# Annual Report 2010-11


TROPICAL FOREST RESEARCH INSTITUTE
(Indian Council of Forestry Research and Education)
P.O. RFRC, Mandla Road
Jabalpur-482021 (M.P.)

# ***EXECUTIVE SUMMARY***

- Developed package of practices for the *Dalbergia sissoo* based agri-silviculture system under 3 year old sissoo plantation.
- Developed package of practices for the bamboo based agri-silviculture system like Bamboo-wheat (*Bambusa nutans* + *Triticum aestivum)* during Rabi season and Bamboo-Urad model in Kharif season for extra income generation for the growers/farmers in Jabalpur district.
- For the establishment of lac based Silvi-agri-lac system in the tropical region of Jabalpur, saplings of Lac host species viz. *Flemingia macrophylla* and *Flemingia semialata* were raised in the experimental area of agroforestry of TFRI.
- Two varieties of *Phyllanthus emblica* i.e. NA7 and NA10 were transplanted to establish the multitier silvi-agri-spice system at TFRI, Jabalpur. The data on growth parameters shows the best performance of NA10 as compared to NA7 of Aonla.
- Identified for the first time the localities of selected target species of medicinal plants, such as *Thalictrum foliolosum, Embelia tsjeriam cottam, Rubia cordifolia* and *Celastrus paniculatus* in buffer and transition zone of Achanakmar-Amarkantak biosphere reserve.

- In nursery, foliar spray of monocrotophos 36 E.C. 0.05% followed by metasystox 25 E.C. 0.05% and soil application of phorate 10 G @ 25 g and furadon 4G @ / 1x1m were also found to be equally effective against gall forming insect- *B. stylophora.*
- In plantations, synthetic pyrethroids i.e. deltamethrin 0.005% followed by alphamethrin 0.01% was found to be most effective against key insect pests of teak.
- Twenty two Braconid larval parasitoids were recovered from key insect pests of forest tree species, with varied degree of field parasitisation; from Chhattisgarh and Maharashtra; which are important biological control agents of key forest insect pests.
- Gall making alien invasive insect species, *Leptocybe invasa*, found to be a major threat to Eucalyptus in nurseries of central India.
- Identified major insect pests of medicinal plants viz. Muskdana (*Abelmoschus moschatus)*, kalihari (*Glorisa superb)* and ashwagandha (*Withania somnifera).*
- Fifteen species of *Apanteles* have also recorded for the first time from Orissa, which are promising biological control agents against defoliators of teak and sal forests.
- Isolated seven entomopathogenic nematode strains native to central India for the first time from the forest floor, out of which one has been identified as new-to-science. These have been evaluated as potential prospective biological control agents against the major insect pests of forest trees, especially soil insect pests.
- Diseases of medicinal plants, *Rauvolfia serpentina, Withania somnifera* and *Chlorophytum borivillianum* were identified from Madhya Pradesh and Chhattisgarh. A new damping off disease of *W. somnifera* caused by *Sclerotium rolfsii* was reported for the first time from India.

- Integreted management of vascular wilt disease in neem (*Azadirachta indica*), aonla (*Emblica officinalis*) and khamer (*Gmelina arborea*) were carried out in forest nurseries. Three pathogens viz. *Fusarium solani, Verticilium nigrescens* and *Rhizoctonia solani* causing wilt in these species have been identified.
- Studies on wood decay and its control in stored tropical timber were carried out. Nine hyper parasitic fungi colonizing decaying wood have been isolated. Out of them *Trichoderma viride* and *Aspergillus flavus* were selected and tested for biological control of 10 wood decaying fungi.
- Taxonomy and documentation of wood decay fungi of Chhattisgarh and Orissa were carried out. One new species *Nitschkia tectonae* and four new records of fungi were reported from India viz. *Australohydnum dregeanum, Hapalopilus nidulans, Hjorstamia fresii,* and *Schizopora flavipora.*
- Fungi causing root rot and stem decay diseases in *Acacia catechu* were collected from Khandwa and Yavatmal and 4 to 60% mortality due disease was recorded.
- Fungi forming ectotrophic mycorrhizae (*Russula*, and *Pulveroboletus* among basidiomycetes and *Geastrum, Astraeus* and *Scleroderma* among gasteromycetes) with sal have been collected and identified.
- Seed treatment for better germination, maturity index for determination of collection time and storage conditions to retain the viability were determined for 12 species: *Schleichera trijuga, Terminalia arjuna, Hardwickia binnata, Moringa oleifera, Holoptelea integrifolia, Sapindus laurifolia, Terminalia chebula Abelmoscus moscatus, Bassia latifolia, Mimusops elengi, Emblica officinalis* and *Rauvolfia serpentina.*
- Type of seed dormancy and seed treatment was studied on *Schleichera oleosa* and *Pterocarpus marsupium*. Effect of maturation stage on seed germination was studied on *Pterocarpus marsupium*.
- Studies on sustainable management of medicinal plants in JFM areas in two agroclimatic zone of Madhya Pradesh have been conducted. The study reveals that regeneration of *A. paniculata*, *B. lanzan, A. racemosus and C. borivillium* have been found sustainable at 80%, 90%, 60% and 60% harvesting level respectively.
- Studies on the effect of different level of seed collection on natural regeneration of Sal (*Shorea robusta*) was conducted in three agroclimatic zones i.e. Bilaspur, Raipur and Bastar in Chhattisgarh. Phyto-sociological studies including regeneration survey of newly recruited seedlings of seed and coppice origin were recorded by laying out standard size of vegetation quadrate. Impact of hoeing, cleaning and fire treatments was observed on regeneration of sal.
- Protocol was developed for cultivation of *Asparagus racemosus* (Satawar).
- Screened tree species for biodrainage in Bargi canal command area through plantations along left bank canal and lysimetric experiments.
- Assessed plantations raised by NTPC Dadri for carbon sequestration potential and valuation.

