EXTERNALLY AIDED PROJECTS COMPLETED DURING THE YEAR 2007-08

FRI

Project 1: Maintenance of Chakrata NWFP Nursery (UFDC sponsored)

Findings: The maintenance and improvement works of the High Altitude Herbal Garden at Chakrata was done. Important medicinal plants like *Aconitum heterophyllum, Podophyllum hexandrum, Picrorhiza kurroa, Digitalis* spp., *Artemisia annua, Swertia chirata, Ephedra gerardiana, Microstylis wallichii* and *Habenaria intermediata*, etc. were conserved for research and further development in the well protected garden. The nursery is provided with extension boards for education and awareness. The garden has been made fit for taking up research studies of high altitude plants.

Project 2: Development of Ecorestoration Model for Iron Ore Mines of Bihar and Orissa [Funded by MoEF, New Delhi]

Findings: The project is of immense practical utility for the mine areas of Bihar and Orissa, where out of 47,797.00 hectares of mine lease area, nearly 11,500 hectares of the land area is under leases for Iron Ore alone. The objective of this project is to develop ecologically and economically viable restoration model for Iron Ore mines of Bihar and Orissa which are spread over an area of 11,500.00 hectares. Ecorestoration model has to be developed on the basis of detailed soil, vegetation and parent materials in relation to ecological and ethno- botanical information. The model developed can be replicated in all these areas for overburden dumps mined out benches and degraded areas in vicinity of mines. Project report has been submitted.

Project 3: Forest Fire Monitoring and Management

Findings: The quantity of pre fire fuel load, fuel moisture and soil temperature has been determined in all selected sites i.e., Pure Sal, Sal mixed, Pure Pine, Oak, Mixed Deciduous forests and degraded sites. Post fire estimations of all these parameters have also been made in different forest types to evaluate the impact of fire.

The amount of Gaseous emissions of as CO, CO_2 and Methane emitted from the different forest during/after fire have been estimated at different distance such as 10 m, 20 m, 40 m, 50 m, 60 m, 70 m, 80 m, 90 m and 100 m from the source of fire.

Post fire temperature variations along the vertical gradient in different forests have been recorded using Infra red thermometer to assess the impact of fire in the forest stand. Leaf Area Index and canopy gaps are being recorded using canopy analyzer in different forest types, the recording is in progress.

Project 4: Restoration of biodiversity in the hills of Kujapuri following Badriran restoration approach (Funded by G.B. Pant Institute of Himalayan, Environment and Development, Almora)

Findings: Sixteen native forestry species of multi uses i.e. fodder, commercial sacred and ornamental have successfully been introduced in the area during the process of

restoration measures. Among them the most successful species in term of survival and growth were *Fraxinus micrantha, Quercus leucotrichophora, Aesculus indica, Celtis australis, Grewia optiva, Toona serrata (*Syn.*Cedrela serrata), Arundinaria falcata* and *Dendrocalamus strictus*. Species diversity index of shrub layer, which was 0.67 before restoration, has significantly increased to 2.40 after restoration. Similarly in the case of herbaceous layer, the diversity index value increased from 1.40 to 2.21 due to restoration activities. *Chrysopogon fulvus*, a native grass species, has registered a significant dominance in its presence in the area after restoration. A significant reduction in the diversity of *Eupatorium glandulosum*, an exotic under shrub and *Bidens beternata*, an annual weed, has been recorded after restoration.

Project 5: Identification, development and utilization of natural dyes from the forest plants of Uttaranchal (Funded by DSIR, MoEF and ICFRE) [FRI–249/Chem-12/ Ext.]

Findings: Specifications for the fabrication of natural dye pilot plant were drawn, procured, installed and commissioned for the first time in Uttarakhand. Processes were developed for the isolation of natural dye from abundantly available *Eucalyptus* hybrid (leaves and bark), *Populus deltoides* (bark), *Pinus roxburghii* (needles) *Lantana camara* (leaves) and *Cassia tora* (seeds). Fifty two trials were carried out in pilot plant at 20 to 40 kg batch scale, depending upon the bulk density of the material. Methods were developed for dyeing of different fabrics using the dyes of aluminium, copper, chromium and tin salts as mordants. The blends prepared using the isolated dyes from five plant species did not show appreciable changes in the shades of dyed fabrics. The dyed fabrics having fascinating shades exhibited very good fastness properties. It was established that vacuum tray drying is better than the spray drying in the case of all five dyes. MoU was signed with Sikkim Khadi and Village Industries Board (SKVIB) for installation of pilot plant for isolation of natural dye from plant species occurring in Sikkim under the technical guidance of FRI. An agreement has been signed with Uttarakhand Khadi Village Industries Board for the supply of dye. A documentary on the isolation of natural dyes was prepared by Pulse Media Limited, New Delhi for telecast on Doordarshan. The different parts of these plant species which are not of much use can be used for the isolation of dye thereby finding their utilization. The technology is ready for its transfer to interested entrepreneurs.

Project 6: Utilization of economic potential of *Parthenium* [FRI-262/Chem-13/External; Department of Biotechnology, New Delhi funded/2004-07]

Findings: Phenol formaldehyde resin was prepared and analysed using commercial grade phenol and formaldehyde. Particle boards were prepared at 17.5 kg/cm^2, 21 kg/cm^2 and 24 kg/cm^2 pressure levels using 10%, 12% and 14 % phenol formaldehyde resin with pressing temperature 150^{o}C. For reducing the water absorption of boards, 0.5 and 1.0 % wax emulsion was also used for making particle boards. Particle boards thus obtained were tested for various physical and mechanical properties such as density, moisture content, water absorption, swelling due to surface absorption, Modulus of Rupture (MoR), tensile strength perpendicular to surface etc. as per relevant IS specifications. It was observed that the particle boards prepared at 24 kg/cm^2 pressure level using 14 % resin meet the IS specifications.

Project 7: Development of improved chemical formulation and equipment for efficient treatment of bamboo for long term preservation and fire retardance

Activity 1: Modification of Boucherie equipment and its extension for the treatment of green bamboo – design etc.

Activity 2: To develop low cost chemical compositions of eco-friendly/conventional preservative and fire retardant for treatment of structural bamboo for rural application NMBA (TIFAC).

