

CHAPTER-IV
FOREST RESEARCH INSTITUTE
DEHRADUN

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

PROJECTS COMPLETED DURING 1999-2000

Sl. No.: 1

Project identification No: FRI-75/BOT-9 (Normal)

Name of the principal investigator: Dr. T.C. Pokhriyal

Title of the project: Identification and screening of suitable nitrogen fixing herbs, shrubs, climbers and tree species for agro-social forestry plantations and wasteland afforestation programmes.

Year of start of project: 1994

Cost of the project : Rs. 3.7 lakhs

Objectives: (a) Survey, identification and distribution of leguminous and non leguminous nitrogen fixing herbs, shrubs, climbers and tree species already existing in the Uttarakhand region of Himalayan ecosystem. (b) Evaluation of suitable, fast growing nitrogen fixing tree species, which can be recommended for agro-social forestry plantation and wasteland afforestation, programmes. (c) To study the physiological and biochemical parameters responsible for establishing the efficient symbiotic relationship and maximizing the biomass production in short rotation even under stress conditions. (d) To evaluate N utilization efficiency i.e., uptake, translocation, storage, assimilation, fixation and losses of different fast growing NFTs and other tree species recommended for agro-social forestry plantations.

Scientific importance of investigations: The studies will assess the potential of nitrogen fixation and biomass production in relation to the seasonal variation in nitrogen fixing tree species under nursery conditions. Nitrogen assessment studies will give an idea of the performance of individual plant parts. The species identified can be used for rehabilitation of degraded sites.

Results/Achievements : More than 150 nitrogen fixing species distributed at various altitudes in Himalayas were identified on the basis of the presence of nodules and nitrogenase activity.

Some well known nitrogen fixing species:

- a. **Leguminous trees :** *Albizia lebbek*, *Acacia nilotica*, *Robinia pseudoacacia*, *Erythrina indica*, and *Gliricidia maculata*.
- b. **Non-leguminous trees :** *Alnus nepalensis*, *Myrica esculenta* and *Casuarina equisetifolia*.

- c. **Shrubs :** *Crotolaria psoraliodes*, *Desmodium caudatum*, *Desmodium floribundum*, *Flemingia strobilifera* and *Indigofera heterantha*.
- d. **Climbers:** *Abrus fruticulosus*, *Atylosia scarabaeoides*, *Melletia extensa* and *Mucuna puriens*.
- e. **Herbs:** *Alysicarpus* spp., *Algyrolobium* spp., *Astragalus* spp., *Crotolaria* spp., *Indigofera* spp., *Medicago* spp. and *Vicia* spp.

The nitrogen fixation and assimilation behaviour in the different tree species reveals the process of nitrogen utilization behaviour as influenced by the three i.e., winter, summer and rainy seasons.

Non-nodulating leguminous and non-leguminous species were also identified and listed separately.

Sl. No.: 2

Project identification No.: FRI-95/BOT-10

Name of the principal investigator: Dr. Sangeeta Gupta

Title of the project: Study of wood anatomy of Indian *Terminalias*.

Year of start of project: October, 1997

Cost of the project : Rs.0.15 lakhs

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

Scientific importance of investigations: This work is of practical use in the identification and utilisation of various species of *Terminalia*.

Results/Achievements: The work is completed and an identification key for 14 species of *Terminalia* has been developed.

Sl.No.: 3

Project identification No.: F.R.I. -92/C&P-11

Name of the principal investigator: Dr. K. S. Bhandari

Title of the project: Studies on high yield pulping and environmental friendly bleaching of *Eucalyptus tereticornis* and *Dendrocalamus strictus*.

Year of start of project: 1998

Cost of the project : Rs.0.25 lakhs

Objectives: (a) To prepare high yield pulps from *E. tereticornis* using different doses of the chemicals. (b) Evaluation of the unbleached pulps prepared for strength properties. (c) Bleaching of the pulps using different bleaching sequence. (d) Evaluation of bleached pulps for strength properties and brightness.

Scientific importance of investigations: High yield pulps from *E. tereticornis* bleached using OPP and OHP, would be comparatively more environmental friendly than the pulps by the conventional HH sequence. The data generated would be of scientific and practical utility.

Results/Achievements : High yield pulps using 10,20,30,40,50 and 60 gpl of sodium hydroxide were prepared from *E. tereticornis* and *D. strictus* and evaluated for strength properties. Pulp yield was in the range of 82 to 92%. It was observed that, in general, strength properties improved with increase in alkali charge. However, the improvement in strength properties was more pronounced in the case of *D. strictus* pulps.

Each pulp was bleached adopting oxygen/peroxide/peroxide (O/P/P/), oxygen/hypochlorite (H/H) bleaching sequences. Oxygen treatment was given at 4 kg/sq.cm pressure and 90°C using 2.5% alkali. It was observed that the cold soda pulps from *E. tereticornis* responded better towards bleaching chemicals as compared to cold soda pulps from *D. strictus*. O/P/P bleaching lignin yielded pulps possessing high brightness as followed by O/H/P bleaching sequence. It was lowest in the case of H/H bleaching sequence. It is also expected that the effluent quality of O/P/P bleaching sequence would be better than the O/H/P and H/H bleaching sequences due to the elimination of hypochlorite.

Sl. No. 4

Project identification No.: FRI-93/C&P-12

Name of the principal investigator: Dr. S.V. Singh

Title of the project: Studies on variations in lignin and fiber vessel ratio in different clones of *Eucalyptus* hybrid with respect to papermaking.

Year of start of the project: 1-4-1998

Cost of the project : Rs.0.52 lakhs

Objectives: To examine the chemical characteristics of lignin and fibre vessel ratio and pulping and paper making qualities of different clones of *Eucalyptus* hybrid.

Scientific importance of investigations: Better quality clones for pulpwood production would be identified.

Results/Achievements: On an overall assessment it could be seen that clone-B gave best pulp yield with acceptable strength properties.

Three clones of *Eucalyptus* hybrid named as clone A, clone B and clone C received from Institute of Wood Science and Technology, Bangalore were taken for the kraft pulping and papermaking studies

The average screened pulp yield followed the following pattern:

Clone B >	Clone C >	Clone A
(48.00%)	(43.71%)	(42.92%)

Strength properties of the paper made from three clones under study follows the following pattern in decreasing order of their strength.

Average tensile index

Clone C >	Clone A >	Clone B
(74.88 Nm/g)	(69.23 Nm/g)	(62.94 Nm/g)

Average burst index

Clone C >	Clone A >	Clone B
(4.79 kPam ² /g)	(4.59 kPam ² /g)	(3.40 kPam ² /g)

Average tear index

Clone A >	Clone B >	Clone C
(3.44 mNm ² /g)	(3.35 mNm ² /g)	(3.08 mNm ² /g)

Sl. No.: 5

Project identification No.: FRI-90/C&P-9

Name of the principal investigator: O.P. Bhatt

Title of the project: Studies on behaviour of different papermaking fibres during accelerated drying for energy conservation.

Year of start of the project: 1-4-1998

Cost of the project : Rs.0.80 lakhs

Objectives: To determine the dewatering properties of different papermaking fibres under different temperature range and degree of beating and their behavior during accelerated drying.

Scientific importance of investigations: The result would be useful for energy conservation in papermaking.

Results/Achievements: Results recorded for eucalyptus and wheat straw pulps revealed that beating reduces the thickness of sheets and makes it denser increasing overall evaporation rate. The evaporation rate can be further accelerated by increasing the temperature of dryer or circulating high temperature air at a higher rate and velocity. The acceleration in the drying reduces the overall energy consumption due to reduction in drying time. Beating also reduces the surface irregularities of the sheet and improves heat transfer coefficient of drying cylinder

Sl. No.: 6

Project identification No.: FRI-77/Chem-5

Name of the principal investigator: Dr. Vineet Kumar

Title of the project: Standardisation of process for isolation of taxol and other bioactive compounds from *Taxus baccata*.

Year of start of the project: January, 1998

Cost of the project : Rs.0.90 lakhs

Objectives: To develop a method for the isolation of taxol from *Taxus baccata* needles.

Scientific importance of investigations: A process of isolation of bioactive compounds viz.10-deacetyl baccatin-III was developed.

Results/Achievements: A method was standardised to isolate 10-deacetyl baccatin-III (.01-.02%) from *Taxus baccata* needles. The method involves extraction of needles with aqueous methanolic solution, partition into different solvent systems followed by column chromatography to get the pure compound.

Sl. No.: 7

Project identification No.: FRI-62/FED-1

Name of the principal investigator: Dr. H.R. Khan

Title of the project: Surveillance and monitoring of insect pest, their seasonal abundance, pest activity and management by light trap techniques.

Year of start of the project: April 1994.

Cost of the project : Rs.0.15 lakhs

Objectives: (a) Constant monitoring and surveillance of insect pest population. (b) To know the distribution of insect fauna and local abundance. (c) To reduce the pest population by light trap technique, a non-toxic, non-hazardous methods. (d) To study bio-ecology, seasonal abundance and population dynamics of target insect pests. (e) To detect pest population built up at an early stage, for undertaking timely management/control operation.

Scientific importance of investigations: The method will reduce insect damage to important forest species.

Results/Achievements: The light trap record showed that total number of insect species (target pest) was 89237 during the whole period (1994-1999). The population trend showed that the highest population was recorded in *Asota*, high in *Dysdercus*, moderate in *Agrotis*, *Plusia* and *Gryllus* and low in *Cerura*. The record of host plant species of the target pest species was maintained. In addition, the non-target species trapped were also studied and kept in collection followed by introduction of new species in NIRC (FRI).

Sl. No.: 8

Project identification No.: FRI-64/FED-3

Name of the principal investigator: Dr. S.C. Mishra

Title of the project: Laboratory evaluation of natural termite resistance in timbers (*Eucalyptus* and poplar) and bamboos.

Year of start of the project: April 1994

Cost of the project : Rs.1.35 lakhs

Objectives: (a) Laboratory evaluation of natural termite resistance in bamboo for rational and judicious utilization by the farmers, villagers, foresters, builders and others interested in propagating bamboo. (b) Influence of various factors/parameters such as moon phase, age/girth, height, method of seasoning (water, kiln) etc. on natural resistance of bamboo.

Scientific importance of investigations: The results will help increase lives of various timber and bamboo products.

Results/Achievements:

Laboratory testing of bamboo:

Samples of seven species of bamboo *Bambusa polymorpha* (Wt. Loss 18.1%), *B. arundinacea* (Wt. Loss 79.8%), *B. ventricosa* (wt. Loss 23.7%), *Gigantichlva alter* (wt. Loss 55.6%) and *Melocalamus compactiflorus* (Wt. Loss 41.4%) were evaluated against termite *Microcerotermes besoni* Snyder for their natural termite resistance and were categorized into different resistance classes.

Effect of height and age on natural termite resistance:

The samples of bamboo *Bambusa polymorpha*, *B. arundinaceae* and *Dendrocalamus strictus* of different height were tested against termite *M. besoni* Snyder. The result indicates that lower portion of

bamboo is more resistant than the upper one. Similarly, bamboo of higher age group (more than 3 years) are more resistant as compared to lower age group.

Influence of water seasoning on natural termite resistance :

The result shows that water seasoning increases termite resistance in bamboo.

Causes of natural termite resistance in bamboo :

Result indicates that higher amounts of silica and lignin were responsible for termite resistance in bamboo.

Sl. No.: 9

Project identification No.: FRI-108/FPD (TM)- 21

Name of the principal investigator: J.D. Jain

Title of the project: Studies on thermal conductivity, dielectric constant and creep behaviour of timber.

Year of start of the project: April, 1997

Cost of the project: Rs.14.80 lakhs

Objectives: To study thermal conductivity, dielectric constant, and creep behaviour of timber.

Scientific importance of investigations: Studies will lead to efficient utilization of timber for industrial, structural and other engineering uses.

Results/Achievements: Experimental work to study dielectric properties of *Toona ciliata*, *Salix alba*, *Grevillea robusta* and *Paulownia fortunei* was completed. Thermal conductivity of *Paulownia fortunei* along transverse direction and *Toona ciliata*, *Salix alba*, and *Grevillea robusta* along transverse and longitudinal directions was measured in oven dry condition. A research paper entitled "Studies on thermal conductivity of some India hardwoods" was written and sent for publication.

Results indicate that thermal conductivity of hardwoods increases linearly with increase in specific gravity as well as mean temperature within the range 18° to 48° C.

Dynamic and static modulus of elasticity of four wood species viz. *Toona ciliata*, *Salix alba*, *Grevillea robusta* and *Paulownia fortunei* were determined.

Sl. No.: 10

Project identification No.: FRI-107/FPD(CW)-20

Name of the principal investigator: Dr. S.P. Singh

Title of the project: Evaluating the suitability of *Melia azedarach*, *Pinus roxburghii*, *Ailanthus excelsa* and *Prosopis juliflora* for particle board.

Year of start of the project: 1997

Target year of completion: 2001

Cost of the project: Rs.5.8 lakhs

Objectives: To utilise various lignocellulosic residues for building particle boards.

Scientific importance of investigations : Evaluating the suitability of lignocellulosic wastes from plantation species for building boards like particle boards will help reduce the shortages of timbers for various purposes in the country.

Results/Achievements: Lops and tops of *Prosopis juliflora* was procured from Haryana. These lops and tops were converted into particles. Prepared flat pressed single layer particle board from *Prosopis juliflora* with bark using 5, 6, 8, 10, 12 and 14% of phenol formaldehyde resin. Testing of these boards for various physical and mechanical properties is in progress.

Sl. No.: 11

Project identification No.: FRI-119/FPD(CW)-26

Name of the principal investigator: K.S. Shukla

Title of the project: Evaluation of suitability of LVL from *Ailanthus excelsa*, for door/window shutters.

Note: As per suggestion of RAG two clones of poplar viz., L-34/82 and L-52/82 have also been included in the research plan.

Year of start of the project: 1998

Target year of completion: 2000

Cost of the project: Rs.4.56 lakhs

Objectives: *Ailanthus excelsa* wood is not finding use in the manufacture of door/window shutters and furniture because of low density, physical and mechanical properties. It is therefore, proposed to study its properties after making laminated veneer lumber and evaluate its suitability for door/window shutters.

Scientific importance of investigations : Laminated veneer lumber is an engineered product and has scope for utilization of plantation grown species. The study would help in utilization of gokul and poplar in door/window shutters and help in narrowing the gap between demand and supply of timber for the manufacture of joinery and furniture.

Results/Achievements: *Ailanthus excelsa* logs were procured from Haryana and peeled into three thickness i.e. 5.0, 3.0 and 2.0 mm. LVL boards were prepared using PF glue, three pressure i.e. 14.0, 17.5 and 21.0 kg/cm² and two durations of pressing time i.e. 20 and 30 minutes for 600 x 600 mm size boards LVL thus prepared were tested for specific gravity, compression loss percentage, tensile strength, modulus of rupture flat wise and edge wise, screw holding power etc. Two clones of poplar were also peeled into 5.0, 3.0 and 2.0 mm thick veneers for making LVL using same glue (PF) and tested for their physical and mechanical properties. Further tests are in progress.

Sl. No.: 12

Project identification No.: FRI-12/Bot-2

Name of the principal investigator: Dr. S. Nautiyal

Title of the project: Physiological effects of water stress on various clones and provenances of *Dalbergia sissoo*.

Year of start of the project: 1994

Cost of the project: Rs.21.85 lakhs

Objectives: (a) To screen the elite clones of *Dalbergia sissoo* for their water stress tolerance behaviour. (b) To select few drought tolerant clones for large-scale plantation in arid and semi-arid regions of the country.

Scientific importance of investigations: Drought resistant clones with some chemical components of plant ramets as a marker for drought resistance can be used for large-scale afforestation in arid areas.

Results/Achievements: Six clones of *Dalbergia sissoo* were propagated in mist chamber through juvenile shoot cutting in July 1998. These rooted cuttings were shifted to the glazed earthenware pots, containing the soil, sand and Farm Yard Manure (FYM) in a ratio of 2:1:1 in August 1998. After 10 months of establishment of ramets in the pots, the plants were subjected to four different watering intervals i.e. daily, weekly, fortnight and monthly under controlled conditions in the glass house. Five hundred ml of water was given to each pot at successive intervals. After one-month of acclimatization of plants at each watering interval, survival percentage, height, collar diameter and other details were noted. The experiment is going on.

Sl. No.: 13

Project identification No.: FRI-96/BOT-11

Name of the principal investigator: Dr. Mohinder Pal

Title of the project: Clonal propagation of *Dalbergia sissoo*, *Tectona grandis*, *Eucalyptus* hybrid and Bamboos.

Year of start of the Project: 1996

Cost of the project: Rs. 24.34 lakhs

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

Scientific importance of investigations: The rooting behaviour study will be useful for clonal selection and mass propagation for production of superior quality clonal planting stock.

Results/Achievements: Results have indicated important intraclonal variation in the clonal propagules of several clones of *Dalbergia sissoo*. Differences were apparent in the rooting of binodal cuttings and growth of rooted cuttings.

Rooting response of branch cuttings of *T. grandis* varied with type of cutting, season and auxin treatment.

Rooting response of culm cuttings of *D. strictus* varied with the age of the clump.

Sl. No.: 14

Project identification No.: FRI-78/Silva-8

Name of the principal investigator: K.G. Sood

Title of the project: Studies of Forest Operations.

Sub-Project: Uprooting of *Lantana* – A comparative study of conventional method v/s uprooting with Stalk Puller developed by the FRI.

Year of start of the project: 1997

Cost of the project: Rs. 0.18 lakhs

Objectives: To develop better forestry operation implements.

Scientific importance of investigations: Cost-effective and more efficient implements will address the issue of scarcity of resources.

Results and achievements: Presently the *Lantana* plants are either cut or dug out by traditional method. In this process, after some time the roots of *Lantana* sprout again and the plants spread more densely covering still larger area. The Stalk puller developed by FRI was subjected to extensive field trials and found very advantageous and efficient.