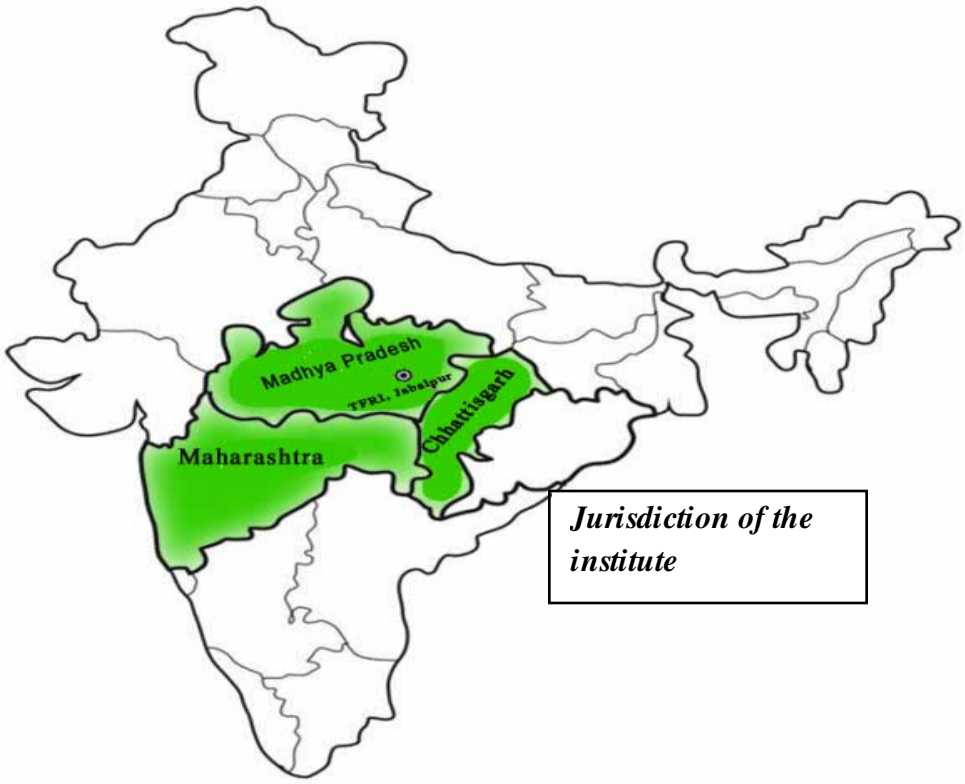
- Ten training programmes including the trainings to the trainees from State Forest Services were conducted during the year.
- Nomination form of Achanakmar-Amarkantak biosphere Researves was submitted to UNESCO for consideration to include in World Network of Biosphere Reserve.

***Summary of the Projects***

| **Project type** | **Completed projects** | **Ongoing projects** | **New projects initiated during the year** |
|---|---|---|---|
| Plan | 5 | 8 | 15 |
| Externally Aided | 5+1(2 subprojects) = 6 | 9 | 9+1(3 subprojects)=10 |