Findings:

1. Fabrication, Installation and testing of Automized Boucherie equipment for the treatment of 24 Bamboos at a time.
2. Ten fire retardant and preservative compositions were prepared and tested for performance against fire. Out of ten combinations of fire retardants and preservatives tested, five combinations i.e. I, II, III, IV and VII were passed as per BIS no. 5509: 2000 and 1734 (part III) 1972.
3. The old flame penetration test equipment is modified and upgraded with special attachments

Project 8: Biotechnological approaches for improvement of plant species with special reference to pulp and paper [CSIR-NMITLI funded/2004 – 08]

Findings: This was a multi-disciplinary and multi-institutional project involving FRI, KFRI Peechi, NCL Pune, IHBT Palampur, NBRI Lucknow, CIMAP Lucknow, Lucknow University and Osmania University, who got together for a common goal of improving plant species for pulp and paper having low lignin and higher fibre length. Under its component, FRI achieved the following:

1. 1140 wood samples from different locations / collections of *Leucaena leucocephala* (Subabul) trees representing 14 States were received from the participating institutes including FRI for chemical, physical and anatomical characterization.
2. Large variation was observed in lignin, fibre length and other parameters.
3. Fifty two elites short listed based on higher fibre length and low lignin content.
4. FT-NIR protocols developed for specific gravity, lignin, holocellulose and extractives estimation.
5. List of elites further shortened to 18 and then to 8.
6. Lignin and extractive content variation in wood samples with and without bark and for bark only studied.
7. Ash content studied for all the wood samples.

Project 9: *Ex-situ* conservation of some critically endangered plants of Uttaranchal [FRI-277/Bot-42/Ext./2005-08]

Findings: The project was funded by National Botanical Research Institute under the Investing in Nature-India (IIN-India) scheme. *Ex-situ* conservation was the prime objective of the project. A list of 165 rare and endangered species of Uttarakhand was prepared based on published literature such as Red Data Books. An Assessment of

Threatened Plants of India, The Indian Plant Red Data Book, etc. Nine endangered species were collected and introduced in the botanical garden of FRI. The monotypic species *Catamixis baccaroides* found only on the shiwaliks of Dehradun was successfully grown in the botanical garden. The species has hence been flowered and produced seeds. Five species have been propagated and grown in their original habitats. Awareness training programmes were organized for school children of Kendriya Vidyalaya of Dehradun. In all 52 childrens and 12 teachers attended the programme. The endangered palm *Trachycarpus takil* was provided to NBRI, Lucknow, WII, and Dehradun for planting in their conservation gardens.

Catamixis baccaroides in FRI Botanical Garden

Catamixis baccaroides in original habitat

Project 10: Creation of germplasm bank of medicinally important tree species of Punjab [FRI-336/Bot-50/Ext./2006-09]

Findings: Five medicinally important tree species were selected for establishment of their germplasm banks. The field survey was done for whole of the State of Punjab and two sites selected for establishment of germplasm bank of various species. The lands were developed by removing the existing trees, shrubs and herbs, digging out tube wells for irrigation and fenced the areas by barbed wire fencing. The site maps were prepared providing parks and blocks for each species to be accommodated. The irrigation channels and under ground pipefitting were carried out for proper irrigation. The seedlings of different plus trees were grown as a progenies. The data on seed and seedlings characteristics, nursery performance of planting material etc was recorded and analyzed. The planting material was properly tagged by aluminum foil before shifting it to the field. The germplasm bank map was prepared depending upon the availability of land and the number of plants to be accommodated in the field. Generally, the planting was done in RBD with row or block plantation. The out planting was done generally during rainy season. Proper weeding, watering and soil working is being done as and when required. The casualties' replacement was followed in next growing season by identified material. The display of sign boards for each species giving details of the field map and progenies with other details like date of planting, spacing, no. of plants and area etc was also carried out. The field performance of different species was assessed regularly.

Project 11: Development of suitable propagation technology of three *Terminalia* species [FRI-261/Bot-40/Ext./2003-06]

Findings: Survey for distribution and availability of species in Uttarakhand region has been completed.Vegetative propagation technology through juvenile shoot cuttings of *Terminalia arjuna, T. bellirica* and *T. chebula* is developed.

An attempt has been made to study the effect of season and growth hormones on branch cuttings of these three species. The experiment was conducted during February 2005, May 2005, July 2005, August 2005, November 2005, February 2006 and May 2006. Seasonal effect was found important factor in response of callus formation and root initiation. In case of *T. arjuna* and *T. chebula*, maximum rooting response was observed in August planted cuttings. On the other hand in case of *T. bellirica,* maximum rooting response was observed in July 2005 while no rooting was initiated during February, May and November 2005 planted cuttings.

Collection of seed and other reproductive planting materials from plus trees from different areas of Uttarakhand has been completed. Seed dimension (seed length and seed width) and germination behaviour (germination percentage, germination speed, germination period, germination energy, germination value and seed viability) study is completed.

One year seedlings studied for various growth parameters like (height, collar diameter, number of leaves and root length) and biomass production (dry weight of leaf, stem and root) was carried out.

The other propagation methods like air layering and grafting were tried and found successful.

In rooting response of juvenile shoot cuttings (mononodal cutting) of *Terminalia arjuna, T. bellirica* and *T. chebula* for mass propagation, the maximum rooting response was observed in case of IBA 4000 (*Terminalia arjuna* and *T. chebula*) and IAA 4000 (*T. bellirica*) treated cuttings.

The branch cuttings collected from mature tree of *T. bellirica* failed to root whereas, the branch cuttings of *Terminalia arjuna* and *T. chebula* favourably responded to rooting.

Three papers were published and one communicated so far under this study.

Project 12: Evaluation and standardization of the methods employed in identity of the medicinal plants employing woods of Himalayan and Sub-Himalayan tract [FRI-276/Bot-41/Ext./2004-07]

Findings: The project evaluated and enlisted the woods of Himalayan and Sub-Himalayan tract that are being used in the production of various medicines. Such

woods were studied for standardizing their correct identity through wood microstructure, wood ultrastructure and wood chemistry. Since adulteration in raw materials of medicines is a common problem, therefore, the present study is extremely useful for pharmaceutical companies to check the same.

Project 13: Micropropagation of promising interspecific F_1 hybrids of eucalypts and establishment of field trial [FRI-220/G&TP – 11/Ext.]

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

Project 14: Network program for establishment of demonstrations of Bamboo plantations in Uttaranchal [FRI – 257/Bot. – 36- Ext.]

Findings: *In-vitro* shoots of *Dendrocalamus asper* were multiplied on large scale. 15 and 16 fold shoot multiplication was obtained on MS medium supplemented with 2.5 mg/1 BAP. *In-vitro* rooting was standardized. 95% *in-vitro* rooting was standardized on MS supplemented with 10.0 mg/1 IBA and 3.0 mg/1 NAA.

Tissue culture raised plants were produced and these plants were hardened and acclimatized in mist chamber and shade house. 12,000 plants of *D. asper* were supplied to Uttarakhand Forest Department for field plantation.

Project 15: Development of tissue culture technique for protocol development of *Bambusa balcooa* and *Melocanna bambusoides* [FRI – 258/Bot. – 37- Ext.]

Findings: *In-vitro* shoots of *Bambusa balcooa* were multiplied on MS medium supplemented with 10µM BAP + 2.5 µM Kn, which gave a 3 and 4 multiplication folds. In *Melocanna baccifera (*Syn. *Melocanna bambusoides)* best *in- vitro* multiplication of 3-4 folds were obtained on MS medium supplemented with 10 µM BAP.