Sl. No.: 15

Project identification No.: FRI-78/Silva-9

Name of the principal investigator: K.G. Sood

Title of the project: Development of Forestry Tools.

Sub-project: Development of Weed clearing tool.

Year of start of the project: 1997

Cost of the project: Rs. 0.5 lakhs

Objectives: To develop improved weeding tools.

Scientific importance of investigations: Development of Improved Weed Cutting tool will save cost and time in forestry operations.

Results and achievements: Two types of Weed clearing tools viz. Knife and Aggressive tooth pattern types weed-clearing tools have been developed with improved steel and design.

Sl. No.: 16

Project identification No.: FRI-06/Silva-6

Title of the project: Investigations into viability, germination and longevity of seeds of some important species of upper Gangetic Plains and framing of seed testing rules for *Ailanthus excelsa* and *Syzygium cumini*.

Year of start of the project: 1994

Cost of the project: Rs 0.30 lakhs

Objectives: To develop protocols for the storage and testing for germination under laboratory conditions.

Scientific importance of investigations: The study will enable longer seed storage. In addition, determination of the optimum germination conditions will provide a sound background for developing rules for certification of seeds.

Results/Achievements: Seed are tested in a seed testing laboratory for the purpose of issuing a seed analysis certificate. The International seed testing association has provided prescriptions for the testing of seed i.e., the optimum temperature, light, media, pretreatment, days to first count and days to final count. The same rules or prescriptions need to be developed for tree seeds of important Indian species like sissou, neem, bhimal (*Grewia optiva*), bamboo. Seed require 30°C temperature and top of paper for sissou and bamboo while between paper and 30°C for neem and bhimal.

The seeds of *A. excelsa* exhibited orthodox storage physiology and stored well beyond three years at low temperature with reduced seed moisture content. The seeds of *S. cumini* were short-lived and could not be stored for next sowing season. Seeds of both the species exhibited no dormancy and germinated well at 30°C on top of paper.

OLD PROJECTS CONTINUED DURING 1999-2000

Sl. No.: 1

Project identification No.: VI-51/97 NWFP

Name of the principal investigator: Dr. P.P. Bhojvaid

Title of the project: Central scheme for development of agro-technique and cultivation of medicinal plants.

- *Elaeocarpus ganitrus*
- *Prunus cerasoides*
- *Habenaria intermedia*
- *Microstylis wallichii*

Year of start of the project: Aug. 1998

Cost of the project: Rs. 14.0 lakhs

Objectives: To develop agro-techniques for cultivation of some important medicinal plants.

Scientific importance of investigations: Easily adoptable techniques will reduce pressure on scarce forest resources.

Results/Achievements:

Elaeocarpus ganitrus

Seeds of *E. ganitrus* from various provenances viz. Jalpaiguri, Coimbatore, Port Blair and locally collected seeds were sown in poly bags in NWFP nursery after various pretreatments.

Air layering was performed in *E. ganitrus* tree in March'99. About 50 % rooting was observed in May. Air layered shoots were later on transferred in the field. Observations on their growth and behaviour are regularly being taken.

In June and October'99 girdled and non-girdled stem cutting were planted in open nursery conditions after giving hormonal treatments of various concentrations. Sprouting was recorded but sooner or later the cuttings wilted out.

To study seasonal variation stem cuttings were again planted in March 2000 in root trainers (medium – sand + soil and vermiculite) in open and mist conditions after giving hormonal treatments of various concentrations. Good sprouting has been recorded.

In March 2000 air-layering was performed on *E. ganitrus* tree. Air layered shoots have been planted in poly bags in nursery. Observations are being recorded.

Prunus cerasoides

Seeds of *Prunus* were collected from Chakrata and nearby areas and were sown in poly bags and raised beds in the nursery after various pretreatments. No germination is observed till date.

Stem cuttings of *Prunus* were planted in poly bags in open nursery conditions after giving hormonal treatments of various concentrations. Initial sprouting was recorded but later on cuttings wilted out.

To study seasonal variation stem cuttings were again planted in February 2000 under Mist and open conditions in root trainers (medium-sand + soil and vermiculite) after giving hormonal treatments of various concentrations. Good initial sprouting has been observed.

Habenaria intermedia* and *Microstylis wallichii

Survey was conducted to identify the patches for the natural occurrence of the species in Chakrata and nearby areas.

Germplasm of the species was collected for *ex-situ* conservation at NWFP nursery, Chakrata and at FRI.

From the propagation, tubers of *Habenaria* and pseudo-bulbs of *Microstylis* were planted in nursery in August, 1999 to study the effect of Bed Type (Slant, Ridges and Furrows, Raised and leveled) and Soil Type (sand, sand and wood chips in various proportions and nursery soil). No observations could be recorded as both the species are in dormant condition since October'99. Observation would be recorded as and when sprouting occurs.

Sl. No.: 2

Project identification No.: FRI-111/FPD(TM) -24

Name of the principal investigator: J.D. Jain

Title of the project: Development of packing boxes from plantation grown timbers for horticultural produce.

Year of start of the project: October, 1997

Cost of the project: Rs.6.75 lakhs

Objectives: To design and develop more economic packing cases from plantation grown species.

Scientific importance of investigations: It will help in conserving scarce forest resources by using secondary species.

Results/Achievements: Packing boxes for holding of 20 kg weight of contents of new design using thin planks (3mm thick), wooden battens (2cm x 2cm) and iron binding straps were developed from two timber species i.e. *Populus deltoides* and *Grevillea robusta*. The boxes thus developed were tested for evaluation of their performance and results compared with conventional wooden boxes. Newly design box is stronger in flat drop test but weaker in compression test than conventional wooden box of same size.

Sl. No.: 3

Project identification No.: FRI-121/FPD(WS)-28

Name of the principal investigator: Dr. C.N. Pandey

Title of the project: Developing computerized control kiln drying systems.

Year of start of the project: Oct., 1998

Cost of the project: Rs. 8.50 lakhs

Objectives: To develop a system for computerized kiln drying.

Scientific importance of investigations: Improving energy efficiency of kiln design and development of new energy conserving process for seasoning of timber.

Results and achievements: The existing steam heated kiln of 7 m³ capacity was renovated and detailed specifications for the procurement of automatic kiln control components such as load cells, humidity and temperature control sensors, vent activator were prepared in consultation with the Director, USIC, Roorkee University, Roorkee. However computerization of Indian Standards Kiln drying schedules have been completed. Further work in the project is continued.

Sl. No.: 4

Project identification No.: FRI-134/FPD/30

Name of the principal investigator: J.D. Jain

Title of the project: Evaluation of physical and mechanical properties of *Populus deltoides*, *Ailanthus excelsa*, *Salix alba* and *Paulownia fortunei* and classification and grading of timber for different end uses.

Year of start of the project: April, 1999

Cost of the project: Rs.10.15 lakhs

Objectives: To conduct species wise evaluation of properties and classify and grade the plantations timbers for different end uses.

Scientific importance of investigations: Such studies will help in meeting the requirement of raw material for the industry by using secondary species harvested at short rotation.

Results/Achievements: According to the present system of grouping of timbers *Ailanthus excelsa* has been found to be light, very soft, very weak. Timber. It is suitable for block board core, frames and for such other purposes where light and soft timbers are required and load bearing capacity is not an important consideration.

Salix alba is moderately heavy, very weak, soft and moderately steady timber. From the present studies it seems to be suitable for cheaper varieties of sports goods, artificial limbs, handicrafts, toys etc. besides packing cases and crates.

Sl. No.: 5

Project identification No. : FRI-17/BOT-7

Name of the principal investigator: Dr. Sangeeta Gupta

Title of the project: Computerisation of anatomical database of Indian hardwoods for the purpose of their identification.

Year of start of project: October, 1997

Target year of completion: September, 2002

Cost of the project: Rs.1.90 lakhs

Objectives: To develop a software for computer assisted wood identification and prepare a CD having the wood anatomical details of all Indian woods alongwith their microphotographs.

Scientific importance of investigations : This package will automate identification procedure and reduce considerable time and energy required in carrying out manual identification.

Results/Achievements: A highly user friendly software (Wood Anatomy Information System - WAIS) has been prepared with following facilities:

The provision has been made for entering data as per National list (Brazier & Franklin, 1961) and International list (IAWA, 1989).

The software has all the details related to F.R.I. Xylarium.

Provision has been given for storing images of all the three sections (Cross, Radial and Tangential) of Indian woods which will serve the purpose of photomicrographic atlas of Indian woods.

The software can carry out wood identification by assisting users by asking such features which can short list the possible choices to the minimum. It gives the user the flexibility to skip features not known to him. Also a search order is given for reducing the time taken to search each feature in the sequence listed by IAWA.

Sl. No.: 6

Project identification No.: FRI-97/BOT-12

Name of the principal investigator: Dr. Luxmi Chauhan

Title of the project: Anatomical variation *vis-a-vis* wood quality in different clones of *Populus deltoides*.

Year of start of the project: October, 1997.

Target year of completion: March 2001

Cost of the project: Rs.5.65 lakhs

Objectives: (a) To study the variation in anatomical parameters and specific gravity in different clones of *P. deltoides* grown in plantations with a view to select superior/better clones for different end uses. (b) To develop a quick evaluation method for prediction of whole tree fibre length and specific gravity.

Scientific importance of investigations: The information generated in the project will have impact on tree improvement programmes for selection and screening of specific/better clones for greater wood production and proper utilisation.

Results/achievements: 18 clones of *P. deltoides* collected from Forest Nursery, Lal Kuan, Haldwani were taken for study. Data on various anatomical parameters such as sp.gr., fibre and vessel characteristics have been collected to study both on vertical and radial within tree variation. The data are being analysed for inter clonal variation and effect of age on selected anatomical parameters. The correlations between specific gravity and anatomical parameters will also be worked out for assessing the wood quality of different clones for their utilisation as solid wood or for pulp and paper and also for developing a quick evaluation method for the prediction of whole tree values for fibre length and specific gravity.

The studies on effect of spacing in three clones viz. G3, G48 and D121 indicate that with wide spacing, the girth of trees and specific gravity increases while the fibre length decreases.

Sl. No.: 7

Project identification No.: FRI-87/C&P-6

Name of the principal investigator: Dr. Sushma Mahajan

Title of the project: Environmental Protection through modified pulping and bleaching process- Alkaline peroxide pulping and bleaching of non-woods.

Year of start of the project: 1998

Target year of completion: March, 2002

Cost of the project: Rs. 0.34 lakhs

Objectives: To get better pulp with less pollution load.

Scientific importance of investigations: Small Indian paper mills using wheat straw, rice straw and bagasse bleach their pulps with chlorinated compounds generating pollutants in the form of organic matter and chlorinated compounds, which are toxic and carcinogenic. So by suitably modifying the conventional bleaching of non-woods, amount of pollutants can be reduced without sacrificing pulp quality and quantity.

Results/Achievements: Number of bleaching experiments on soda pulps of wheat straw and rice straw were carried out using conventional bleaching chemicals and suitably replacing them with oxygen, hydrogen peroxide and chlorine dioxide under different conditions.

Effluents generated from above bleaching sequences for whole rice straw and upgraded rice straw are being analyzed for, total solids, suspended solids and COD etc.

Sl. No.: 8

Project identification No.: FRI-91/C&P-10

Name of the principal investigator: Dr. Sanjay Naithani

Title of the project: Studies on modification of industrial lignin for imparting delignifying properties.

Year of start of the project: 1998

Target year of completion: March, 2002

Cost of the project: Rs. 0.65 lakhs

Objectives: To identify economically viable chemical additive for accelerating delignification for higher pulp yield, and reducing chemical demand during bleaching.

Scientific importance of investigations: A group of highly effective alkaline pulping additives has been reported in literature. These reagents are not commercially attractive because of their high cost. Ideally a new chemical additive should give good pulp yield and quality and yet be cheap. The project will achieve this end.

Results/Achievements: Number of experiments on kraft pulping of bamboo were carried out with and without chemical additive (16% total alkali and 25% sulphidity). The additive was varied from .5 to 2.0 % on

o.d. raw material basis. The maximum increase in pulp yield (1.7%) was observed with 2.0 % addition of chemical additive

Pulping experiment of bamboo was carried out at reduced alkali concentration (15% T.A. and 25% sulphidity). The pulp yield, kappa number and strength properties of pulps obtained were determined.

Pulping experiments of *Eucalyptus tereticornis* were carried out with and without chemical additive using Kraft pulping (16%, T.A. and 18% sulphidity). The increase in pulp yield, strength properties and reduction in Kappa number were observed.

SI No.: 9

Project identification No.: FRI-94 C&P / 13

Name of the principal investigator: Dr. Anita Srivastava

Title of the project: Effluent treatment in Pulp and Paper industry: Production of nitrogen fertilizer/soil conditioner.

Year of start of project: 1998.

Target year of completion: 2001

Cost of the project : Rs. 6.25 lakhs

Objectives: (a) Recovery of commercial lignin from black liquors, purification and characterization. (b) Optimization of reaction conditions for Oxidative ammonolysis of lignin to incorporate highest possible amount of nitrogen in lignin.

Scientific importance of investigations: Utilization of waste lignosulphonate by modifying it into N – modified lignosulphonate through oxidative ammonolysis, which would act as a slow nitrogen releasing fertilizer /soil conditioner, would reduce ground water pollution. Further, the biopolymer will be returned to the soil contributing towards ecological balance of soil.

Results/Achievements: It was observed that amount of nitrogen in Ligno sulphonate increases with the increase in reaction time and temperature. Consequently, the C/N ratio decreased. However, reaction temperature has more pronounced effect on nitrogen incorporation rather than the reaction time. Further work is in progress.

SI No.: 10

Project identification No.: FRI-129/C&P –14

Name of the principal investigator: A.K. Rai

Title of the project: Improved utilization of raw materials for pulp and paper making including juvenile tree utilization.

Year of start of the project: 1999

Target year of completion: 2001

Cost of the project: Rs. 3.99 lakhs

Objectives: To explore and identify new raw materials for the manufacture of various grades of paper, particularly from plantation grown and juvenile woods.

Scientific importance of investigations: Utilizing new raw materials for the pulp and paper manufacture will reduce pressure on conventional resources.

Results/Achievements: Eighteen clones of *Populus deltoides* were tested for proximate chemical analysis. The alcohol – benzene solubility varied from 1.25 – 4.52 %, lignin content varied from 22 to 27 % and holocellulose varied from 72.62 – 75.83 % for all the eighteen clones. Kraft pulping of 4 clones of *P. deltoides* of 5 years age with 16 % total chemicals was carried out. The pulp yields were in the range 52.13 to 57.16 % and kappa number variation was 20 – 22. The poplar clone S7C31 gave the best results i.e., 57.16 % pulp yield at 20- kappa number as compared to other three clones.

Paulownia fortunei was evaluated for unbleached grade and bleached grade paper using 14% and 16 % total chemicals by using kraft process. The results are given below:

SL No	TOTAL CHEMICAL (AS Na_2O , %)	PULP YIELD %	KAPPA NUMBER	TENSILE INDEX	TEAR INDEX	BURST INDEX	FOLD MIT	AIR RESISTANCE S/100MM
1	14	51.0	25	106.12	2.67	6.47	763	432.6
2	16	44.54	23	99.84	2.49	5.50	668	276.7

It will be seen from the data above that from *P. fortunei* wood kraft paper of good strength properties and yield can be prepared and it may be a promising raw material for the pulp and paper manufacture if made available on large scale.

Sl. No.: 11

Project identification No.: FRI/51/Chem-1

Name of the principal investigator: Dr. P.L. Soni

Title of the project: Studies on isolation and characterisation of polysaccharides of abundantly available seeds of trees/shrubs, leaves, bark and exudate gums.

Sub-project: Study of *Cassia tora* seed gum (CTG) to find its uses.

Year of start of the project: March, 1997

Target year of completion: 2001

Cost of the project : Rs.12.33 lakhs

Objectives: Structural investigation of *Cassia tora* linn. seed polysaccharide.

Scientific importance of investigations: The project will generate new product and process.

Results/Achievements: *C. tora* gum was fractionated into cold water soluble (12%) and hot water soluble (12%) and purified. Cold water soluble polysaccharide was hydrolysed, derivatised and GLC analysis was carried out which showed its constituent monosugars are galactose and mannose. Synergistical action of bacterial food polysaccharide (Xanthan gum) with *C. tora* gum produces gel which can be exploited for making gellies, marmalade, jam etc. A sample (500gm) was supplied to India Herbex Pvt. Ltd., Karnal for their assessment. Initial reports from end users are very encouraging. Marmalade and Jam industry uses

0.6% of citrus pectin while they will need only 1% of this product to produce the same quality of Jam/marmalade. Likely cost of production *C. tora* based pectin would be Rs.70-80/kg whereas citrus pectin is available at the rate of Rs.400-500/kg. This process to make a substitute of pectin from *C. tora* is to be patented.

A patent entitled "Process for the preparation of *Cassia tora* Gum" having modified morphological character and an increase in the Zeta potential was filed (No.1542/Del/99, 16 Dec., 1999). Modified (gaseous phase reaction) *C. tora* gum will find application in paper industry as wetend additive and flocculent for back water treatment, and for mud setting in sugar industry and as thickner in textile printing etc.

Sl. No.: 11(1)

Project identification No.: FRI/51/Chem-1

Name of the principal investigator: Dr. P.L. Soni

Sub-project: Preparation of flocculants by chemical modification of the galactomannan/starch derived from the biopolymers for the treatment of industrial discharge and recovery of materials.

Year of start of the project : 1997

Target year of completion : 2002

Cost of the project : Rs.11.5 lakhs

Objectives : Chemical modifications of polysaccharides for industrial applications.

Scientific importance of investigations: The project will generate new product and process.