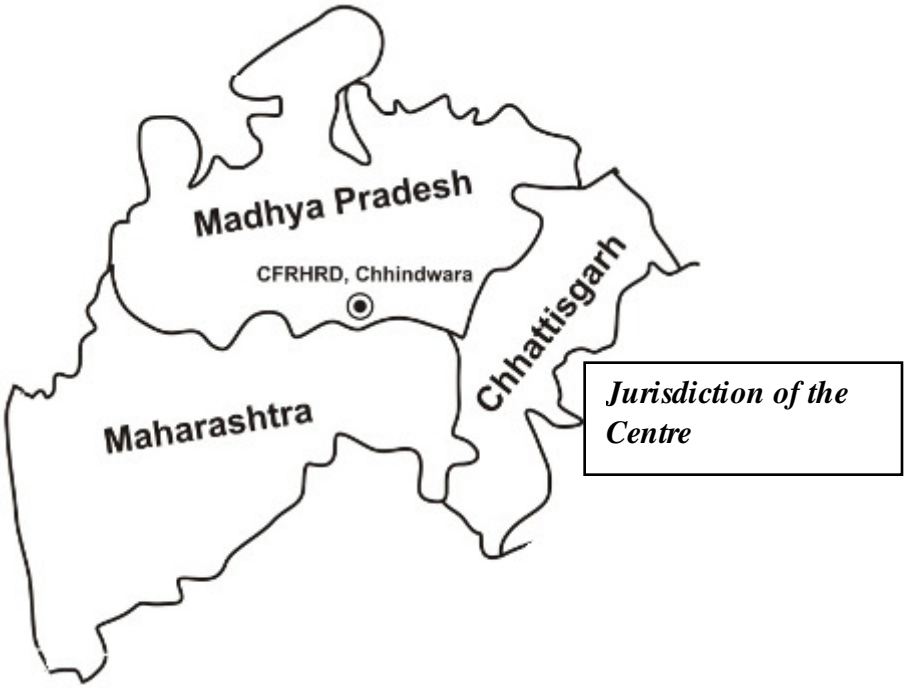
# *1. INTRODUCTION*

Tropical Forest Research Institute (TFRI) Jabalpur, situated on the bank of Gour River on Mandla Road, is one of the institutions under Indian Council of Forestry Research & Education (ICFRE). The institute is headed by Director and has staff strength of 199 including 35 Scientists and 10 officers. The Institute came into existence in April 1988, although its origin goes back to 1973 when a Regional Centre of FRI, Dehradun was established at Jabalpur to provide research support to the problems of forest management in central India. It has an area of 109 ha and a constant liaison with state forest departments, NGOs working in the field of forestry and allied areas, universities imparting education in forestry, and forest based industries. It caters to the forestry research on three states of central India, viz. Madhya Pradesh, Chhattisgarh and Maharashtra. Thrust areas of research in the institute relate to non-wood forest produce, rehabilitation of mined areas and other stress sites, development and demonstration in agroforestry models, planting stock improvement, sustainable forest management, biodiversity conservation and control of forest diseases and pests.




Centre for Forestry Research & Human Resource Development (CFRHRD), Chhindwara came into existence on 30th March 1995 under TFRI, Jabalpur. The mandate of the centre is to

take up forestry research in the specialized areas like biodiversity conservation, non-wood forest products, forest protection, Silviculture and tree improvement. In addition to this, the centre has also been assigned to develop human resource in forestry sector by imparting vocational training leading to poverty alleviation through self employment in central India.




## *2. RESEARCH HIGHLIGHTS*

### *2.1 Ecosystem Conservation and Management*

#### 2.1.1 Overview

The institute is working on climate change, documentation of phyto-diversity and its conservation and management, tribals and their traditional knowledge system in central India.

#### 2.1.1.1 Summary of the achievements under the theme

The Biodiversity division is responsible for documentation of floral diversity of forests; enlist rare and endangered species for their conservation and sustainable use. Ethno-botanical surveys are also carried out to document patterns of utilization of rich biological diversity in the Indian region by various ethnic communities, including the primitive tribes. Investigation on floristic diversity in teak plantation of various age groups in Barnawapara Project Division,

Raipur, Chhattisgarh is being carried out to determine the changing of plant diversity in different year old plantation, changing of soil properties in those teak plantation and the similarities between plant species in each of those teak plantations and plant species in natural forest of teak.

Conducting study on assessment of soil–vegetation carbon pool in dry deciduous mixed forest of Betul under National Carbon Pool assessment project of IIRS Dehradun. A flux tower has been established at Teak Forest of Betul Madhya Pradesh by IIRS Dehradun. The field studies have been carried out around 1 km periphery of tower for inventory of vegetation, estimation of leaf area index, analysis of soil moisture percentage and analysis of carbon and nitrogen of soil, litter and leaf samples is in progress to support national carbon pool modeling.

Documentation and distribution of Forest Invasive Species (FIS) of Jabalpur, Katni, Mandla and Seoni districts of Madhya Pradesh have been carried out. Enumerate FSI their diversity and distribution through laying out quadrats in different types of forest. Total 39 FIS species have been recorded. Phenological observation has also been recorded.

Studies have been carried out on utilization pattern of plants in ethno-medicinal uses prevalent in tribal pockets of Satpura plateau in Madhya Pradesh. Field survey was conducted to identify rich tribal pockets in Mandla, Jabalpur, Katni and Chhindwara districts of MP for documentation of traditional knowledge from traditional herbal healers. In all 507 plants of medicinal value, which are being utilized by 134 traditional herbal healers of tribal pockets of above four districts for cure of various diseases prevailing among tribal / local people were documented.

