enhancement of degraded land of arid region. *Journal of Arid Land Studies*, 14(S): 221-224.

2. Meena, R.L. and Singh, G. (2004). Integrated Ecosystem Approach for Management of Degraded arid and semi-arid areas of north-western India. *Journal of Arid Land Studies,* 14(S): 211-214.

3. Singh, G. (2004). Growth, biomass production and soil water dynamics in relation to habitat and surface vegetation in hot arid region of Indian desert. *Arid Land Research and Management,* 17(2): 1-17.

4. Singh, G. (2004). Influence of soil moisture and nutrient gradient on growth and biomass production of *Calligonum polygonoides* in Indian desert affected by surface vegetation. *J. Arid Environment*, 56(3): 541-558.

5. Singh, G.; Bala, N.; Mutha, Sarita; Rathod, T.R. and Limba, N.K. (2004). Biomass production of *Tecomella undulata* agroforestry in arid India. *Biological Agriculture & Horticulture,* 22(2): 205-216.

6. Singh, G.; Mutha, Sarita; Bala, N.; Rathod, T.R.; Bohra, N.K. and Kacchawaha, G.R. (2005). Growth and productivity of *Tecomella undulata* based on an agroforestry system in Indian desert. *Forests, Trees and Livelihood,* 15(1):89-102.

7. Tewari, V.P. (2004). Desertification and its control through afforestation activities to increase productivity. *Journal of Arid Land Studies,* 14 (S): 57-60.

8. Tewari, V.P. (2004). Stem number development and potential stand density in the unthinned even aged *Azadirachta indica* plantations in the Gujarat State of India *International Forestry Review,* 6(1): 51-55.

9. Thangamani, D.; Ghosh, M.; Thapliyal, M.; Yasodha, R. and Gurumurthi, K. (2004). Purification of antifungal protein against blishter bark pathogen of *Casuarina equisetifolia*. *Acta Botanioca Croatica,* 63(2): 75-82.

10. Thangamani, D.; Ghosh, M.; Thapliyal, M.; Yasodha, R.; Gurumurthi, K. (2004.) Isolation of *Andrographis paniculata* leaf protein with antifungal property. *Acta phyto pathologica et Entomologica Hungarica,* 39(4): 377-381.

11. Tewari, V.P. and Arya, Ranjana (2005). Degradation of arid rangelands in Thar Desert, India: A review, *Arid Land Research and Management,* 19(1): 1-12.

National

1. Ahmed, S.I. and Kumar, Shivesh (2004). Seasonal fluctuations in the population of *Eurytoma settitibia* Gahan (Eurytomotidae: Hymenoptera), a potential stem gall chalcid of Khejri (*Prosopis cineraria* Linn) in Rajasthan. *Indian Forester,* 130 (8): 885-892.

2. Bala, N.; Kumar, Pramod; Kurdaram and Singh, G. (2004). Reclamation of saline waterlogged area through community participation. *Wasteland News*, XIX (4): 33-36.

3. Kant, Tarun and Emmanuel, C.J.S.K. (2004) Tree Biotechnology and Environmental Concerns, *J. Plant Biotechnology,* 6(1): 1-7.

4. Kumar, Pramod; Bala, N.; Singh, G.; Mutha, S.; Limba, N.K. and Bohra, N.K. (2004). Socio-economic conditions with special reference to common access resources: A case study from Gujarat and Rajasthan. *Indian Forester,* 130(9): 981-990.

5. Rathore, Mala and Meena, Rajendra (2004). Nutritional evaluation of famine foods of Rajasthan, *Indian Forester,* 130(3): 304-312.

6. Sharma, Meeta and Ahmed, S.I. (2004). *Beauveria bassiana*. Vuillemin, a potential entomogenous fungal pathogen isolated from marwar Teak defoliator, *Patialus tecomella*. Pajni, Kumar and Rose (Coleoptera: Curculionidae). *Indian Forester,* 130(9): 1060-1064.

7. Singh, G.; Rathod, T.R. and Chouhan, Sahadeo (2004). Growth, biomass production and the associated changes in soil properties in *Acacia tortilis* plantation in relation to stand density in Indian arid zone. *Indian Forester,* 130: 605-614.

Scientific Reports

1. Concluding report on Agroforestry project entitled "Agroforestry research for sustainable production in arid and semi-arid regions of Rajasthan."

2. S.I. Ahmed and K.K. Srivastava (2003). A report on the scientific approach to study the causes of mortality of *Prosopis cineraria* (L.) Druce (Khejri) in Western Rajasthan, MoEF, Govt. of India.

3. G. Singh (2004). A report on floral and faunal diversity for the parts of Jalore and Barmer district under the project 'Ecological and environmental assessment in the Onshore area of RJ-ON-90/2 block.

Proceeding

Proceeding of International Conference on "Multipurpose Tree in the Tropic : Assessment, Growth and Management" Abstract of paper from 22nd to 25th November, 2004 at Arid Forest Research Institute, Jodhpur, Rajasthan.

Scientific Brochures

Azadirachta indica A. Juss. APFORGEN Priority Information Sheet by V.P. Tewari and D.K. Mishra. Published by the APFORGEN Secretariat, Forest Research Institute, Malaysia (FRIM), Kepong, 52109, Kuala Lumpur, Malaysia.

CONSULTANCY

Ministry of Rural Development, Department of Land Resources, Government of India and Department of Rural Development, Land development cell, Government of Rajasthan assigned the evaluation work of Ecological and environmental assessment in the Onshore area of RJ-ON-90/2 block, Rajasthan.

CONFERENCE/MEETINGS/ WORKSHOPS/SEMINARS/ SYMPOSIA/EXHIBITIONS

Organised

1. IUFRO International Conference on "Multipurpose Trees in the Tropics: Assessment, Growth and Management" from 22nd to 25th November, 2004 was organized. 32 foreign and 170 Indian delegates participated in the conference. The conference was inaugurated by the Hon'ble Minister of State for Environment & Forests, Govt. of India, Shri Namo Narain Meena and the function was presided over by Dr. Sim Heok-Choh, Executive Director,

APAFRI. Prof. Christoph Kleinn, IUFRO representative, delivered the keynote address. Shri R.P.S. Katwal, DG, ICFRE delivered the welcome address.

Inauguration of International Conference on Multipurpose Trees in the Tropic at AFRI, Jodhpur

IUFRO International Conference on MPTS

2. An interactive meeting was organized at Arid Forest Research Institute, on 20th August, 2004 to establish liaison with various end users and possible collaborators for smooth implementation of the research project. Eighteen (18) delegates representing different departments, NGOs and farmers and 25 Scientists/Officers from the institute participated and discussed on the abovementioned points in the meeting.

3. Research Advisory Group (RAG) meeting was organized from 15th and 16th February, 2005. The twenty eight on-going research projects were presented before the RAG members for necessary recommendations and five new projects were presented for their prioritization.

Participation

1. Dr. R.L. Srivastava, IFS, Director has participated and chaired a session in National symposium on "*Conversing Space Technologies for National Development*" at Jaipur from 3rd to 5th November, 2004.

2. Dr. R.L. Srivastava, IFS, Director has participated and chaired one session in National seminar on *"Recent advances in analytical chemistry"* at JNV, Jodhpur from 29th November to 1st December, 2004.

3. Shri R.L. Meena, IFS, GC(R) has attended Regional Workshop on "*Emerging trends and issues in forestry*" at Gandhinagar, Gujarat from 4th and 5th November, 2004 and made presentation on *"Thar Biodiversity: its traditional and technological conservations efforts"*.

4. Dr. G. Singh attended 'National Seminar on Recent Advances in analytical Chemistry' held at Jai Narain Vyas University, Jodhpur from 29th November to 1st December, 2004

and presented paper on "*Changes in soil properties as a result of irrigation with effluent of varying chemistry and impact on tree seedlings*".

5. Dr. R.L. Srivastava, IFS, Director AFRI and Shri R.L. Meena, IFS, CF attended workshop on "Rehabilitation of mined land: Protection of environment and helping livelihood" organized at Hotel Taj Hari from 18th and 19th June, 2004.

6. Dr. R.L. Srivastava, Director participated in 'Paryavaran Padyatra 2004' from Parsusram Mahadev to Rajpura nursery (Pali) organized by Rajasthan Forest Department.

7. Shri R.L. Meena, CF and Shri Arvind Apte, DCF attended '*Khejdli Shahid Mela*' at Khejarli and joined 'Paryavaran Padyatra 2004' organized by Rajasthan Forest Department from Jaswantpura to Sundhamata (Jalore).

8. Dr. R.L. Srivastava, Director, Shri K.K. Chaudhuri and Dr. D.K. Mishra, participated in the Brain Storming session on "Herbs for the health of armed forces in desert area" at Defence Lab., Jodhpur on 13th August, 2004.

9. Dr. R.L. Srivastava, IFS, Director, attended chaired the technical session during the workshop on "Integrative Approaches for Assessing Extent and Cause of Degradation in Arid Community Rangelands" organized at CAZRI on 26th May, 2004.

10. Dr. R.L. Srivastava, IFS, Director, attended National workshop on "Famine and water conservation-myths and realties" from 8th to 10th June, 2004.

11. Dr. R.L. Srivastava, IFS, Director, attended "2nd Global summit on medicinal plants" from 25th to 29th October, 2004 at New Delhi.

12. Dr. G. Singh, Scientist-E attended one day workshop on "Persistent organic pollutants at Vadodara" (Gujarat) on 19th May, 2004.

13. Smt. Sangeeta Tripathi, RA-I and Shri R.K. Gupta, RA I attended workshop on Training module of Integrated Watershed management Programme at IGPR&GVS, Jaipur from 15th to 17th April, 2004.

Extension Publications

1. "AFRI Darpan"- Quarterly Newsletter for the period from April to June' 2004. Also updated the AFRI Brochure which constituted a part of reading materials for the delegates of International Conference on Multi Purpose Tree species-Assessment, Growth and Management held at AFRI from 22nd to 25th November, 2004.

2. Updated the AFRI Brochure in Hindi, depicting the research findings and technology developed by the institute.

3. Study Material for the training programme - Shri Balbir Singh, Head, AF&E Div., Smt. Sangeeta Tripathi and Shri R.K. Gupta.

4. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). *Cassia angustifolia* Vahl.: A green gold for arid areas. Extension brochure.

5. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). *Chlorophytum borivilianum* S. and Fernandes.: Tuberous power for healthy life. Extension brochure.

6. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). *Emblica officinalis* Gartn.: The store house of vitamin C. Extension brochure.

7. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). *Commiphora wightii* Arn.: A shining tree of golden gum. Extension brochure.

8. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Ashwagandha, *Withania somnifera* Linn (Dunal): Winter Cherry.

9. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Giloe, *Tinospora cordifolia* (Wild). Miers: The Climber of Longevity.

10. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Sarpgandha, *Rauwolfia serpentina* Benth. Ex. Kurz: Bitter root to better high blood pressure.

11. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Isabgol, *Plantago ovata* (Forsk). Natural defence to digestive disorders.

12. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Bhui Amla, *Phyllanthus amarus* Schum & Thonn: The wonder herb.

13. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Tulsi, *Ocimum santum* Linn: The sacred plant.

14. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Ratanjot, *Jatropha curcas* L: The bio-diesel plant.

15. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Mulhatti, *Glycyrrhiza glabra* Linn: Sweet Root sweeter than sugar.

16. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Shatavari, *Asparagus racemosus* Willd.

17. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Kalmegh, *Andrographis paniculata* (Wall) Ness. The King of bitters.

18. K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2004). Guar Patha, *Aloe vera* (Linn.) Burm.f. Lily of the Desert.

AWARDS

1. Dr. G. Singh, Scientist-E and Shri N. Bala, Scientist-C were awarded S.K. Seth Prize for best paper in Environment and Ecology in *Indian Forester,* 2002.

2. Dr. G. Singh, Scientist-E was conferred ICFRE AWARD for excellence in Forestry Research for the year 2003-2004.

DISTINGUISHED VISITORS

1. Shri Namo Narayan Meena, MOS (E&F), Govt. of India on 23rd November, 2004.

2. Dr. Sim Heok-Choh, Executive Director, APAFRI, Malaysia; Dr. Markku Kanninen, Director, Environmental Services and Sustainable Use of Forests Program, CIFOR and 30 other foreign scientists from 22nd to 25th November, 2004.

CHAPTER VII

HIMALAYAN FOREST RESEARCH INSTITUTE SHIMLA

Himalayan Forest Research Institute (HFRI), Shimla, Himachal Pradesh was established as Conifer Research Centre during May, 1977 for carrying out Research on problems associated with natural regeneration of Silver fir and Spruce. The Centre developed the technology for the same and transferred it to the State Forest Departments. During reorganization of forestry research and coming up of Indian Council of Forestry Research and Education (ICFRE), Dehradun in 1987, the mandate of this Centre was enhanced from Regeneration of Silver fir and Spruce to Eco-Rehabilitation of Cold Deserts, Mined Areas Rehabilitation besides studies on Regeneration of Coniferous and Broadleaved Forests with the responsibility of addressing the problems of Forestry Research in the Western Himalayan States of Himachal Pradesh and Jammu and Kashmir. This Centre was re-designated as Himalayan Forest Research Institute, Shimla in 1998.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

Project 1: Comparative studies on the ecology of degraded forests vis-a-vis relatively undisturbed forests in different eco-climatic zones of the region [HFRI-010/ 01(EBC-04)/ PLAN/2000-2005]

Findings: A degraded site was selected in Mandhala Forests of Kuthar Forest Range falling under Kunihar Forest Division, Himachal Pradesh and initial ecological survey of the area was conducted. Dominant species of the site identified and diversity index also recorded. Survey to assess the fuelwood need and fodder requirement of the villagers living around the degraded area was also carried out in the beginning following PRA techniques.

After analyzing the initial information, demonstration plantations of *Grewia optiva, Bauhinia variegata, Acacia catechu, Leucaena leucocephala, Dalbergia sissoo* and *Terminalia tomentosa* were established in the degraded sites.

Degraded Site

Floristic surveys both in and outside the plantation areas were carried out after three years of establishment of plantations so as to assess the changes in plant species diversity. Number of plant species as recorded in the plantation and outside the plantation area was 70/ m^2 and 38/ m^2, respectively. On the basis of Importance Value Index (IVI), *Andropogon* sp. was found to be the dominant species both in plantation and out side the plantation area. Distribution of most of plant species was contiguous in both the areas. Index of dominance

for plants was lower (0.048) in the plantations while compared to the area outside the plantations (0.092). Index of diversity for plants was higher (5.237) in plantation in comparison to the area falling outside it (4.249).

Soil pH as recorded for the plantation area was 6.32 with electrical conductivity of 0.173 ms. Organic carbon of the planted area was 0.89 per cent, whereas available forms of nitrogen, phosphorus and potassium were 324.80 Kg/ ha, 26.11 Kg/ ha and 164.25 Kg/ ha, respectively. The soil of area falling outside the plantation was slightly alkaline with pH 7.46 and with electrical conductivity of 0.150 ms. Organic carbon in this site, however, was 0.47 per cent with 23.35 Kg/ ha of available phosphorus and 132.45 Kg/ ha of available potassium. The finding clearly shows that over a period of time the sites/ soils regain better fertility status in the planted areas compared to the soils which are allowed to degrade further without taking up any ameliorative activities.