Results/Achievements: Cyanoethylation of *Cassia tora* gum was carried out to study the optimum conditions for modification of this gum. Variables studied were temperature, concentration of acrylonitrile and alkali. Increase in temperature resulted in products with low cyanoethylation. The best conditions were obtained using 30°C temperature. Similarly maximum modification was obtained using 2.5% of NaOH. The extent of cyanoethylation was maximum by using 1:1 concentration of gum and acrylonitrile. The chemical modification using acrylonitrile resulted in complete water soluble product with increased viscosity and solution stability upto 72 hours. Chemical modification of guar gum (*Cyamopsis tetragonolobus*) was carried out to increase its solution viscosity and stability in cold water. Variables studied were temperature and conc of acrylamide. Increase in temperature had a detrimental effect on the extent of reaction expressed in terms of concentration of nitrogen. The maximum modification occurred using 30° C temperature. In contrast to cyanoethylation, the apparent viscosity was maximum using minimum concentration of acrylamide (.03175 mole). The products were completely cold water soluble and a dramatic increase in solution stability was obtained from one day to seven days. The products can be utilised as viscosifier, thickner in textile printing etc. Four paper entitled (a) Preparation of flocculants using modification of biopolymers - Part I: Carbomoyethation of guar gum; (b) Ceric Ammonium nitrate - initiated graft copolymerization of acrylamide onto *Cassia tora* gum; (c) Pyrolytic cleaved products of starch - Dextrins : Prospects and Perspectives; and (d) Recent development in Galactomannan applications, were presented at XIVth Carbohydrate Conference held at I.I.T. Madras during Dec. 16-17, 1999.

Sl. No.: 11(2)

Project identification No: FRI/51/Chem-1

Name of the principal investigator: Dr. P.L. Soni

Sub-project: Chemical Investigation of *Kydia calycinia* bark polysaccharide.

Year of start of the project: 1997

Target year of completion: Feb.' 2002

Cost of the project: Rs.22.35 lakhs

Objectives : Chemical Investigation of *Kydia calycinia* bark polysaccharide.

Scientific importance of investigations: The project will generate new scientific data.

Results/Achievements: Pure polysaccharide was partially hydrolysed with 0.1, 0.5 and 0.75N, sulphuric acid for 13, 24, and 16 hrs. respectively. One oligosaccharide was obtained in each partially hydrolysed hydrolysate. GLC analysis shows that *K. calycinia* polysaccharide is composed of glucose, mannose, galactose, rhamnose, arabinose, xylose and glucuronic acid. Optical rotation of the constituent monosugars were determined. Uronic acid content determined spectrophotometrically in polysaccharide was found to be 6 per cent only. ¹HNMR of the polysaccharide was carried out.

Sl. No.: 12

Project identification No.: FRI-52/Chem-2

Name of the principal investigator: Dr. P.L. Soni

Title of the project: Development of adhesives from renewable sources.

Year of start of the project : 1997

Target year of completion : 2002

Cost of the project: Rs.9.55 lakhs

Objectives: Development of adhesive from biopolymers.

Scientific importance of investigations: The project will generate new product and process.

Results/Achievements: Analysis of tannins of *A. catechu* and *U. gambier* was carried out to find the percentage of reactive group and nature of tannins. Condensation of tannins with formaldehyde and fortification with phenol-formaldehyde under different molar concentrations were carried out. Adhesive so prepared is being tested for making plywood.

Synopsis entitled "Development of Adhesives from Biopolymer" was submitted by Ms Smita Mathur for her Ph.D. work under Dr. P.L. Soni and Mr. K.S. Shukla, supervisor and co-supervisor respectively. After synopsis seminar by Ms Smita Mathur it was admitted for her Ph.D. work.

Sl. No.: 13

Project identification No.: FRI-53/Chem-3

Name of the principal investigator: Dr. Rameshwar Dayal

Title of the project: Phytochemical examination for the utilisation of leaves, barks, fruits and root of Indian forest trees.

Sub-project : Studies on vegetable dyes from *Shorea robusta*, Lantana, Teak, *P. roxburghii*, and *P. deltoides conyzoides*.

Year of start of the project: 1994

Target year of completion: 2003

Cost of the project: Rs.19.20 lakhs

Objectives: Development of natural dyes from hitherto unexplored abundantly available plants to protect the environmental pollution.

Scientific importance of investigations: The project will generate new environment friendly products and processes.

Results/Achievements: Methods were standardized to isolate dye from *Shorea robusta* (bark), Lantana (leaves) and other species. Optimum dyeing conditions using these dyes and mordants were determined. Fascinating shades with good fastness properties were developed on silk, wool and cotton using Lantana and Sal dyes. Practical demonstration of dyeing with natural dyes was done in Virasat Mela (Dehra Dun), on World Environment Day and on Technology Day (Mussoorie). Experimental trial of pine sawdust compost on wheat and *Eucalyptus* saw dust compost on Poplar gave very good results. Double yield of wheat in comparison to control was obtained while 0.5 meters higher growth & 1.5 times increase in diameter was observed with poplar.

Sl. No.: 13(1)

Project identification No.: FRI/53-Chem-3

Name of the principal investigator : Dr. Rameshwar Dayal

Sub-project: Screening of *Cephalotaxus harringtonii* needles for bioactive principles.

Year of start of the project: 1997

Target year of completion : 2003

Objectives : To isolate and characterize novel bioactive compounds from *Cephalotaxus harringtonii* needles.

Scientific importance of investigations: The project will generate new natural product(s) and scientific data.

Results/Achievements: Preparation of the needles extracts with different solvents like petroleum ether, acetone, methanol and 25% water methanol was completed. Five compounds— B, C, D, F and H were isolated from the acetone and methanol extracts using column chromatography / TLC, their acetates were prepared and spectral data (IR, NMR and MS) were recorded at QUT, Australia. Their structures were elucidated as ginkgetin (C), sequoiaflavone (D) and apigenin-neohesperidoside (F, a new compound) using spectral data. Compound C showed very good hepatoprotective activity. Structure elucidation of B and H is in progress.

Sl. No. : 13(2)

Project identification No.: FRI/53-Chem-3

Name of the principal investigator: Dr. Rameshwar Dayal

Sub-project: Development of pest control agents and other bioactive compounds from *Vitex negundo*

Year of start of the project: 1997

Target year of completion : 2003

Objectives: To isolate and characterize the chemical compounds from *Vitex negundo* and screening their biopesticidal activity.

Scientific importance of investigations: The project will generate new natural product(s) and scientific data.

Results/Achievements: Extracts of *Vitex negundo* leaves were prepared using petroleum ether, acetone and methanol. Compounds namely VNLA1, VNLA2, and VNLA3 were isolated from the acetone extract and their spectral data (IR, ¹HNMR, ¹³CNMR and MS) were recorded at QUT, Australia. These were characterised as 5,3'-dihydroxy-6,7,4'-trimethoxy flavanone, p-hydroxybenzoic acid and 5-hydroxy-3,6,7,3',4'-penta methoxy flavones.

Three compounds (VNL1, VNL2, and VNL6) were isolated from the methanol extract and their structures were elucidated as agnuside, 3, 4-dihydroxy benzoic acid and 2'-p- hydroxybenzoyl- mussaenosidic acid by spectral data. A method was standardised to isolate agnuside in ~2% yield from the leaves. Essential oil isolated from the flowering twigs was analysed by GC-MS.

Viridiflorol a major constituent of the essential oil of the leaves, agnuside a main compound of the methanol extract of the leaves, water extract, petrol, acetone and methanol extracts showed highly significant antifeedant activity against rice weevil, *Sitophilus oryzae*. Viridiflorol also showed significant ovipositional activity against pulse beetle, *Callosobruchus chinensis*.

Sl. No.: 14

Project identification No.: FRI-22/Eco-1

Name of the principal investigator: Dr. J.D.S. Negi and Dr. S.C. Sharma

Title of the project: Regeneration, Mortality and Species diversity in Sal forest of U.P.

Year of start of the project: 1998

Target year of completion: 2002

Cost of the project: Rs.22.00 lakhs

Objectives: (a) To assess the cause of poor regeneration and mortality in sal forest of U.P. (b) To develop the methods for restoring species diversity of sal forests. (c) To assess the carrying capacity and sustainable productivity of sal.

Scientific importance of investigations: The study will suggest measures to accelerate regeneration of sal and restore biodiversity.

Results/Achievements: Rishikesh Range and Lachiwala Range exhibited better regeneration and can be considered as potential regenerative areas for future. Whereas Phandowala in Ramgarh Range exhibited total failure of sal regeneration.

Studies showed that the canopy openings with low Leaf Area Index (LAI) and soil moisture are the most important factors for improving regeneration of *Shorea robusta*.

Sl. No. 15

Project identification No.: FRI-83/ Eco-2

Name of the principal investigator : Dr. J.D.S. Negi

Title of the project: Ecological monitoring of biological diversity and conservation strategy in regions of U.P.

Sub project: Structure and functioning of selected 'Hot-Spot' diversity areas for conservation of rare and threatened species.

Year of start of the project: April 1999

Target year of completion: March 2001

Cost of the project : Rs.12.8 lakhs

Objectives: *Long term* (a) To determine the ecological succession and future of ecosystem. (b) Conservational strategies (*in situ*) of rare and threatened species.

Short-term : (a) To determine the population structure and community organization based on resource availability. (b) Plant trait and their strategy with relation to altitudinal variation.

Scientific importance of investigations: The study will help in evaluating the environmental conditions, which have changed with time and space. If suitable steps are taken in time to conserve the present status of the system, there is every possibility that the species which are under threat, will bounce back to as a result of cycling succession.

Results/Achievements: Preliminary survey has been made in temperate forest ecosystem of Garhwal Forest Division.

Sl. No.: 16

Project identification No.: FRI-116/Eco-3

Name of the principal investigator: Dr Laxmi Rawat

Title of the project: Impacts of pollutants on tree species in Doon valley.

Year of start of the project: 1998 (Oct)

Target year of completion: 2003 (March)

Cost of the project: Rs.3.00 lakhs

Objectives: (a) To assess eco-physiological changes due to pollutants. (b) To evaluate the efficacy of sal forests in pollution abatement on highways.

Scientific importance of investigations: Trees absorb the harmful gaseous pollutants. Through metabolic activities like photosynthesis etc. these pollutants are gradually converted into harmless metabolites. Selection of tree species, which can be grown around industrial complex or urban areas, requires a complete know-how about plants and their expected behaviour in a polluted environment. This study will find out the levels of pollutants and their adverse effects along the gradient and suggest the structure of planting along the highways.

Results/Achievements: Selection and designing of experimental plots have been done. Initial study of vegetation, collection of soil samples, canopy structure, leaf area index has been completed for one period.

Sl. No.: 17

Project identification No.: FRI-117/Eco- 4.

Name of the principal investigator: Dr. Kalyan Singh

Title of the project: Role of forests in soil and water conservation.

Year of start of the project: December, 1998

Target year of completion: December, 2003

Cost of the project: Rs. 15.5 lakhs.

Objectives: To study hydrology and nutrient dynamics in forest watershed of Shiwaliks.

Scientific importance of investigations: Proposed study will provide the information on soil and hydrology of the forest watersheds in Shiwaliks. The relationship of trees, shrubs, grasses and other ground covers with water yield, soil erosion, quality of filtering capacity for clearing water, nutrients and water dynamics, evaporation and evapo-transpiration rates due to shade and shelter effects, habitat for macro and micro-organisms, etc. can be assessed under given watershed conditions. Changes in diurnal variations as a result of the forest watershed treatments may also give insight into deep slope hydrologic processes.

Results/Achievements: Kulhal watershed (Bhura Shah Rao) was selected in Shiwaliks of Dehra Dun district (U.P.) for detailed watershed management studies. The other two micro-sites at Asarori and Selakui were selected for comparative assessment of erosion and hydrologic hazards. Soil, vegetation and hydrological studies have been initiated in Kulhal forest watershed. Infiltration rate, cumulative infiltration and available water percentage were found more in forest watersheds than the treeless micro-sites. Mixed forest watershed had higher values of these parameters than the soil under pure sal. Hydraulic conductivity increased with moisture content. Further, vegetated watersheds had lower bulk density, higher pore space, higher water retention, higher organic matter, higher nutrient contents (NPK) and lower surface runoff of water than the watershed having no tree cover. Further studies are in progress.

Sl. No.: 18

Project identification No.: FRI-130/Eco-5

Name of the principal investigator: Dr H.B. Vasistha

Title of the project: Plant growth strategy characterization, diversity and vegetational dynamics of rehabilitated and derelict mined ecosystem in Western Himalaya.

Year of start of the project: Oct., 1999

Target year of completion: Sept. 2004

Cost of the project: Rs. 11.00 lakhs

Objectives: (a) To provide inputs for eco-restoration of degraded habitats in the Himalayan region.
(b) Biodiversity conservation in degraded habitats.

Scientific importance of investigations: The study will be of value in suggesting the species to be used for revegetation of degraded habitats and restoration of bio-diversity thereof.

Results/Achievements: Analysis to find out the relationship between plant strategy, diversity and resource availability is under progress. Preliminary observations of soil moisture content for two successive period (Oct-Nov & March-April) at two different depth (0-15 cm & 15-30 cm) of different microhabitats identified at rehabilitated and derelict mined ecosystem show higher a value of moisture percentage at lower depth (15-30 cm).

Alnus nepalensis dominated microhabitat was found to contain high moisture value at both the depth as compared to *Cupressus torulosa* dominated microhabitat in mined rehabilitated sites.

Sl. No.: 19

Project identification No.: FRI-131/Eco-6

Name of the principal investigator: Dr. H.B. Vasistha

Title of the project: Role of Forest Cover in Landslides in Himalaya.

Year of start of the project: 1999

Target year of completion: Sept. 2001

Cost of the project: Rs. 7.10 lakhs

Objectives: (a) Implication of forest cover and deforestation on landslides. (b) Surveillance of past landslides and analysis of possible causes.

Scientific importance of investigations: It would be possible to take up the remedial measures for combating landslides.

Results/Achievements: Field survey has been carried out in Alaknanda and Mandakini valley of Garhwal hills of Western Himalaya. A total 51 landslides ranging from small to big have been identified. In relation to vegetation type, a maximum of 17 number have been spotted in *Pinus roxburghii* dominated forests followed by 10 in *Alnus nepalensis* dominated forests five each in mixed and cultivated areas and only one in *Quercus leucotrichophora* forests. As regard to the altitudinal variation, a large number of landslides (21 nos.) were spotted in between 1100-1600 m, followed by 12 in 1600-2000 m, seven in 700-1100m and only four in 2000 m and above altitudinal range.

In relation to disturbances, the largest number of landslides (19 nos.) have been spotted in the areas having intense biotic disturbances biotic (i.e. grazing, lopping, cultivation etc.) followed by road construction (12 nos), change in natural drainage pattern (9 nos.) and natural calamities (earthquake, cloud burst) (3 nos).

Sl. No.: 20

Project identification No.: FRI-63/FED-2.

Name of the principal investigator: R.S. Bhandari

Title of the project: Management of sal heart wood borer in natural forests.

Year of the start of the project: April, 1993.

Target year of completion: March, 2002

Cost of the project: Rs. 13.0 lakhs

Objectives: (a) To protect the Sal forest from sal heart wood borer and evolve environmentally safe and economically viable management methods for the control of sal heart wood borer. (b) Epidemiology of sal heart-wood borer and testing and analysis of oozing sap (Kairomone). Use of Kairomone for management. (c) To work out possible biological control agents and their efficiency. (d) To develop integrated approach (IPM) for the management of sal heart-wood borer.

Scientific importance of investigations: Studies on kairomone (a new approach) will be a significant contribution in controlling the borer epidemics, besides trap tree operation.

Results/Achievements: The study revealed that the incidence of attack decreased following large scale trap tree operation. During the year 1997, 1998 and 1999, the incidence was 15%, 11%, and 9%. There was no heavy attack of borer in those compartments where trap tree operation was carried out. The incidence of the borer was found higher in compartments where no trap tree operation was conducted.

A special type of trap was fabricated locally for testing and using Kairomone to attract beetle of the borer *H. spiniornis* in the field. Essential oil isolated from sapwood, resin and heartwood was sent to QUT for GCMS analysis. These kairomone traps were modified further. Further purification of the extracts of sal tree is in progress so as to achieve best possible results.

Sl. No.: 21

Project identification No.: FRI-76/FED-6

Name of the principal investigator: Arun P. Singh

Title of the project: Evaluation of natural resistance in different clones/hybrids of *Populus deltoides* against important defoliators.

Year of start of the project : April 1997

Target year of completion: March, 2001

Cost of the project: Rs. 0.35 lakhs

Objectives: (a) To identify and rank resistant and susceptible clones of *Populus deltoides* against its important defoliators. (b) To find out physical characteristics of the plant (clone) such as leaf shape, leaf size, height, sprouting time; leaf fall and growth, factors correlated with resistance/susceptibility. (c) To determine the feeding potential of the pest on different clones by the sex of the pest. (d) To determine the feeding potential of the pest correlated with the larval weight and period; pupal weight and period.

Scientific importance of investigations: Insect resistant clones will be identified for raising large scale plantations.

Results/Achievements: Experiments to evaluate natural resistance/ susceptibility of 150 *Populus deltoides* clones/hybrids against the defoliator *Clostera cupreata* were carried out on the basis of feeding potential of the pest. The data analysis for 130 clones has been completed. The work on 150 more newly introduced clones from U.S.A. is in progress.

Sl. No.: 22

Project identification No.: FRI-8/SF-1

Name of the principal investigator: Shivendu K. Srivastava and K.K. Sharma.

Title of the project: Effect of Trees on Agricultural Crops.