### 2.1.1.2 Projects under the Theme

| Projects | Completed projects | Ongoing projects | New projects initiated during the year |
|---|---|---|---|
| Plan | | | 3 |
| Externally Aided | 1 | 1 | 3 |

## 2.1.2 Climate Change

**Utilization of Automatic weather station/Agrometeorological station data for agriculture, forestry and hydrological applications in Madhya Pradesh**

Sites were selected near Automatic Weather Station (AWS) and Agrometeorological Station (AMS) in Kanha National Park (KNP), Bandhavgarh National Park (BNP) and Madhav National Park (MNP) in Madhya Pradesh. Grass biomass studies were conducted in the selected sites. Maximum grass production was found in September (post rainy season) and December (winter season), which gradually decreased in the month of March. Soil moisture profile at an interval of 30 cm and till the depth 150 cm was quantified by volumetric method. AMS has been installed at Ronda in Kanha National Park, which is a plain area with clayey loam soil. In all four

seasons, soil moisture increased with depth because of vertical seepage and accumulation of water to lower horizons. The soil of the Supkhar area was sandy loam to loam. Soil moisture increased from surface till 60-90 cm or 90-120 cm, then slightly decreased due to the presence of few gravels. Maximum soil moisture was recorded in September, followed by December and March. Regression equation for quantifying above ground biomass against GBH was developed for *Shorea robusta*. Specific leaf area of major tree species of three national parks was calculated.

Grass biomass studies near AWS and AMS in national parks

Soil moisture profile studies near AWS and AMS in national parks

### 2.1.3 Ecology & Environment

**Investigation on floristic diversity in teak plantation of various age groups in Barnawapara Project Division, Raipur, Chhattisgarh**

Plantations promote understory regeneration by shading out grasses and other light-demanding species, changing understory microclimates, improving soil properties and increasing vegetation structural complexity. With this view the project has been started to determine the changing of plant diversity in different year old plantation, changing of soil properties in those teak plantation and the similarities between plant species in each of those teak plantations and plant species in natural forest of teak.

Team at work with forest officials

Teak plantation

Preliminary survey of Barnawapara project has been completed for selection of sites and collection of maps etc and site details have been recorded. Quadrats have been laid out in 12 compartment of teak plantation of various age groups. Enumeration of vegetation has been carried out in 21, 26, 30, 36 year's old plantation of teak. 36 trees, 6 shrubs and 13 herbs species have been recorded other than teak. 62 soil samples have been collected and analysis of soil samples is in progress.

**Vegetation Carbon Pool Assessment Project in India**

The Indian Institute of Remote Sensing (IIRS) has undertaken a National Carbon Project (NCP) under Geosphere Biosphere Programme (GBP) of the Indian Space Research Organization (ISRO) to estimate the carbon pools and fluxes in different terrestrial ecosystems of India. The project envisages temporal inventory of the forest and soil carbon stocks as well as measurement and modeling of carbon exchange along atmosphere-vegetation boundary. Six carbon flux measurement towers using eddy covariance techniques are installed in five major forest types of the country. Betul (teak forest) in Madhya Pradesh is one of them. The objectives of the project are to measure the vegetation and soil parameters to support modeling and to collect the data related to silviculture, inventory, management and utilization, to estimate the net ecosystem exchange of carbon

Carbon Flux Tower

Enumeration of trees at site

Litter collection pit

**Achievements**

- Preliminary survey of Teak Forest Betul near tower has been carried out for selection of site. Carried out inventory of teak forest.
- Laid out 9 plots of 31.6 x 31.6 m randomly around 1 Km periphery of tower.
- Enumeration of vegetation has been done. Samples for analysis of leaf, litter and soil have been collected. Collected leaf samples of 9 tree species for LAI, and recorded data on phenophase of 10 species.

**Documentation and distribution of Forest Invasive Species (FIS) of Jabalpur, Katni, Mandla and Seoni districts of Madhya Pradesh.**

Alien species are non-native or exotic organisms that occur outside of their natural adapted ranges due to their dispersal potential. Many alien species support our farming and forestry systems. Alien species become invasive when they are introduced deliberately or unintentionally outside their natural habitats into new areas where they express the capability to establish, invade and compete with native species. Many of the plant species intentionally introduced in various countries in the past have become major threat to the forest biodiversity and their control measures consume substantial financial resources.

*Hyptis suaveolens* in mixed forest

**Achievements:**

*Lantana camara* in teak forest

- Preliminary survey of four districts (Jabalpur, Mandla, Katni and Seoni) has been completed for selection of site and collection of maps etc.
- Site details of the study sites have been recorded.
- 144 quadrats (1x1 m.) for herbs and grass have been laid out in all sites and vegetation parameters recorded.
- 48 quadrats (5x5 m.) laid out for the study of shrubs and saplings along with invasive species.
- 48 quadrate 20m x 20m for the enumeration of the species have been laid out in all districts.
- Total 39 FIS recorded.
- Phenological observations have also been recorded.