Project 2: Assessment of conservation status of hill Bamboos (Nirgals), collection of germplasm from various eco-climatic zones in Sutlej catchment area and establishment of germplasm bank [HFRI-011/02(EBC-05)/ PLAN/2000-2005]

Findings: Survey of hill Bamboos i.e. *Arundinaria falcata* (*Sinarundinaria falcata*) – growing in the lower altitude and *Arundinaria spathiflora (Thamanoacalamus spathiflorus*) – a species of higher elevations – commonly known as Nirgals, was conducted in Sutlej catchment of district Shimla comprising forest areas of Taklech, Khunni and Khul in the lower zones and forests of Kashapath, Sungri-Bali, Nankhari, Hattu and Chichhar, etc. in the higher zones. It was found that above two species showed peculiar distribution in the areas of their natural occurrence and the studies have further confirmed the earlier reports that hill Bamboo group in the state of Himachal Pradesh is represented by wild populations of the above two species only. It has also been found that this little studied group of plants is very significant from ecological point of view in addition to being of great local socio-economic values. Both the species flowered during the period under study and it was observed that the flowering of *A. falcata* varied from gregarious in some patches to few flowering in others, however, it was a case of complete mass flowering for *T. spathiflorus*.

Density of hill Bamboos per ha has been found to be dependent upon various factors affecting their distribution, the most prominent factor being the canopy cover and the optimum altitudinal range. As regards population structure, a ratio of 63: 37 between live and dead culms with 18 per cent of total culms being formed by current year culms has been observed in case of *A. falcata* whereas this ratio was 58: 42 between dead and live culms.

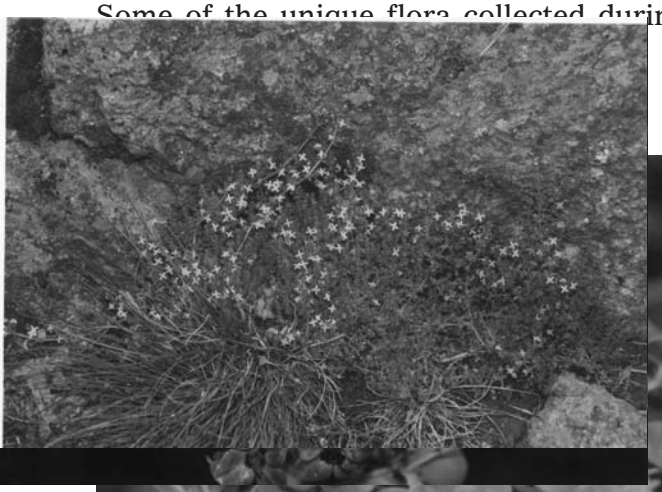
It was seen that the hill Bamboos play a significant role in the day-to-day life of local people. Basketry based on these species alone generates a wage equivalent of nearly Rupees One crore in the study area. Unrestricted access to right holders, high harvesting levels, inadequate research base and management prescriptions, changing land use and development pressures have, however, put this resource under great stress.

Project 3: Comparative studies on the floristic composition of two diversely located alpine pastures [HFRI-023/ 03(EBC-09)/ PLAN/2003-2005]

Findings: Field surveys conducted in the alpine and sub-alpine areas in Churdhar Wildlife Sanctuary, lead to the formation of different forest types viz., anthropogenic grasslands (2,150–2,450 m); Khasru oak – Rhododendron forests (2,400-2,700

m); conifer dominated forests (2,700–3,000 m); sub-alpine forests (3,100–3,250 m) and alpine pastures (3,200–3,450 m).

Interesting species of the area as recorded during the surveys included, *Thalictrum alpinum*, *Rohododendron arboreum*, *R. campanulatum*, *R. anthopogon*, *R. lapidoptum*, *Rheum webbianum*, *Viola biflora*, *Salix calycantha*, *Fritillaria royleii*, *Ranunculus* spp., *Potentela* spp., *Anemone obtusifolia*, *Allium humile*, *Swertia petiolata* and *Geum elatum*, etc. which were recorded from different altitudinal zonations. Besides this, interesting species like, *Ponerochis chusua*, *Goodayrea* sp., *Allium humile* and *Primula rheedii* were also collected from the site. The presence of all the four *Rhododendron* spp. in the sanctuary area and association of *Rhododendron arboreum* with *Quercus semecarpifolia* is quite unique to the sanctuary. Some of the unique flora collected during the



Euphorbia stracheyii

Primula redii

Euphorbia pilosa

Galium aculium

Project 4: Standardization of methodology for collection of seed, its handling, storage, testing and certification of seeds of important tree species [HFRI-012/05(SFG-04)/PLAN/2000-2005]

Findings: Storage trials using different types of containers/ storage environment were conducted with the seeds of *Cedrus deodara*. Results showed the declining trends in its seed germination with the passage of time including the environment used during storage. It was found that the seeds stored in refrigerator (<4.0° C) retained almost 50% viability after one year of its storage, which further reduced to 44 per cent after 18 months when stored in refrigerator under the same temperature. Storage of seeds in other types of containers, which were used as storage environments showed total loss of viability over a period of time.

Seeds of *Picea smithiana* retained more than 55 per cent viability even after one and a half years whereas in case of *Abies pindrow* around 70 per cent viability was lost over a period of one and a half years when stored under different storage environment/ containers.

Storage trials when conducted on different seed source of *Jatropa curcas* revealed that the seeds collected from Bilaspur source retained more than 64 per cent germination even after 6 months when stored at room temperature.

Studies on the optimum time of seed collection in *Prunus cornuta*, *Aesculus indica* and *Quercus dilatata* were carried out with respect to germination and subsequent growth performance of the seedlings raised in the nursery. It was found that in *Prunus cornuta,* optimum time of collection of seeds under temperate conditions of Shillaru - Narkanda region was third week of September with maximum 27.33 per cent germination in nursery whereas seeds collected during fourth week of September gave only 4.00 per cent germination. No germination was recorded in the seeds of *Prunus cornuta* collected during the first week of August. In *Aesculus indica*, optimum time of collection of seeds under temperate conditions of the above region was found to be third week of October with maximum 46.00 per cent germination in the nursery conditions. Similarly, on the basis of seed germination and growth performance of Mohru oak (*Quercus dilatata*) seedlings raised from the seeds collected in the first week of August, showed better growth when compared to other collection dates.

Project 5: Developing efficient methods for preparation of compost from different locally available raw materials in different eco-climatic zones [HFRI-015/ 05(SFG-05)/PLAN/ 2000-2005]

Findings: Trials to assess the time for preparation of compost from locally available organic raw material was undertaken in temperate regions. It took around 4 months for production of compost from grasses, nursery weeds and leaves of broadleaved species like, Poplar, Salix and Alnus, etc. through aerobic composting technique as tried during March to December at Shillaru - Narkanda region (2500 m msl) of district Shimla. Aerobic composting of Kail and Deodar needles in the region, however, took 5-6 months (May – December) when around 20-25 per cent fresh cow dung fully soaked in urine was added to the total volume of material being used for composting.

In sub-tropical/lower regions of Himachal Pradesh time period of 50-60 days only was enough for production of compost through aerobic composting from nursery weeds, grasses

and leaves of shrubs and trees of broadleaved species with the addition of 15-20 per cent fresh cowdung.

Project 6: Studies to evaluate impact of ban on green felling on regeneration of conifer species (Deodar) [HFRI-20/05 (SFG-07) PLAN/2002-2005]

Findings: Stand evaluation was carried out at Cheyog forest, Chopal (Chopal forest), Kullu (Manali and Nagar forests), Chamba (Khani and Kalhail forests) and Dalhousie (Kalatop forests) covering 16 sites and data collected.

On the basis of the population curves, study sites/stands were classified into following three groups:

Stands with good regeneration: This condition was witnessed in stands where the canopy was sufficiently wide-open allowing sunlight to reach the ground surface. Such stands have shown profuse regeneration. The regeneration in Bajraundi was so profuse that it was difficult to pass through that area.

Stands with moderate regeneration: The regeneration of Deodar is fair in stands where gaps were created due to salvage removal. Such sites were observed in Chamba, Chopal and Nagarjhir of Kullu.

Stands with poor regeneration: High density leading to canopy closure lead to poor regeneration as observed in RF Khanni forest of Chamba, Kalatop and Phetaban of Kullu.

Project 7: Planting stock improvement: improved technology for mass production of quality planting stock of *Dalbergia sissoo* [HFRI-21/05(SFG-08)/ PLAN/2002-2005]

Findings: Trials to understand the effect of age of hedging on rooting, type of shoot on rooting and level of hedging on rooting and their subsequent growth pattern were conducted with 100 clones in Vegetative Multiplication Garden (VMG) at Birplasi, Nalagarh. Apart from the above trials, supplementary studies to understand the effect of leaf area on rooting, effect of cutting length and diameter on rooting and effect of cutting angle on rooting and subsequent growth were also performed.

Results of the study revealed that the rejuvenation in Shisham is possible through planting of root pieces and maintaining them as hedges. Juvenile root suckers/ shoots extracted from them can be exploited for further multiplication. The best months for hedging are January-February whereas the best season for planting juvenile cuttings is April-May. The best time of shoot collection is morning hours when the cuttings are fully saturated.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

Project 1: Introduction and performance trial of *Paulownia* spp. for agroforestry in different agro-climatic zones of Himachal Pradesh [HFRI-026/08 (AGF-02)PLAN/2003-2008]

Status: Relevant growth data of the trials as laid out earlier to assess the performance of different species of Paulownia both in the field and in nursery conditions were recorded. Field introduction/ demonstration trials at village Johron in Poanta Sahib and at Dharja in district Solan, representing low and mid hill zones were maintained. Besides this, nursery trials at Model Nursery, Baragaon, Shimla and Johron nursery, Paonta Sahib were also conducted. Five thousand seedlings of *Paulownia* spp. were raised in polybags and root trainers. Vegetative multiplication of *Paulownia* spp. was also carried in the nursery beds. To study the performance

and suitability of different *Paulownia* spp. in the high hill zone, one field trial was established over an area of one hectare in the foothills of Dhauladhar ranges at Khaniyara (Dharamsala) of district Kangra.

Paulownia sp. in the nursery

Project 2: Diagnostic survey and appraisal of existing agroforestry systems in mid and high hills of Himachal Pradesh [HFRI-028/08 (AGE-03) PLAN/ 2003-2008]

Status: Surveys were carried out in the mid and high hill zones of Kullu district to select additional sites for undertaking agroforestry diagnostic survey and accordingly two villages each in the mid and high hill zones of Kullu district were selected through two stage random sampling. The existing agroforestry systems and practices prevalent in the region were studied.

During the preliminary agroforestry survey in high hill zone, scattered tree species of *Quercus dilatata* (Mohru), *Ulmus laevigata, Grewia optiva, Morus alba, Robinia pseudoacacia, Alnus nitida, Aesculus indica, Ficus palmata, Prunus armerinica, Pistacia integerrima, Populus ciliata, P. nigra, Pyrus pashia* and *Salix* spp., etc. were recorded.

In mid hill zone, *Grewia optiva, Alnus nidita, Quercus leucotrichophora, Q. dilata, Morus alba* and *Robinia pseudoacacia* were found in the field boundaries of the agricultural and horticultural plantations. Data collected are being analysed.

Project 3: Development of suitable models for afforestation of mined areas [HFRI-018/ 01(EBC-07)/PLAN/2002-2006]

Status: Nursery experiments conducted to assess the effect of different combinations of lime mine spoil and forest soils on the performance of five tree species viz. *Bauhinia variegata, Robinia pseudoacacia, Eucalyptus* hybrid, *Grewia optiva* and *Toona ciliata* revealed that the combination of lime mine spoil: forest soil in the ratio of 1:5 or 1:2 (v/ v) was found to be the most effective combination for the survival, growth and biomass parameters of the five tree species. As far as species performance in the nursery conditions was concerned, *Eucalyptus* hybrid showed maximum value for height, collar diameter, shoot, root dry weight and total biomass whereas, survival was recorded maximum in *Grewia optiva*. Performance of *Eucalyptus* hybrid was followed by *Bauhinia variegata,* whereas least values of growth and biomass parameters were recorded in *Toona ciliata*. Another nursery trial with different combinations of lime mine spoil, forest soil, farmyard manure, sand and compost showed that the combination of lime mine spoil: forest soil: farmyard manure in the ratio of 1:2:1 was the most effective combination for the growth and biomass production of the species like *Leucaena leucocephala, Eucalyptus* hybrid, *Bauhinia variegata* and *Acacia catechu*.

Survival percentage of the tree species planted out during 2003 was recorded, and found to be 84.04%, 60%, 53.33% and 85.7% for *Grewia optiva, Bauhinia variegata, Robinia pseudoacacia* and *Leucaena leucocephala*, respectively. Survival per cent of the plantation raised during the year 2004 was recorded maximum (78.66%) in *Alnus nitida* and minimum (46%) in *Grewia optiva*.

Project 4: Standardization of nursery techniques of five dominant indigenous species (*Capparis spinosa, Collutea* spp., *Caragana* spp., *Ribes* spp. and *Cratagus* spp.) besides *Elaegnus angustifolia* and *Rosa webbiana* of cold deserts [HFRI-019/03(EBC-08)/PLAN/2002-2007]

Status: To initiate trials on the standardization of nursery techniques, basic ecological details and relevant literature were scanned and nursery experiments were designed for initiating various experiments in the nursery and in field conditions.

Number of trials were laid out in the nursery to understand the effect of IBA on rooting in shoot cuttings of *Ribes* sp., *Collutea* sp., *Elaeganus angustifolia* and *Hippophae rhamnoides* and in root suckers of *Rosa webbiana* and *Capparis spinosa*. Effects of different pre-sowing treatments (hot-water and Gibbrellic ... seeds ... *ophae* ... *Rosa* ... taking ... se five ... Mane, ... amdoh ... esh.

Rosa webbiana

Capparis spinosa

Collutea

Biomass studies on the species viz., Collutea, Cratagus and Ribes were also conducted. Maximum above ground (2.45 kg/ m^2) and below ground (1.27 kg/ m^2) biomass was recorded in *Cratagus* sp. followed by *Collutea* sp. having above ground and below ground biomass of 2.16 kg/ m^2 and 1.27 kg/ m^2, respectively.

In *Ribes* sp., quite low rooting (20%) in the shoot cuttings was observed, whereas in *Elaeganus angustifolia,* as high as 85 per cent rooting was recorded. The shoot cuttings of

Hippophae rhamnoides showed rooting up to 75 per cent in poly-house condition whereas only 40% rooting was recorded outside the poly-house. Root suckers of *Rosa webbiana*, showed 80 per cent sprouting in the open condition whereas in case of *Capparis spinosa* 60 per cent sprouting in the root suckers was recorded.