Year of start of the project: 1996

Target year of completion: Sept. 2001

Cost of the project : Rs 6.00 lakhs

Objectives: (a) To study the effect of leaf litter of *Eucalyptus*, *Populus deltoides* and *Dalbergia sissoo* on germination and growth of agricultural crops. (b) To study growth and yield of different varieties of wheat in

block plantation of poplar. (c) To study performance of papaya and shade-bearing crops in block plantation of poplar.

Scientific importance of investigations: The study will provide information about the feasibility of growing papaya and shade-bearing crops under poplar in block plantation. The project will also identify less shade-sensitive cultivars of wheat for intercropping with poplar in block plantation.

Results/Achievements: Performance of six varieties of wheat, which were under planted with 3-year-old block plantation of poplar, was evaluated. Variety PBW 3077 gave the greatest grain yield (weight as well as number of grains) per unit area. Variety PBW 172 produced the shortest plants but this variety was intermediate in terms of grain yield.

In another study, wheat and pea were grown in soil mixtures containing leaf litter of (a) *Eucalyptus*, (b) *Populus deltoides* and (c) *Dalbergia sissoo*. The germination and seedling growth were not significantly affected by the presence of leaf litter of any of the tree species. This suggests that the allelo-chemicals released by these trees in the soil in agroforestry situation do not significantly reduce the germination and growth of the crops. The losses in crop growth due to trees, as reported by other workers, should be ascribed to the reduction in photosynthesis in crops caused by shade of trees, physical hindrance by tree leaves, to emergence of seedling of crops, competition between tree and crop for moisture, nutrients, etc. rather than to allelopathy *per se*.

In another trial, papaya was under planted in a block plantation having 3 year old poplar plants at three different spacings. No significant differences were found in height and diameter of papaya in the first year of growth. However, papaya failed to produce flowers during this period.

Sl. No.: 23

Project identification No.: FRI-73/SF-2

Name of the principal investigator: Dinesh Kumar

Title of the project: *Paulownia* propagation and introduction.

Year of start of project: 1997

Target year of completion: Sept. 2001

Cost of the project : Rs 8.00 lakhs

Objectives: (a) Development of nursery and planting technology for *Paulownia* species. (b) Development of new clones of different species of *Paulownia*, their evaluation and multiplication. (c) Laying out of field trials to study the field performance of *Paulownia* clones.

Scientific importance of investigations: The study will help in examining the potential of growing *Paulownia* in India. Nursery and planting techniques of *Paulownia* will be developed suiting Indian conditions.

Results/Achievements: Plants of 175 newly produced clones of three species of *Paulownia* were raised in the nursery during 1999. The plants were evaluated after one year of growth in the nursery and the best 100 clones were identified for future testing.

A replicated trial of selected 100 clones of three species of *Paulownia* has been laid out in randomized block design in the nursery during March 2000.

In a nursery experiment, black plastic mulch significantly improve height, collar diameter and dbh of *P. fortunei* plants. Collar diameter and dbh in the mulched plants were about twice of the control plants after one year of planting root cuttings.

A field trial consisting of *Paulownia* plants in three different planting geometries was laid out at village Devipur, dist. Dehra Dun during March 2000. Another field trial comprising three different kinds of planting stock has been established in village Meerpur, district Hardwar.

Sl. No.: 24

Project identification No.: FRI-120/FPD(WS)-27

Name of the principal investigator: Dr. C.N. Pandey

Title of the project: Chemical plasticization and densification of wood for making bent wood components for furniture and joinery.

Year of start of the project : 1998

Target year of the project: 2001

Cost of the project: Rs.2.5 lakhs

Objectives: To produce compressed wood after vapour phase ammonia treatment and testing its properties for arched doors, window frame and oval table tops where losses due to cutting are quite significant.

Scientific importance of investigations: Versatility in use of wood will be achieved.

Results and achievements: Using the process of vapour phase ammonia plasticization and subsequent densification it was possible to achieve embossing on 5 timber species namely *Mangifera indica*, *Dalbergia sissoo*, *Tectona grandis*, *Populus deltoides* and *Albizia procera*. Results showed that the technique can be utilized on commercial scale to achieve embossing on these woods. Optimization of treatment period, pressing load, time and temperature were standardized. Embossing is being tried for the first time.

Sl. No.: 25

Project identification No.: FRI/40/FPD(WS)-3

Name of the principal investigator: A.S. Kambo

Title of the project: Studies on reducing drying time in solar kiln.

Year of start of the project: 1998

Target year of the project: 2001

Cost of the project: Rs.1.2 lakhs

Objectives: To explore the possibility on reducing drying time in the solar kiln by incorporating dehumidification drying technique.

Scientific importance of investigations: The results will help reduce seasoning time of wood.

Results and achievements: The existing solar kiln at FRI got renovated and a dehumidifier was installed to compare drying time. Two identical charges of 40 mm thick wooden planks were dried in the solar-cum-

dehumidification kiln and data collected. Data is also being collected from the trials carried out in solar-cum-dehumidification plants installed at Trivendrum and Jodhpur.

Sl. No.: 26

Project identification No.: FRI/110-FPD(CW)-23

Name of the principal investigator: Satish Kumar

Title of the project: Chemical modification of wood particle and fibres for enhanced durability and performance of solid wood reconstituted pannels.

Year of start of the project: 1997

Target year of completion : Dec. 2001

Cost of the project : Rs.2.5 lakhs

Objectives: (a) To produce improved panels with enhanced durability and dimensional stability from different types of materials. (b) To develop non toxic methods of preserving wood.

Scientific importance of investigations: Particle boards/MDF have found much acceptance in the Indian market because of their performance vis-à-vis plywood and solid wood. Improved properties of such products will favour their utilisation. Most of the conventional wood preservatives containing chromium, arsenic, pentachlorophenol etc. are not environmental friendly and are likely to be phased out. Since protection of wood is a must to save forests, such alternate methods will be useful if preservative like CCA are banned.

Results/Achievements : *Eucalyptus* hybrid wood particles were prepared and treated with acetic anhydride and xylene in the ratio 1:4 at temperature $125+5^{\circ}$ C for different time interval by vapour phase treatment. Particle boards from the treated particle were prepared. Physical and mechanical properties of the boards were determined. The results showed that water absorption (general and due to surface) and linear expansion in the acetylated board were less than the untreated board. In acetylated boards there was negligible change in the value of modulus of rupture (MOR) and tensile strength perpendicular to the surface as compared to untreated board. Samples of acetylated boards were also prepared for termite mound tests. *Eucalyptus* hybrid wood particles were treated with 37% formaline in vapour phase at $120+5^{\circ}$ C and their boards were prepared to study their properties.

Sl. No.: 27

Project identification No.: FRI-135/FPD(WP)-31

Name of the principal investigator: Dr. Indra Dev

Title of the project: Studies on natural durability, treatability and efficacy of preservative treated wood species including plantation species.

Year of the start of the project: Oct. 1999

Target year of completion: Sept. 2002

Cost of the project: Rs.16.82 lakhs

Objectives : To evaluate natural durability/treatability of bamboo and plantation grown wood species and efficacy of preservatives.

Scientific importance of investigations: Proper preservative treatment will enhance durability of wood and bamboos.

Results and achievements : Culms of *Bambusa tulda* treated with CCA and CCB by non-pressure methods in green condition at three levels were analysed for chemical content and samples of size 30 cm length were prepared and installed in the test yard. Samples of *Ailanthus excelsa* and *Azadirachta indica* were treated with CCA and creosote fuel oil at three levels and installed in the test yard. Periodic inspection of old and new samples was carried out at Chakrata, Dehra Dun centres. Further observations are on.

Sl. No. : 28

Project identification No.: FRI-85/ FSLR-8

Name of the principal investigator: Dr. M.K. Gupta

Title of the project: Efficiency of organic *vis-a-vis* chemical fertilizers in improving the productivity of sodic soils.

Year of the start of the project : October 1997

Target year of completion : March 2002

Cost of the project : Rs.7.45 lakhs

Objectives : a) To compare the effects of applied chemical and organic fertilizers on the performance of tree species in sodic soils. b) To assess the soil amelioration due to applied nutrition and tree species under test. c) To find out efficient, cost effective and ecofriendly substitute of chemical fertilizers.

Scientific importance of investigations: The chemical fertilizer are costly and may lead to pollution of ground water. Nitrate contamination of ground water is one of the most important environmental hazard. The present investigation will help in standardising the use of organic fertilizer for sustained growth of tree species through slow and steady nutrient release to ameliorate and increase the productivity of sodic soils.

Results/Achievements : Processing and analysis of soil samples were done. Amended soil (collected from pits) have shown improvement in physical as well as chemical characters. Soils of study site have not shown any significant changes in their physio-chemical characters. Preliminary data of growth parameters indicate that for *Albizia procera*, the treatments with mustard cake 0.5 kg/pit, neem cake 1.0 Kg / pit and sunflower cake 0.5 kg / pit are effective and for Eucalyptus, mahua cake 0.5 & 1.0 Kg / pit, neem cake 0.5 and 1.0 kg / pit and sunflower cake 0.5 kg / pit are more effective.

Sl. No.: 29

Project identification No.: FRI-123/ FSLR-10

Name of the principal investigator: Dr. M.N. Jha

Title of the project : Studies on sustainability of soil fertility in natural forest ecosystems of Doon Valley.

Year of the start of the project : October 1998

Target year of completion : October 2001

Cost of the project : Rs.9.10 lakhs

Objectives : (a) Collection of base line information on selected wet land forest ecosystems of Doon Valley (b) To Work out soil indices for sustainability of soil fertility (c) Use of GIS on selected sites for mapping.

Scientific importance of investigations: This study will bring out comprehensive data supported information on the state of existing wet lands of Doon Valley. GIS based map for the purpose of conservation of these areas may be proposed on this basis.

Results/Achievements : Soil and water sample were collected from six selected sites from Golatappad and processed. Analysis of physico-chemical attributes is in progress. Vegetation study in all selected sites has been completed. Litter study and ground flora study were also carried out in all selected sites and data processing and tabulation are in progress.

Sl. No.: 30

Project identification No.: FRI-27/ FSLR-4

Name of the principal investigator: Dr. M.N. Jha

Title of the project : Sustainable Management of Sodic Soil

Year of the start of the project: April, 1997

Target year of completion: March, 2002

Cost of the project : Rs.12.30 lakhs

Objectives: a) Use of farm and Industrial wastes in biological rejuvenation of sodic soils. b) To find out suitable and cost effective substitute of gypsum and organic residue.

Scientific importance of investigations: Fly ash is a massive by product of coal based thermal power plants in India. Unless disposed off effectively and safely, it remains suspended in air and causes serious air pollution. Using fly ash as an ameliorant for sodic soils can effectively solve the problem of disposal and improve the bioproductive potential of land which is otherwise rendered waste due to sodicity.

Results/Achievements: Observations on survival and growth (collar circumference, plant height and crown spread) were taken. Data processing and tabulation was done. The data indicate that, as far as survival of the plants are concerned, treatments like Gypsum + Fly ash; Gypsum + Rice husk + Fertilizer + Fly ash; Gypsum + Fertilizer + Rice husk + 1:1 (Soil : Fly ash) are effective. The treatments like Gypsum + Fertilizer + Rice husk + 1:1 (soil : Fly ash); Fertilizer + 1:1 (Soil : Fly ash); Gypsum + Rice husk + Soil; Fertilizer + Fly ash are effective for plant growth.. Monitoring of experiment is currently going on.

Sl. No.: 31

Project identification No.: FRI-124/ FSLR-11

Name of the principal investigator: Dr. S.D. Sharma

Title of the project: Evaluation of the ameliorative role of tree plantation on soil properties in sodic areas.

Year of the start of the project: October 1998

Target year of completion: October 2001

Cost of the project : Rs.5.5000/-

Objectives: To investigate efficiency of different species in bio-rejuvenating sodic soils.

Scientific importance of investigations: The findings of the project will provide guidelines for selecting the species for afforestation of sodic soils from soil reclamation point of view

Results/Achievements :

Field Work: The afforested sodic lands (1000 ha.) in Pratapgarh, Allahabad and Raebareli districts were visited. 9 sites under 3 species of 3 age groups were selected. The vegetation study and infiltration study were carried out at each sites. The soil samples were collected from 4 points at each selected sites. The soil samples were analyzed for physical as well as chemical attributes.

Sl. No.: 32

Project identification No.: FRI-84/ FSLR-7

Name of the principal investigator: Dr. A.K.Raina

Title of the project: Soil geological studies in the degraded land and problem soils for sustainable afforestation.

Year of the start of the project : January, 1998

Target year of completion : January, 2002

Cost of the project : Rs.5.3 lakhs

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

Scientific importance of investigations: The study will provide diagnostic support to work out potential productivity of soil etc. for the overall reclamation of degraded/ sodic lands

Results/Achievements : Samples were collected from degraded sites in Raipur range of Mussoorie forest division and sodic sites in Sultanpur & Raibareli districts of U.P. Physical & Chemical analysis of soil samples was done. Thin sections of rocks, sand fractions and soil were prepared for mineralogical and micromorphological studies. Oriented slides of clay fractions were prepared for X-ray studies. Data are being analysed.

Sl. No.: 33

Project identification No.: FRI-72/ FSLR-5

Name of the principal investigator: Dr. B. L. Dhar

Title of the project : Bio-geochemistry of forest ecosystems of Chakrata Mussoorie Forest Divisions.

Year of the start of the project : 1997

Target year of completion : 2001

Cost of the project : Rs. 5.3 lakhs

Objectives: To determine the effect of geomorphology and topographic positions on the properties and nutrient status of soils and the variations in the forest composition and the distribution of flora and ecological species groups. Interrelationship between soil, geomorphology and vegetation will be worked out and utility maps will be prepared.

Scientific importance of investigations: Such studies are of a comparatively recent origin and have not been carried out in the country so far. The proposed study will, therefore, provide support to evaluate the potential of fertility and productivity of forest ecosystems on watershed basis.

Results/Achievements : Data collected from the field are being analysed for various attributes. Soil samples collected from the field were further analysed in the laboratory for oven dry moisture, organic carbon, total N, sand, silt and clay percentages, cation exchange capacity, exchangeable bases such as Ca and Mg, moisture equivalents, water holding and soil texture.

Sl. No.: 34

Project identification No.: FRI-23/ FSLR-6

Name of the principal investigator: Dr. (Mrs) P. Soni

Title of the project : Reclamation and ecological monitoring of Iron ore mines in Saranda Bonai range (SAIL-ICFRE).

Year of the start of the project : July, 1996

Target year of completion : July, 2000

Cost of the project : Rs. 0.30 (Funded by SAIL)

Objectives: To develop appropriate ecorestoration technology for iron ore mines in Bihar & Orissa.

Scientific importance of investigations: Saranda Bonai ranges were one of the richest forest of the country in the past. These areas have been severely disturbed due to mining activities. Development of ecorestoration model will restore the forest ecosystems.

Results/Achievements : Rapid ecological appraisal of iron ore mines in Bihar & Orissa was done. Detailed soil, floristic and ethnobotanical studies were done in these area. Suitability of the plant species was tested under field and nursery conditions. On the basis of these preliminary studies guidelines for soil treatment, selection of species, plantation techniques and involvement of local people in these sites have been worked out.

Sl. No.: 35

Project identification No.: FRI-86 / FSLR-9

Name of the principal investigator: Dr. (Mrs) P. Soni

Title of the project : Ecological Impact assessment of bio-reclamation projects in Raibareli and Sultanpur.

Year of the start of the project : January, 1998

Target year of completion : December, 2002

Cost of the project : Rs. 10.09 lakhs (Funded by IFFDC)

Objectives: To assess the impact of biological reclamation on the development of plant communities in relation to improvement of soil, interception of rainfall, and infiltration.

Scientific importance of investigations: The project would be useful in generating valuable information on the use of appropriate tree species in sustainable development of sodic lands in the country.

Results/Achievements : Floristic structure and composition in four study sites have been evaluated.

Sl. No.: 36

Project identification No.: FRI-20/G & TP-2 (i)

Title of the project: *In vitro* multiplication of Chirpine and bamboos.

Year of start of project: 1997

Target year of completion: Sept. 2001

Cost of the project: Rs. 3.4 lakhs

Objectives: (a) To develop a protocol for multiplication of Chir pine through somatic embryogenesis, axillary bud proliferation and adventitious bud differentiation. (b) To develop tissue culture technique through axillary bud break and its multiplication for rapid *in vitro* production of bamboo plantlets.

Scientific importance of investigations: Development of micropropagation protocol will lead to largescale multiplication of selected genotypes. After development of protocol, studies can be initiated for development of trees with superior traits like disease resistance, high resin yield, good timber quality, etc. The plants produced through tissue culture can be made available for plantation to the user agencies.

Result and achievements:

Chir Pine : Immature cones were collected from Dehradun, Nahan and Solan area from May to July, 1999. The immature zygotic embryos were excised and cultured on auxin supplemented media (2, 4-D and NAA) for repetition of experiments pertaining to induction of somatic embryogenesis.

Effect of cytokinin viz. BAP and Kinetin with and without NAA on axillary shoot multiplication was studied. 4-5 fold shoot multiplication rate was achieved.

For rooting, the elongated shoots were transferred to auxin (NAA, IBA or IAA) supplemented medium. Auxins were added either singly or in combination of two. A rooting percentage of 40% was achieved. The rooted plantlets were transferred to basal medium for elongation of both roots and shoot.

Bamboos :

D. asper : Sterilization was done with 0.1% mercuric chloride (5-20min). Contamination % varied from 40-60%. For axillary bud break different concentration of PGR alone or in combination were tried. Preliminary observations have shown that bud break was higher at high conc. of BAP i.e. at 5, 9, 12mg/l.

Aseptically established explants were placed in MS+(3-15 mg/l) BAP and MS+(0-15mg/l) BAP+Kn (0-2mg/l). Propagule of 3-4 shoots was used for multiplication. Preliminary observations have shown 3-6 fold multiplication.