***Cassia tora***

*Hyptis suaveolens* infestation

**Influence of forest canopy cover on ground flora and micro-climate in Western Ghats (Maharashtra)**

Interactions between forest canopy cover and understorey vegetation for phytodiversity conservation was studied and the effect of changing canopy structure and density on regeneration and growth of ground flora including native and alien species, edaphic and micro-climatic parameters was observed. 15 study sites were selected in Raigad, Ratnagiri and Sindhudurg districts (5 in each district) of Western Ghats of Maharashtra. Change in ground flora, soil characteristics and microclimatic parameters like temperature and humidity were observed with change in canopy density. Number of species in ground flora increased with decrease in canopy density. Change in soil parameters was also observed due to change in organic matter, litter fall and decomposition, moisture conservation, light intensity, temperature and humidity which was attributed to varying canopy density. Natural regeneration of the species was also studied in the selected sites.

**Counterbalancing the detrimental effect of Sponge Iron Factory-emitted Particulate Matters (SIFPM) with the protective effect of Vesicular Arbuscular Mycorrhiza (VAM) on the growth of seedlings of important tree species**

The project was started to assess the protective effect of Vesicular Arbuscular Mycorrhiza (VAM) on the growth of seedlings of important tree species. The sites selected for the study are industrial areas of Ghugus (Maharashtra), Raigarh, Raipur (Chhattisgarh) and Bhopal (Madhya Pradesh). Innumerable Sponge Iron Factories have been established in Madhya Pradesh, Chhattisgarh and Maharashtra which emit pollutants mainly in the form of $SO_2$, NO, $NO_2$, $N_2O_5$ and Suspended Particulate Matters (SPM). SPM causes a huge loss to the environment on vegetations like closing of stomata in leaves and dispersal of several toxins in the environment. Around these factories, the average growth of the trees found to be stunted and deformed.

Six months old 1200 plants of ten tree species are presently under study of this project namely *Tectona grandis, Gmelina arborea, Dendrocalamus strictus, Dalbergia sissoo, Pongamia pinnata, Cassia siamea, Azadirachta indica, Emblica officinalis, Peltaforum ferrugineum* and *Butea monosperma* on a critical comparison with control data collected from

least polluted areas. Physicochemical estimations in terms of biochemical estimations (Chlorophyll, Sugar, Ascorbic Acid and Phenol) of leaf and soil samples are on process.

Experiments have been made with two sets at the nursery of TFRI; Soil + FYM (Control) and Soil + FYM + SPM (Experimental); the soil has been treated with the SPM collected from the industrial areas affected with the pollution from sponge iron factories. This is a model experiment which shall mimic the polluted condition and analyses of which along with growth data should tell us the magnitude of the loss or how much the plant is immune to pollution effects.

Soil around the feeder roots and feeder roots were collected from different tree species for VAM culture. These soil and root samples were inoculated in different pots with maize seeds for VAM culture. For VAM culture firstly the potting mixture was autoclaved (Soil + Sand + FYM) twice for sterility, and then transferred to earthen pots (10 kg capacity) in field. Then soil and root samples collected from the affected sites were mixed with this pot-mix in 1:20 ratio, and immediately after, 15 maize (*Zea mays*) seeds were sown at 2.5 inch depth. The maize plants were irrigated with sterile water to avoid any VAM contamination from other sources. The Mycorrhiza grew well in 3 months, and after that, the desired VAM was harvested.

Initial growth data of height (cm), number of leaves, and number of branches and collar circumference (1.5 inches above-ground level) of all the 1200 plants were recorded during December 2010 to January 2011. Suspended Particulate Matter (SPM) was added in 600 of plants while 300 were maintained as control an d 300 more to which only VAM will be added. VAM will be mixed with the potting media of specific number (400) of experimental plants.

- Categories and variables
    i. Control (Soil + FYM) 300 plants (□□ baseline data)
    ii. Soil + FYM + SPM 300 plants (degrading agent▼)
    iii. Soil + FYM + VAM 300 plants (enhancing agent▲)
    iv. Soil + FYM + SPM (Pollutant▼) + VAM (Enhancer▲) 300 plants (result data)

VAM culture

Treated plantlets

### 2.1.4 Biodiversity

**Achanakmar-Amarkantak Biosphere Reserve**

A complete UNESCO nomination document of Achanakmar-Amarkantak biosphere reserve was prepared and submitted for designation on the World Network of Biosphere Reserves. Collected literature on biosphere reserves of tropical moist / dry deciduous forest types and information on flora and fauna was updated. Meteorological data from core and buffer zones of Achanakmar-Amarkantak biosphere reserve were collected. Status of economically important threatened flora was recorded in buffer zone. One day workshop on identification of butterflies and birds of Achanakmar-Amarkantak biosphere reserve and sustainable harvesting of NTFP's was conducted in October, 2010. Biannual series of information of biosphere reserve (BRIS) was published. Out of 12 species of butterflies and 24 species of moths collected from the buffer and transition zones of biosphere reserve, butterfly *Ypthima avanta* and 20 species of moths is new addition to the insect faunal composition of Achanakmar-Amarkantak biosphere reserve.