Ecological studies related to biomass and distribution of *Capparis spinosa* and *Ribes alpestre* in Spiti Valley were undertaken and biomass as high as 400 g and 940 g for above ground component was recorded, respectively. In case of below ground parts, the biomass as high as 1750 g and 1200 g was recorded for these two species, respectively thereby showing the capacity of roots to store water and nutrients to tide over the adverse conditions in the cold deserts. The longest root as dug out for *Ribes alpestre* was 210 cm whereas in case of *Capparis spinosa*, the root measured 290 cm.

Roots of *Capparis spinosa*

Project 5: Studies on plant diversity of Renuka and Simbalwara Wildlife Sanctuaries of Himachal Pradesh [HFRI-024/ 02(EBC-10)/ PLAN/ 2003-2006]

Status: Plant diversity studies were conducted to assess the diversity of trees, shrubs and herbs by laying out quadrats of different sizes in Renuka and Simbalwara Wildlife Sanctuaries of Himachal Pradesh, which are located at altitude varying from 600 – 850 m above msl and 400 – 650 m above msl, respectively. Approximately 250 plant species from Renuka and 200 plant species from Simbalwara were recorded. Some plant samples for further identification and soil samples for assessing chemical properties of the soils were collected from these sanctuaries. On the basis of importance value index (IVI), *Xanthium indicum* was the dominant species followed by *Oplimonus* sp., *Neuimbo nucifera* and *Phylla nudiflora*. Distribution of most of the plant species was contiguous. The value of diversity index and dominance index was 5.976 and 0.021, respectively.

An overview of Renuka Wildlife Sanctuary

In Simbalwara Wildlife Sanctuary, a total of 206 species were present in the altitude ranging from 400-525 m msl, whereas 189 species were recorded at elevations varying from 525-650 m msl. *Shorea robusta* was the dominant tree species whereas *Mallotus phillipensis* was the dominant shrub.

Project 6: Development of ecologically viable and socio-economically acceptable integrated model for arresting Willow (*Salix* sp.) mortality in Lahaul Valley of Himachal Pradesh [HFRI-021/03(EBC-09)/PLAN/2003-2008]

Status: Basic causes behind large-scale mortality of Willow were ascertained and accordingly, a detailed report was submitted to the State Forest Department and all other concerned authorities of the state of Himachal Pradesh. Dr. (Ms.) Ketrin Heinsoo from Estonian Agricultural University was contacted for the import of clonal material of Willow from her Institute. Eight different species of Salix were collected from 7 different provenances/ sources including Tabo – the cold deserts – and about 350 cuttings raised and are being maintained in the Model Nursery for establishing demonstration trials. Various provenances of Willow from Jammu & Kashmir were also introduced and multiplied. All the experiments are being maintained.

Willow Mortality in Lahaul Valley

Project 7: Screening and selection of insect pest and disease resistant phenotypes provenances of important tree species [HFRI-13/06(FPT-02)/ PLAN/2000-2006]

Status: Provenances and clones of selected tree species were surveyed for insect pest and disease incidences. Seedlings of Deodar from 19 seed sources as raised at Field Research Station, Shilly, Solan were examined regularly and systematically for Deodar defoliator attack, which revealed that the seeds collected from Sareen, Solan, Kalpa and Himgiri showed more resistance against *Ectropis deodarae* while compared to others.

Six provenances of Chir pine in Himachal Pradesh were screened against stem borer complex. Data collected for 4 provenances was analyzed and it was found that Seer Kunar Khud provenance is comparatively more resistant to insect borer complex in comparison to provenances of Giri Gambhar, Kangra valley and Pabbar-Tons.

Nursery trial to assess seed source variation for resistance towards nursery diseases i.e. damping-off, root rot, etc. in Deodar was initiated for which seeds from six different sources were collected. Seed morphometric traits were observed and sown in nursery beds as well as polybags. Observations on germination, seedling mortality and reasons for mortality are being recorded. A pot culture trial had also been laid to assess the seed source variation for susceptibility to damping-off caused by *Fusarium oxysporum*. Experiment is being repeated and data is to be analysed statistically to arrive at conclusive results.

Project 8: Development of model for integrated pest management with special reference to *Cedrus deodara* [HFRI-017/06(FPT-03)/PLAN/2000-2006]

Status: Bio-ecology of *Ectropis deodarae*, a key insect-pest of *Cedrus deodara* was studied in detail. It was observed that the pest completed one generation in a year with its peak activity during May and June.

The pest was found on four coniferous trees only, among 37 tree species surveyed. Maximum infestation was observed on *Cedrus deodara*. Minor incidence of the pest was observed on *Pinus wallichiana*, *Picea smithiana* and *Abies pindrow*. The highest larval population was recorded on deodar (1.8 ± 1.0 per meter of branch) followed by *Pinus wallichiana* (0.3 ± 0.02), *Picea smithiana* (0.02 ± 0.01) and *Abies pindrow* (0.03 ± 0.01), respectively under field conditions. Under laboratory condition, *Cedrus deodara* was found to be the best host showing maximum larval survival, growth index (84.7%, 2.6) and minimum larval period (32.8 days). On *Pinus wallichiana*, *Picea smithiana* and *Abies pindrow* total larval period ranged from 37.2 – 39.5 days, but larval survival was below 40.0 per cent. In Deodar, 5th instar larvae consumed 185 mg needles in 72 hours.

The larvae were found to cause damage to the needles not only by consuming them but also by making the needle to fall by nibbling and cutting them above middle or at the base. Total needle loss due to cumulative action of various instars rendered the affected trees needleless. Regeneration and younger crop of deodar was found to be most susceptible to the attack of this pest.

Project 9: Natural enemy complex of key and potential pest of five *Quercus* sp. in Himachal Pradesh [HFRI-027/06(FPD-5)/ PLAN/2003-2006]

Status : Natural forests and plantations of Oaks from almost all the altitudinal zones of Himachal Pradesh were surveyed, comprising mainly of Jhungi Forest and Darer Forest (Sudernagar), Sargheen, Shiog, Shogi-Taradevi Forest (Shimla), Taradevi roadside plantation towards Shimla Airport Salni: Koti Forest (Chamba), Kalpa, Brelingi, Song Thong (Kinnaur), Khalti, Korgu (Rampur) and Narkanda, Hattu (Shimla), Karsog (Mandi), Gadachh, Khirki, Jabna (Chopal), Shilly (Solan), Tikkar, Charech, Bhajiana and Charavag (Sirmaur).

All five species of Oaks viz. *Quercus glauca, Q. leucotrichophora, Q. dilatata, Q. semicarpifolia* and *Q. ilex* were screened. The most destructive pests are *Sitophilus glandium* and *Curculio sikkimensis* that attack acorns; *Lymantria obfuscata*, *L. mathura* and *Trabala vishnou*, that defoliate heavily; *Callirthites semicarpifolia*, *Andricus* sp. and *Neuroterous hassi*, that cause leaf and stem galls; adults of *Holotrichia longipennis* also causes defoliation and *Eriophyes* sp., a mite that damage the leaves.

Lymantria obfuscata, the Indian Gypsy moth and *Lymantria mathura*, the Rosy Gypsy moth (Lymantridae) cause heavy defoliation to Ban and Bani oak. Evaluation of the damage by Indian Gypsy moth and working out pest control measures are in progress.

Project 10: Standardization of nursery technology for mass propagation of selected medicinal plant species [HFRI-009/07(NWFP-01)/PLAN/2000-2007]

Status: Germplasm of 33 species of medicinal plants of temperate Himalayas in Field Research Station, Brundhar (Manali) and 30 species at Field Research Station, Shilly (Solan) and 10 species each at Field Research Station, Shillaru (Shimla) and Model Nursery (Shimla) raised and is being maintained. Trials are in progress for improving the agro-techniques of economically important medicinal plant species e.g. Karu,

Patish, Mushkbala, Salam-Misri and Chora, etc. Macro-proliferation technique developed in the project for the multiplication of *Picrorhiza kurooa* and *Valeriana jatamansi* has been successfully tested under National Medicinal Plants Board (NMPB) funded project on large-scale basis for the production of thousands of plants of these species.

Project 11: Standardization of nursery techniques of raising containerized seedlings of conifers and their broadleaved associates [HFRI-016/05(SFG-06)/PLAN/2002-2007]

Status: Nursery stock of Deodar, Fir and Spruce were maintained under various trials in root trainers at Model Nursery, Baragaon, Shimla and Field Research Station, Shillaru. Trials laid to find out the optimum size/ type of root trainer for seedling production of *Cedrus deodara, Picea smithiana* and *Alnus nitida* have revealed that the growth performance of all these three species was found to be the best in root trainers of the size 500 cc vis-à-vis, grown in the traditional system.

Trials on plug+3 seedling production system in *Abies pindrow* were carried out and it was found that suitable root-plug formation was achieved in 150 cc block type root-trainer after $1^{1}/_{4}$ years, which when planted subsequently in the nursery beds resulted in better root biomass and root/ shoot ratio over control after 3 years of its out planting.

Project 12: Planting Stock Improvement Programme in *Cedrus deodara* [HFRI- 028/ 05(SFG-08)/PLAN-03/2003-2008]

Status: Surveys of Deodar forests to select best stands based on the ocular estimates of morphometric traits were carried out. As a result of these surveys, areas were marked in Theog, Chopal, Chamba and Kullu Forest Divisions of Himachal Pradesh. Survey to mark more areas is in progress. Sample plot study, wherein each individual tree in the sample plot would be assessed for quantitative as well as qualitative traits using score method and the areas with maximum average for the stand will finally be selected for their conversion into Seed Production Area (SPA).

After finalizing the criteria for selection of phenotypically superior trees, 19 CPTs of Deodar have been marked in different forests. Further selection of plus trees is in progress.

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

Project 1: Studies on plant diversity in cold deserts of district Kinnaur, Himachal Pradesh [HFRI-029/ 02(EBC-11)/PLAN/2004-2007]

Status: Floristic surveys were carried out at an altitude varying from 3000 m – 5000 m above msl in Labrang Valley of Pooh sub-division of district Kinnaur, Himachal Pradesh during 2004. Approximately 15 species of trees, 25 of shrubs and 175 species of herbs were recorded during the survey.

Tim Cho - A Lake at 5000 m in study area

Three species of Junipers viz., *Juniperus macropoda* (3000-4000 m), *J. communis* (3300-4000 m) and *J. indica* (3500-4400 m) were recorded as per their altitudinal zonations. *Orobanche* sp. (parasitic plant) collected during the survey may be one of the new records for the flora of Himachal Pradesh.

Project 2: Establishment of Amla and Khair demonstration plantations in lower hills of Himachal Pradesh

Status: Two sites have been selected for the establishment of demonstration plantations of Amla and Khair in degraded grasslands of Hamirpur district of Himachal Pradesh. The sites namely Upper Darogan and Bhareta situated on Hamirpur – Sarkaghat National Highway near Toni Devi Town. The sites have been fenced and soil of planting pits replaced with loamy soil brought from outside sources along with addition of fully decomposed F.Y.M. The plantations of Amla and Khair have been carried out during July-August, 2004 on 2.5 ha of degraded grasslands. The plantations are being maintained intensively for the development of realistic model of Amla and Khair plantations.

Plantation of Amla and Khair

PROJECTS COMPLETED DURING THE YEAR 2004-2005

(Externally Aided)

NIL.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Development of suitable model for intercropping of commercially important medicinal plants with horticultural plantations in temperate region of Himachal Pradesh [BT/PR4372/PBD/17/285/2003-2006]

Status: Extensive surveys were carried out to select the farmers and experimental sites for undertaking trials on medicinal plants intercropping interventions with horticultural plantations in high hill temperate regions of Kullu and Shimla districts of Himachal Pradesh. Sites in the village Sajala of Kullu and in Shillaru of Shimla districts were selected and 7 and 4 farmers were identified in these two respective locations as an ultimate unit for the proposed study.

Planting stocks of selected medicinal plants viz. *Aconitum heterophyllum* (Atish), *Valeriana jatamansi* (Muskbala), *Picrorhiza kurrooa* (Kutki), *Polygonetum verticillatum* (Salam Misri) and *Angelica glauca* (Chora) in Field Research Stations located at Burndhar (Kullu) and Shillaru (Shimla) were raised and maintained.

Project 2: Production of quality planting material of *Picrorhiza kurooa* Royle ex Benth. and *Valeriana jatamansi* Jones and extension of their cultivation technology to local communities [GO/HP-2/2004-2007]

Status: In the first year of this project, a total of 2.3 lacs seedlings of quality planting material were

raised and maintained comprising of *Picrorhiza kurooa* (70,000) and *Valeriana jatamansi* (1,60,000) at three nurseries of the Institute viz. Field Research Station, Brundhar (Manali), Field Research Station, Shilly (Solan) and Field Research Station, Shillaru (Shimla). Poly-house and Shade-house were designed, established and commissioned at Field Research Station, Brundhar besides strengthening irrigation facilities. Various nursery and camping equipments were procured. Two training programmes and demonstration programme on "Commercial Cultivation of Karu and Valeriana" on 19th and 20th October, 2004 at Jagatsukh (Manali) and on 4th and 5th March, 2005 at Shillaru and Baragaon Model Nursery (Shimla) were organised for selected farmers of Kullu and Shimla districts, respectively. Extension material on Karu and Mushakbala was published under the project.

Valeriana jatamansi

Project 3: Development of elite planting material, establishment of model plantations and extension of nursery and plantation techniques of wild apricot to local communities in Himachal Pradesh [27-79/ NOVOD/2004/ 1188-89/ 2004-2007]

Status: Around 50 kg seeds were collected from four different sources located in Shimla and Kinnaur districts of Himachal Pradesh. Seeds were stratified for 50 days in sand layers before sowing in nursery during March, 2005. Plantations were carried out at two locations namely Baragaon (Shimla) and Alampur (Kufri - Chail road) by using the material raised from the above sources. One short-term training programme was organised on 'Wild Apricot-Nursery, Plantation, Oil Production and its uses' at HFRI-Shimla from 24th and 25th March, 2005 for selected farmers of Shimla district.

Project 4: Suitability of *Jatropha curcas* L. seed sources in lower and mid Himalayan regions of Himachal Pradesh [BT/PR/5094/ AGR-16/429/2004-2007]

Status: Around 30 kg of seeds of *Jatropha curcas* were collected from 22 seed sources mostly from Himachal Pradesh. Sowing has been done in 15,000 polybags during March, 2005. Site selection for raising 10 ha plantations of *Jatropha curcas* in lower and mid hills of Himachal Pradesh is being done.

Project 5: Ecological and management studies in certain dry temperate and alpine pastures of Lahaul and Spiti, Himachal Pradesh [BT/PR-4102/NDB- 51/027/2003/ 2004-2007]

Status: Annual Action Plan for implementation of the projects was discussed with another PI (being a collaborative project) and modalities for smooth execution of the project were worked out.

Major equipments pertaining to the project were procured and one Junior Research Fellow was appointed. Discussions were held with the Divisional Forest Officers of Lahaul and Spiti Forest Divisions to get the basic data regarding distribution of alpine pastures in the project area. Field activities will commence from May, 2005.