In *M. bambusoides in vitro* rooting was obtained on MS medium supplemented with 25 µM IBA, while in *B. balcooa* scanty roots were obtained by pulse treatment of IBA. A complete tissue culture protocol has been developed.

Project 16: Study on pathogenic and molecular variability in *Fusarium solani* causing shisham (*Dalbergia sissoo*) wilt. [BT/BR/4273/AGR/16/356/ 2003; 2004-07] Funded by DBT

Findings: Out of 129 isolates of *Fusarium solani* collected from the high infection zones, a total of 53 isolates were selected for various studies. Nutritional studies using four

nutrient media viz. Potato Dextrose Agar, Czapek Dox Yeast Extract Agar, Malt Extract Agar and Joff's medium were conducted for variation in growth, sporulation and development of pigmentation. Bavistin and Propiconazole were most effective while Bayleton and Topsin-M were least effective in all concentrations.

Molecular characterization of *Fusarium* isolates

RAPD

Forty five primers showed a total of 659 reproducible bands. Each of these primers varied greatly in their ability to resolve variability among the genotypes. The individual primer produced bands in a range of nine (LC94 and 1319) to 22 (LC-102) with an average of 14.64 bands per primer. Out of the 659 bands, 15 bands were monomorphic *i.e.* they were present in all the 38 isolates. The values of the coefficients were estimated on the basis of 45 primers which ranged between 22% (between F1 and F37) to 94.5% between F29 and F30 isolates. The maximum similarity coefficient between F29 and F30 (0.945) indicated the closeness of these two genotypes.

Cluster analysis

Phylogenetic tree showed clear distinction among all the 38 isolates by dividing the isolates into two major groups. The first major group consisted of 24 isolates while the second major group included 13 isolates, which were isolated from ooze of the plant. Isolate F26 was separated from these two groups. All *Fusarium* spp. except *F. solani* isolates were present in major cluster 2. Principal coordinate analysis was performed in order to highlight the resolving power of the ordination.

ISSR

A total of 206 bands were detected using 20 ISSR primers out of which 202 bands were polymorphic and only 4 were monomorphic. The number of amplified bands varied from 6 with primer LC-6 and LC-7 to a maximum of 14 with primer LC-64 and LC-65 with an average of 10.3 bands per primer while the amplified fragment ranged from 250 bp (primer LC-11 and LC-12) to 3250 bp (primer LC-59). Jaccard's similarity coefficients estimated using twenty ISSR primers ranged from 23 between F22 and F36 to the maximum of 97.3% between F1 and F2. Thus the result revealed closeness between F1 and F2 and high diversity between F22 and F36 isolates.

Cluster analysis

All the 38 isolates were clearly separated by dendrogram. Two major groups could be identified excluding F13 and F26. The first major group included all the *F. solani* isolates excluding F13 while second major group includes all other *Fusarium* spp. isolates obtained from ooze (F6, F7, F8, F9, F10, F11, F14, F15, F16, F18, F21, F22 and F37). Principal coordinate analysis was also performed in order to highlight the resolving power of the ordination.

SSR

Out of 62 tested, twenty five rice SSR markers revealed 294 bands in the 38 isolates. The number of bands per primer varied widely among these markers, ranging from 1 (LC-285 and LC-319) to 21 (primer LC-310). The average number of bands per primer was 11.76. The value of the coefficient varied from 16.5% between F22 and F36 to 97.1% between F29 and F30 followed by 88.4% between F8 and F9. The isolates F29 and F30 were found to be closely related.

Cluster analysis

All non *F. solani* isolates except F26 were present in two major clusters. The isolates F29 and F30 showing maximum similarity coefficient (>90%) were grouped in one cluster. There were two major clusters where the first major cluster includes 24 isolates and the second cluster includes thirteen isolates.

Project 17: Biotechnological approaches for improvement of plant species with special reference to pulp and paper [2004-06/ CSIR-NIMITLI Funded]

Findings: **Chemical screening of subabul with respect to lignin content, holo-cellulose and pentosan was carried out. 1130 samples of subabul collected from different geographical region were analyzed for lignin content and holo-cellulose. The lignin content varied from 17% to 31% and holo-cellulose was in the range of 58-77%. Pentosan was also determined in 50 samples. The project completion report submitted to CSIR.**

Project 18: Evaluation of appropriate technologies and its adoption as applicable in rural environment [FRI-321/PLO-3]

Findings: Bamboo seeds were sown in the mist chamber of Silviculture Division. But the germination percentage was low. Later on, fresh seeds were procured and were germinated in the seed lab as well as in the nursery of Shatabdi Van Vigyan Kendra. Germination was better and some of them were shifted to polybags. Observations in the nursery raised seeds are being taken. Bamboo cuttings were multiplied in the polybags in the nursery area. Training to 10 persons was conducted from the villages of Badonwala, Harbajwala and Umedhpur. During training, lectures were given regarding the macro-proliferation technique and also regarding the bamboo protection from fungus and insects. Practical work was done by the trainees in the field and the seedlings were separated and replanted in the field by the trainees to learn the technique. Cuttings were also raised in the bed by the trainees.

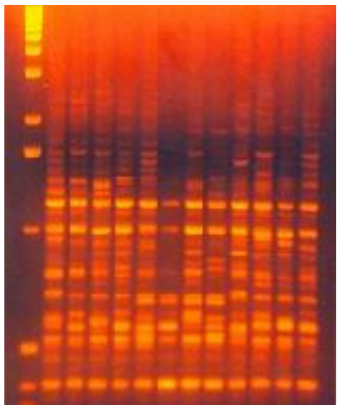
Bamboo seedlings/rhizomes of *Melocanna baccifera, D. memberaceous, D. strictus, Japanese Bamboo* and *D. asper* were brought from Shyampur Forest Nursery and were introduced in Shatabdi Van Vigyan Kendra. One sample each was given to Plant Physiology for further multiplication and as germplasm collection. Further multiplication of the seedlings was also done by separating the young seedlings of the species available in the nursery. Observations are being taken regularly.

Bamboo seedlings raised in Shatabdi Van Vigyan Kendra were maintained and routine watering and weeding was done in nursery. Protection from frost was also provided. The seedlings were kept in polybags, root trainers and in beds. Field observations regarding the bamboo seedlings raised by the villagers were also noted. Separation and further multiplication by adopting macroproliferation technique will be done and the seedlings will be given to the villagers.

IFGTB

Project 1: Genome evaluation and characterization in Casuarinas and Eucalyptus for improving productivity and conservation

Findings: The project aimed at assessing the genetic diversity in different population levels in *Casuarina* and *Eucalyptus*, specifically targeting those which are currently utilized under the breeding program developed by the Institute. The second major focus of the project was on developing end use markers for diagnosing species identity and specific traits. The genetic diversity existing between and within six eucalypts and five *Casuarina* species were assessed using ISSR marker system. Subsequently, nine species-diagnostic markers were identified for *Casuarina* and *Allocasuarina* species and twenty one diagnostic markers were identified for five species (*E. camaldulensis, E. citriodora, E. grandis, E. tereticornis* and *E. urophylla*).