In another experiment to enhance the multiplication rate varied concentration of myoinositol MS + (0-100 mg/l) myoinositol were tried. A 5 fold multiplication was observed for 30-40mg/l myoinositol.

For *in-vitro* rooting MS + (0-15 mg/l) NAA MS + (0-10 mg/l) IBA were tried. 80-90% of root induction was observed in 3 mg/l NAA & 10 mg/l IBA.

Bambusa wamin- and *Gigantochloa atter* : Technique for surface sterilization of explant (Node) have been standardized. Freshly harvested nodal explants scrubbed with alcohol, followed by 0.1% mercuric chloride treatment for (5-10min) proved to be satisfactory. This methodology has proved satisfactory for both the bamboo species.

As regards induction of bud break, maximum bud break was recorded in MS + (3.0 mg/l) BAP.

Sl. No.: 37

Project identification No.: FRI-20/G & T P-2 (ii).

Name of the principal investigator: Dr. I.D. Arya

Title of the project: *In vitro* multiplication of Shisham and Eucalyptus.

Year of start of project: 1997

Target year of completion: Sept. 2001

Cost of the project: Rs. 4.5 lakhs

Objectives: (a) To produce Eucalyptus planting stock material through tissue culture from already identified plus trees. (b) To develop procedure for hardening and acclimatization of plantlets to obtain 100% field transplantation. (c) To develop tissue culture technique for rapid *in vitro* production of Shisham plantlets.

Scientific importance of investigations: The project will help generate superior planting stock on large scale. This will also help in preserving the germplasm *in vitro*.

Result and achievements: Technique for the surface sterilization of the nodal explant taken from mature tree of *Dalbergia sissoo* and *Dalbergia latifolia* have been standardized

Experiments for *in vitro* shoot multiplication of *D. sissoo* was conducted with respect to hormone and media selection. MS medium supplemented with BAP was found to be the best and multiplication rate of 5-6 fold was achieved. Experiments for *in vitro* and *in vivo* rooting are in progress.

Experiments have been initiated recently for induction of organogenesis and embryogenesis from explant derived from aseptically grown seedling.

Sl. No.: 38

Project identification No.: FRI-20/G & T P-2 (iii).

Name of the principal investigator : S. K. Sharma

Title of the project : *In vitro* multiplication of Teak and Neem.

Year of start of project: 1997

Target year of completion: Sept. 2001

Cost of the project: Rs. 7.4 lakhs

Objectives:

Long-term : (a) To develop cost effective protocol for the production of teak on mass scale for afforestation and clonal testing in the field. (b) To increase the productivity of plantations by planting the monoclonal planting stock with wider genetic base.

Short term : (a) Standardization of the technique for *in-vitro* aseptic establishment of nodal explant. (b) Standardization of the technique for *in-vitro* requirement for proliferation of the shoot. (c) Standardization of the technique for *in-vitro* regeneration and multiplication. (d) Standardization of the *in-vitro* and *ex-vitro* rooting requirement. (e) Standardization of the hardening and acclimatization procedures. (f) Scientific importance of investigations of Investigations.

Scientific importance of investigations: Development of micropropagation protocol will lead to large scale multiplication of selected genotypes. This will also help in preserving the germplasm *in vitro*.

Result and achievements:

Neem : Multiplication of shoots was carried out of MS+BAP (1.0mg/l)+NAA (0.5 mg/l) and MS+BAP (2.0 mg/l)+NAA (0.5mg/l). The effectivity of both the treatments was observed on the extent of multiple shoot formation. The former treatment was more effective in producing 6-8 shoot per explant.

For finding out the *in-vitro* rooting requirement of the microshoots experimental trials were conducted and maximum rooting was recorded in 1/2 MS+IBA (1.0 mg/l) for Neem.

In-vitro hardening was performed for 15 days on 1/4th MS with 2.0% sucrose without PGR. Almost all the transferred plantlets remained in good condition of growth. New secondary root formation was also observed. Two acclimatization trials were initiated during the year.

Teak : The technique tried earlier was repeated this year to ascertain its validity and it was recorded that more than 90 percent explants remained uncontaminated upto one month from the date of explant plating onto the medium. It clearly indicates the efficiency of the technique for surface sterilization of explant.

For standardization the PGR level in the establishment medium, various permutations and combinations of the cytokinin and auxins were tried. Initial observations pertaining to standardization of establishment medium revealed that MS medium with following PGR level were suitable:

MS+BAP (1.0 mg/l) + NAA (0.5 mg/l) {95.83 percent}

MS+KN (2.0 mg/l) + NAA (0.5 mg/l) {91.67 percent}

MS+BAP (1.0 mg/l) + KN (0.1 mg/l) {87.50 percent}

On sub-culturing the sprouted shoots in the above-mentioned medium, necrosis of the shoot was recorded after 15 days. To get rid off the necrosis another set of experiment was initiated. Following additives were introduced in the medium:

Casein Hydrolysate	1g/l	2g/l	3 g/l
Glutamine	50 mg/l	100 mg/l	500 mg/l
Glycine	50 mg/l	100 mg/l	500 mg/l

Initial observations showed the control of necrosis. Multiplication experiments are underway.

Sl. No.: 39

Project identification No.: FRI-21/G & T P-3

Name of the principal investigator: D. P. Uniyal

Title of the project: Genetic Improvement of Pine (*Pinus roxburghii*) including provenances research.

Year of start of project: 1997

Target year of completion: Sept. 2001

Cost of the project: Rs. 1.70 lakhs

Objectives: (a) Survey, selection of superior stands, provenances and collection of planting material. (b) Studies on variation based on qualitative and quantitative traits. (c) To identify the provenance(s) giving the highest possible economic gains based on the observations recorded from the field trials.

Scientific importance of investigations: Genetically superior planting material will be available for increasing the productivity.

Results and achievements: Collected seeds from 38 CPT's belonging to Nainital/Ranikhet/Almora (U.P.), Nurpur (H.P.) Provenances and raised progenies in hycotrays. Analysis of data has revealed large differences between CPT in germination and survival percent viz. 28 to 97% and 36 to 95% respectively.

Sl. No.: 40

Project identification No.: FRI-125/G & T P-5

Name of the principal investigator: N. D. Dobriyal

Title of the project: Genetic Improvement of *Grewia optiva*.

Year of start of project: 1998

Target year of completion: March 2002

Cost of the project: Rs. 4.00 lakhs.

Objectives: The study variation in respect of growth parameters of selected superior Phenotypes from different area and standardize the technique for vegetative propagation viz. Rooting of cuttings and grafting Establishment/Conservation of germplasm and establishment of breeding orchard.

Scientific importance of investigations: The establishment of seed orchard and conservation of germplasm of superior trees and improved variety of seedling and seed will be useful to the using agencies.

Results/Achievements : Cutting of *G. optiva* were collected from different places and 1500 cuttings were planted in the earthen pots. Observations are on regarding sprouting and rooting.

The seed of *G. optiva* collected from 10 superior trees of different provenance were sown in the earthen pots. Different type of treatments (Soaking in cold water soaking, hot water and in conc. H_2SO_4) and without any treatment (control) were applied. The observation on germination are being recorded.

Sl. No.: 41

Project identification No.: FRI/30/NWFP-3

Name of the principal investigator: A.K. Sharma

Title of the project: Studies on cultivation and optimum time of harvesting of temperate and alpine medicinal plants of high market value.

Year of start of the project: 1997

Target year of completion: 2002

Cost of the project: Rs. 3.4 lakhs

Objectives: a) To conduct field surveys to assess the range and quantity of some species high in demand in the UP, HP & J & K hills. b) To collect the germplasm and identify the best provenance's rich in active

principles. c) To study the behavior (Phytosocial & ecological) *in-situ* and *ex-situ* of the species and develop suitable cultivation techniques for commercial plantations.

Results/Achievements: Collection of germplasm of *Nardostachys jatamansi* and *Picrorrhiza kurroa* from provenances identified last year was made and experimental trials at Chakrata nursery were laid out.

Observations on above and below ground biomass productivity are in progress.

Stem cuttings of *T. baccata* rooted earlier and transplanted in field were observed for their survival and growth behaviour to determine annual growth rate.

Phyto-sociological studies have revealed that the density of *Taxus baccata* is dependent on the density of *Q. semecarpifolia* irrespective of the sites studied in Garhwal region. Similarly, *P. kurroa* and *N. jatamansi* were observed to determine the presence and density of each other.

Soil samples collected from different sites of germplasm were analysed. The results reveal inter-site and intra-site differences in the physico-chemical properties. The effect of these variations on the presence and density of the project species are being worked out.

Sl. No.: 42

Project identification No.: FRI/ FREEP/ 02

Name of the principal investigator: Dr. M.S. Negi

Title of the project: Market Monitoring of Tree Products.

Year of start of the project : 1994

Target year of completion: Dec, 2000

Cost of the project : Rs. 55.0 lakhs

Objectives: a) To collect Market Intelligence for tree products. b) To publish monthly price bulletins and publicize market information. c) To analyze price trends and suggest policy measures to give impetus to planting of trees.

Scientific importance of investigation : To sustain the interest of private entrepreneurs in tree farming, it is essential that besides providing technical inputs in improving productivity of tree plantations, we must also generate intelligence on the markets and marketability of different tree products. This project will fulfill this need.

Result/Achievements: Preliminary survey was conducted in the timber markets of U.P. (Agra, Bareilly, Meerut and Saharanpur), Haryana (Ambala and Yamuna Nagar), Punjab (Jalandhar and Pathankot), Delhi, and U.T.(Chandigarh). The species included are Teak, Sal, Shisham, Eucalyptus, Poplar, Khair, Babul, Prosopis, Chir, Deodar, Kail, Fir, Spruce and Bamboo. Market price data were collected since Oct. 1995. Besides, the auction price of U.P., Haryana and Punjab Forest Corporations were also collected.

Fifty four issues of Market Price Bulletin have been published upto March, 2000. The price bulletin were distributed among the user groups which include; ICFRE institutes, State Forest Departments, State Forest Corporations, Village Panchayats through District Panchayat Officers, Timber Traders, NGO's, Press and other forestry related organisations.

For analyzing the price trend and suggesting policy measures to give impetus to planting of trees, a consultancy has been given to Indian Institute of Public Administration, New Delhi.

Sl. No.: 43

Project identification No.: FRI-37/RSM - 7

Name of the principal investigator: Dr. M.S. Negi

Title of the project: Marketing mechanism for Farm Forestry Trees - A case of important north Indian markets.

Year of start of the project : 1997

Target year of completion: Sept . 2000.

Cost of the project : Rs. 7.00 lakhs

Objectives: (a) To study the mix of forestry tree species (along with agricultural crops) in the farming systems. (b) To examine existing market structure (network) and price – spread for selected forest trees in sample markets. (c) To document and analyse Farmers perceptions about the role of existing harvesting laws for farm forestry trees. (d) To explore possibilities for effecting efficiency in the present forest tree marketing systems.

Scientific importance of the investigation : Efficient marketing is crucial for ensuring better returns to the tree planters and sustaining their interest in forest farming. The detailed analysis under this project would bring out the areas where there is scope for further improvements or for selection of alternative system.

Result/Achievements: The household based socio-economic information related to tree growing and marketing of trees has been tabulated for the study areas of Amritsar, Ludhiana, Ropar, Yamuna Nagar, Hissar and Saharanpur. Analysis of data on land holding size, land use pattern, major crops grown, etc. in the tree growing belts has been completed.

Data on market information on the selected markets has also been tabulated and the analysis of data is being done. Draft report writing is in progress.

Sl. No.: 44

Project identification No.: Consultancy Project.

Name of the principal investigator: Dr. M.S. Negi

Title of the project: Study on alternative eco-friendly wood varieties for handicrafts and futuristic wood availability in Rajasthan and Kerela states.

Year of start of the project : Jan , 1999

Target year of completion: June 2000.

Cost of the project : Rs. 12 lakhs

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

Scientific importance of investigations: Alternative eco-friendly wood varieties as substitutes to scarce species will be identified for handicraft sector.

Result/Achievements: The project is financed by Department of Handicrafts, Ministry of Textiles, Govt. of India. A list of tree species grown in and around the states of Kerala and Rajasthan which are currently used for handicrafts products and alternative eco-friendly wood species available in respective states, has been prepared. The ICFRE institutes at Jodhpur and Coimbatore have collected the information pertaining to present and future availability of wood from the listed tree species. The collected data has been compiled and analyzed by this division. The work of report writing is in progress.

Sl. No.: 45

Project identification No.: FRI - 33 / RSM - 3

Name of the principal investigator: Dr. A. Upadhyay.

Title of the project: Preparation of Volume and Yield tables of promising (D-121 and G-48) clones of *Populus deltoides* in North India.

Year of start of the project: Dec, 1997

Target year of completion: March, 2001

Cost of the project : Rs.1.3 lakhs

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

Scientific importance of investigation: Different clones of poplar are being extensively grown all over northern India, and there is an increasing demand for their volume and yield tables for assessment of yield. This project will meet this demand.

Result/Achievements: Ten permanent Sample plots of G - 48 and D - 121 clones of Poplar were laid out in the Tarai Bhabar region of U.P. in the Tanda and Pipal parao range of Haldwani Division. Survey and site selection for laying out of sample plots of poplar was done in Haryana and U.P. and eight permanent sample plots were laid out in Yamuna Nagar in Haryana and six sample plots were laid out in the Haridwar and Roorkee Division of U.P. Four permanent sample plots were laid out in the Ludhiana Division of Punjab. Remesurement of sixteen sample plots laid out in 1998-1999 in the Haldwani Division was carried out at different periods.

The measurements and remeasurement data were compiled and sample plot files with complete details were prepared.

Sl. No.: 46

Project identification No.: FRI -2 /Silva -2

Name of the principal investigator: Dr. N.B. Singh

Title of the project: Poplar Improvement in India.

Year of start of the project: Jan, 1997

Target year of completion: March, 2001

Cost of the project : Rs.14.38 lakhs

Objectives : (a) Multiplication and clonal testing of selected Poplar clones (Genotypes x site interaction studies). (b) Nursery screening and field testing of USA germplasm for releasing FRI series Poplar clones.

(c) Control and open pollinated progeny testing for evolving site specific clones. (d) Establishment and enrichment of national germplasm bank, breeding rchard, breeding nursery and gene bank. (e) Investigation of genetic variability and diversity with the help of molecular method and DNA finger printing of Poplar clones.

Scientific importance of investigations: This project will increase the genetic base of Poplar and provide improved planting stock.

Results/Achievements:

(a) Multiplication and clonal testing (Multilocational trial) : The ETPs of 25 clones were planted in two sites i.e. Ramsahpur society (Sultanpur) and Malik mau society (Raebareilly) in three replications (4 tree plot system). The cuttings of 50 clones were planted in nursery at Ramsahpur society, which would be planted in field during Jan. - Feb. 2001.

Forty clones were planted at 18 different coordinating centres during Jan. - Feb. 2000 covering 10 states of the country.

(b) Nursery Screening and field testing of U.S.A. germplasm : The cuttings of 44 CPTs of USA Germplasm of *P. deltoides* were planted in Brandis road nursery in the month of Feb. 99, in the spacing 80cm x 60cm.. 256 clones were selected on the basis of individual plants performance and these individuals were multiplied and planted in same locality.

The annual data were recorded and statistical analysis of five characters of 32 families was computed. The total range of variability in plant height was observed 190.11- 304.97 cm with mean of 232.01 cm. The maximum height was found from the genotypes of tree number 51 (304.97cm) followed by tree number 93 (303.83 cm) and tree number 13 (269.77cm).

The total range of variability in collar diameter was observed 14.92 – 38.47 mm with mean of 21.64 mm. The maximum height observed from the genotypes of tree number 93 (38.47 mm) followed by the progeny of tree number 13 (26.29 mm) and 101 (25.60 mm) respectively.

The total range of variability in branch No. was observed 0.28 – 2.46 with mean of 1.00. The maximum branch no. observed from the genotypes of tree number 93 (2.46) followed by the progeny of tree number 51 (1.85) and 3 (1.81).

The total range of variability in percent of plant with branch was observed 5.33- 72.86 with mean of 31.67. The maximum percent of plant with branch observed from the genotypes of the tree number 77 (72.86 %) followed by the progeny of tree number 17 (64.43%) and 51 (55.06%) respectively.

The total range of variability in internodal length was observed 5.12- 6.71 cm with mean of 5.76 cm. The maximum internodal length was recorded in the genotypes of family number 3 (6.71cm) followed by the progeny of tree number 75 (6.45 cm) and 20 (6.43cm).

The coefficient of variability for all the characters have been calculated. In general, the values of coefficient of genotypic variance were lower than their respective coefficient of phenotypic variance.

The maximum amount of coefficient of genotypic variance was observed for branch no. (37.18), percent of plant with branch (45.83) and minimum for internodal length (5.13) and plant height (9.03) percent of mean for five characters were worked out:

High heritability was estimated for all five characters. The expected genetic advance expressed as percent mean was high for percent of plant with branches and branch no. and moderate for collar diameter, plant height and internodal length.

Control and open pollinated progeny testing : Control crosses were made in April 1999 and in total 20 combinations were tried by using different male and female clones. Catkins (fruits) matured in the second week of May and continued up to end of May. Seeds of 11 surviving combinations of control crosses (full-sib) were harvested in third and fourth week of May. Seeds of 20 open pollinated clones (half-sib) were collected in May 1999 from Lalkuan, Haldwani and Nainital (U.P.).

The seedlings of half sib and full sib progeny raised in root trainers were transplanted in 4 replications (20 seedlings / replication) in Central Nursery during Feb.-March 2000. Cultural operation and irrigation was done properly.

Flowering branches of 16 female clones and 18 male clones were collected in Jan. 2000 from Phoolbag, Tanda and Lalkuan etc. of experimental plantation of the Haldwani, Nainital. These were grafted on one year old root stock of the same species at Brandis road, FRI for control crosses (Hybridization).