Project 6: Ecological assessment under Kol Dam Hydroelectric Project [Ft. 48-88/86 (CFA) 2004-2007] – Conservator of Forest, Bilaspur under Catchment Area Treatment (CAT) Plan

Status: In consultation with the Conservator of Forests, Bilaspur modalities for execution of the project were finalized. Divisional Forest Officers of six Forest Divisions namely, Suket, Bilaspur, Kunihar, Karsog, Shimla and Theog were contacted regarding execution of the project. Thereafter, field trips were undertaken and sites for undertaking detailed studies selected in Theog, Kunihar and Bilaspur Forest Divisions.

Besides the above mentioned externally funded projects, following three research proposals were approved for funding by G.B. Pant Institute of Himalayan Environment and Development, Almora under their Integrated Eco-development Research Programme (IERP):

1. Development of Ecologically Viable and Socio-economically Acceptable Integrated Models for Arresting Willow (*Salix* spp.)
2. Studies on plant diversity in Rakchham, Chitkul Wildlife Sanctuary of district Kinnaur, Himachal Pradesh.
3. Inventorization, documentation of plant diversity and to evolve site-specific management strategies for conservation of various sacred groves in Kullu Valley of Himachal Pradesh.

RESEARCH ACHIEVEMENTS

Name of State	No. of Projects completed in 2004-2005	No. of on-going Projects in 2004-2005	No. of Projects initiated in 2004-2005
Himachal Pradesh	7	14	8 (2-Plan; 6-Externally funded)
Jammu & Kashmir	-	-	-

EDUCATION AND TRAINING

Training

Organized

1. IFS trainees from Indira Gandhi National Forest Academy, Dehra Dun visited the Institute and held discussions with the Officers and Scientists, where questions pertaining to modern trends in forestry in general and forestry research in Himalayas in particular were discussed.
2. Range Forest Officers from State Forest Service College, Dehra Dun; Eastern Forest Rangers' College, Kurseong and Forest

Rangers' College, Burnihat visited the Institute and interacted with the Officers and Scientists on issues pertaining to forestry research.

3. Students undergoing different B.Sc. and M.Sc. (Forestry) courses at Tamil Nadu Agriculture University, Mettupalayam and Forest Research Institute – Deemed University, Dehra Dun visited the Institute and interacted with the Officers and Scientists.

4. Forty teachers serving in different Senior Secondary Schools of Shimla district visited this Institute to have discussion on various aspects of forestry in general and environmental issues in particular enabling them to discuss the feedback with their students after return to their respective places.

5. To observe National Science Day, programmes in local governmental schools were organized, where the Scientists of this Institute delivered popular science lectures. Sensitization and generation of environmental awareness amongst the school children was the main aim behind the activities.

6. Dr. Ranjeet Singh, Dr. Charan Singh and Dr. Vijender P. Panwar from this Institute were awarded Ph. D. Degrees in various fields of Forestry from FRI – Deemed University, Dehra Dun and Himachal Pradesh University, Shimla.

7. Trainings and Demonstration Programmes on Commercial Cultivation of Karu (*Picrorhiza kurrooa*) and Mushakbala (*Valeriana jatamansi*) for 23 farmers of Kullu district at Jagatsukh, Manali from 19th and 20th October, 2004.

8. Trainings and Demonstration Programmes on Commercial Cultivation of Karu and Mushakbala for 34 farmers of Shimla district at Shillaru and Model Nursery Baragaon, Shimla from 4th and 5th March, 2005.

9. Trainings and Demonstration Programmes on Commercial Cultivation of Medicinal and Aromatic Plants for 100 farmers of lower region of Himachal Pradesh at Majholi and Sai from 18th and19th March, 2005.

10. Trainings and Demonstration Programmes on Wild Apricot – Nursery, Plantation, Oil Production and Its Uses for 29 farmers of Shimla district at HFRI – Shimla from 24th and 25th March, 2005.

Attended

1. Shri K.S. Thakur, IFS, DCF attended compulsory training on "Environmental Priorities and Sustainable Development" at the Indian Institute of Management, Bangalore from 20th to 24th September, 2004.

2. Shri Jagdish Singh, Scientist-C attended training programme on "Agroforestry" at FRI, Dehra Dun from 20th to 24th September, 2004.

3. Shri Sani Pradhan, Forest Range Officer and Shri Sanjeev Kumar, RA-I attended four days training on "Disaster Management" as organized by Central Potato Research Institute, Shimla and Institute of Integrated Himalayan Studies at Himachal Pradesh University, Shimla from 23rd to 26th October, 2004.

4. Dr. R.K. Verma, Scientist-D attended five days training programme on "Eco-restoration of Wastelands" at FRI, Dehra Dun from 25th to 29th October, 2004.

5. Shri Surinder Kumar, IFS, Director attended five days compulsory training on "Environmental Sustainable Development

and Forests vis-à-vis Globalization" at Gopabandhu Academy of Administration, Chandrashekharpur, Bhubhneshwar from 1st to 5th November, 2004.

6. Dr. Sandeep Sharma and Dr. R.K. Verma, Scientists of this Institute attended five days training programme on ISO 14000: 1996 – Environmental Management Systems – Auditor's Training Course organized by ICFRE, Dehra Dun from 22nd to 27th November, 2004.

7. Dr. Sandeep Sharma, Scientist-D attended a five days training programme on "Management Development Programme" on 'Marketing of Forestry Products in the Changing Market Scenario' held at Indian Institute of Forest Management, Bhopal from 17th to 21st January, 2005.

LINKAGES AND COLLABORATION

1. The Institute remained in constant touch with the State Forest Departments of Himachal Pradesh and Jammu & Kashmir, State Forest Research Institute, Jammu & Kashmir, National Bureau of Plant Genetic Resources, Shimla; Dr. Y.S. Parmar University of Horticulture and Forestry, Solan; CSK Himachal Pradesh Krishi Vishvavidayala, Palampur; Himachal Pradesh University, Shimla; Punjab University, Chandigarh and Punjab Agriculture University, Ludhiana and other research and non governmental organizations working in the field of forestry and forestry research in the state of Himachal Pradesh and Jammu & Kashmir.

2. Shri Surinder Kumar, IFS, Director visited Jammu as an expert in connection with evaluation of projects funded by Science and Society Division of Department of Biotechnology, Government of India, New Delhi.

3. Shri Surinder Kumar, IFS, Director has also been nominated as an Expert – Member by the Ministry of Environment & Forests, Government of India for evaluation of the policy research proposal of the Ministry.

4. Besides this, efforts were initiated to link the Institute with the common people especially village farmers by establishing demonstration plantations of Amla and Khair in lower hills of Himachal Pradesh. For this activity farmers fields and village common lands were taken up for establishing such field plantations.

PUBLICATIONS

Brochures/ Technical Bulletins/ Booklets

1. Jagdish Singh, K.D. Sharma and Surinder Kumar (2005). Agroforestry Tree Species for Different Agro-climatic Zones of Himachal Pradesh: The Package and Practice. HFRI Publication BR. No. 014. (pp 51).

2. Sandeep, Sharma; P.S. Negi and K.S.Thakur (2005). Mushakbala Ki Kheti. Technical booklet in Hindi (10 pp).

3. Sandeep, Sharma; P.S. Negi and K.S.Thakur (2005). 'Karu Ki Kheti' Technical booklet in Hindi (10 pp).

4. Technical study material prepared for its distribution in the following trainings:

   i. Commercial Cultivation of Medicinal and Aromatic plants for Lower Hill Zone of Himachal Pradesh.

   ii. Commercial Cultivation of Medicinal Plants for farmers of High Hill Temperate Zone of Kullu district.

iii. Commercial Cultivation of Medicinal Plants for farmers of High Hill Temperate Zone of Shimla district.

iv. Wild Chulli for the farmers of Baragoan and Chail, Shimla district.

v. Commercial Cultivation of Karu and Mushakbala.

vi. Cultivation of Medicinal and Aromatic Plants

vii. Wild Apricot-Nursery, Plantation, Oil Production.

Research Reports

1. Kumar, Ashok; Kumar, Shailendra and Kumar, Surinder. 2004. Pit Canker Disease of Siris (*Albizzia procera* Benth.) due to *Fusarium solani* (Mart.) at Forest Plantation, Badhlech (Dharja) in Solan Forest Division, (H.P.). Research Report No. HFRI/RP/026, September, 2004.

2. Kumar, Ashok; Kumar, Surinder; Singh, Ranjeet, and Kumar, Shailendra. 2004. Drying of Deodar trees in heritage zone, Shimla Research Report No. HFRI/RP/027, October, 2004.

CONSULTANCIES

1. A detailed proposal for seeking consultancy, submitted to the authorities of Border Road Task Force, Kullu District Kullu, Himachal Pradesh.

2. A detailed report after investigations and a proposal for consultancy, submitted to the authorities of Sutlej Jal Vidyut Nigam, Nathpa-Jhakri, District Shimla, Himachal Pradesh.

3. A detailed report and a proposal for consultancy submitted to the authorities of M/S Gujrat Ambuja Cements Ltd., Darlaghat, District Solan, Himachal Pradesh.

CONFERENCES/MEETINGS/ WORKSHOPS/SEMINARS/ SYMPOSIA/EXHIBITIONS

1. Shri Surinder Kumar, Director, HFRI attended two days workshop on "Need for Change – Vision Development Workshop" from 20th and 21st May, 2004 as organized by H.P. State Forest Department at Shimla.

2. Shri Surinder Kumar, Director, HFRI attended two days workshop on "Strategies for Conservation of Sacred Grooves" as organized by IFGTB, Coimbatore from 26th and 27th May, 2004.

3. Shri Surinder Kumar, IFS, Director and Dr. A. Rajasekaran, Scientist attended two days workshop on "Forest and Water Conservation – Myths and Realities" held at FRI, Dehra Dun from 8th to 10th June, 2004.

4. Dr. K.S. Kapoor, Scientist attended two days workshop on "Creation of Awareness amongst the Prospective PIs/Group/NGOs/, etc. of Himachal Region for Execution of Location Specific Action Oriented R&D Activities under IERP Programme" as organized by Institute of Himalayan Bio-resource Technology, Palampur and G.B. Pant Institute of Himalayan Environment and Development, Almora at IHBT, Palampur from 28th and 29th June, 2004.

5. Jagdish, Singh, Scientist-C, participated and presented a paper at 'National Workshop on Agroforestry', organised by Forest Department Haryana, at CII Complex, Chandigarh from 22nd to 24th November, 2004.

6. Dr. Ranjeet Singh, Scientist-D participated and presented a paper in International Conference on "Multipurpose trees in the Tropics: Assessment, Growth and

Management" organized by IUFRO at AFRI, Jodhpur from 22nd to 25th November, 2004.

7. Jagdish, Singh, Scientist-C, participated and presented paper at 'National Conference on Resource Conserving Technologies for Social Upliftment' organized by Indian Association of Soil and Water Conservationists, CSWCRI, Dehra Dun (Uttaranchal) from 7th and 8th December, 2004.

8. Dr. K.S. Kapoor and Dr. A. Rajasekaran, Scientists of this Institute attended two days interactive workshop on "Problems and Prospects of Afforestation and Tree Planting in Degraded Hill Slopes with special reference to NTFP Species" as organized by Regional Centre of National Afforestation and Eco-Development Board, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan from 15th and16th February, 2005 at Shimla.

9. Shri Surinder Kumar, IFS, Director along with Dr. K.S. Kapoor and Dr. Sandeep Sharma, Scientists attended two days workshop on "Mainstreaming Medicinal Plants for Development of Region – Himachal Pradesh: A Case in Point" as organized by G.B. Pant Institute of Himalayan Environment and Development – Himachal Unit, Kullu from 12th and 13th March, 2005.

10. Dr. Ranjeet Singh, Scientist-D and Dr. Rajesh Sharma, Scientist-D participated and presented a paper in National Symposium on "Exotics in Indian Forestry" organized by Department of Forestry and Natural Resources and ICFRE, Dehradun at Punjab Agricultural University, Ludhiana from 15th to 18th March, 2005.

11. Shri Surinder Kumar, IFS, Director, Dr. Sandeep Sharma, Scientist-D and Shri Jagdish Singh, Scientist-C participated in a meeting on 'State Medicinal Plants Policy' held at Hotel Holiday Home on 22nd March, 2005.

DISTINGUISHED VISITORS

1. Thakur Satya Prakash, Chairman, Himachal Pradesh Marketing Board, Shimla and ex Minister for Horticulture visited HFRI, Shimla on 1st July, 2004 and interacted with the Officers and Scientists of this Institute.

CHAPTER VIII

INSTITUTE OF FOREST PRODUCTIVITY RANCHI

The Institute of Forest Productivity (IFP) under the Indian Council of Forestry Research and Education is mandated for steering the forestry research in the states of Jharkhand, Bihar, West Bengal and Sikkim having total actual forest cover of about 38002 sq. km, which is 14.1 per cent of total geographical area. Six agro-ecological zones and eight main forests types are covered within its jurisdiction.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

NIL.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

Project 1: Soil Vegetation interaction with special reference to nutrient cycling in some selected plantations under different edaphic conditions [IFP-9/SLR/P-III/2002-2006]

Status: A series of nursery trials have been conducted at Netaipur, Midnapore to study the role of major plant nutrients (N, P, K, Mg and Lime) on growth and uptake pattern of nutrients for optimization of most suitable combinations of nutrient doses for *A. auriculiformis*, *A. mangium* and *Eucalyptus* sp. The optimum doses of individual N, P, and K for *A. mangium* seedlings on degraded lateritic soil without liming were found to be 25 to 40 mg N, 25 mg P_2O_5 and 5 mg K_2O per kg soil. While combined dose of 54 to 81.5 mg urea, 27.5 to 42 mg SSP with 8 to 12 mg MOP was found to be optimum. Liming (@ 2.84 mg / kg soil) of degraded soil favoured growth of all the three tested species and combined application N, P and K have further improved the growth. For the seedlings of the said species under lime treatment the most economic doses were found to be 67.8 mg urea, 27.5 mg SSP and 8.33 mg MOP. The individual optimum doses for these species were: 97.83 mg urea, 27.78 mg SSP, 33.33 mg MOP for *Eucalyptus* sp.; 32.6 mg urea, 111.1 mg SSP, 33.33 mg MOP for *A. auriculiformis*; 65.22 mg urea, 69 to 111.1 mh SSP and 33.33 mg MOP for *A. mangium*.

Project 2: Development of biofertilizers and standardization of their application in relation to productivity of forest tree species under degraded lateritic soil condition [IFP-3/BGT-SP-3/P-I/2002-2006]

Status: Rhizobium inoculation with organic amendments in soils on *Acacia auriculiformis* showed incremental role of biofertilizers for growth and biomass production. In the absence of organic amendments Rhizobium culture Rz/A-02 favoured maximum growth followed by Rz/A-06. Pot soils untreated with biofertilizers favoured maximum growth with vermicompost followed by coconut coir, rice husk, bamboo litter and FYM. However, coconut coir did not favour better growth increase with rhizobium culture. Steady growth and organic matter production were recorded in *A. auriculiformis* treated with acacia seed hull bamboo litter and vermicompost in addition to biofertilizer inoculation. As far as collar diameter is concerned, vermicompost, compost, FYM and bamboo litter accentuated growth of the plants though biofertilizer

application with saw dust showed delayed but little positive effect.