### 2.1.6 Tribals and Traditional Knowledge System

**Utilization pattern of plants in enthno-medicinal uses prevalent in tribal pockets of Satpura plateau in Madhya Pradesh**

The traditional healers prevalent in the area of present study were in the district of Jabalpur Mandla, Katni and Chhindwara belong to Baiga, Gond, Bhariya, Kol tribes located in the satpura eco-region of MP. These folk healers have inherited the art of healing, curing the patient by using medicinal and aromatic plants found forest ecosystem around their tribal localities. These healers know the properties of large number of plants found in forest ecosystem which needs to be documented and scientifically examined for cure of ailment. Gradually such plants are uprooted from forest in wild forms and due to heavy exploitation many of these species are in stage of being extinct category due to commercial utilization. Accordingly such information on traditional knowledge has been documented on priority basis along with the commercial utilization of medicinal plants by traditional healers and several pharmaceutical companies involved in trade of this region.

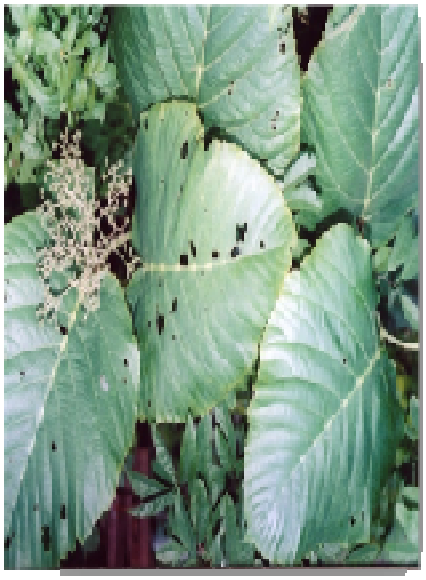
**Achievements:**

Field survey was conducted to identify rich tribal pockets in Mandla, Jabalpur, Katni and Chhindwara districts of MP for documentation of traditional knowledge from traditional herbal healers. In all 507 plants of medicinal value, which are being utilized by 134 traditional herbal healers of tribal pockets of above four districts for cure of various diseases prevailing among tribal / local people were documented.

Existing utilization pattern along with formulation and duration of treatment etc. of medicinal plant being utilized by traditional herbal healers against various common diseases were also documented. Survey of Mandla, Jabalpur, Katni, Satna, Chhindwara, Bhopal and Sagar districts

of MP were carried out to document the channels involved in marketing of herbal plants. 68 traders involved in trading of herbal plants/parts were contacted to collect the information on trading. The price structure of sale of raw herbal medicinal plant parts was collected from local traders. Market day of tribal villages of Mandla, Jabalpur, Katni and Chhindwara districts, where, trading of raw and finished products take place was also visited and the information on trade was recorded.

*Andrographis paniculata*



*Leea macrophylla*

**Details of medicinal plants, traditional herbal healers and traders documented**

| District | Medicinal plants documented | Traditional herbal healers | Traders |
|---|---|---|---|
| Mandla | 133 | 31 | 11 |
| Jabalpur | 128 | 38 | 10 |
| Katni | 119 | 35 | 10 |
| Chhindwara | 127 | 30 | 21 |
| Sagar | - | - | 02 |
| Bhopal | - | - | 07 |
| Satna | - | - | 07 |
| **TOTAL** | **507** | **134** | **68** |

Awareness was created through local contacts to the tribal people, traditional herbal healers and villagers of the study area regarding utilization of medicinal plants, importance and sustainable uses of herbal medicinal plants and their conservation during the field visits. Pamphlets on 15 medicinal plants have been published particularly on uses and conservation of medicinal plants for distribution and creating awareness among tribal and local communities.

## *2.2 Forest Productivity*

### 2.2.1 Overview

Forests may reproduce more successfully when special efforts are made to encourage regeneration. Either artificial regeneration that involves planting seeds or seedlings, or natural regeneration that relies on existing seedlings or seed may be used. During the year under forest productivity research, one project was completed and one project was initiated.

#### 2.2.1.1 Summary of the achievements under the Theme

Experiments on foliar spray of chemical fertilizers were conducted in Morga to observe the effect of different doses of fertilizers, either individually or in combination, on increment in size of tendu leaves.

Studies on sustainable management of medicinal plants in JFM areas in two agroclimatic zone of Madhya Pradesh have been conducted. Germination percentage was improved by pretreatments on *Schleichera trijuga, Terminalia arjuna, Sapindus laurifolia, Terminalia chebula, Ablomoscus moscatus, Rauvolfia serpentina, Emblica officinalis* and *Mxvimusops elengi,* out of 12 target species.

Phyto-sociological studies including regeneration survey of newly recruited seedlings of seed and coppice origin were recorded. Flowered trees were enumerated. Hoeing, cleaning and fire treatments were applied to see its effect on regeneration of sal. Two species of bamboos viz. *Bambusa nutans* and *Dendrocalamus strictus* were selected to establish the bamboo based agroforestry system at experimental area of TFRI and to create the awareness among the farmers of different villages of M.P. and Chhattisgarh state for the adoption of bamboo in their field. Identified and selected two study sites as an OSR experimental area of TFRI and as an OFR in farmer's field, Neemkheda village, Jabalpur district to establish the multitier cropping system by raising Aonla intercropped with Arhar and Adrak. Survey was conducted in Kanhan region of Western Coal Fields Limited, Junnardeo and Pench area of Western Coal Fields Limited, Shivpuri area for selection of coal mine overburden site for laying out experiment. Shivpuri open cast mine-1 has been selected for taking up the experiment.