Establishment of Poplar breeding orchard, germplasm bank and DNA finger printing of Poplar clones :

(i) Enrichment of Poplar Breeding Orchard at FRI, Dehra Dun: In Feb. 1998, 40 clones of *Populus deltoides* were planted in Poplar breeding orchard with the spacing of 7m x 7m covering 12 females and 28 males clones. During Feb. 99 another 10 promising clones of *Populus deltoides* were further added in the breeding orchard. Vacancy filling and cultural operations were carried out.

ii) Establishment of national germplasm bank: Establishment of germplasm bank of poplar was initiated in 1997. About 285 different clones were planted in randomized layout with two replications having single tree plot. The spacing was 3m x 3m and pit size for planting of ETP was 60cm x 60cm x 60cm.

23 clones were added during 1998 in poplar germplasm bank and 7 new clones developed from U.H.F., Solan, were further planted in the germplasm in 1999. Pruning and follow up cultural operations were subjected.

iii) Maintenance and multiplication in Poplar Breeding Nursery: 80 different clones were multiplied for raising the ETPs. The cuttings of these ETPs were supplied to 15 different new voluntary centres in Jan.2000 under coordinated Research Project on Poplar. The nursery characteristics were recorded for different clones.

Sl. No.: 47

Project identification No.: F.R.I. – 4/Silva-4

Name of the principal investigator: R.K. Singh

Title of the project: Improvement of nursery techniques of commercially important forestry tree species.

Year of start of project: April, 1997

Target year of completion: March, 2002

Cost of the project: Rs.2.72 lakhs

Objectives : (a) To determine the effect of seed size and weight on germination and growth of seedlings of *Hardwickia binata*. (b) To ascertain proper depth of seed sowing of Teak, *Juglans regia* and *Hardwickia binata* etc. in nursery. (c) To find out the requirement of shade and mulching for the better germination of *Juglans regia* and *Hardwickia binata*.

Scientific importance of investigations: About 25 to 30% cost of plantation is incurred on nursery component. This cost can be reduced by reducing cost on watering, economic use of seeds, reducing period of seedlings in nursery. This project will achieve this end.

Investigation were carried out to study the effect of orientation of seed sowing on germination behaviour of *Hardwickia binata* seeds in nursery. Three positions of seed sowing were tried. The results indicated that *Hardwickia binata* seeds should be sown in vertical position (embryonic and downward) or in horizontal position for better germination.

Studies have been conducted to determine the proper depth of seed sowing of Teak and *Hardwickia binata*. The results indicated that seeds of *Hardwickia binata* and Teak should be sown at 2-5 cms deep (equal to its dimensions in the nursery beds for better germination. Work on nursery techniques of *Juglans regia* is in progress.

Sl. No.: 48

Project identification No.: FRI/ FREEP/01

Name of the principal investigator: Dr. R.C. Thapliyal

Title of the project: Storage of Forest Tree Seeds.

Year of start of the project: 1994

Target year of completion : 2000

Cost of the project: Rs. 108.40 lakhs

Objectives: To develop protocols for the storage of seed of forestry importance.

Scientific importance of investigations : This project will help maintain seed in long term storage for regular seed supply as well as for *ex situ* germplasm conservation.

Results/Achievements: The orthodox storage physiology of *Dalbergia sissoo*, *Grewia optiva*, bamboo species and intermediate storage physiology of neem seed was established.

The protocols for the storage of bamboos, sissoo and *Grewia optiva* developed and the seeds which normally retain viability for about one year now can be stored for several years by manipulating storage temperature and seed moisture content. Similarly the seed of neem, which loses viability within a month under ambient conditions can now be successfully stored for about two years.

Indices of proper seed maturity and optimum time of seed collection established for sissoo, *Grewia* and neem.

Optimum conditions for the laboratory germination of seed of *Dendrocalamus strictus*, *D. membranaceous*, *B. nutans*, *Dalbergis sissoo*, *Grewia optiva* and *Azadirachta indica* have been determined for seed certification purposes.

The pretreatment of *Azadirachta indica* seed by cutting them into half resulted in germination on the 4th day as compared to 13th days of intact seeds. In *Dalbergia sissoo*, *Grewia optiva* and bamboo species show orthodox storage physiology and their viability, in storage was shown to be maintained in storage for several years under conditions of low seed moisture content (5%) and low storage temperature (-5°C). *Azadirachta*

indica seeds on the other hand has been shown to be of intermediate storage physiology. Following reduction of seed moisture content to 7% and storage at 15°C lead to twenty fold increase in seed viability upto 2 years in comparison to earlier reports which indicated maximum viability as 6 months.

Sl. No.: 49

Project identification No. : IN-S-121 and FG-IN-781 USDA-Pine project

Name of the principal investigator : Dr. J.K. Rawat

Title of the project : Studies on Himalayan Pines.

Year of start of the project : 1996

Target year of completion : 2004

Cost of the project : Rs. 202.70 lakhs

Objectives: (a) Identification, selection and collection of superior provenances of *Pinus roxburghii* from their distribution range. (b) Study of seed source variation. (c) Studies on Seed Biology.

Scientific importance of investigations: The project will determine the nature and extent of natural variation in wide population of chir in some prominent characters and relate them to adaptability and growth in different site. The studies on storability of seed will result in sustained seed supply from superior provenance for annual sowing programmes in the time of very poor seed years.

Results/Achievements: Seeds from 65 sources from the Himalayan region of India have been collected and distributed to different Divisions in FRI for nursery technology, seed pathology, entomology and physiological studies. Preliminary studies on seed biology have been taken up.

Sl. No.: 50

Project identification No.: FRI-105/FPD(CW)-18

Name of the principal investigator: Dr. S.P. Singh

Title of the project: Studies on Cashew Nut Shell Liquid (CNSL) oil based phenolic adhesives for exterior grade plywood.

Year of start of the project: 1997

Target year of completion: 2001

Cost of the project : Rs.8.28 lakhs

Objectives: To develop cheaper adhesives from naturally occurring material like CNSL oil for plywood industry.

Scientific importance of investigations: The work carried out will help the plywood industry in replacing phenol with CNSL oil for preparation of phenolic adhesives.

Results/Achievements: CNSL oil was procured from local market for preparation of phenolic adhesives for plywood. Analysis of CNSL oil for specific gravity, viscosity was carried out. Prepared CNSL oil based phenolic adhesives by replacing 50% of phenol with CNSL oil using ammonia and NaOH as catalyst. The resins were dissolved in different solvents like trichloroethylene, alcohol, benzene and acetone. These adhesives were used for making plywood. Plywood was prepared using toon, poplar and sal veneers and tested for glue adhesion strength. Data is being analysed.

Sl. No. 51

Project identification No.: FRI/112-FPD/WP-25

Name of the principal investigator: Dr. Indra Dev

Title of the project: Development and evaluation of eco-friendly wood preservatives.

Year of start of the project: 1-4-1997

Target year of completion: 2001

Cost of the project : Rs. 16.04 lakhs

Objectives: To develop non hazardous and eco-friendly wood preservatives and investigate environmental contamination by conventional wood preservatives.

Scientific importance of investigations: Wood preservation is essential to enhance life of nondurable plantation timber. Some of the conventional wood preservatives have carcinogenic properties. Development of environmentally safe preservatives is the need of the hour.

Results/Achievements : The composition ACZB at three retention levels i.e. 5.5, 21.5 & 35.0 kg/m³ (dry salt) was tested against termites on poplar samples in termite mound. The results were not encouraging. Experiments to test residual effect of ACZB in soil showed 5% & 10% leaching of copper and boron from the wood respectively. 15 months data collected on accelerated field tests on chir and semul veneers treated with copper lignin complex at five retention levels i.e. .037, .061, .10, .162, .262 kg/m³ indicated negative results. The efficacy of higher retention is being studied. Termite mound tests on copper resinate and their blends with Chloropyrifos 20 EC and lindane (Technical grade) indicated that lindane reduced the effect of copper resinate. Fungus tests by filter paper disc method of *Ipomea carnea* extracts were carried out. Water and petroleum ether extracts were not found effective. However alcohol and benzene extracts showed positive effects.

Sl. No.: 52

Project identification No.: FRI-80/NWFP-4

Name of the principal investigator : Dr.D.C. Chaudhari

Title of the project: Identification of high gum yielding varieties of *Acacia nilotica* for future regeneration for socio-economic development.

Year of start of the project: 1998

Target year of completion: 2002

Cost of the project: Rs.23.05 lakhs

Objectives : (a) To find out suitable scientific and environmental friendly method of tapping, best time of making initial blazes, and period required for freshening. (b) To study co-relation between the yield of gum and girth classes of the trees in different seasons. (c) To find out the treatment which exudes maximum gum. (d) To study the working quality of different types of newly designed tools with reference to production of gum.

Scientific importance of investigations : Better gum yielding methods will reduce waste and conserve forest wealth.

Results/Achievements: New site has been selected for gum tapping experiment at Motichur Forest Range.

Trees of different girth classes have been selected to lay out the experiment according to the statistical design.

New blazes were made on *Acacia nilotica* trees standing near Deemed University and *A. benthamii* near Wood seasoning Branch, Forest Research Institute and three different treatments were given in both the species.

Sl. No.: 53

Project identification No.: FRI-28/NWFPP.1

Name of the principal investigator: Dr. P.P. Bhojvaid

Title of the project: Studies on cultivation techniques and optimum time of harvesting subtropical medicinal plants of high market value

Year of start of the project : April, 1997

Target year of completion: 2000

Cost of the project: Rs. 16.30 lakhs

Objectives: (a) Development of suitable package for large scale cultivation of medicinal plants. (b) Studies on maximum biomass production on per /ha basis under different culture media as per R & D design (given by statistical division).

Scientific importance of investigations: Large scale cultivation techniques when adopted by farmers and companies will reduce pressure on forests.

Results/Achievements : Preliminary results show that maximum biomass production is obtained (maximum dry wt 3.56 qtl/ha) under soil + FYM treatment followed by river sand + FYM (2.* qtl./ha), garden soil (1.9 qtl/ha), and river sand (1.4 qtl./ha).

Sl. No. 54

Project identification No.: FRI-126/NWFP-6

Name of the principal investigator: Dr. P.P. Bhojvaid

Title of the project: To develop a technique for mass cultivation of *Uncaria gambier* and popularise the species in India.

Year of start of project: Oct, 1998

Target year of completion: March 2003

Cost of project: Rs. 3.00 lakhs

Objectives: (a) To propagate and popularise the species in India by co-ordinating with user Agency. (b) To provide sufficient amount of gambier extract to Katha factories. (c) To collect germplasm of Gambier. (d) To develop suitable cultivation techniques for mass production of *Uncaria gambier*.

Scientific importance of investigations: Gambier which hitherto is being imported from other countries would be made possible to extract in our own country thereby contributing to the GNP of our country.

Adoption of *Uncaria gambier* at commercial level would improve socio-economic condition of our country and would save the biodiversity of entire world.

Results/achievements: The requisite permit to obtain germ plasm of *Uncaria gambier* from native countries such as Indonesia, Malaysia and Thailand has been obtained from National Bureau of Plant Genetics Resource, New Delhi, India. The Director General, ICFRE has sanctioned a study tour to collect germ plasm from these countries and study the propagation, cultivation and utilization of *Uncaria gambier* in Indonesia and Malaysia. Itinerary of the proposed tour is being sent to the Director General, ICFRE for approval. The real experiment of the cultivation and mass propagation will start only after germ plasm is procured from the countries mentioned above.

Sl. No. 55

Project identification No.: FRI-118/SF-3

Name of the principal investigator: Dr. K. K. Sharma

Title of the project: Studies on agroforestry systems and development of suitable agroforestry models.

Sub Project (i): Investigations on the structure and functional dynamics of agroforestry systems in Punjab, Haryana and Uttar Pradesh.

Year of start of project: Aug., 1998

Target year of completion: March 2001

Cost of the project: Rs. 5.6 lakhs

Objectives: (a) Survey of the Agroforestry Systems in Punjab, Haryana and Uttar Pradesh. (b) Studies on crop-combination and geometry of plantation. (c) Studies on growth, yield and economics of various combinations and their sustainability. (d) System inventory description to undertake studies on interaction between different component and existing management practices. (e) Domestication of plant species. (f) Study viability of the system vis-à-vis socio-economic conditions of the rural people.

Scientific importance of investigations: The project envisages to provide information by generating qualitative and quantitative information on structure, function and biological efficiency of the systems in different agroclimatic zones in the States of Punjab, Haryana and Uttar Pradesh. The project proposes a comprehensive evaluation of the existing agroforestry practices throughout the States. The study will also provide information on the sustainability factors in agroforestry systems. The results will help to evolve scientific information, listing of various tree species and crop combined in the system and to prescribe suitable agroforestry models. This will help farmers/tree growers depending on agroforestry practices for day to day needs for their livelihood and raw material for industry.

Results/Achievements: Data on tree-crop interaction and growth performance of agriculture crops (turmeric) viz, plant height, no. of plants per quadrat, no. of rhizome per plant, yield (Kg.) etc., growth in association with three, four, five and six year old plantations of *Populus deltoides* has been collected on farmers field at Fatehgarh village of distt. Yamunanagar in Haryana. Growth data on trees were also recorded during October 1999.

Germination and growth data were recorded in respect of varietal trial of wheat. Varieties UP2338, PBW154, PBW343 and HD2329 and mustard were grown as intercrop under different plantations of *Mangifera indica*, *Litchi chinensis* and *Embllica officinalis* etc. Periodical growth data was recorded of plants of

different *Populus deltoides* clones and *Paulownia fortunei* for selecting suitable clone / species for agroforestry systems at Kalesar , Khadari (Haryana) and Kuhedi (UP).

The following work has been conducted at RIMC, Dehradun during the year 1999-2000.

Clonal trial:

During November three varieties of wheat viz., UP2338, PBW 343 and HD 2325 were tested using randomized block design to select suitable variety for intercultivation in a clonal trial of *P. deltoides* (G-48, G-3, S₇C₁₅, S₇C₂₀, L₃₀₋₈₂, L₂₀₀₋₈₄ and D-121 and *Paulownia fortunei*. Observations were recorded in respect of no. of germination, number of tillers etc . The data recorded indicated that upto a distance of 0.5m near tree the germination was poor. However, in the centre of 4 trees of Poplar, the germination was found excellent. Number of tiller varies from 3 to 7 numbers.

Block Plantation:

The plants of Kadam and Semul were planted at two spacing of 5m x 4m and 4m x 4m respectively along with Poplar plantation. Four varieties of wheat UP 2338, PBW 343, HD2329, PBW154 were sown in two spacing of 5m x 4m and 6m x 4m in randomized block design. Observations on germinations, number of tillers etc were recorded.

Row Plantation:

During July 1999, plants of Silver oak and Eucalyptus hybrid along with Poplar and *Paulownia* were planted. Four varieties of wheat UP 2338, PBW 343, HD2329, PBW154 were sown in two spacing of 5m x 4m and 6m x 4m in randomized block design. Observations on germination, number of tillers etc. were recorded.

Boundary Plantation:

During July 1998-1999 Jamun, Semul, Silver Oak and Eucalyptus were planted. Four varieties of wheat UP2338, PBW 343, HD2329, PBW154 were sown in two spacing of 5m x 4m and 6m x 4m in randomized block design. Observations on germination, number of tillers etc were recorded.

Silvi-Horti Model:

The plants of Litchi, Mango and Aonla were planted during July 1999 and Poplar were planted in January 2000. Four varieties of wheat UP 2338, PBW 343, HD2329, PBW154 were sown in two spacing of 5m x 4m and 6m x 4m in randomized block design. Observations on germination, number of tillers etc. were recorded.

Sl. No. 56

Project identification No.: FRI-05/Chem.-I

Name of the principal investigator: Dr. P.L. Soni

Title of the project: Studies on isolation and characterization of polysaccharides of abundantly available seeds trees/shrubs, leaves, bark and exudate gums.

Sub-Project (vi): Chemical investigation of *Kydia calycinia* bark polyascharide.

Year of start of project: March 1997

Target year of completion: Feb, 2001

Cost of the projects: Rs. 11.0 lakhs

Objectives: To find the industrial uses of renewable biomass for industrial growth and upliftment of forest dwellers.

Scientific importance of investigations: Carbohydrates constitute about 75-80% of total biomass, which can be exploited to produce chemicals and their derivatives for different industrial uses.

Results/Achievements: Pure polysaccharide was partially hydrolysed by 0.1, 0.5 and 0.75 N, sulphuric acid for 13, 24, and 16 hrs. respectively. One oligosaccharide was obtained in each partially hydrolysed hydrolysate. GLC analysis shows that *K. calycina* polysaccharide is composed of glucose, mannose, galactose, rhamnose, arabinose, xylose and glucuronic acid. Optical rotation of the constituent monosugars were determined. Uronic acid was determined spectrophotometrically of the polysaccharide and found 6 per cent only. ¹HNMR of the polysaccharide was carried out.

Sl. No. 57

Project identification No.: FRI-46/FPD (WWF) - 9

Name of the principal investigator: Shri S.P. Badoni

Title of the project: Studies on woodworking, carving and wood finishing on plantation timbers. Development work on utility process and performance.

Year of start of project: April, 1997

Target year of completion: March 2001

Cost of the project: Rs 8.25 Lacks

Objectives: Developmental work on mechanicality other related properties and their optimization for Eucalyptus and poplars.

Scientific importance of investigations: The emphasized introduction of plantations woods into the diverse wood industry will be facilitated by above R&D work.

Results/Achievements: The working, carving and finishing behaviour of *Salix alba* studied under six major wood working operations. The results obtained on Paulownia and *Salix alba* are being analyzed.