The percent increment in stem length of *Eucalyptus tereticornis* in soils without organic matter amendment was increased from 240 to 288 with Azotobacter culture. In general, all the organic matter except rice husk increased the growth of plants (up to 414% increment in stem length) without biofertilizers. With biofertilizers, this increase attained maximum value of 543% with bamboo litter. For combined effect of biofertilizer and organic matter, consistently better performance was recorded with bamboo litter followed by vermicompost, compost and rice husk. This trend was reflected in collar diameter development and total organic matter production by the *Eucalyptus* sp.

Results on the role of VAM and Azotobacter on *Azadirachta indica* showed that organic matter addition significantly enhanced the growth of the species in comparison to that observed in untreated soil. Liming was found to be more prominent than individual influence of VAM fungi and Azotobacter bacterial inoculation in soil treated or untreated with organic matter. However, mixed biofertilizer inoculation in addition to liming were found to be more effective in increasing shoot length, collar diameter root and above ground biomass of *Azadirachta indica*.

Project 3: Follow-up activities and maintenance of PSIP assets developed under FREE Project [IFP-19/BGT-SP-8/P-1/2002-2007]

Status: Due to financial crunch in the current financial year 2004-2005, action plan has been revised. The work is being done according to revised action plan. Weeding, hoeing, and fertilizer application has been completed in VMG and SSO plots of Gamhar and Sissoo. The Bark treatment of insecticide (Dursban) to all Sissoo plants was done. After maintenance for two years some plants showed good growth in seed orchards.

Project 4: Multilocational field trial of tissue culture raised plantlets of *Dendrocalamus asper* [IFP-4/BGT-SP-4/P-I/2002-2006]

Status: Pre-monsoon 2002 plantation at Mandar and Midnapore has crossed two years of age. Mean performance for all characters has been computed. Though the increase in mean culm height along with duration has been found in both the locations, the rate of increment is more in Midnapore.

Monsoon plantation has been carried out in all the three locations in 2003. Till now the performance of Sukna is the best among three locations. Moreover, pre-monsoon and monsoon plantation has already been carried out in this year in all the three locations with 4 irrigation treatments including control as per the recommendation of RAG. For the plantation in post-monsoon 2004, hardened plantlets have already been sent to Sukna and Midnapore.

Project 5: Genetic Improvement of Eucalyptus through progeny trial and hybridisation [IFP-7/BGT-SP-7/P-1/2002-2006]

Status: Seedlings were planted and established well. Mortality were replaced. Phytosanitory measures were undertaken by applying bavistin and dursban. Growth data (Collar diameter, height and number of branches) of all the plants have been recorded. Further work is in progress.

Project 6: Studies on variability of Bamboo species, their performance, conservation and economics with reference to Bihar, Jharkhand and West Bengal [IFP-10/BS/P-IV/2002-2007]

Status: Field survey was conducted in Deoghar, Dumka, Hazaribagh and Chatra districts of

Jharkhand, Purnia district of Bihar and West Midnapore district of West Bengal. Altogether, distribution of of 22 species was observed of which 12 were identified. Two flowering species (*B. tulda* and *Dendrocalamus strictus*) were also recorded during survey work.

Natural regeneration of Bamboo have been studied at Trikut hills, Deoghar, Saparam Hills, Dumka, National Park, Hazaribagh and Natural Forests, Pabo, Chatra. Natural regeneration has also been observed in villages of Midnapore, West Bengal. Only two species (*Bambusa arundinaceae* and *Dendrocalamus strictus*) were found to be regenerating naturally within the study areas. Forest plantation data have also been collected from Purnia, Bihar, Deoghar (Jharkhand) and Midnapore (South-West Bengal).

Dendrocalamus membranaceous
Rhizome

Among the species studied in Jharkhand and South-West Bengal, *Bambusa vulgaris* and *B. balcooa* showed higher growth in terms of culm circumference at breast height and culm or clump height. In respect to number of culms per clump, naturally occurring *D. strictus* showed rapid development. Among the species of Bihar, Kathiashoed bears maximum culm height and diameter at breast height. This is followed by Ban Bans, Harauth, Chabb and *B. nutan*.

Project 7: Planting Stock Improvement in relevance to Chotanagpur plateau area and South-West Bengal [IFP-1/BS-SP-1/P-I/2002-2006]

Sub-project: Standardization of suitable potting media and root trainer size for improved planting stock production of some mandate species of Jharkhand and Southern West Bengal

Status: *Acacia mangium* and *Eucalyptus camaldulensis* species have been raised in three sized hykopots of 150 cc, 250 cc and 350 cc for assessing the suitable media mixture, dose of biofertilizer and chemical fertilizer for hykopot. Height of the seedlings raised in 350 cc hykopot was found higher after 45 days than that under 250 and 150 cc hykopots.

Project 8: Cultivation and extension of Lac on new non-traditional hosts [IFP-13/NWFP-SP-l/P-VII/2002-2005]

Sub-project: Exploration of Lac Cultivation on non-traditional host *Flemingia* spp. and its possibility in sustainable plantation forestry

Status: Jethvi and Baisakhi plantations were pruned for inoculations and Agani and Katki plantations were inoculated with broodlac in *Flemingia macrophylla*, sub-plot Jathvi and Baisaki crop of Kusumi and Rangeeni strains respectively were pruned and five shoots per plant are maintained. Sub-plot Agani and Katki crop of Kusumi and Rangeeni strains,

respectively, were inoculated with brood lac. Lac crop is maintained by timely application of insecticide (Thiodan and Nuvon) and fungicide (Bavistin). Insect pest of lac and lac host are recorded. Light intensity and humidity both in under shade and open conditions were recorded.

Flemingia macrophylla and *Flemingia semialata* plantations were maintained with proper weeding, watering and timely application of fertilizer, FYM and insecticide.

Lac cultivation in Agani plot

Project 9: Trials on composting for Specific afforestation needs and development of cost-effective [IFP-2/BS-SP-2/P-I/2002-2007]

Status: Pot trial with compost (5 treatments) under *D. sissoo* and *G. arborea* species has been carried out for 6 months to study the effect of compost on the growth of the said species. Growth of *G. arborea* under field trial of compost was measured and data tabulation and computation have been done. In field trial of compost 5 treatments 0, 200, 300, 400 and 500 g/pit compost were applied. Growth of plant (height and collar dia) was measured and data were recorded. Tabulation and computation of data for the experiments are being carried out.

Project 10: R&D Activities on Lac (Annual Programme) "R&D and Extension Activities in Nucleus Broadlac Farms and Market data collection and dissemination" [IFP-18/ERM/P-XII/2002/R&D and Extension on Lac]

Status: Training programmes were organized at different locations. Work is in progress.

Project 11: Development of appropriate agro-silvicultural systems for selected medicinal flora of Chotanagpur and Santhal Parganas [IFP-20/ERM (MP)/2003-2008]

Status: Plants collected from the wild in Parasnath and Netarhat tour viz. *Asparagus racemosus*, *Rauwolfia serpentina* and *Withania somnifera* were planted in big cement pots containing a mixture of mud, sand, compost and insecticide. Some of the tubers of *Gloriosa superba* and *R. serpentina* plants were also planted in 500 cc hycopots where they have grown quite well. All the plants grown in pots survived very successfully. Germination experiments were conducted with the seeds of the plants *A. racemosus* and *R. serpentina*.

Project 12: Creation of Germplasm Resource bank of threatened medicinal plants of Darjeeling, Himalaya [IFP-11/ERM (MP)/P-V/2003-2008]

Status: Five medicinal plants species i.e. *Rauwolfia serpentina, Dioscoria deltoidea* and *Curculigo orchioides, Acorus calamus* and *Hedychium spicatum* have been collected from different regions of Darjeeling and are being raised in nursery beds. Herbarium of collected specimen species has been prepared. Soil

samples were also collected for analysis. All medicinal plants under study except *Aconitum ferox* have been raised in permanent nurseries at Udai Singh Jote Research Plot. Proper caring and maintenance of growing plants are being carried out. Timely intercultural operations and pest control measures were provided to plants in beds. Plants are grown at different spacing to see the effect of spacing on growth and yields of crop.

Project 13: Studies of perceptible transitions and their dynamics in forest management policies and operational mechanism in Bihar (Now Bihar and Jharkhand), West Bengal and Sikkim in recent times [IFP-21/FMS (Policy Research)/2003-2006]

Status: Documents related to study (chiefly circulars, executive instructions and policy guidelines) has been collected from Sikkim and Bihar.

Design of Questionnaire Survey for JFM has been finalized and question contents on JFM policies (for top executives) have been formulated with special reference to Bihar and Jharkhand and it has been circulated to the top officials of both the states (Secretary to the Ministry of Forests, Principal Chief Conservator of Forests and C.C.F. (Development)).

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

Project 1: Development of agro-techniques for *Gynmena sylvestre* and *Embelia ribes*- medicinal plants of high marketing potential [IFP-22/ERM(MP)-P-VIII/2004]

Status: Plants and seed collection activities have been going on from various sources viz. natural forests, SFDs, NBPGR and private nurseries. Appropriate planting techniques for the propagation of different medicinal plants are being developed. Suitable germination experiments have been designed for the seeds collected from different sources.

Project 2: Progeny trial of *Gmelina arborea* [IFP-24/BGT(TI)/2004-2007]

Status: Progeny trial is in progress. Attempts to replace causalities are being made.

Project 3: Documentation of indigenous knowledge on conservation and sustainable management in Darjeeling, Himalayas [IFP-25/EE/2004-2007]

Status: Literature survey was conducted during the period. Local forest officials and personals from University and NGO were contacted. Topographical map of area was obtained.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

(Externally Aided)

NIL.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

(Externally Aided

Project 1: *Schleichera oleosa* (Lour.) Oken, a lac host: *In vitro* propagation (Funded by DBT) [IFP/2003-2006]

Status: So far 17 CPTs has been selected from different regions of Jharkhand and Orissa.

RESEARCH ACHIEVEMENTS

Name of State	No. of Projects completed in 2004-2005	No. of on-going Projects in 2004-2005	No. of Projects initiated in 2004-2005
Jharkhand	Nil	11	Nil
West Bengal	2	11	2
Bihar	Nil	2	NIL
Sikkim	Nil	1	Nil

TECHNOLOGY ASSESSED AND TRANSFERRED

1. Clearing of ground weed before inoculation prevents lac crop from predator insects.
2. During summer, when temperature was around 38-45^0 C, spraying of water on lac crop has prevented lac crop from mortality.
3. For few species optimal dose of fertilizer requirement for nursery seedlings was developed under the Project "Soil-Vegetation interaction with special reference to nutrient cycling in some selected plantations under different edaphic conditions".
4. Optimization of time for biofertilizer application in seedlings.
5. Compost prepared from rice straw and rice husk mix in below and above ground chamber in bulk quantity.
6. Vermicompost has been prepared from cowdung and rice straw.

EDUCATION AND TRAINING

1. 60 Foresters/Forest Guards of SFD Jharkhand participated in two day training programmes on "Modern Nursery Techniques" in four modules from 6th and 7th May, 11th and 12th May, 14th and 15th May and 18th and 19th May, 2004.

LINKAGE AND COLLABORATION

International

- DFID (U.K.)
- IDRC

National

- NABARD
- Medicinal Plant Board
- Department of Biotechnology
- Central Coalfields Limited
- Damodar Valley Corporation
- ILRI, Namkum
- ISM, Dhanbad
- HARP, Plandu
- BAU, Kanke, Ranchi
- SFD, Jharkhand
- SFD, West Bengal
- SFD, Bihar

PUBLICATIONS

- Annual Lac Bulletin of the Institute.

CONSULTANCY

Consultancy was taken up on Green Belt Development in Chandrapura Thermal Power Station and Maithan Right Bank Thermal Power Station proposed by Damodar Valley Corporation, Kolkata.

CONFERENCES/MEETINGS/ WORKSHOPS/SEMINARS/ SYMPOSIA/EXHIBITIONS

Organized

1. One day training programme on "Lac Cultivation on Modern Techniques" was imparted by Shri S. N. Vaidya, R.A.-II and Shri B. D. Pandit, R.A.-II of the Institute on 9th June, 2004 at Gumla Divisional Forest Office, in which DFOs, ACFs. Foresters, Forest Guards, Villagers, Van Samiti Members of different Van Samitis participated.

2. Two days training programme on "Lac Cultivation on Modern Techniques" alongwith demonstration with Kusmi Broodlac was imparted at Kansabel Range and Pathargaon Range (Chingrapathak), Chhattisgarh by Sh. S. N. Vaidya, RA-II, Shri B. D. Pandit, RA-II and Shri Basant Kumar, TA-'C' of the Institute on 25th and 26th June, 2004 in presence of SDO (ACF), Asstt. Development Officer of Kansabel Block in which Farmers, Members of Van Samiti and Forest Staff participated.

3. Two days field training on "Improved and Scientific Methods of Lac Cultivation" was organized at Pendra Road, under Marwahi Forest Division, Chhattisgarh from 6th and 7th October, 2004. The training was imparted by Shri S. N. Vaidya, RA-II and Shri B. D. Pandit, RA-II and was attended by 30 trainees which included Foresters, Forest Guards and members of Van Suraksha Samitis under Marwahi Forest Division.

4. Four days Training Program on "Improved and Scientific Methods of Lac Cultivation" for 10 number of Forest Guards and Van Suraksha Samiti of 'Jaspur Forest Division, Chhattisgarh from 27th to 30th October, 2004. The training also included Field Demonstration at Turhamu N.B. Farm and field visit at ILRI Namkum and Sidrawl Lac Factory of JHASCOLAMF, Ranchi.

Attended

1. Shri R. K. Mishra, DCF attended the 24th meeting of Kharif Research Council of Birsa Agricultural University, Ranchi on 1st and 2nd June, 2004.

2. Shri R. K. Mishra, DCF attended the 22nd Research Advisory Committee – Vanya Silk meeting held at Central Tassar Research and Training Institute, Central Silk Board, Nagri, Ranchi on 10th and 11th June, 2004.

3. Shri R. K. Mishra, DCF and Dr. B. N. Diavakara, Scientist-B attended the meeting of "Inter Institutional linkage for Agroforestry Research" held on 28th June, 2004 organized by Horticulture Agriculture Research Programme, Ranchi at Plandu.

4. Shri Premjit Anand, DCF attended group meeting of 'Lac Related Organizations' on "Researchable Issues" held on 24th August, 2004 at ILRI, Namkum, Ranchi.

5. Shri M. P. Gupta, Technical Assistant Gr.'C' is attending three weeks Agromet Observer's Course scheduled from 20th September to 8th October, 2004 conducted by Office of the Deputy Director General of

Meteorology (Agrimet Division), Shivajinagar, Pune.

6. Dr. V. P. Panwar, Research Officer attended the International Workshop on "Ecological Process" held from 4th to 8th October, 2004 at Shenyang, China organized by Institute of Applied Ecology, Chinese Academy of Sciences, China. An oral presentation on the topic "Patterns of Liter Nutrient Concentration in *Taxus baccata* Linn. and *Quercus semecarpifolia* Smith forests of the Western Himalayas" was delivered by him.