ISSR-PCR profile of the species *Eucalyptus tereticornis* for genetic diversity estimation

These markers were converted into SCAR markers in *C. equisetifolia* and *C. junghuhniana*. At the sub specific taxa level, genetic diversity was estimated within and between fifteen provenances of *E. tereticornis*, six progenies of seed orchards of *E. camaldulensis* and *E. tereticornis*, forty superior performing clones of *E. tereticornis* and *E. camaldulensis*, four SSOs of *C. equisetifolia* and two SSOs of *C. junghuhniana* using ISSR marker system. Further, three putative markers were identified using RAPD and four markers using SSRs for non-rooting clones of *E. tereticornis* and the SSR markers were validated at the family level. The project also provided leads for developing early selection markers for pulping trait in *E. tereticornis*, where in allelic diversity in the *CCR* and *CesA* genes were correlated with the holocellulose, lignin and pentosan content of the wood.

Project 2: Identification of Broad Spectrum Antifungal Proteins from Elite Medicinal Plants for Control of Plant Pathogens

Findings: The project aimed at identification and characterization of broad spectrum antifungal proteins from medicinal plants including *Acorus calamus, Withania somnifera, Piper longum* and *Rauwolfia tetraphylla*. Initially the above mentioned species were screened for antifungal proteins and *A. calamus* and *W. somnifera* were short listed for protein purification. Further, optimized the source tissue, developmental stage and buffer composition for extraction of total proteins with antifungal activity from these two species. Subsequently, purified a 32 KDa antifungal protein from leaves of *A. calamus* with pI value of 7.93, pH optima at 5.6 and temperature optima at 36^{o}C. The

protein was localized in the epidermal layers and xylem lumen of the leaf tissues. The peptide sequence showed similarity to peroxidase from *Oryza sativa*. It inhibited the hyphal extension of major pathogens including *Trichosporium vesiculosum, Macrophomina phaseolina* and *Fusarium moniliforme.* In *W. somnifera*, an acidic lectin with 30 KDa size and pI value of 4.0 was purified. It showed a similarity with concanavalin A like lectin from *Canavalia maritime* and inhibited the hyphal extension of *T. vesiculosum, M. phaseolina, F. moniliforme* and *Rhizoctonia solani.*

Project 3: Refinement of *in vitro* multiplication protocol for *Bambusa nutans* and *Dendrocalamus giganteus*

Findings: Developed *in vitro* axillary bud proliferation protocol for the multiplication of mature plants of *Bambusa nutans* and *Dendrocalamus giganteus*. Pruning of actively growing culms was effective in *D. giganteus* for the emergence of axillary shoots, where more explants with suitable size can be extracted for inoculation. Modification in supply of Nitrogen and Magnesium was found to be favorable for culture establishment and shoot multiplication in *D. giganteus*. Addition of low levels IBA was effective in controlling shoot necrosis of *D. giganteus* rooted plants. Glucose as a carbon source was identified as the major regulator for root induction in multishoots derived from mature plants like *B. nutans* and *D. giganteus*. Field demonstration trial was established with 500 plants of *B. nutans* in the ongoing field trial project for tissue culture plants.

Project 4: Selection and clonal propagation of commercially important medicinal plants [IFGTB/G.O./TN –11/2005 / Ext./2005-08]

Findings: 60% to 90% rooting of different genotypes was observed in the combination of 100 ppm IBA concentration and composted coirpith in *Tinospora cordifolia*. Cuttings from young trees of *Aegle marmelos* responded to the combination of 2000 ppm IBA concentration and vermiculite. 60% rooting was observed. In the case of *Terminalia bellerica,* woody branch cuttings were tried with different concentrations of IBA and potting media. Initially, 3% of rooting was observed in the combination of 2000 ppm IBA and vermiculite. Further, using serial propagation technique, rooting of cuttings from the rejuvenated plants was enhanced to 30% using the combination of IBA and NAA with a concentration of 1500 ppm each and soilrite. Eleven genotypes of *Tinospora cordifolia* were subjected to biochemical analysis for alkaloid content. High alkaloid content was observed in the roots of the genotype from Anaikatti with a value of 50. Eight genotypes of *Aegle marmelos* were studied for alkaloid content. High alkaloid content was observed in the leaves (64) and fruits (80) from the genotype in IFGTB campus. Four genotypes of *Saraca asoca* were studied to find the tannin content. High tannin content was observed in the leaves (3.22) of the genotype from Peechi, Kerala and in the bark (22.03) of the genotype from Courtrallam. Twenty four genotypes of *Terminalia chebula* were studied to find the tannin content. High tannin content was observed in the bark (8.69) of the genotype from Bargur and in the fruits (7.36) of the genotype from Thalaimalai.

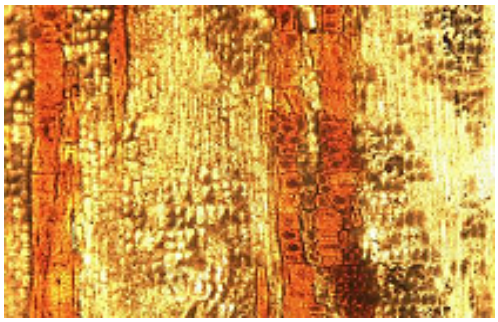
Project 5: Development of yield assessment methods for *Eucalyptus* species and *Anacardium occidentale* using image analyzer. (Funding agency: Tamil Nadu Forest Plantation Corporation-TAFCORN) [IFGTB/EF-RP-22/2005-07]

Findings: Methods were developed for single tree height, diameter and volume estimation. Pictures taken from 10 to 30 meters ground distance with a reference scale at breast height can be measured using Image analyser. Correction factors were worked out for the above measurements to estimate actual height, diameter and volume. Height and diameter of single tree can be estimated in high precision and accuracy with an error of ∀1.0%. A formula was developed and validated for estimation of single tree volume from trunk surface area and height. This method of volume estimation showed an error of ∀3.02%.

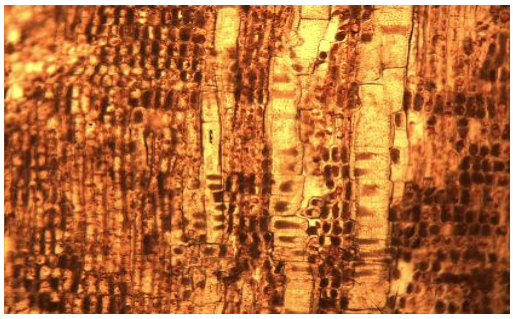
IWST

Project 1: Studies on the properties of coffee wood as indicators of white stem borer resistance (Funded by Central Coffee Research Institute) [2005-08]

Findings: The project was basically consisted of training in-service officials of CCRI in histo-chemistry. As per the agreement, a number of clones (selections) were collected at regular intervals of different locations of coffee growing areas which were affected by stem borer alongwith healthy (immune) and inoculated ones. Histo-chemical tests like presence of starch, proteins and lipids were made on these samples for finding any relationships. Histo-chemical studies were also made on the presence of tannins. Studies have indicated that the presence of these food reserves in different stages of phenology have no direct relevance to borer attack. However, the presence of sclerotic cells in the bark of immune variety compared to the susceptible one is an indication of their resistance offered against the borer attack.