Matched sample of 125 x 75 x 10mm (radial and tangential) were prepared. One set was subjected to the oleoresin oozing treatment in ammonical solution followed by half an hour's boiling. The samples were then conditioned a long with matched counterparts in a chamber maintained at 35° C temperature and 50% and above 90% RH in two constant rates.

It was observed that the increasing weight of the treated samples was lower as compared to that of controlled samples due to sealing of the amorphous sites by resin while coming out of the samples. Thus the hygroscopicity of the treated samples was reduced although it was expected to increase. Further MEE tests including coating and utilization of oozed material as a filler cum staining material is required to be tested.

Sl. No. 58

Project identification No.: FRI-109/FPD (WWF) - 22

Name of the principal investigator: Shri S.P. Badooni

Title of the project: Development of laminated wood from Eucalyptus and Poplar for joinery and furniture items.

Year of start of project: April, 1997

Target year of completion: March, 2001

Cost of the project: Rs. 4.0 Lacks

Objectives: To work on newer concepts of green dimensioning and associated variables and utilization of saw mill waste and low girth plantation wood for laminate wood making and to control growth and drying stress.

Scientific importance of investigations: The research result will help to suggest the user the use of small dimensioner logs in place of large one specially of Eucalyptus and poplar/saw mill wastage.

Results/Achievement: Laminated sections of Eucalyptus, Poplar and Paulownia kept for year round observation revealed that the Poplar and Paulownia beams behaved well as a laminated wood of better properties. The Eucalyptus lamination was not found much successful and some failures near glue line were observed even under normal conditions. Thus, Poplar and Paulownia can be successfully used for lamination wherever desired. The project has been completed.

Sl. No.: 59

Project identification No.: FRI/FREEP/04

Name of the principal investigator: Shri S.N. Khan

Title of the project: Forest Pathology

Sub-projects (i): Examine disease of economically important tree species and develop suitable control measures.

Sub-projects (ii): Examine biofertilizers beneficial to economically important tree species and develop practical methods for field application.

Year of start of project: Oct., 1994

Target year of completion: Dec. 2000

Cost of the projects: Rs. 123.93 Lacks

Objectives: (a) Isolation and identification of pathogens and pathogenicity test. (b) Isolation of rhizobium and VAM of host species for culturing and mass inoculation of seedling.

Scientific Importance of investigations: This study will provide information on the diseases of agricultural and forest crops and their remedial measures. Provide information on the effect of application of biofertilizers for the rejuvenation of wastelands, which results in the reduction of the dependency on inorganic fertilizers.

Results/Achievements: Studied AM association with *Dalbergia sissoo* in a plantation in Bijnore Forest Division, U.P. A total of 14 AM fungi belonging to 4 genera i.e. *Glomus* (8), *Acaulospora*(2), *Sclerocystis* (2) and *Scutellospora* (2) were isolated and identified.

Starter cultures of *Glomus* spp. were initiated and are under progress.

Pot cultures were multiplied and maintained.

Rhizobium strains were isolated from plantations and nursery seedlings from U.P.

Rhizobium isolates were purified and maintained.

Sl. No. : 60

Project identification No.: FRI/FREEP/05

Name of the principal investigator: Dr. S.K. Bagchi

Title of the project: Tree Improvement

Sub project (i): Study floral biology and breeding system and develop hybrids specific to site in order to maximize productivity.

Sub project (ii): Develop techniques for rejuvenation of mature plant tissue to maximise multiplication rate.

Sub project (iii): Develop *in vitro/in vivo* propagation technique for mass multiplication of selected genotypes.

Year of start of project: Oct., 1994

Target year of completion: Dec., 2000

Cost of the project: Rs. 120.90 Lacks

Objectives: To increase productivity, production of quality seeds/ planting materials, establishment of seed production areas, seed orchards and provenance selection.

Scientific importance of investigations: Production of the quality seeds/ planting materials. Different rejuvenation methods like repeated cutting and hedging for multiplication. Hybridization programmes for Eucalyptus and other fast growing species for multiplications. Genetic improvement through biotechnology.

Results/Achievements: This work is season dependent and *Dalbergia sissoo* flowers during April hence no work could be done during the period under report. However preparations are underway to repeat the control pollination work and confirm earlier findings.

Maintained the cultures of immature seed/embryos resulting from control crosses.

Out of 2500 cuttings, only 260 cuttings survived and out of 1260 grafts 130, which were out planted. Serial grafts numbering 80 has also been attempted to achieve rejuvenation. All the grafts are surviving and being maintained. Cuttings taken from the 3rd serial grafting have rooted with higher percentage as compared to cutting taken from 1st and 2nd serial grafting. Plant material raised from these experiments was maintained which will be used for further rejuvenation experiment. Hedging in VMG has been undertaken and older clones from VMG are being replaced with new ramets having juvenility.

Maintained hedge garden comprising grafts of 80 clones established at Kaulagarh F.R.I. After rooting 150 plants from 15 clones were added in hedge garden. Completed hedging in all the VMG to produce juvenile shoot cuttings for mass multiplication.

The construction of green house and mist chamber in Central Nursery has been completed and is now functional. This year rooting of experiments will be carried out in mist chamber to produce ramets of maximum clones established in hedge garden.

In Chirpine different explants like megagametophyte containing immature zygotic embryos, mature zygotic embryos, young shoots and needles were cultured *in vitro* for shoot multiplication collected at different age Different stages of zygotic embryos were selected and used as explant source. Callus was established from immature zygotic embryos and somatic embryogenesis was obtained in few lines Maintenance and multiplication of this embryogenic callus is now in process so far our attempts has resulted in production

of non-embryogenic callus only. *In vitro* raised seedlings were used as explant source material for axillary shoots. These *in vitro* grown shoots were multiplied on well defined medium. However, the process so far is very slow. In Chir pine different regeneration pathways were followed using different explants. Mature zygotic embryos were induced to produce adventitious buds which were cultured further for elongation. Seeding explants were used for induction of multiple axillary buds. Immature zygotic embryos collected from Nahan and Solan were extracted from cones cultured along with the megagametophytes for induction of embryogenic callus. Different stages of zygotic embryos were cultured for selection of best responding stage. Callus was established and somatic embryogenesis was obtained in few lines. Maintenance and multiplication of this embryogenic callus is in process. Above work was continued, no further breakthrough has been achieved.

Only 8 to 10-years-old plants have been hedged and shoots emanating from them could be rooted using different hormones/media. While no success has been achieved so far in rejuvenating mature plant material. Process of grafting of scion taken from CPT's (mature trees) is being continued with a little success.

Hedging in old multiplication garden in *Dalbergia sissoo* and rooting of juvenile shoots emanating from them have suggested that in *D. sissoo* serial hedging creates juvenility in this species.

Experiments on periodic planting of cuttings under mist condition using hormones were conducted to see the rooting response. Cuttings were also taken from hedge garden and effect of clone on rooting response was also studied. Data are being collected.

In Shisham protocol for *in vitro* clonal multiplication of superior phenotypes (CPTs) has been developed.

Sl. No. : 61

Project identification No.: FRI/FREEP/06

Name of the principal investigator: Dr. M. Ahmad

Title of the project: Forest Entomology

Sub project (i): Survey of indigenous fauna of parasitoids and predators of key defoliator of poplar in Tarai region of U.P. and Haryana.

Sub project (ii): Survey of indigenous parasitoid fauna of key defoliators of shisham.

Sub project (iii): Screening of parasitoids for promising bio control agents of identified key defoliator of poplar (*Populus deltoides*) and develop techniques for mass culture of parasitoids.

Year of start of project: Oct., 1994

Target year of completion: Dec., 2000

Cost of the project: Rs. 167.40 Lacks

Objectives: (a) To survey and screen the indigenous parasitoid fauna of forest pests. (b) To develop techniques to mass culture these biocontrol agents under laboratory conditions. (c) To attempt field release of the promising parasitoids. (d) Screening of forest tree seeds for insect infestations.

Scientific importance of investigations: Provide information on the bioremediation of forest insect pests, which are ecologically sound and environmentally safe. Testing of the efficacy of Nuclear polyhedrosis virus

and its culture, which will provide methods for mass rearing of biocontrol agents of teak, poplar defoliator and other insect pests of important social forestry species.

Results/Achievements: Regular survey was conducted in Poplar nurseries till December, 1999 to observe population of primary defoliator, *Clostera cupreata* and its parasitoids and predators. The population of poplar defoliator was moderate at the sampling sites in Haryana and in Uttar Pradesh. Cumulative egg parasitization was observed up to thirty eight per cent during December. *Telenomus colemani* and *Trichogramma poliae* were the two main egg parasitoids recorded parasitising the eggs of *Clostera* spp. besides occasional presence of *Ooencyrtus lucina*, and *Pediobius* sp. Larval parasitization by *Aleiodes percurrens* was also observed while predatory bug, *Canthecona furcellata* (Hemiptera : pentatomidae) and praying mantis were found preying upon the *Clostera* larvae at various poplar nurseries in Haryana and Uttar Pradesh. Population of the defoliator and its parasitoids was disappeared by the end of December with natural leaf fall in poplar plants. This activity is completed in December, 1999.

Survey of shisham plantation revealed decreasing trend of defoliation. Population of *Plecoptera reflexa* (Lepidoptera: Noctuidae) was almost nil in October and November. Defoliation by *Dichomeris eridantis* (Lepidoptera : Gelechiidae) was very light in October and November and only few larvae could be observed. Population of larval parasitoid *Copidosoma varicorne* (Hymenoptera: Encyrtidae) was meagre. December, January and February was leafless period. New flush on plants came out in March and appearance of *D. eridantis* was observed and starting of Parasitisation by *C. varicorne* was also observed in the field.

Laboratory rearing of poplar defoliator (*Clostera cupreata*) was continued in chimney cages as well as in wooden glass cages on the foliage of *Populus deltoides*. Larvae of *Clostera cupreata* were reared on the foliage of *Xylosoma* sp. during leaf fall period of poplar from December, 99 to February, 2000. Emergence of over 100 adult moths was recorded during the period under report.

Rearing of *Trichogramma poliae* was continued on the alternate laboratory host, *Corcyra cephalonica* to develop mass culture. Laboratory experiments were conducted to study the parasitization potential, fecundity and longevity of another egg parasitoid, *Telenomus colemani*. Parasitoid was able to cause parasitism to 89.8 eggs of *Clostera cupreata* when a single pair of parasitoid was exposed whereas two and three pairs caused parasitism of 128.68(31.3%) and 162.19 (22.42%) host eggs respectively. Replacing of dead male parasitoids with the surviving females not only enhanced the parasitization per single female but also increased the longevity of female but also increased the longevity of female from 6 to 10 days. Fecundity of the parasitoids was found to be negatively correlated with elapsing days.

Attempts were continued to prepare artificial diet for the larvae of *Clostera cupreata* with ingredients including PDA, Vitamins, Casein, Antibiotics etc.

Laboratory rearing of *P. reflexa* and *Dichomeris eridantis* was carried out and over 500 larvae of *P. reflexa* and 700 larvae of *D. eridantis* were reared in the laboratory.

Laboratory rearing of *Copidosoma varicorne* was carried out in the laboratory. Rearing of *Helicoverpa armigera* and its potential as a predator of *P. reflexa* was also carried out. Technique regarding mass rearing on artificial diet was learnt at M.S.U., U.S.A during training course completed recently.

Attempts were made to develop artificial diet for the rearing of larvae of *Plecoptera reflexa* using Agar Kabuligram powder, shisham leaf powder, vitamins etc. Some improvements in the quality of artificial diet were made by incorporating antibiotics like Acetic acid and tetracycline. Experiments were also conducted to study the effect of low temperature on the viability of the pupae of *P. reflexa*.

Surveys were conducted to nurseries and plantations at Lachhiwala, Narsan and adjacent areas to study pest and parasite situation. Intensity of defoliation and presence of natural enemy complex were recorded.

Survey were conducted in young plantations of *Dalbergia sissoo* at Barkot Range and Lachhiwala forest Range, Dehradun Division to study the pest and parasitoid situation. Intensity of defoliation and presence of natural enemy complex were recorded.

Data pertaining to the survey, collection and screening of forest tree seed for insect infestation was compiled.

Pods and seed of Khair, *Acacia catechu* were collected from Dehra Dun Forest Division had 22% incidence of *Bruchidius uberatus* was observed.

An experimental plot was laid in clonal seed orchard of shisham, *Dalbergia sissoo* at Lachhiwala, Dehradun Forest Division, U.P. for the control of pod and seed insects of *Dalbergia sissoo*.

Post-treatment observation of chemical control of seed and pod insect of semul in CSO Champeiranj revealed that, spraying method have better than the tree injection method and monocrotophos perform better than dimethoate in protecting seed and pods of semul in CSO.

An experimental plot was laid in SPA of Kharshu at Deoban, Chakrata Forest Division following a statistical design. As the acorn crop was poor, insecticide was not applied.

Sl. No. : 62

Project identification No.: FRI-07/FREEP

Name of the principal investigator: DP Uniyal.

Title of the project: Plantin Stock Improvement Programme.

Year of start of project: Oct., 1994

Target year of completion: Dec., 2000

Cost of the projects: Rs. 226.42 Lacks

Objectives: Establishments of seed stand (SPA), Clonal Seed Orchard (CSO), Seedling Seed Production Area (SSPA), seed harvesting handling, testing and storage, Vegetative Multiplication Garden (VMG) and development of central nursery.

Scientific importance of investigations: Provide information regarding tree improvement programmes in production of improved planting materials. The CSO's and SSPA's will also serve as breeding population as they contain valuable germplasm. Data generated from these plantation raised from improved seeds in CSO's SSPA's and SPA,s will be used to estimate the genetic gain, on the basis of that suitable planting material will be selected.

Results/Achievements: Out of 21.80 ha. SPA established at U.P., Punjab and Haryana culling has been completed in all the SPA's of *E. tereticornis* 2.5 ha. SPA at Jind, has been damaged due to storms.

Progenies emanating from controlled crosses and open pollinations were maintained at FRI, Dehra Dun. Recorded data on growth assessment of these progenies about 1800 individuals representing 44 open pollinated families of *P. deltoides* were planted at FRI in Feb 99 which will be used in future breeding work. The families were maintained for further multiplication and breeding work. Preparation are under way to establish germplasm of these families in FRI central nursery for further multiplication.

Conveyed permission of the competent authority for culling inferior trees in the selected SPA's to U.P. Forest Department. Contacted Silviculturist Utranchal and DFO's and concerned CF's to expedite the operation of culling in all the 10 SPA's. 70 ha. area has been handed over to SFD for culling. Instruction were issued for collection of seed from seed trees marked in these seed stands during this season to the Silva Utranchal. During visit it was observed that this year is poor seed year only 2 to 4% trees have been observed bearing cones. First phase culling is expected to be completed by May 2000 in some of the SPA's. SFD have been approached to collect seeds from these SPA's.

In *D. sissoo* of 50 ha. SPA established and culling in all the 50 ha. completed. Instructions were issued to SFDs for collection of pods with complete instructions and maintaining records of supply etc. This has been done for all the three species.

Grafting was again tried in Feb, 2000 at F.R.I. but no encouraging results could be obtained due to change in weather resulting in early bud break. Grafting at different zones were carried out by PIs of RGF projects. Still the technique needs to be improvised. Results obtained from different zones but the success of grafting is much poor than previous season. To overcome this problem in situ grafting was also carried out for which stock material has been planted in the field. Visited UHF, Solan to demonstration the grafting technique. Grafting carried out in situ failed completely. Results from other PIS have not yet been received. Experiments have already been initiated on rooting of mature cuttings using cuttings of different diameter class and root promoting hormonal treatment.

Maintained 17 ha. CSO, established in Haryana and U.P. Recorded observations on performance of different clones in CSOs. Analysis of data is in progress pertaining to Seonthi.

Maintained already established 11.0 ha. clonal seed orchards and recorded data on performance of different clones. Analysis of data is in progress, using statistical programme to evaluate, genetic parameter estimated heritability for various parameters. Selection of superior clones is in progress based on the data analysis so far for establishment of improved CSO.

Hedging has been completed in all VMGs and preparation are under way to multiply the CPTs for which central nursery has been kept ready.

Maintained 6 ha. of SSPA of Chir pine. Some of the plants have been damaged by hail storm, in the 2 ha. area established in 1999-2000 which will be replaced in coming season if they do not recover. For this purpose progenies of 40 CPTs have been raised at FRI.

Maintained already established 7.1 ha. SSPA. Received recorded data on family performance in different SSPA's. Seeds obtained from CSIRO, Australia. One lot has been kept for raising progenies to make use as infusion population in SSPA's. Sowing has been done at FRI.

In *Dalbergia sissoo* maintained 12.1 ha. of SSPA's established. Recorded data in respect of these SSPA's. Analysis is in progress.

Maintained 1.2 ha. multiplication garden of *Eucalyptus tereticornis* comprising 80 clones and 25 clones at Kaulagarh and 15 at Brandis Road established at New Forest, Dehradun.

Maintained already established 1.25 ha. VMG at FRI. Completed hedging in all the VMGs to multiply CPTs.

Maintained already established 0.5 ha. VMG established at FRI. High degree of mortality was observed due to unprecedented rains which caused water logging multiplication of 12 clones through rooting of cutting for replacement in VMG Experiments carried out on rooting have indicated 12 to 14% rooting in

Juvenile shoot cuttings under different media used. To produce ramets, multiplication of clonal material is in progress. Results are quite encouraging as in vermiculite about 42 to 60% cuttings have shown rooting response which will be confirmed when the cuttings attain sufficient growth to conclude the final results.

Established 1.15 ha. of VMG of *P. deltoides* using 37 clones at spacing 1 x 1.5 m. and 0.8 x 2 m. The total No. of ramets are 10145.

NEW PROJECT TAKEN UP DURING 1999-2000

Sl. No.: 1

Project identification No.: FRI-132/FED-7

Name of the principal investigator: Dr. H.R. Khan

Title of the project : Bio-Ecology and management of some important key defoliators of agroforestry species.