7. Shri P. K. Chawdhry, Director of the Institute attended the Regional Workshop on "Non Wood Forest Produce including Medicinal, Aromatic and Dye Plants" held from 3rd and 4th November, 2004 at Raipur organized by Chhattisgarh State Minor Forest Produce (T&D) Cooperative Federation Ltd., Raipur.

8. Dr. Animesh Sinha Scientist-C and Shri B. S. Chandrashekar, Scientist-B attended IUFRO International Conference on "Multipurpose Trees in the Tropics: Assessment, Growth and Management" at AFRI, Jodhpur from 22nd to 25th November, 2004.

CHAPTER IX

CENTRE FOR SOCIAL FORESTRY AND ECO-REHABILITATION ALLAHABAD

Centre for Social Forestry and Eco-Rehabilitation (CSFER), Allahabad was established in October, 1992 as an advanced Centre under the umbrella of ICFRE, Dehradun. Presently, it is a branch of Forest Research Institute, Dehradun. The Centre aims to nurture and cultivate professional excellence in the field of social forestry and eco-rehabilitation in Eastern Uttar Pradesh, North Bihar and Vindhyan Region of Uttar Pradesh and Madhya Pradesh.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

Project 1: Development of suitable technology for artificial regeneration of *Buchnania lanzan* in eastern U.P. [FRI-141/CSFER-02]

Findings: Seeds of identified CPTs from various forest divisions were collected and sown in research nursery of CSFER at Padila. The applications of different pre-sowing treatments viz. cold water for 24 hrs, cold water for 48 hrs, hot water 12 hrs, conc. acid for 10 Min., BGA, VAM and shed / sunlight were given in polybags as well as in nursery beds in Randomized Block Design.

Out of all the treatments, seeds treated with cold water for 24 hrs and Blue Green Algae (BGA) performed better than others. It was also observed that seedlings in natural shed performed well over seedlings placed in sunlight. During the study it was recorded that germination time reduced and germination percent increased in all the treatments over control where no addition was involved.

Project 2: To study the socio-economic constraints to "People oriented forestry programmes" in Eastern Uttar Pradesh [FRI-253/CSFER-04]

Findings: The representative districts, viz. Allahabad, Varanasi, Ballia, Gorakhpur and Gonda have been selected. The questionnaire for the survey has also been prepared after consultation with State forest officials. The socio-economic survey in selected areas of five representative districts has been completed. A total of 5,000 entries have been done during the survey i.e. 1,000 for each district. Analysis of data is in progress to study peoples' perception about constraints and problems in opting forestry/agro-forestry.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

Project 1: Re-vegetation of Silica mining tracts through microbial technology at Vindhyan Range of Allahabad District [FRI-141/CSFER-01]

Status: Nursery trial of selected species, viz. *Acacia nilotica, Acacia catechu, Butea monosperma* and *Pongamia pinnata* has been carried out to study effect of different biofertilizer combinations on germination and growth behavior. The biofertilizers used were Azotobacter, Rhizobium, Phosphate Solubilizing Microbes, Blue Green Algae and VAM.

It was observed that effect of VAM is remarkable on selected species as compared to other treatments. Nursery trial results also indicated that germination time was also reduced in seeds treated with different biofertilizer

combinations as compared to control. Maintenance, management and weeding operation was also performed for this nursery trial. A field trial of these inoculated seedlings has been laid out at silica mining tract of Shankargarh, Allahabad to study survival and further growth performance.

Project 2: To develop medicinal plant nursery for generating awareness amongst local people [FRI-254/CSFER-2005]

Status: Literature survey has been carried out for status of medicinal species in Eastern U.P. After correlating social and literature studies, 12 species have been screened out for germplasm collection.

The species planted in herbal garden of research nursery are: *Asparagus racemosus* (Satawar), *Vinca rosea* (Sadabahar), *Tinospora cordifolia* (Giloy), *Chlorophytum arundinaceum* (Safed Musli), *Bacopa munnerii* (Brahmi), *Rauwolfia serpentina* (Sarpgandha), *Barleria prionites* (Kalabansa), *Plantago ovata* (Isabgol), *Plumbago zeylanica* (Chitrak), *Hyoscymus niger* (Ajwayan), *Piper longum* (Pippali) and *Ocimum sanctum* (Tulsi). The maintenance and management of these species are in progress.

Project 3: Research and Development of Jatropha

Status: The CPTs of Jatropha in selected areas have been marked. The seeds of different provenance were collected / received from selected sources. An experiment on provenance trial has been established in nursery to study germination and survival parameters. The germination of seeds was 60-80 per cent.

Training programs for Trainers and farmers on research and development of Jatropha have been organized for further extension of Jatropha plantations. The techniques related to nursery, planting methods, field demonstration, various uses and its Bio-diesel applications have been explained to the participants.

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

NIL.

RESEARCH ACHIEVEMENTS

Name of State	No. of Projects completed in 2004-2005	No. of on-going Projects in 2004-2005	No. of Projects initiated in 2004-2005
Uttar Pradesh	02	03	Nil

CONFERENCES/MEETINGS/ WORKSHOPS/SEMINARS/ SYMPOSIA/EXHIBITIONS

1. Training for Trainers under NOVOD Project on Research and Development of Jatropha from 4th and 5th March, 2005.
2. Three Farmer's training under NOVOD Project on Research and Development of Jatropha 15th to 18th and 22nd and 23rd March, 2005.

Workshop Attended

1. Sri V. K. Singh attended Workshop on Agroforestry at UP Forest Department, Varanasi on 29 th December, 2004.

CHAPTER X

CENTRE FOR FORESTRY RESEARCH AND HUMAN RESOURCE DEVELOPMENT CHHINDWARA

Centre for Forestry Research and Human Resource Development (CFRHRD), Chhindwara came in to existence on 30th March, 1995 and declared as Satellite Centre of Tropical Forest Research Institute, Jabalpur under the ICFRE Dehradun on 3rd January, 1996. The mandate of the Centre is to take up the forestry research in the specialized areas like biodiversity conservation, non-wood forest products and forest protection, socio-economics, silviculture and tree improvement. In addition to this the Centre has also been assigned to develop the human resource in forestry sector by imparting vocational training leading to poverty alleviation through self-employment.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

NIL.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

Project 1: Studies on the feasibility of cultivation of medicinal and aromatic plants as intercrop in natural forests and plantations and their photochemical investigations [049/ CFRHRD-1(2)/2001-2002]

Status: *Andrographis paniculata* (Kalmegh), *Asparagus racemosus* (Satawar), *Rauwolfia serpentina* (Sarpgandha) and *Costus speciosa* (Keokand) were planted at different spacing and results on productivity were recorded. Performance of Kalmegh, Lemon grass and Ganwarpatha as intercrop in natural forests was observed.

Cultivation technique of *Withania somnifera* (Aswagandha) has been standardized for Satpura plateau region of central India.

Cultivation technique was developed for the cultivation of *Chlorophytum borivillianum* (Safed Musli) in central India. The crop can be cultivated as intercrop with tree species.

Influence of harvesting time on productivity and quality of Kalmegh (*Andrographis paniculata*) was studied. Harvesting time influenced the quality of herb in terms of major active constituent andrographolide.

Project: 2 Studies on the insect pests of *Emblica officinalis* and *Gmelina arborea* in agroforestry and plantation ecosystems [2-050/CFRHRD-2(3)/ 2001-2002]

Status: Fourteen insect pests were recorded on *E. officinalis* and *G. arborea*. New defoliator *Parasa lepida* and *Trypanphora semihylina* as pest of *G. arborea* and sap sucker, *Secutellers nobilis* on fruits of *E. officinalis* were reported for the first time.

Dying off of *Gmelina arborea* plantation due to insect disease complex

Five varities of *E. officinalis* were screened against gall forming insects *Betousa stylophora*, Chaikaiya followed by Kanchan varieties was found having more pest.

Different age group plantations of *G. arborea* in western Maharashtra were evaluated for monitoring the status of pests. Possible control measures were also suggested.

Incidence and basis of resistance of different national provenance and seedling-raised plantation (RT,PB,PT and RS) by bark eating caterpillar, *Inderbela quadrilotata* on *G. arborea* were studied.

Project 3: Standardization of nursery techniques and propagation methods pf *Buchanania lanzan* spreng. (Achar or Chironji) [051/CFRHRD-3(4)/2001-2002]

Status: Studies of effect of IAA, IBA, and GA3, on germination and seedling growth of *B. lanzan* has shown significant effect of GA3 on germination of *B. lanzan*. Experiments has been laid out in the nursery for optimizing the dosages of inorganic fertilizers for raising the seedling of *B. lanzan*.

High input *Buchnania lanzan* Plantation

Project 4: Standardization of the cultivation technique and utilization of *Laccate stipitate* species of *Ganoderma taceae* [056/CFRHRD-2(6)/2003]

Status: Collected fruit bodies of *G. lucidum* on 26 species from several ecological zones of different climatic type of Chhattisgarh, M.P. *G. lucidum* was cultivated artificially on wood chips and wooden logs. Isolated and purified the culture from collected fruit bodies.

Project 5: Standardization of production technology of some important medicinal plants under tropical climate of Madhya Pradesh [055/CFRHRD-5/(MHFW)/2003]

Status: Seedlings of *Emblica officinalis* (Awla), and *Andrographis paniculata* (Kalmegh), cutting of *Gymnema sylvestris* (Gudmar) and *Tinospora cordifolia* (Giloe) seeds of *Rauwolfia serpentina* (Sarpgandha) were distributed to farmers/tree growers after testing stability and adaptability.

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

Project 1: Studies on edible potential of some Indian Bamboo shoots

Status: This Project has been started from March, 2005.

EDUCATION AND TRAINING

Training

Six training programmes were organized at CFRHRD, Chhindwara on various subjects ranging from Agroforestry to cultivation of medicinal plants and biofertilizers. Officials of Zila Panchayat, state forest departments and progressive farmers of nearby districts actively participated in the training.

Bulletins Published

1. Meshram, P.B. and Patra, A.K. (2004). आंवले की खेती एवं उससे लाभ 109 ICFRE BL-14/ CFRHRD BL.-5, 14 pp.
2. Vijayaraghavan, A. and Patra, A.K. (2004). औषधीय पौधों की खेती–घृतकुमारी (ग्वारपाठा) 108 ICFRE BL-13/CFRHRD BL.-4, 8 pp.
3. Nandeshwar, D.L. and Patra, A.K. (2004). चिरोंजी एक बहुपयोगी पौधा– 110 ICFRE-15/ CFRHRD BL.-4, 9 pp.

CONFERENCES/MEETINGS/ WORKSHOPS/SEMINARS/ SYMPOSIA/EXHIBITIONS

Dr. P.B. Meshram, Scientist-D and Shri A. Vijayaraghavan, Scientist-B participated and presented research paper in IUFRO International conference on "Multipurpose Trees in the Tropics: Assessment, Growth and Management" organised by AFRI, Jodhpur from 22nd to 25th November, 2004.

CHAPTER XI

FOREST RESEARCH CENTRE HYDERABAD

The Forest Research Centre (FRC), Hyderabad started functioning under the administrative control of Institute of Wood Science and Technology, Bangalore, since July, 1997. The Centre was established to meet the research needs of the southern dry deciduous ecosystem of the states of Andhra Pradesh, Karnataka and Goa on all field of Forestry Research.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

NIL.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

Project 1: Performance of different agroforestry Systems in Semi-arid Tropics of Andhra Pradesh [FRC -01/AF-01/2001-2006]

Status: On station trials of Teak + Sandal. Rose wood + Sandal, Eucalyptus + Sandal and Teak + Sandal + Rose wood have been established and castor as a rainfed crop was raised. The castor growth and performance was monitored across different tree combinations.

Project 2: Screening of natural populations of *Lagerstroemia* spp. for domestication [FRC-05/TI-02/2003-2006]

Status: Two species of Lagerstroemia prevalent in Andhra Pradesh and Karnataka were surveyed and several populations were identified. The process of germplasm collection has been initiated.

Project 3: Natural variation studies in Rose wood (*Dalbergia latifolia* Roxb.) for tree improvement [FRC-04/TI-02/2003-2006]

Status: The plus trees were marked in various parts of the Andhra Pradesh and Karnataka. The process of germplasm collection has been initiated.

Project 4: Estimation of Variability in *Pterocarpus marsupium* and germplasm collection [FRC-07/TI-04/2003-2005]

Status: The plus trees were marked in various parts of the Andhra Pradesh and Karnataka. The process of germplasm collection has been initiated.

Project 5: Studies on phenotypic variation in *Pterocarpus santalinus* and collection of germplasm [FRC-04/TI-01/2003-2005]

Status: Kurnool, Cuddapah and Chittoor districts of Andhra Pradesh were surveyed and tree species for collection of germplasm was identified.

Project 6: Dynamics of Insect Populations in Cotton based Agroforestry Systems of Andhra Pradesh [FRC-08/EB-04/2002-2005]

Status: Data is being collected from time to time on the incidence of insect pest on the tree and cotton crop along with the spectrum of natural enemies in the canopy of various systems under investigation.

Project 7: Reclamation of Iron Ore, limestone mine spoils in Andhra Pradesh and Karnataka [FRC-03/EB-02/2002-2005]

Status: The work is in progress.

Project 8 : Assessment of the impact of forest fire on regeneration of forests in Andhra Pradesh [FRC-01/EB-01/2002-2005]

Status: Phyto-social studies have been conducted. Soil samples have been collected and is in progress.

NEW PROJECTS INITIATED DURING THE YEAR 2004-2005

Project 1: Estimation of Forest Carbon Pool in Western Ghats, Karnataka –Development of biomass expansion factors for major forest types [FRC-10/CC-01/2004-2006]

Status: Root biomass estimation in respect of the tropical deciduous forests is being done and data is being colleted on different aspects.

Project 2: Impact of the Clonal Eucalyptus plantations on soil, physical and chemical properties in farmers land in Andhra Pradesh [FRC-10/SS-01/2004-2006]

Status: Soil samples were collected from the Eucalyptus clonal plantation of different ages and analysis is being done.

PROJECTS COMPLETED DURING THE YEAR 2004-2005

(Externally Aided)

NIL.

PROJECTS CONTINUED DURING THE YEAR 2004-2005

(Externally Aided)

Project 1: Estimation of Forest Carbon Pool in Western Ghats, Karnataka –Development of biomass expansion factors for major forest types [2004-2007]

Status: Root biomass estimation in respect of the tropical deciduous forests is being done and data is being colleted on different aspects.

RESEARCH ACHIEVEMENTS

Name of State	No. of Projects completed in 2004-2005	No. of on-going Projects in 2004-2005	No. of Projects initiated in 2004-2005
Andhra Pradesh	Nil	2	6
Karnataka	Nil	1	1
Goa	Nil	Nil	Nil

TECHNOLOGY ASSESSED AND TRANSFERRED

As part of transfer of technology programme, demonstration plantations have been established in FRC, Hyderabad campus in the field of Agroforestry systems.