#### 2.2.1.2 Projects under the Theme

| Projects | Completed projects | Ongoing projects | New projects initiated during the year |
|---|---|---|---|
| Plan | 4 | - | 4 |
| Externally Aided | 1(subproject) | 1 | 1+1(subproject) |

### 2.2.2 Silviculture

**Standardization of pruning practices and optimum doses of organic and inorganic fertilizers to increase leaf surface area of tendu.**

Sites were selected in Morga, Kotadol, Litipara and Lohattar in Chhattisgarh. Experiments on foliar spray of chemical fertilizers were conducted in Morga to observe the effect of different doses of fertilizers, either individually or in combination, on increment in size of tendu leaves using RBD statistical design. Surface and sub-surface soil samples were collected from the selected site and analysed in laboratory for their physico-chemical characteristics.

Foliar spray of chemical fertilizers on tendu leaves in Morga (Chhattisgarh)

**Sustainable management of medicinal plants in JFM areas in different agro-climatic zones of Madhya Pradesh**

Studies on sustainable management of medicinal plants in JFM areas in two agroclimatic zone of Madhya Pradesh have been conducted. Sample plots for the study of sustainable harvesting of *Andorgraphis paniculata* (Kalmegh) was laid out in Satnur, Naunichhapar, Delakhadi and Umaranala Forest area, Chhindwara Forest Division. Sample plots for the study of sustainable harvesting of *Buchanania lanzan* (Chironjii) was laid out in Sitadongri, Delakhadi, Khumbhadeo, Batkakhapa and Ojhaldhana Forest Area, Chhindwara Forest Division. Sample plots was also laid out as per statistical design in Umariya Forest Area, Katni Forest Division for the study of sustainable harvesting of *Asparagus recemosus* (Satawar) and Chlorphytum borivillium (Safed Musli).

Data on sustainable harvesting collected from the field was statistically analysed and interpreted. On the basis of three year's observation it may be concluded that regeneration of *A. paniculata* is sustainable at all harvesting level (20-80%) and thus, 80% entire plant of *A. paniculata* can be harvested for maximum productivity and without loss in regeneration. Regeneration of *B. lanzan is* sustainable at all harvesting level (60-90%) and thus upto 90% fruits of *B. lanzan* can be harvested for maximum productivity and without loss in regeneration. Regeneration of *A. racemosus* and *C. borivillium* is sustainable at the harvesting level (20-60%) and thus for maximum productivity and without loss in regeneration 60% *A. racemosus* and *C. borivillium* plants with roots can be harvested.

**Seed physiology of the tropical forest species with special reference to their maturity and storage**

Germination percentage was improved by pretreatments on *Schleichera trijuga, Terminalia arjuna, Sapindus laurifolia, Terminalia chebula, Ablomoscus moscatus, Rauvolfia serpentina, Emblica officinalis* and *Mimusops elengi,* out of 12 target species. Other species does not need any seed pretreatment. Studies on desiccation tolerance and seed storage behavior had been done on *Schleichera trijuga, Terminalia arjuna, Hardwickia binnata, Moringa oleifera, Holoptelea integrifolia, Sapindus laurifolia, Terminalia chebula Ablomoscus moscatus, Rauvolfia serpentina, Emblica officinalis, Bassia latifolia* and *Mimusops elengi. Mimusops elengi* was found as intermediate and *Bassia latifolia* as recalcitrant. Other species were observed orthodox type and can be programmed for long term storage. Seeds of *Terminalia arjuna, Hardwickia binnata, Moringa oleifera, Holoptelea integrifolia, Sapindus laurifolia, Terminalia chebula, Rauvolfia serpentina, Emblica officinalis, Bassia latifolia* and *Mimusops elengi.* were adjusted to three to five moisture contents and stored at four different temperatures for evaluation of storage potential for estimation of viability at regular intervals.. Viability constants were estimated for four orthodox species: *Hardwickia binnata, Moringa oleifera, Holoptelea integrifolia,* and *Sapindus laurifolia.* Best storage conditions were determined for other species. Studies on seed maturation for determination of seed collection time had been done and maturity indicators were determined on *Schleichera trijuga, Hardwickia binnata, Moringa oleifera, Holoptelea integrifolia, Sapindus laurifolia, Ablomoscus moscatus, Bassia latifolia* and *Mimusops elengi.* Seeds of *Rauvolfia serpentine* and *Emblica officinalis* should be collected after full maturity and seeds of these species need after-ripening for better germination. Biochemical characterisation of three categories of seed Total fatty oil and carbohydrate composition was compared between different categories of seeds. It was concluded that there was no significant difference among the three categories of seeds. As all these three species are oil-rich seed (fatty oil composition: *Schleichera trijuga*- 45%, *Bassia latifolia*- 51%, *Mimusops elengi*- 31 %.) As only one out of 12 species was identified as recalcitrant and another as intermediate, no conclusion can be made in this aspect.