Sarchimor Immune Bark, Tannin, 2006



Sarchimor Susceptible Bark, Tannin, 2006

Project 2: Investigations on lesser known aspects of mangrove biodiversity and ecology in the States of Goa, Karnataka and Andhra Pradesh (Funding Agency: Ministry of Environment and Forests (MoEF)) [2004-08]

Findings: Survey and inventory of mangrove floral diversity in selected areas along Goa, Karnataka and Andhra Pradesh coast was carried out. Twenty two lesser known mangrove wetlands were reported for the first time from Andhra Pradesh. A total of 885 plant specimens were collected and all the specimens were made into herbarium and identified. Ecological data were also collected. *Brownlowia tersa* (L.) Kosterm. was

collected and reported for the first time from Southern India. *Ruppia maritima* L.– a marshy plant was reported as new distributional record from Andhra Pradesh. Three rare mangrove species, namely, *Aegialites rotundifolia* Roxb., *Ceriops tagal* (Per.) C. B. Rob. and *Scyphiphora hydrophyllacea* Gaertn. were recorded from Andhra coast. Collected insects, foulers and borers from mangrove areas along Goa, Karnataka and Andhra Pradesh coasts and identified. Anatomical studies of selected mangrove trees were completed. Phytochemical studies on selected species, namely, *Rhizophora mucronata* Poir., *Xylocarpus granatum* Koenig, *X. mekongensis* Pierre and *Excoecaria agallocha* L. were carried out. Selected mangrove species were screened for wood energy values. A workshop on mangroves was conducted at IWST, Bangalore during February 2008.

Project 3: Community ecology of a detritus systems. Insects and fungi associated with fallen trees in the Nilgiri Biosphere Reserve (Funding Agency : MoEF, Govt. of India) [2004-07]

Findings: Different landscape elements were selected in Rajeev Gandhi National Park for assessing the role of fallen logs in biodiversity conservation. Various sampling methods, including black light traps were used to collect the insects from fallen logs. Specially designed traps for collection of emerging insects from fallen logs were fixed to each log. A weather recorder was installed for studying the effect of seasonal variation in insect and fungal biodiversity. About 300 species of xylophagous insects were recorded from fallen logs at Nagarhole national park. The insects are being identified. Twenty species of fungi and 42 species of mycophagous insects were recorded from fungi inhabiting fallen logs. Chemical characterization of different stages of fallen logs of 10 species is completed and was correlated with the community structure of insects and fungi. The role and interactions of insect and fungal communities in the fallen log system was assessed. Final technical report is prepared and submitted to MoEF.

Project 4: Studies on the Entomofaunal diversity and their interactions in selected provenances of sandal (Funding Agency: Ministry of Environment and Forests (MoEF)) [2004-May 2007]

Findings: The project was completed on 31st May 2007 and the completion report is submitted.

Project 5: Development of protocols for rapid and mass clonal propagation of *Bambusa pallida* Munro and *Phyllostachys bambusoides* Sieb.et Jucc. (Funding Agency: Department of Biotechnology) [2004-07]

Findings: Developed protocols for micropropagation of *Bambusa pallida* and *Phyllostachys bambusoides* from nodal shoot segments of mature clumps. High frequency (>95%) multiple shoot induction (4-6 shoots/explant) obtained in liquid MS medium with NAA 0.25 mg/l + BAP 2.5 mg/l in *B. pallida*. *P. bambusoides* MS liquid medium with NAA 0.25 mg/; + TDZ (0.5-1.0 mg/l) proved most suitable for multiple shoot induction (3-4 shoots/explants). Shoot multiplication rate was high (3-4 fold) in *B. pallida* as compared to *P. bambusoides* (2.5 fold in 4 weeks period). Low nutrient medium (MS/2 and MS/4 basal salts) with NAA/IBA (1.0-2.0 mg/l) favoured rooting

in both the species. Shoot clumps (2-3 shoots per clump) proved better than single shoot for rooting. In case of *P. bambusoides,* macro-propagation using nodal branch cutting was also standardized for high rate of rooting (>80%). Attempts were also made for *in vitro* propagation through somatic embryogenesis but results were not encouraging.

Project 6: Studies on assessing growth performance of *Guadua angustifolia* Kunth under different management schedules. (Funding Agency: National Mission for Bamboo Application) [2005-08]

Status: Established field trials for assessing growth performance of *Guadua angustifolia* Kunth at two spacing (5m x 5m and 5m x 9m) and fertilizer trials consisting seven treatments at two sites viz; Yelwala near Mysore and Gottipura near Bangalore in 1.3 ha each. Intercropping has been done continuously with horse gram since 2005. Evaluated survival rate and growth performance of the exotic bamboo *Guadua angustifolia*. Survival rate varied from 60 – 90% initially, which decreased to 45-60% in 2007 mainly due to termite infestation. Initial results suggest that *Guadua angustifolia* may not be a suitable species for semi-arid areas.

Project 7: Bamboo location trials (Funding Agency: National Mission for Bamboo Application) [2005-08]

Status: Trials were established in respect of 8 bamboo species viz; *Bambusa bambos, B. balcooa, B. nutans, B. tulda, Dendrocalamus asper, D. hamiltonii, D. gigenteus* and *D. stocksii* (in Bangalore) and *Guadua angustifolia* in place of *D. stocksii* in FRC, Hyderabad) during July-Sept. 2005 and maintained at Nallal, Bangalore and Dulapally, Hyderabad. Maximum survival (100%) was in *B. balcooa* and minimum (about 50%) in *D. asper*. Based on the growth performance, *D. hamiltonii* proved the most promising species whereas, *D. asper* and *G. angustifolia* were found unsuitable in semi-arid conditions of Bangalore and Hyderabad.

TFRI

Project 1: Studies on refinement and scaling up of existing micro-propagation and macro-propagation technologies for *Bambusa nutans* and *Bambusa tulda* [063/TFRI-2004/Gen-1/DBT (7)]

Findings: A reproducible micropropagation system for field grown culms of *B. nutans* and *B. tulda* was developed, which incorporates surface sterilization for 10 min with 0.1% aqueous mercuric chloride and establishment on 0.8% agarified MS semi-solid medium supplemented with 3% sucrose, 10µM BA and 0.1 µM IAA through five subculture cycles each of 15 days. Supplementing MS liquid medium with 100 µM glutamine, 0.1 µM IAA and 12 µM BA ensured a stable two fold shoots multiplication rate at a subculture cycle of 15 days and that with 40 µM coumarin induced ≥98% *in vitro* adventitious roots at one month after inoculation, regenerating plantlet production @ 1.96 fold per culture cycle of 45 days. The *in vitro* regenerated plantlets were hardened and field acclimatized with 90-100% survival.