EDUCATION AND TRAINING

A group of twenty five educated youth under an NGO, Village Reconstruction Organisation (India), visited the Centre. On going research and other developmental activities in

forestry sector with respect to employment opportunities to rural youth were discussed.

LINKAGES AND COLLABORATION

National

FRC, Hyderabad presently have two ongoing Projects in collaboration with NRSA, Hyderabad, ITC-PSPD, Bhadhrachalam, Andhra Pradesh Forest Department and APFDC.

CONSULTANCIES

1. Contributed to preparation of final mine closure plan of Kudremukh Iron Ore Co. Ltd.
2. Contributed to study of changes in flora and fauna due to the diversion of Thellavagu river Singareni Colleries.
3. Contributed to the study of the flora in FORELIMIT Project in Singareni Colleries.

CONFERENCES/MEETINGS/ WORKSHOPS/SEMINARS/ SYMPOSIA/EXHIBITIONS

1. Dr. G.R.S. Reddy, Scientist-E attended Workshop in Hyderabad on National seminar on *Jatropa curcas* and Aloe from 15th and 16th October, 2004 organised by Info Concepts India inc.
2. Shri M. Lokeswara Rao, Conservator of Forests attended training on Joint Forest Management: Tools and Techniques from 24th to 29th January, 2005 at NIRD, Hyderabad.
3. Shri M. Lokeswara Rao, Conservator of Forests, Dr. G.R.S. Reddy Scientist-E and Dr. Y. Sridhar, Scientist-B attended Workshop on "Bamboo for Livelihoods" from 19th and 20th February, 2005 organised by Andhra Pradesh Forest Department.
4. Dr. Y. Sridhar, Scientist-B attended Workshop on "Persistent Organic Pollutants held at Hyderabad from 15th and 16th July, 2004.
5. Shri T.S. Dange, DCF attended in service training to IFS officers on "Advanced Forest Management" at IGNFA, Dehradun in February, 2005.
6. Dr. G.R.S. Reddy Scientist-E attended Workshop in Hyderabad from 15th and 16th July, 2004 on "Managing Intellectual Property: Fostering, Intellectual property culture in industry and institute" sponsored by TIFAC and CII.
7. Shri T.S. Dange, DCF attended "Expert meet under Technology Information Facilitation Programme of DSIR" conducted by DSIR Ministry of Science and Technology at CCMB, Hyderabad.

AUDITOR'S REPORT

We have examined the attached Balance Sheet of INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN, as at 31st March 2005 and the annexed Income & Expenditure Account for the year ended on that date. These Financial Statements are the responsibility of the Council's Management. Our responsibility is to express an opinion on these financial statements based on our audit.

We have conducted our audit in accordance with the accounting standards generally accepted in India. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material mis-statements. An audit includes examining on test basis evidence supporting the accounting and disclosures in the financial statements. An audit also includes assessing the accounting principles and significant estimates made by the management as well as evaluating the overall financial statements presentation. We believe that our audit provides a reasonable basis of our opinion.

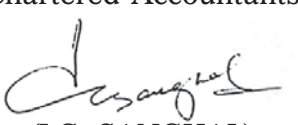
In our opinion and to the best of our information and according to the explanations given to us the said accounts give a true and fair view :-

1) In the case of the Balance Sheet of the State of Affairs of the above named Council as at 31st March 2005,

2) In the case of the Income & Expenditure Account, of the SURPLUS for the year ended on 31st March 2005.

17-Rajpur Road, Dehradun
Dated : 24-8-2005

For I.C. Sanghal & Co.,
Chartered Accountants



(I.C. SANGHAL)
Partner

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
BALANCE SHEET AS ON 31ST MARCH, 2005

PREVIOUS YEAR	LIABILITIES	AMOUNT	TOTAL AMOUNT
	CAPITAL FUND		
1,629,192,159	Opening balance	1,629,192,159	
	Add : Transferred from General Reserve	5,598,959	
	Less : Depreciation	232,825,250	1,401,965,868
	GENERAL FUND		
159,039,805	(As Per Annexure 'A')		179,275,840
	PENSION FUND		
644,207,698	(As Per Annexure 'B')		681,763,073
	CURRENT LIABILITIES & LOANS		
	Amount Payable to Controller ICFRE		
1,278	(As Per Annexure 'C')		12,760
	Amount Payable to PAO, New Delhi		
5,645	(As Per Annexure 'D')		43,365
	Amount Payable to Other Units		
165,639	(As Per Annexure 'E')		165,639
	Amount Payable to Others		
1,184,697	(As Per Annexure 'F')		4,305,875
40,537,013	Project Balances		45,139,381
	EMD/Security		2,853,351
3,042,346	(As Per Annexure 'G')		
2,477,376,280	**T O T A L**		**2,315,525,152**

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
BALANCE SHEET AS ON 31ST MARCH, 2005

PREVIOUS YEAR	ASSETS	AMOUNT	TOTAL AMOUNT
	FIXED ASSETS		
	Fixed Assets		1,401,965,868
1,629,192,159	(As per Annexure 'H')		
15,249,000	**Work In Progress**		39,938,000
66,561,955	**Advance for Capital Works**		71,872,955
	(As per Annexure 'I')		
11,982,000	**INVESTMENTS**		
			0
	CURRENT ASSETS, LOANS & ADVANCES		
	A. CURRENT ASSETS		
	CASH & BANK BALANCES		
715,962,441	(As per Annexure 'J')		765,593,264
	B. LOANS & ADVANCES		
	Staff Advances		
19,992,443	(As per Annexure 'K')		19,099,906
	Recoverable from Controller ICFRE		
6,997,731	(As per Annexure 'L')		6,730,356
	Recoverable from PAO,New Delhi		
11,200,096	(As per Annexure 'M')		8,896,609
	Recoverable from Other Units		
181,602	(As per Annexure 'N')		1,428,194
56,853	Recoverable from Others		0
2,477,376,280	**T O T A L**		**2,315,525,152**

G.K. PRASAD, (Director General, ICFRE)

M.S GARBYAL , (Director General Admn. , ICFRE)

DR. ATUL.K. SRIVASTAVA,
(FIN. ADVISOR & CHIEF Accout officer ICFRE)

PIARA SINGH
(Controller Pension / E & A.O.)

I.C. Sanghal & Co.
Chartered Accountants
17, Rajpur Road, Dehradun

24 Aug 2005

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

ANNEXURE A	TOTAL
GENERAL FUND	
Opening	159,039,805
Add : Excess Of Income Over Expenditure	33,306,043
Add : Received from other units	27,559,793
Less : Transferred to Revenue ICFRE	35,030,842
Less : Transferred to Capital Fund	5,598,959
	179,275,840

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

ANNEXURE B PENSION FUND	GPF	GSLIS	PENSION	TOTAL
Opening	142,433,581	222,867	501,551,250	644,207,698
Add : Excess Of Income Over Expenditure	25,016,275	5,749	44,566,294	69,588,318
Add :				0
Saving Fund under GSLIS		558,068		558,068
Death Claim		291,117		291,117
Received from PAO	4,349,892		0	4,349,892
Subscription/contribution	37,681,040	1,653,300	12,825,791	52,160,131
Received from OthersDepartments	159,940		118,776	278,716
Refund of Excess Payment			29,315	29,315
	42,190,872	2,502,485	12,973,882	57,667,239
Less :				0
Death Claim Paid		291,117		291,117
Saving Fund		464,085		464,085
Subscription to LIC		1,662,913		1,662,913
GPF Advance Reimbursement	16,199,320			16,199,320
GPF Part/Final Payment	13,110,622			13,110,622
GPF Final Payment	11,690,446		0	11,690,446
Pensionary Benefit paid			35,258,746	35,258,746
DCRG			11,022,933	11,022,933
	41,000,388	2,418,115	46,281,679	89,700,182
	168,640,340	**312,986**	**512,809,747**	**681,763,073**

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

PART OF ANNEXURE B :

PENSION-INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH 2005

INCOME		AMOUNT
GRANT IN AID		
Received through DDG(ADMIN)		20000000
Received from Revenue ICFRE		23742000
Received from DDO ADMIN		
Interest		824294
		44566294
EXPENDITURE		
Excess Of Income Over Expentiture		44566294
		44566294

GPF-INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH 2005

INCOME		AMOUNT
Interest & Dividend		25,165,442
		25,165,442
EXPENDITURE		
Loss on Sale of Investments		149,167
Excess Of Income Over Expentiture		25,016,275
		25,165,442

GSLIS-INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH 2005

INCOME		AMOUNT
Interest		5749
		5749
EXPENDITURE		
Excess Of Income Over Expentiture		5749
		5749

ANNEXURE C Amount Payable to Controller ICFRE	TOTAL
GPF Subscription	5,735
Refund of GPF Advance	3,145
GSLIS	387
Pension Contribution	3,493
	12,760

ANNEXURE D Amount Payable to PAO New Delhi	TOTAL
GPF Subscription/Refund	4,705
CGEIS	5,520
Any Other Recovery	33,140
	43,365

ANNEXURE E Amount Payable to Other Units	TOTAL
Saving Fund	64,071
Death Claim	44,013
Advance Recovery	57,555
	165,639

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

ANNEXURE F Amount Payable to Others	TOTAL
TDS	71,938
Professional Tax	5,970
Misc. Recoveries	2,656,329
Payble to Conttroller ICFRE	1,567,638
Computer Advance	4,000
	4,305,875

ANNEXURE 'G'	TOTAL
SECURITY/EMD	2,853,351
	2,853,351

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

ANNEXURE 'H' : DEPRECIATION ON FIXED ASSETS						
	OPENING BALANCE AS ON 01/04/04	ADDITIONS	ADJUSTMENTS	GROSS BALANCE AS ON 31/03/05	DEPRICIATION	CLOSING BALANCE AS ON 31/03/05
PLAN ASSETS						
Land	5,072,750			5,072,750		5,072,750
Scientific Equipments	111,939,803	3,163,088		115,102,891	28,380,337	86,722,554
Furniture & Fixtures	17,293,637	222,339		17,515,976	2,610,721	14,905,255
Books & Journals	73,763,618	200,136		73,963,754	18,465,922	55,497,833
Vehicles	28,112,120			28,112,120	5,622,424	22,489,696
Building & Road	1,138,389,238			1,138,389,238	113,838,924	1,024,550,314
Office Equipments	231,968,555	2,013,396		233,981,951	58,243,813	175,738,138
Tools & Equipments	13,578,386			13,578,386	3,394,597	10,183,790
Electrical Fittings	9,074,052			9,074,052	2,268,513	6,805,539
						-
TOTAL	**1,629,192,159**	**5,598,959**	**-**	**1,634,791,118**	**232,825,250**	**1,401,965,868**

NOTE: Depriciation on additions has been charged for half year

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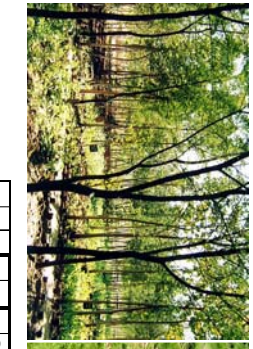


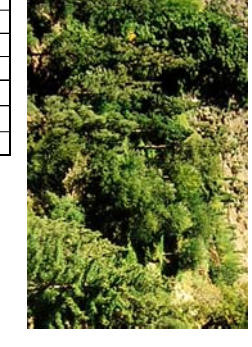

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

ANNEXURE 'I'	TOTAL
Advance for Capital Works/Equipment	
CPWD	-
CCU	71,550,334
OTHERS	322,621
	71,872,955

ANNEXURE 'J'	TOTAL
Cash In Hand	531,068
Cash at Bank	87,721,102
FDRs	677,341,094
	765,593,264

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J. C. Sanghal & Co. Chartered Accountants D. Dun

ANNEXURE 'K' :	
	TOTAL
STAFF ADVANCES	
> Forest Advance	2,766,806
> Festival Advance	920,380
> Car Advance	854,432
> Scooter Advance	1,605,658
> Cycle Advance	46,171
> House Building Advance (HBA)	7,487,278
> TA Advance	1,464,896
> TTA Advance	412,017
> LTC Advance	708,296
> Pay Advance	138,377
> Medical Advance	609,600
> Other Advance	2,085,995
	19,099,906

G.K. PRASAD, (Director General, ICFRE)

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PIARA SINGH
(Controller Pension / E & A.O.)

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

ANNEXURE 'L'	**TOTAL**
Amount Recoverable from Controller	
ICFRE	
GPF Advance	2,349,166
DCGRG	2,520,331
Provisional Pension	195,015
GPFPart/Final Payment	1,665,844
	6,730,356

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ANNEXURE 'M'	TOTAL
Amount Recoverable from PAO,	
NEW DELHI	
GPF Advance	5,956,418
CGEGIS	1,014,584
DCRG	1,646,590
Provisional Pension	252,617
GPF Part/ Final Payment	26,400
	8,896,609

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

ANNEXURE 'N'	TOTAL
Amount Recoverable from Other Units	
DDOs (Premium for the month of March)	168,944
DEPUTATION & OTHERS	12,168
Service Tax	1,247,082
	1,428,194

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION
INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31-3-2005

PREVIOUS YEAR	EXPENDITURE	AMOUNT	TOTAL AMOUNT
	NON PLAN (GENERAL COMPONENT		
49995333	Salary Research	51091541	
52804667	Salary Non Research	51794990	102886531
	EDUCATION & TRAINING		
11845000	Payment to KVS	11759000	
3943036	Payment to KVS (from IGNFA)	6860154	18619154
	PLAN (GENERAL COMPONENT)		
	Salaries		
117186964	Research Staff	133305777	
74149780	Non Research Staff	81463022	214768799
	Travelling		
4782482	Research Staff	3625360	
2159594	Non Research Staff	2680547	6305907
64725615	**O.E. (Research Staff)**		53159067
	Others		
1076552	Publication	537620	
1727809	M & S (Lab. Contingencies)	540300	
16542178	Minor Work / Maintenance	6959640	
0	Others	23787	
0	Building & Roads	188601	8249948
25000000	**EDUCATION & TRAINING**		20000000
22000000	Grant to Pension Fund	20000000	
31500000	Revenue Paid to Pension Fund	23742000	
0	Revenue Receipts Refunded	3457720	47199720
62781063	Excess of Income Over Expenditure		33306043
542220073	**TOTAL**		**504495169**

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J. C. Sanghal & Co. Chartered Accountants D. Dun

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31-3-2005

PREVIOUS YEAR	INCOME	AMOUNT	TOTAL AMOUNT
	GRANT IN AID		
	PLAN		
324900000	- GENERAL COMPONENT	300000000	
25000000	- EDUCATION & TRAINING	20000000	320000000
	NON PLAN		
102800000	- GENERAL COMPONENT	102800000	
11845000	- EDUCATION & TRAINING	11759000	114559000
	PLAN		
40000000	- NORTH EAST JOHRAT	30000000	
0	- NORTH EAST MIZORAM	2500000	32500000
3100	Revolving Fund		4000
7400756	Grant from IGNFA for KVS		7346906
0	Grant from Ministry for Workshop		476000
30271217	Revenue Receipts & Others		29609263
542220073	**TOTAL**		**504495169**