Year of start of the project : 1999

Target year of completion: Sept. 2002.

Cost of the project: Rs. 0.5 lakhs

Objectives : (a) To evaluate the present status of the key defoliator species- *Ascotis selenaria imparata* Walk. and *Selepa celtis* Moore. (b) To work out biology, ecology, population dynamics of the pests (c) To develop suitable control measures following IPM methods so as to prevent insect outbreaks and management of the pests.

Scientific importance of investigations : Suitable measures to prevent pest outbreaks and control measures will reduce insect damage and increase productivity.

Results and Achievements : The work is in progress.

Sl. No.: 2

Project identification No.: FRI 136/Path-06

Name of the principal investigator: Ajab Singh

Title of the project : Studies on disease resistance of newly introduced germ plasm (progenies of *Populus deltoides*).

Year of start of the project: 1999

Target year of completion : Sept. 2002

Cost of the project : Rs.0.74 lakhs

Objectives: To evaluate the internal resistance of newly introduced germplasm against potentially important pathogens.

Scientific importance of investigations: Screening will facilitate genetic improvement of poplar through selection of disease resistant clones/hybrids.

Results/Achievements : Monitored and assessed disease status of 419 clones of *Populus deltoides* raised at New Forest, Dehra Dun. Out of these, 280 clones showed high degree of susceptibility to *Alternaria alternata*

and *Phyllosticta adjuncta*. 190 clones were susceptible to *Bipolaris maydi*. Incidence of *Sphaecloma populi* was recorded only on 90 clones. 139 clones raised by seeds (F1 progeny) showed resistance to foliar pathogens. 102 clones were found resistant to *P. adjuncta*, *A. alternata*, *S. populi* and *Myrothecium roridum*. One clone (Evergreen) showed 100% rust infection with D.S.I. value 33-54.

Sl. No.: 3

Project identification No.: FRI-139/Path-09

Name of the principal investigator: S.N. Khan

Title of the project: Studies on nursery diseases of *Dalbergia sissoo*.

Year of start of the project: 1999

Target year of completion: Sept. 2001

Cost of the project: Rs. 2.50 lakhs

Objectives: To study diseases in nurseries and prepare a disease calendar.

Scientific importance of investigations: The project will make available a package of practices to SFDs for control of potentially destructive diseases.

Results/Achievements: Periodic monitoring of diseases in nurseries were done. The occurrence of number of foliage pathogens at different times of the year was studied. The fungi were identified and their appearance and persistence was recorded. *Marasmiella achroa* leaf and twig rust of sissoo, appeared in the month of March- April in Dehra Dun (UP) nurseries. The disease was absent in Haryana nurseries. The rust infection persists upto September. *Pseudocercospora* leaf spot was observed in the month of April in UP and Haryana nurseries. *Rhizoctonia solani*, leaf web blight appears in the first half of July and remained serious during rainy season in the nurseries in UP and Haryana. *Myrothecium roridum* leaf spot was recorded from UP and Haryana nurseries in the second half of July and persisted upto last of August. *Alternaria alternata* leaf spot was recorded in the month of July and persisted up to October. However, no fresh infection was observed after September. *Colletotrichum* leaf blight appeared in the last week of June and continued during monsoon period. *Uredo sissoo*, leaf rust appears at the end of November and persists upto leaf fall. Powdery mildew, *Phyllactinia dalbergiae* appeared at the end of October and persisted till leaf fall. *Phyllachora* sp. leaf spot was recorded in the month of June and continued upto leaf fall.

Sl. No. :4

Project identification No.: FRI-137/Path-07

Name of the principal investigator: Dr. A.N. Shukla

Title of the project: Seed mycoflora of important tree species and its management.

Year of start of the project: 1999

Target year of completion: Sept., 2002

Cost of the project: Rs. 1.10 lakhs

Objectives: To detect and study seed fungi causing loss of seeds workout and their management.

Scientific importance of investigations: The study on seed mycoflora and their management will minimize loss of seeds in storage and damage to seedling stock by seed borne pathogens.

Results/Achievements: The seeds were collected from different provenances in Haryana, Himachal Pradesh and Uttar Pradesh. They were cleaned and stored for future study. The seed mycoflora were isolated on PDA and they were identified. Effect of leaf and stem extracts of *Ricinus communis* was tested on the seeds of *A. lebbek* and mycoflora isolated.

Sl. No. : 5

Project identification No.: FRI-138/Path-08

Name of the principal investigator: Dr. Y. P. Singh

Title of the project: Parasitic and symbiotic associations of tree fungi and species used for harsh site afforestation.

Year of start of the project: 1999

Target year of completion: Sept., 2004

Cost of the project: Rs. 18.64 lakhs

Objectives: (a) To monitor and identify diseases in nurseries and plantations and suggest their management. (b) To scan and select predominant AM fungi. (c) To establish correlation between symbiotic fungi *vis-à-vis* soil properties.

Scientific importance of investigations: The project will help create disease free planting stock for use under stress conditions like sodic soil.

Results/Achievements: Conducted a preliminary survey for site and species selection for mycorrhizal status. Pure plantations of *Acacia*, *Arjuna*, *Eucalyptus*, *Leucaena*, *Prosopis* and *Dalbergia* and a mixed plantation having *Albizia*, *Eucalyptus*, *Leucaena*, *Pongamia* and *Prosopis* were scanned for mycorrhizal fungi. In pure plantations, highest and lowest infection was observed in *Leucaena* (77.4%) and *Prosopis* (57.2%), respectively. Even in mixed plantation, *Prosopis* supported minimum root infection of 42.5 per cent. Also, surveyed few nurseries and plantations of different PFFCs for gathering information regarding disease situation.

Sl. No.: 6

Project identification No. : FRI/NOVOD-1

Name of the principal investigator: Dr. J.K. Rawat.

Title of the project: Development of Neem in various agro-ecological regions of India.

Year of start of the project: 1999

Target year of completion: 2002

Cost of the project: Rs.18.48 lakhs

Objectives: To collect seeds from different sources for processing, storage and distribution for laying seed source trials.

Scientific importance of investigations: Neem is one of the most important tree species as a biopesticide. There is very little information on the seed source variation in neem oil and azadirachtin content. The proposed study will help in the selection of superior genotypes with high oil and azadirachtin content.

Results/Achievements: The seeds were collected from different sources and distributed for trials after extraction and processing. The remaining seeds were stored for further studies.

Sl. No.: 7

Project identification No.: FRI/NOVOD-1(i)

Name of the principal investigator: Dr. P.P. Jain

Title of the project : Studies on tree bearing oil seed.

Sub-project: Studies on oilseeds of forest origin to find sources of oils and to prepare wetting agents from oils containing hydroxy acids.

Year of start of the project : March, 1998

Target year of completion : February, 2002

Objectives: To find sources of oils and wetting agents from tree borne oil seeds.

Scientific importance of investigations: The project will generate new scientific data and products.

Results/Achievements: Oil contents were determined in the seeds of *Cedrella serrata* (17.4%), *Lannea coromandelica* (6.38%), *Phoebe hainesiana* (7.36%) and *Prunus armeniaca* (31%). Physico-chemical constants of the oils isolated from the seeds of above mentioned species and their fatty acid composition were also determined. Wetting agents (surfactants) were prepared from oils, isolated from the seeds of *Dillenia pentagyna*, *Prunus padus*, *Jatropha curcas* and Castor using different concentrations of concentrated Sulphuric Acid. Properties of the wetting agents such as surface tension and foaming were determined and compared with the properties of commercially used wetting agent i.e. Turkey Red Oil (TRO). Results revealed that surfactants prepared from the seed oils of *Dillenia pentagyna* and *Jatropha curcas* are better than the commercially used Wetting agent (surfactant) i.e. TRO.

Sl. No.: 8

Project identification No.: FRI 132/FED-7

Name of the principal Investigator: Dr. H.R. Khan

Title of the project: Bio-Ecology and Management of some Important Key Defoliators of Agroforestry species.

Year of Start of project: Oct., 1999

Target year of completion: Sept., 2002

Cost of the project: Rs. 0.30 Lacks

Objectives: (a) To conduct insect pest surveys in forest nurseries, plantations and to record damage and incidence of attack due to insect species under study. (b) To evaluate the present status of the various insect pest species under study and to assess the actual and potential threat due to insects in forest nurseries, young plantations including natural forest. (c) To study in detail, the biology, ecology and life-history, number of generations, population dynamics and seasonal abundance of the various insect species (target pests). (d) To develop suitable control measures by evolving non-toxic, non-hazardous, ecofriendly methods for management of the insect species concerned so as to prevent pest outbreak.

Scientific Importance of investigations: Defoliation at repeated interval specially during the growing period, in nurseries and young plantation of these species (Shisham, Teak, Poplar, Babool, Sal, Amla and Gamhar) due to insect attack, also appearing in outbreak cause retarding growth and increment, destroying the planting stock material. The insect species involved requires detailed investigation to work out the pest problem, keeping it within tolerance limit.

Result/Achievement: Studies were conducted on the two (2) important polyphagous defoliators *Selepa celtis* Moore and *Ascotis selenaria* Walk, pest of wide range of host plant species, often appears in epidemic. The work undertaken during the period under report for the period October 1999 till March 2000 is given below:-

Consultation of literature on the insect species under study was carried out and reviewed.

Surveyed forest nurseries, plantations in Dehra Dun and Shiwalik Forest Division localities includes Lachhiwala, Kaluwala, Ghamandpur, Majri, Barkot, Thano, Timli, Chohrpur and Jhajra. The adults and immature stages of the insects were collected and recorded incidence and extent of damage to Amla, Mulberry and Sal due to *Selepa* and in *Murraya*, Raini, Jamun, Bakain and Sal due to *Ascotis*.

Field collected insects were reared in laboratory for stock culture and bred in mass, conducted experiments on the biology and life cycle of the pests. Observations on the pest-biology, mating, oviposition, egg and incubation, larval and pupal stages and development were recorded under laboratory conditions.

During the field visit at periodic intervals, observations were recorded on the pest population and its fluctuation, seasonal abundance etc. to study the pest ecology.

Under Biocontrol, during surveys, the natural insect enemy complex (Bio-control agents) of the insect species also studied. Collected few parasites and predators of the pest. The identification work is in progress.

Sl. No.: 9

Project identification No.: FRI 133/SF-4

Name of the principal investigator: Ranjana Gupta

Title of the project: Forest Community Interface – A Study on the Impact of Participatory Forest Management on the Status of Forests and on Socio-Economic Development of Rural People in Dehra Dun District of U.P.

Year of start of project: Oct., 1999

Target year of completion: Sept., 2002

Cost of the project: Rs. 10.00 Lacks

Objectives: (a) To study the impact of PFM in Dehra Dun district of U.P. on the status of forests and environment. (b) To assess the socio-economic benefits (qualitative and quantitative) accruing to rural people through PFM in these areas. (c) To identify the prime ingredients of the PFM programmes responsible for bringing about change if any in the status of rural people. (d) To study management prescriptions i.e. successful approaches / components of PFM programmes in the area.

Scientific importance of investigation: Peoples Participation in planning, protection, management and sharing of usufructs of jointly managed forest areas is of recent origin. PFM has stories of success as well as failure and the opinion about its success and failure varies from state to state and from village to village.

But, there are very few systematic studies on the impact of PFM on the status of forest and on socio-economic development of rural people. Proposed project which aims at identifying the mechanism and reasons for its success would enable policy making, planning and decision-making at macro-levels for expanding the activities in new areas and making corrections in areas where successes have been low. This study shall also be helpful in deciding and adopting suitable strategy for making PFM successful.

The rural people will continue to participate actively in PFM and the whole process will become sustainable and institutionalised if the people find that in return for their effort, they are benefitting, and their socio-politico-economic condition is improving. It is important to study if it is so and examine the favourable and the unfavourable factors.

Result/achievements: Action plan implemented, literature survey done, initial contact established, reconnaissance survey conducted, questionnaires developed & tested for results and work in progress.

EXTENSION

Facilities generated and services rendered

About 2100 wood samples were examined and identified as received from various Govt. Deptts., Public undertakings, CBI/Police Deptts.

Technical evaluation of stored bamboo for pulping and papermaking qualities was carried out on behalf of Nepa Limited Neapanagar.

Consultancy services on various aspects of timber utilization were provided to different Govt. departments/user agencies etc for improving the quality of wood products etc. Testing of wood and wood products/adhesives/preservatives etc was also done for wood Processing Industry/Govt. organisation and individuals. Total consultancy and testing charges collected during the year is Rs.15.58 lakhs.

Video films – time spared and revenue earned

One video film covering all aspects on seasoning of timber was prepared for Doordarshan.

Transfer of Technology.

Training and Teaching support

Short Term Training Courses on the following subjects were organised during the year 1999-2000, in which officials of the Govt. of India, the state forest departments, Public Sector Undertakings as well as representatives from various industries were the participants.

- Plantation Technology
- Forest Ecology
- Extension Methodology
- Forest Protection, Disease & Pests
- Seed Technology & Management
- Containerised Nursery Technology
- Wood Preservation Technology
- Classification & Grading of Timber
- Management of Forest Herbarium & Arboreta
- Bio-Diversity Conservation

Courses on the following subjects were also organised as a part of compulsory training of IFS officers, sponsored by the Ministry of Environment and Forests, Govt. of India:

- Forestry Extension
- Bio-Diversity Conservation

Other activities are detailed below :

1. Two weeks regular course on "Field Identification of Timber" was conducted for trainees from various Govt. Deptts.
2. A special one week training course on "Fibre morphology and identification was conducted for the trainees of National Institute of Criminology and Forensic Science, New Dehi.
3. Transfer of Technology on wood bending though NRDC, New Delhi was effected.
4. Two courses of one month duration on "Wood Processing Technology for handicrafts sponsored by DC(H), New Delhi. were organised.
5. Training courses on 'Trap Tree Operation' for control of Sal borer, for SFD officials, (short term course) was organised in 3 batches and trained more than 300 SFD officials were trained.
6. Training on the raising of poplar nursery was organized to the field worker of Indian Farm Forestry Development Co-operative Ltd. One day training programme on technology demonstration for timber harvesting tools and techniques and other forestry tools" was also organised.

The technology of the production of katha from *Uncaria gambier* to the following industries:

- M/s Mantu Khair Industries, Rangia, Assam – 10.00 lakhs.
- M/s Shiv Shakti Industries, Hanuman Garh (Rajasthan) – 10.00 lakhs.
- M/s TVL Hi-Tech Polymers Pvt. Ltd., Dehra Dun – 10.00 lakhs.
- M/s T.K. Products Ltd., Tilak Bazar, New Delhi – 05.00 lakhs.

A technology to prepare alpha-cellulose (purity 99.5%, brightness>80%) of different degree of polymerisation (800-3000) for Gujrat Alkali & Chemicals Ltd., Vadodara was developed.

Field demonstration

Field demonstration on Poplar cultivation to the farmer societies of I.F..F. D.C., Ltd. Sultanpur was carried out.

Exhibition/Kisan Mela etc.

- Forest Research Institute participated in "Swadeshi Vigyan Mela" held at IIT, Delhi.
- Forest Research Institute participated in the following exhibitions, melas held at different places in Uttar Pradesh and displayed live medicinal plants and offered technical advise for their cultivation, conservation and utilization to various target groups:
- Ayurveda Mahatosava –1999 at Rishikul Govt. Ayurvedic College, Haridwar between November 14 – 20,1999.
- S.S.B. Mela – 1999 at Agastyamuni (Rudraprayag) on 23 November, 1999.
- Magh Mela – 2000 at Allahabad (One month duration).

Seminars, Workshops etc.

- Two workshops cum -peer review one on Chir Pine (*Pinus roxburghii*) and the others on Eucalyptus were held to review the progress made under ICFRE funded RGF projects under World Bank (FREEP).
- National Seminar on Poplar was organized at F.R.I., Dehra Dun in Nov. 1999. one CTA workshop was also conducted by the CTA seed technology.
- One day workshop on Shisham Mortality was organised on 11th January, 2000

Publication and Extension literature brought out by the Institute

Books, Brochures, Folders and Pamphlets with titles

1. Studies on the fungicidal toxicity of Sal (*Shorea robusta*) heartwood extractives by Poonam Gupta and Indra Dev.
2. ACA treatment versus dimensional stability of Eucalyptus wood by Indra Dev, S.N. Nautiyal, J.K. Bagga and K.S. Shukla.
3. Pamphlets on "Wood bending" and "Solar Kiln" were prepared for distribution on Swadeshi Vigyan Melá.

FINANCIAL STATEMENT FOR THE YEAR 1999-2000

I. PLAN			
Sl.No.		SUB-HEAD	Expenditure (Rs. in lakh)
1.	A.	REVENUE EXPENDITURE	
		(a) Research	471.36
		(b) Administrative Support	222.08
		Total for Revenue Expenditure 'A'	693.44
	B.	LOAN AND ADVANCES	
		(a) Loan Advances (Conveyance)	6.06
		(b) House Building Advance	5.90
		Total for 'B'	11.96
	C.	CAPITAL EXPENDITURE	
		(a) Building & Roads	-
		(b) Equipments, Library Books	-
		(c) Vehicles	-
		Total for 'C'	-
		GRAND TOTAL FOR A+B+C(PLAN)	705.40
II. NON-PLAN			
1.	A.	REVENUE EXPENDITURE	
		(a) Research	346.58
		(b) Administrative Support (Salary)	384.06
		Total Non-Plan	730.64
		TOTAL FOR PLAN + NON-PLAN	1436.04
III. FUNDED PROJECTS			
	A.	World Bank Project	183.81
	B.	UNDP Project	1.86
	C.	NABARD Project	-
	D.	FORTIP	-
		GRAND TOTAL for (A+B+C+D) FUNDED PROJECTS	185.67