Adventitious rhizogenesis was influenced much by season in *B. nutans* and by season, nature of cuttings and IBA treatment in *B. tulda.* Culm cuttings exhibited superiority over culm-branch cuttings for rooting in both species. However, rooting of culm-branch cuttings appeared to be a viable procedure for propagation in *B. nutans.* Thus, single node culm and culm-branch cuttings in *B. nutans* and only culm cuttings in *B. tulda* treated with 2 mM IBA during the whole year and February to May, respectively can be employed for their clonal multiplication and production of planting stock. By both procedures, about 5000 hardened and acclimatized plantlets from nodal segments of field grown culms of *B. nutans* and *B. tulda* have been produced. Micro-propagation technologies for *B. nutans* and *B. tulda* and macro-propagation technology for *B. nutans* have been developed on conclusion of the project.

RFRI

Project 1: Conservation of productive land and promising flora of Majuli Island in Brahmaputra River [RFRI/EP-05/2003-08]

Findings: Planting of grasses with *Ipomea* spp. were found to be effective in checking sand deposition on productive lands. Banana also performed better with grasses. High density planting of flood tolerant nitrogen fixing leguminous species *Sesbania sesban* during May-June (Flood time) was found to enrich soil fertility status and its harvesting in October- November provided fuel wood and fibre for local use. Thereafter, farmers were advised to cultivate mustard, potato, vegetables and other crops to utilize the land resources properly. These reclaimed areas have shown very encouraging results when put under different agroforestry models. The local people have very much appreciated and adopted the method for replication in other nearby areas.

Project 2: Control of soil and river bank erosion in Majuli through bamboo based vegetative embankment [RFRI/EP-08/2004-07]

Findings: Zero zone plantation of *Ipomea* spp. and grasses gave good results in arresting soils from surface erosion. Bamboo mats provided shelter to sandy soil. First zone plantations of *Bambusa nana*, *Dalbergia sissoo*, *Bombax ceiba* and second zone plantation of *Bambusa bambos*, *B. nutans*, *B. tulda* and *Dendrocalamus hamiltonii* showed good performance. Bamboo treatment unit provided to Bamboo Co-operative Society, Majuli had motivated local people to a great extent and more than one hundred seventy people have used this facility.

Project 3: Study of the current market prices of timber in Nagaland. [RFRI/EP-17/ 2007-08]

Findings: Current market price of different timbers was collected from Tizit, Mokokchang and Dimapur (Nagaland) timber markets and submitted to Resource Survey and Management Division, Forest Research Institute (FRI), Dehradun for further processing.

Project 4: Improvement of infrastructure facilities in Botanical Garden / Centres of *ex-situ* conservation at, Rain Forest Research Institute Jorhat, Assam [RFRI/EP/09/2003-2006]

Findings: Introduced as many as 7 species each of bamboo and Rattan, more than 39 of orchid species, 24 commercially important tree species and 12 species of endangered and rare plants of North-East India in the botanical garden at RFRI campus.

Orchids in shade house

General view of RFRI Botanical garden

Project 5: Augmentation of entomopathogenic fungi for the management of *Calopepla leayana* on *Gmelina arborea*: an eco-friendly approach [RFRI/EP-10/2005-07]

Findings: Population dynamics of *Calopepla leayana* was monitored in the study areas. The population trends were correlated with abiotic factors (temperature, relative humidity, and rain fall) of the study site, which exhibited a significant dependence on the abiotic factors such as temperature, relative humidity, and rain fall. Regression equation was also arrived to predict population of *C. leayana* based on abiotic factors. Entomopathogenic fungi viz., *Beauveria bassiana* and *Metarhizium anisopliae* were isolated and identified as natural enemies of *Calopepla leayana* from different insect groups. It was found that both the fungi were effective against both larval and adult stages of *C. leayana.* Mass production of *B. bassiana* using different substrates was tried to harvest ample amount of spores. Bakery waste/desolate bread was identified as one of the suitable substrates for the mass production of *B. bassiana*. 72-93% mortality of targeted insect was observed in field condition**.** Isolates of *B. bassiana* was harmless to silkworm and all of them attained healthy pupa (cocoon).

AFRI

Project 1: Integrated management for qualitative improvement and increased production of Rohida *(Tecomella undulata)* in Rajasthan [AFRI-65/FP/2005-08]

Component 1: Insect pests and disease studies

Findings: The entire IGNP area in Jaiselmer and Bikaner districts was surveyed and 21 sites were evaluated for the insect pests and disease studies. Subsequently, on the basis of infestation intensity, six sites viz., were selected in IGNP area covering Jaiselmer and Bikaner districts. Three species of fungi belonging to the family imperfacti (*Phoma* sp.,

Fomes sp. and *Botryodiplodia theobromae*) are primarily responsible for canker-rots in *T. undulata* in IGNP area at Mohangarh. It was observed that no significant hollowness problem was encountered in the Rohida plantations raised in the IGNP area except in a few trees, which exhibited the initiation of canker formation in the main trunk.

Component II: Rohida Macropropagation

Findings: Technology developed on macro-propagation of important tree of arid region known as Marwar Teak and locally called Rohida (*Tecomella undulata*). Studies carried out in last two years indicate that rooting response of Rohida stem cuttings is not only difficult influence by several factors such as donar trees health, physiological status of cuttings and the external environmental conditions. However, tree has the potential to root relative high frequency if tree is managed well before collecting the stem cuttings. Selection of cuttings from well managed selected tree and established in mist chamber at proper time period after treating proper fungicide, insecticide and antibiotic treatments can be rooted successfully.

Component III: Growth and Yield Studies on Rohida Plantations

Findings: Total wood volume equations have been constructed and validated which assume importance in projecting the total volume at different stages (thinning and final harvest) as the plantations mature. Volume equations proposed may be applied on any population/sample of these species available in the study area as these equations have been validated for independent data set. The site index equation has been developed that may be used for assessing productive capacity of site and to select sites suitable for the particular species. These are also useful in estimating site index at a base age given height at some other age as well as estimating height at some desired age given site index. Generalized diameter height models have been developed which are useful tools for forest inventory purposes.