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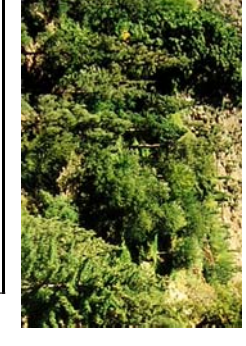
J. C. Sanghal & Co. Chartered Accountants D.Dun

INDIAN COUNCIL OF FORESHTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31-3-2005

RECEIPTS	AMOUNT	TOTAL	PAYMENTS	AMOUNT	TOTAL AMOUNT
OPENING BALANCE AS ON 1-4-2004			**NON PLAN**		
Cash & Bank (Including FDRs)	709008798		Salary Research	51091541	
	0		Salary Non Research	51794990	102886531
	0				
Investment	11982000				
Money in Transit	6953643		**PLAN**		
		727944441			
			Salary Research	133305777	
GRANT IN AID			Salary Non Research	81463022	214768799
RECEIVED FROM MINISTRY			**By Travelling Expenses**		
PLAN			> Research Staff	3625360	
-General	300000000		> Non Research	2680547	6305907
-Education & Training	20000000				
-North East Johrat	32500000	352500000	**By O.E. (Research Staff)**		
NON PLAN			> Maintenance of Vehicle		
-General Component	102800000		- Fuel	3250990	
-Education & Training	11759000	114559000	- Repair	1891380	
-Sponsored Project	30000		- Taxes	706771	
-Foreign Projects	0	30000	> Electricity Charges	20857509	
-Workshop from Ministry		476000	> Telephone charges	3084594	
			> Wages	1066473	
-Revolving Fund		4000	> Maintenance of Equipments		
To Revenue Receipts from DDO'S		27559793	- Scientific	377745	
To Revenue Receipts Payable to Own Account		4559215	- Office	2475930	
To Revenue Eamed		29609263	> Others		
To Transfer of Fund		41250	- Water Charges	1303245	
To Sharing Cost of Facilities for KVS		7346906	- Stationery	968862	
To Amt Recd by Controller from ICFRE Rev		23742000	- Contingency Expenditure	5868793	
			- Legal / Consultancy charges	457552	
To Reimbursement from Controller ICFRE			- Municipal Tax	1093221	
			- Medicines / X-ray	1973516	
> GPF Advance	14944525		- Liveries	221662	
> DCRD	10112383		- Postal / Stamp Charges	562729	
> Provisional Pension	598108		- Advertisement	670684	
> GPF Part/Final Payment	319400		- Field Research Expenses	3421043	
>GSLIS	0	25974416	- Seminar / Conference / HRD	1791428	
			- Newspaper Bill	361966	
To Reimbursement from PAO(F), New Delhi			- Extension	189824	
			- Rent building / Equipment	563150	
> GPF Advance	10257678			0	53159067
> DCRG	662270		By Others		
> Provisional Pension	20705		> Publication	537620	
> GPF Part/Final Payment	0		> M & S (Lab. Contingencies)	540300	
> CGEGIS	0	10940653	> Minor Work / Maintenance	6959640	
			> Others	23787	
			> Building & Roads	188601	
			> Service Tax	1247082	9497030

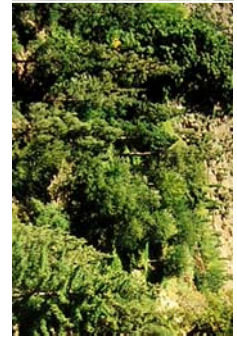


INDIAN COUNCIL OF FORESHTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31-3-2005

RECEIPTS	AMOUNT	TOTAL	PAYMENTS	AMOUNT	TOTAL AMOUNT
To Recoveries from Staff on behalf of ICFRE			By Advances		
> GPF Subscription	30755358		> CPWD	0	
> GPF Advance Refund	6927828		> CCU	30000000	30000000
> GSLIS	1648200				
> Pension Contribution	12796302	52127688	**By Equipment / Library Books**		
To Recoveries from Staff on Behalf of PAO(F)			> Scientific Equipments	3163088	
			> Office Equipments	2013396	
> GPF Subscription	11658039		> Furniture & Fixtures	222339	
> CGEGIS	165407		> Books & Journals	200136	
> Pension Contribution	0		> Tools & Equipments	0	5598959
> CGHS	3470		> Advances		
> Other Recovery	388787	12215703	- Scientific Equipments	0	
			- Office Equipments	0	
To Recoveries from Staff on Behalf of Others			- Furniture & Fixtures	0	
			- Books & Journals	0	
> GPF Subscription	2447605		-Tools & Equipments	0	
> CGEGIS / GIS	107497		- Any Other (Specify)	0	
> Intt. On Car Advance	18000				
> Other	1097511	3670613	By Vehicles		
			> Vehicles Purchase	0	
To Recoveries of Advance from Staff on behalf of ICFRE			> Advance Payaments for Vehicles	0	0
			By Revenue Receipt Refunded		3457720
>Forest Advance	15382963		By Revenue Receipt paid to DG ICFRE		35030842
> Festival Advance	1709000		By EMD / Security Refunded		1285586
> Car advance	546769		By Revenue receipt paid to Controller ICFRE		23742000
> Scooter Advance	924005		By Revenue Receipits paid to own Revenue A/c		2991577
> Cycle Advance	158315				
> House Building Advance (HBA)	1914183		**By Payment made on behalf of PAO (F)**		
> TA Advance	6447215		>GPF Advance	8513197	
> TTA Advance	131830		> CGEGIS	0	
> LTC Advance	2155813		> DCRG	116319	
> Computer Advance	18800		> Provisional Pension	7650	
> Pay Advance	97937		> GPF Part / Final Payment	0	8637166
> Medical Advance	1016533				
> Flood Advance	0		**By Payment made on behalf of the**		
>Electric Charges	18159				
> HLF	26647	30548169			
			Controller (ICFRE)		
To Other Deduction & Recoveries			>GPF Advance	13292295	
			> DCGRG	10932738	
> TDS (Salary)	11725508		> Provisional Pension	662093	
> TDS (Contractor)	372038		> GPF Part / Final Payment	819915	25707041
> LIC	2267088				
> Professional	294150		**By Payment made to PAO (F) on**		
> Others	7298450	21957234	**Behalf of Staff**		
			> GPF Subscription / Refund	11654721	
To EMD / Security		1096591	> CGEIS	159902	
To Sale of Assets		0	> Interest on House Building Advance	110694	
			> Car Advance	60090	
			> Scooter Advance	0	
			> Interest on car advance	24617	
			> HBA	23444	
			> Any Other Recovery (Specify)	144515	12177983

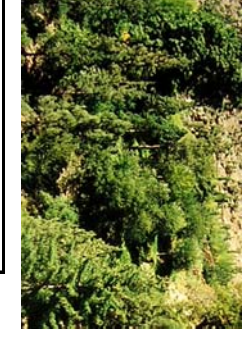


INDIAN COUNCIL OF FORESHTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31-3-2005

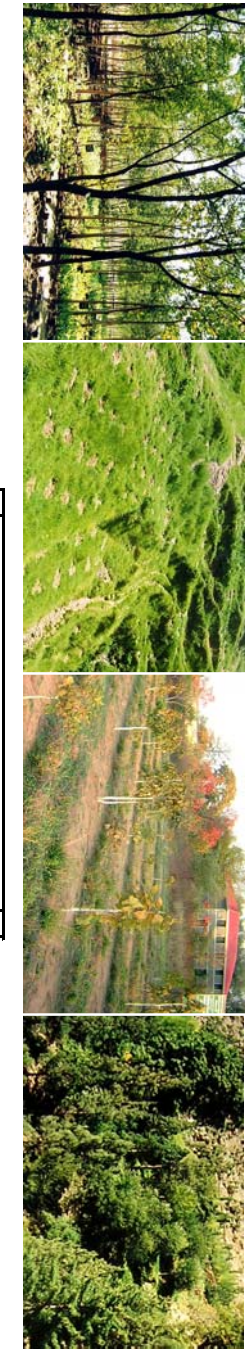
RECEIPTS	AMOUNT	TOTAL	PAYMENTS	AMOUNT	TOTAL AMOUNT
Amount Received by Controller ICFRE			**By Payment made to The Controller (Pension Cell ICFRE on behalf of staff**		
			> GPE Subsripiton	30749623	
Amount received from PAO (F) on			> Refund of GPF Advance	6924683	
account of GPF transfer		4349892	> GSLIS	1648071	
			> Pension Contribution	12793829	52116206
Amount received from Various DDO'S on					
account of GPF Subscription		37681040	**By Payment made to Other Offices on Behalf on**		
			> GPF Subsription / Refund	2442755	
Amount Received from Others on account of refund of			> CGEGIS	112537	
refund of excess GPF Payments		159940	> TDS	345030	
			> Sales Tax	42728	
Dividends on Govt. Securities		-149167	> Professional Tax	293420	
Bank & FDR Interest		891792	> Income Tax	11667800	
			> House Building Advance	630778	
Amount received on account of Saving			> Car Advance	278820	
Fund Under GSLIS		558068	> Scooter Advance	18812	
			> LIC	1573900	
Amount received on account of Death			> Any Other Recovery (Specify)	3182757	20589337
Claim under GSLIS		291117			
			By Advances paid to Staff		
Subscription from various DDO'S		1653300	> Forest Advance	15044222	
			> Festival Advance	1595000	
Pro-rata Pensionary benefit received			> Car Advance	107761	
from PAO (F)			> Scooter Advance	24640	
			> Cycle Advance	5200	
Amount received from Various DDO's on			> HBA	154571	
account of Pension contribution		12825791	> TA Advance	6805671	
			> LTC Advance	2428528	
Amount recovere on account of excess			> Medical Advance	1199728	
payment of pension by bank		29315	> Pay Advance	142710	
			> Computer Advance	12800	
Amount Received from other Departments			> Any Other Recovery (Specify)	2103601	29624432
on account of Pensionery Benefits		118776			
Govt. Securities		224910	By Any Other Payments (Specify)		3500077
FDR Interest		24878783			
			By Project Payments		50551474
Total Project Receipts		55123842			
			Amount paid by Controller ICFRE		
			By GPF reimbursement to DDO's	16199320	
			By GPF Part Final payment	13110622	
			By GPF Final payment	11690446	
			Death Claims Paid	291117	
			Saving Fund Paid	464085	
			Amt of premium to LIC for GSLIS Subsrcription	1662913	
			Pensionary benefit paid	35258746	
			Rembursement of DCRG, Pension to Various DDOs	11022933	89700182



INDIAN COUNCIL OF FORESHTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31-3-2005

RECEIPTS	AMOUNT	TOTAL	PAYMENTS	AMOUNT	TOTAL AMOUNT
			By KVS Expenditure		11759000
			By Traning & Education - Plan		20000000
			By Sharing Cost of Facilities for KVS		6860154
			CLOSING BALANCE		
			CASH	531068	
			BANK	87721102	
			FDR	677341094	
			EMD	0	
					765593264
		1585540334			1585540334



Indian Council of Forestry Research and Education - Dehradun
Accounting Policies & Notes to Accounts

1. **System of Accounting :**
   The council follows cash system of accounting.
2. **Fixed Assets :**
   All Fixed Assets are stated at historical cost less depreciation.
3. **Depreciation :**
   Depreciation has been provided at the rates prescribed by the Income Tax Act 1962. Depreciation on the additions made during the year has been provided for Six months only.
4. **Retirement Benefits :**
   No provision for gratuity & leave encashment liabilities is made.
5. **Amount Recoverable from Controller, Pension Cell :**
   The amount recoverable from Controller has been arrived at based on the data produced by the unit and after reconciling the same with the books of the controller, Pension Cell
6. **Project Balances :**
   Balance outstanding of various projects are subject to reconcilation.
7. **Previous Year Figures :**
   Previous year figures have been regrouped and recasted wherever necessary.

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(Director General, ICFRE)

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I.C. SANGHAL & CO.
Chartered Accountants
17, Rajpur Road, Dehradun

24 Aug., 2005

LIST OF ABBREVIATIONS

AFRI	Arid Forest Research Institute
AMF	Arbuscular Mycorrhizal Fungi
APFDC	Andhra Pradesh Forest Development Corporation.
APMP	Alkaline Peroxide Mechanical Pulping
CD-ROM	Compact Disc Read Only Memory
CFR&HRD	Centre for Forestry Research and Human Resource Development
CPT	Candidate Plus Tree
CSF&ER	Centre for Social Forestry Research and Eco-Rehabilitation
CSIRO	Commonwealth Scientific and Industrial Research Organization, Australia
CSO	Clonal Seed Orchard
CTG	Cassia Tora Gum
ESF	Extension Support Fund
FRC	Forest Research Centre
FREE-P	Forestry Research Education and Extension Project
FRI	Forest Research Institute
FRLHT	Foundation for Revitalization of Local Health Tradition
FYM	Farm Yard Manure
GACL	Gujarat Alkali and Chemicals Ltd.
GEF	Global Environmental Facility
GHG	Green House Gas
HFRI	Himalayan Forest Research Institute
HPLC	High Performance Liquid Chromatography
ICFRE	Indian Council of Forestry Research and Education
IFFDC	Indian Farm Forestry Development Cooperative
IFGTB	Institute of Forest Genetics and Tree Breeding
IPM	Integrated Pest Management
IPMA	Indian Paper Manufacturers Association
IPT	International Provenance Trial
IR	Infra Red
IRS	Institute of Remote Sensing
ISSR	Inter Sample Sequence Repeat
IWST	Institute of Wood Science and Technology
KFD	Kerala Forest Department

LAN	Local Area Network
LOSP	Light Organic Solvent Preservative
MPT	Multi Purpose Tree
NABARD	National Agricultural Bank for Agriculture and Rural Development
NFLIC	National Forest Library and Information Centre
NFT	Nitrogen Fixing Trees
NMR	Nuclear Magnetic Resonance
NOVOD	National Oil Seed and Vegetable Oil Development
NRDC	National Research Development Corporation
NWFP	Non-Wood Forest Produce
PFM	Participatory Forest Management
PGD	Post Graduate Diploma
PSB	Phosphate Solubilizing Bacteria
PSIP	Planting Stock Improvement Programe
PT	Progeny Trial
PTG	Primitive Tribe Groups
RAPD	Randomly Amplified Polymorphic DNA
RBD	Randomized Block Design
RCBD	Randomized Complete Block Design
RDBMS	Research Data Base Management System
RFRI	Rain Forest Research Institute
SP	Self Pruning
SPA	Seed Production Area
SPM	Suspended Particulate Matter
SSO	Seedling Seed Orchard
SSPA	Seedling Seed Production Area
TFRI	Tropical Forest Research Institute
TKP	Tamarind Kernel Powder
TLC	Thin Layer Chromatography
TNFD	Tamil Nadu Forest Department
USDA	United States of Department of Agriculture
UV	Ultra Violet
VAM	Vasicular Arbuscular Mycorrhiza
VMG	Vegetative Multiple Garden
WAN	Wide Area Network

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