Project 2: Studies on prediction of NTFP availability and potential for extraction in Aravali region of Rajasthan

Findings: Significant quantities of NTFPs are gathered in three forest divisions of the Aravali region and the annual estimated values of NTFPs realized per household are Rs. 2765.00, Rs.1794.00 and Rs. 478.00 in Udaipur (central), Pratapgarh and Banswara forest divisions respectively, ignoring fuel wood and fodder grasses collection. Taking removal of fuel wood and fodder grasses from the nearby forests into account, estimated annual financial values realized per household are Rs. 5965, Rs. 4994 and Rs. 3678 in Udaipur (central), Pratapgarh and Banswara forest divisions respectively. The financial value realized per ha or NTFP income generated from a hectare area of tropical dry deciduous forest of Aravali region was estimated as Rs.1442.00 in Udaipur (central) forest division followed by the Pratapgarh and Banswara forest divisions, yielding Rs.1006.00/ha and Rs. 392.00/ha. Such species include important commercial and medicinal plant species like *Acacia catechu* (Khair), *Boswellia serrata* (Salar or Salai), *Lannea coromandelica* (Godal), *Sapindus trifolatus* (Aritha), *Anogeissus latifolia* (Dhavra), *Madhuca latifolia* (Mahua), *Chlorophytum borivilianum* (Safed Musli), *Dendrocalamus strictus* (Bamboo) and *Embelica officinalis* (Aonla) etc.

Project 3: Efficacy and economics of water harvesting devices in controlling run-off losses and enhancing biomass productivity in Aravalli ranges [AFRI-39/FED/2002-08] (Note: Concluded from State Forest Department, Rajasthan but got extension of one year in ICFRE Plan fund in 2008-09)

Findings: Experiment was started in July 2005 with the financial assistance from Rajasthan Forest Department. Seventy five plots of about 700 m^2 area were laid in 0-10, 10-20% and >20% slope with five treatments (control, contour trench, gradonie, box trench and 'V' ditch rainwater harvesting structure) in five replicates. Growth and seedling survival were recorded in June and December 2007. Run-off was measured from July to September (8 times) and water samples were collected (two times) for soil and nutrient loss. Vegetation and shrub/ tree diversity was monitored and diversity indices calculated. Vegetation productivity was also estimated.

Presence of coarse fragment in most of the plots of >20% slope facilitated the infiltration and subsurface drainage reducing surface loss and enhanced duration of soil water availability for vegetation. Preparation of RWH structures further enhanced water availability increasing vegetation production and soil organic carbon, a benefit of carbon sequestration. Highest run-off (11.43%) was from the Control and lowest was from V-ditch plots (9.33%). The losses in other treatments were 11.28% from Box trench, 10.89% from Gradonie and 10.82% from Contour trench plots. Thus adoption of rainwater harvesting devices reduced run-off losses as the water loss in V-ditch plots was reduced by 2.1% of the total rainfall when compared with the control.

Report prepared and submitted to funding agency i.e., State Forest Department, Rajasthan.

Project 4: Baseline survey study on biological diversity in Mangala, Sarswati and Rageswari areas of Rajasthan Hydrocarbon Project [AFRI-75/FED/2006-08] (Funded by CAIRNS Energy India Pvt. Ltd.)

Findings: An extensive survey was conducted in the Mangala, Sarswati and Rageswari areas of Rajasthan Hydrocarbon Project in Barmer district to study the biological diversity in the area. Sensitive areas like community lands (Oran and Gauchar) and forest areas were also studied in detail. Site wise map has been prepared. Final report submitted to the funding agency.

HFRI

Project 1: Development of suitable model for inter-cropping of commercially important medicinal plants with horticultural plantations in temperate region of Himachal Pradesh [BT/PR4372/PBD/17/285/03]

Findings: Developed the package of cultural practices for intercropping of temperate medicinal plants viz. *Aconitum heterophyllum, Angelica glauca, Polganatum verticilatum, Picrorhiza kurrooa* and *Valeriana jatamansi* with horticultural crops i.e. Apple and Cherry in high hill temperate region of Himachal Pradesh. All the five selected medicinal plants were found suitable for inter cropping with horticultural plantation. It has been observed that active ingredient contents in intercropping samples was lower than the

samples from natural habitat, however is not that significantly lower, that cannot be saleable. The net economic return from intercropping of medicinal plants was found to be in the order *Aconitum heterophyllum*> *Angelica glauca*> *Valeriana jatamansi*> *Polganatum verticilatum*> and *Picrorhiza kurrooa.* The finding gives an opportunity to the farming communities to go for diversification and generate extra income in a sustainable manner.

Project 2: Ecological and management studies in certain, dry temperate and alpine pastures of Lahaul and Spiti, Himachal Pradesh

Findings: Alpine pastures in the entire Himalayan region constitute approximately 1.7 million ha and over 2/3 of this area lie in Himachal Pradesh. The state is predominantly mountainous and more than 92 % of the population is mainly rural and is directly engaged in animal husbandry. However, indiscriminate use of the grazing areas has resulted in critically low biomass availability and accordingly, adversely affected the livestock production. The utility and usefulness of various species of livestock can not exploited fully unless and until the feed and fodder resources are fully developed and properly utilized. Hence, the importance of alpine pastures – which is not only a group of grasses but is an ecosystem in itself can not be underestimated.

Keeping all the above points in views, sites supporting alpine pastures in each part of the district of Lahaul and Spiti i.e. Miyad Nallah, Triloknath, Dalang and Kwaring in Lahaul valley and Gue, Tabo and Kunjam in Spiti valley were selected for detailed structural and functional aspects like floristics, phyto-sociological and biomass studies/ estimations. Management aspects were also worked out at length. The studies have revealed that these alpine pastures certainly require proper attention. A booklet on Flora of Miyad valley – The lesser known Lahaul was also brought out under the project.

Project 3: Development of ecologically viable and socio-economically acceptable integrated model for arresting Willow (*Salix* sp.) mortality in Lahaul valley of Himachal Pradesh

Findings: Benchmark surveys for assessing the causes behind large scale mortality in *Salix* were conducted in different areas of Lahaul valley of Himachal Pradesh. The planting stock of *Salix* both local and International clones was raised and maintained at Field Research Station Tabo for establishment of demonstration plantations. *Salix fragilis*, *S. vitellina, S. matsudhana, S. babylonica, S. alba* and *S. corrulea* were the collections from the state of Jammu and Kashmir whereas International clones (given by code names) viz. UWA-1; UWA-2; UWE-1; UWM-1; UWM-2; UWM-3; UWU-1; UWU-2; UWK; UWHY-1; UWHY-2; and WO2-4 were procured from UHF, Solan. Beside this, planting stock from 8 different locations of dist. Kinnaur and Spiti falling within the state of Himachal Pradesh were also collected, raised and maintained at Tabo. As per the objectives of the project, demonstration plantations were established following different models in both farmers and in Govt. lands. Life cycle of the willow aphids were also investigated. Villagers meetings were also organized for generating awareness amongst the local population.

Project 4: Screening of potential germplasm of *Hippophae rhamnoides* (Seabuckthorn) for raising quality planting stock in the nursery and establishment of demonstration plantations in cold desert areas of Spiti valley, Himachal Pradesh [DDP/Spiti/SBT/2006-11/ 2006-09]

Findings: *Hippophae rhamnoides* commonly known as Seabuckthorn is a multipurpose plant species which can conserve the water and soil of fragile cold desert ecosystem. It also enriches the soil fertility through fixing atmospheric nitrogen. Its natural habitat includes river banks, valley and shady slopes and those sites where plenty of moisture is available. To exploit the species on a large scale, especially, in a cold desert areas of Himachal Pradesh, efforts to screen the potential germplasm of the species for raising quality planting stock were carried out. Under the project, population from different areas of Spiti valley were screened and finally planting stock from Shego, Tabo and Susna were collected for establishment of demonstration plantation. Demonstration plantation in an area of half ha was raised and maintained. Data recording were carried out. Different monitoring teams under Desert Development Programmes visited the demonstration plantation and appreciated the efforts of the institute.

Project 5: Inventorization, documentation and plant diversity and to evolve site specific management strategies for conservation of various sacred groves in Kullu valley of Himachal Pradesh

Findings: Plant samples were collected from all the 33 sacred groves as recorded in Kullu Valley and a total of 215 plant species belonging 68 families have been identified so far. Data on GBH and height of trees in seven sacred groves have also been collected. Ethno-botanical information on 62 species belonging to 28 families was documented and information on 9 venerated plants had also been collected during the survey. About 150 Deodar seedlings were planted in the degraded sacred groves of Nashala and Jana. A pamphlet on "*Dev van Ek Prachin Dhrohar*" was prepared for creating awareness amongst the local community for conservation and rejuvenation of the sacred groves. Villager's meeting/discussion on conservation and rejuvenation of sacred groves was organized at Jana and Rujak Villages in Kullu District. To create site-specific management strategies for the conservation and rejuvenation of sacred groves, data on existing management practices, threats affecting each sacred groves and type of rejuvenation required were collected from all the sacred groves.

Project 6: Quality planting material of *Picrorhiza kurrooa* Royle ex. Benth and *Valeriana jatamansi* Jones and extension of their cultivation technology to local communities [GO/HP-2/2004-07: NMPB]

Findings: Under this project the Institute raised 4.6 lacs of quality planting material of *Picrorhiza kurrooa* (Kutki) and *Valeriana jatamansi* (Mushakbala) in different nurseries of the Institute against 4.0 lakhs target given by National Medicinal Plant Board (NMPB), New Delhi. Also distributed 4.08 lakh nursery stock of Kutki and Mushakbala to various end users during the entire project period. Under extension activities of the project, Institute organized four two days training and demonstration programmes at Jagatsukh, Manali for 23 numbers of farmers of Kullu Valley. Such training and demonstration programmes were also organized at Shillaru and Model Nursery, Shimla

for 34 numbers of farmers of Shillaru, Narkanda region of Shimla district. In the process trainings on commercial cultivation of Kutki and Mushakbala were organized at Jhungi and at Chail Chowk, for the farmers of Mandi district. Also organized one camp workshop-cum-training programmes on 'Commercial cultivation of temperate medicinal plants' for various stake holders at Totu near Shimla, which was attended by 50 farmers and field staff of Shimla Forest Division. Besides these, two open meetings were conducted at villages Sajla and Karjan near Manali and another open meeting at Nasogi for the farmers of Kullu valley so as to discuss about the prospects of commercial cultivation of medicinal plants in temperate region to diversify existing horticulture practices. These open meetings were attended by 125 farmers. The farmers, infact, were got sensitized through these open meetings and training programmes for adopting commercial cultivation of Kutki and Mushakbala in temperate areas. Published two booklets and two pamphlets in Hindi on cultivation of Kutki and Mushakbala in Himachal Pradesh for the benefit of various end users.

Project 7: Development of elite planting material, establishment of model plantations and extension of nursery and plantation techniques of Wild Apricot to local communities in Himachal Pradesh [27-114/NOVOD/2006-07: NOVOD]

Findings: Under this project the Institute has raised 11,000 no. of quality planting material of *Prunus armeniaca* (Wild Apricot) in different nurseries of the Institute. Demonstration plantations on 10 ha area in Mandi and Kullu districts of Himachal Pradesh were carried out during 2006-07 and maintained during 2007-08. Two no. training and demonstration programmes on 'Wild Apricot - Nursery, Plantation, Oil Production and Its Uses' were organized under this project for local communities (70 no.) at Jari village in Kullu district of Himachal Pradesh on 12th and 13th March 2007 and for field functionaries of Himachal Pradesh Forest Department (50 no.) at Forest Training Centre, Sunder Nagar, district Mandi of Himachal Pradesh on 27th and 28th December 2006. Published one booklet and one pamphlet in simple Hindi on Wild Apricot (Chuli) for the benefit of various end users.

IFP

Project 1: Identification, collection and genetic evaluation of important oil yielding trees of Jharkhand (NABARD funded project) [IFP-028/BGT–6/ NABARD /2005 – 08]

Findings: Investigation on variability studies, genetic analysis, association studies and genetic diversity analysis of field biometric traits (clones and progenies), pod and seed characters, seedling traits, biochemical traits of 24 CPTs of Karanj and 23 CPTs of Mahua revealed following findings:-

- Variability available among the selected CPTs for biometric traits, pod and seed traits, half-sib traits and biochemical traits were assessed and observed to have significant variation.
- Genetic estimates were worked out in second part to know the GCV, PCV, Heritability and genetic advances for all the traits under study. It was found that

trait volume index, hundred seed weight, vigour index, acid value and total oil content can be improved by breeding.

Important oil yielding trees of Jharkhand

- Inter-relationship between characters by association studies (correlation and path analysis) were worked out. Studies revealed the collar diameter 2D surface area, shoot length and protein content may be considered for selection indenting hire volume index, germination, vigour index and total oil content respectively.
- Genetic diversity of the collected clones using biometric observation were analysed which expressed non conformity with geographical distribution of clones.

FRC

Project 1: Bioecology and Integrated Management of Insect Pests of Aonla, *Emblica officinalis* Gaertn.

Menochilus sexmaculatus a predator on aonla aphid, *Cerciaphis emblica* on *Emblica officinalis*

Findings: Insect pest incidence and their seasonality in Aonla was recorded at Rajahmundry and Hyderabad locations. Aonla aphid, *Cerciaphis emblica,* stem gall insect, *Betuosa stylophora* and Bark eating caterpillar, *Inderbela* sp. followed by *Nipaecoccus viridis* were identified as key pests of Aonla. Five synthetic and one botanical insecticide viz., Dimethoate, Imidacloprid, Spinosad, Profenophos, Neem Seed Kernel Extract, and Acetamipride were evaluated under field conditions at Hyderabad in the month of March 2008 against Aonla aphid, *Cerciaphis emblica* on the cultivar *Chakiya.* Dimethoate 30 EC, Confidor 17.8 SL, and Profenofos 50 EC were found highly effective at 0.06, 0.036, and 0.1 per cent concentration respectively. The project is funded by National Medicinal Plants Board, New Delhi.