**Germination ecophysiology of two important tropical forest tree species: *Schleichera oleosa* and *Pterocarpus marsupium***

A study on germination phenology and physical dormancy was done on *Schleichera oleosa*. Immature & mature Seeds of *Pterocarpus marsupium* were collected from Jabalpur and Mandla District. Effect of seed maturation on germinability was done on *Pterocarpus marsupium*.

**Studies on the effect of different level of seed collection on natural regeneration of Sal (*Shorea robusta*) in Chhattisgarh**

Studies on the effect of different level of seed collection on natural regeneration of Sal (*Shorea robusta*) was conducted in three agroclimatic zones i.e. Bilaspur, Raipur and Bastar in Chhattisgarh. Sample plots were laid out in Marwahi, Dhamtari and Bastar Forest Division as per statistical design.

Phyto-sociological studies including regeneration survey of newly recruited seedlings of seed and coppice origin were recorded. Flowered trees were enumerated. Hoeing, cleaning and fire treatments were applied to see its effect on regeneration of sal.

Sal seeds were collected and their weighing / counting were done. As per treatments seeds were broad casted under the sal trees. After rains again regeneration survey of newly recruited seedlings of seed and coppice origin were recorded to see the impact of different treatments.

### 2.2.3 Social Forestry, Agro-forestry/Farm Forestry

**Sustainable Development of new Bamboo Agroforestry techniques for increased income generation in the Central Indian States**

Two species of bamboos viz. *Bambusa nutans* and *Dendrocalamus strictus* were selected to establish the bamboo based agroforestry system at experimental area of TFRI and to create the awareness among the farmers of different villages of M.P. and Chhattisgarh state for the adoption of bamboo in their field. So far training through PRA technique was conducted for the farmers of Chhindwara and Gwalior district of Madhya Pradesh and Deopur and Raipur of Chhattisgarh during the 2008 and 2009 to train them about the benefits of bamboo based agroforestry system and its management. Distributed the seedlings of *B.nutans* as demanded by them. Standardized the Bamboo-Wheat and bamboo-urad sivi-agri System by repeating the system in two cropping season i.e. Kharif and Rabi.

**Plate 1: Post harvest view of Bamboo –wheat silvi-agri System established as an OSR at the Agroforestry Experimental plot, TFRI, Jabalpur.**

**Plate 2: Demonstration and training on the benefits of Bamboo based silvi-agri systems being imparted to progressive farmers of majhuali block of Jabalpur district on 23rd December,2010 at OSR, TFRI, Jabalpur.**


**Plate3. Director of TFRI addressing to the farmers about the benefits of agroforestry.**

**Plate 4. PI of the project is giving knowhow of the Sissoo-mays silvi-agri system during the technical session of training.**

Prepared nutrient balance sheet through physic-chemical analysis of the soil samples collected before and after the each removal of the crop from the system. The data shows the increasing status of nitrogen as compared to initial stage of land. Data of yield and growth parameters were recorded and statistically analysed to draw the effect of bamboo on grain yield under the intercropping. Data indicates that the maximum grain yield of wheat was registered under the *B.nutans* and minimum in *D.strictus*.

**Evaluation of productivity of maize in *Dalbergia sissoo* (Shisham) and *Zea mays* (Maize) Agroforestry system**

*Dalbergia sissoo* based agri-silviculture system is standardized by intercropping of Hybrid variety of *Zea mays* crops during kharif season under the age of 3 year old *Sissoo* plantation at the experimental area of TFRI. The data were collected on the various parameters (growth, yield, biomass and nutrient status) of tree- crop under the system. Based on the results, data indicates that the maximum productivity of maize crop was found in 5mx 5m spacing of sissoo followed by 4m x 4m when intercropped with sissoo tree. Similarly the growth of *D.sissoo* plants shows gradual increase in height and girth, it may be due to the fact that every cultural operation given to the associated crop was benefitted to the trees under the agroforestry system. Compilation, tabulation and analysis of data is under progress for the writing of report.

Organized one day training cum demonstration programme on *Dalbergia sissoo-zea mays* silvi-agri system for the farmers of four villages' Padariya, Khamariya, Saliwada and Neemkheda of Jabalpur district.

**Development of multitier cropping (Silvi-Agri-Spice) system**

Identified and selected two study sites as an OSR experimental area of TFRI and as an OFR in farmer's field, Neemkheda village, Jabalpur district to establish the multitier cropping system by raising Aonla intercropped with Arhar and Adrak. Preliminary cultural operations like clearing, weeding, ploughing, levelling of field, basal dressing with Farm Yard Manure were done. Procured and transplanted two varieties of *Phyllanthus emblica* (Aonla) viz. NA7 & NA 10 at the spacing of 10mx8m and 10m x 6m intercropped with *Cajanus cajan* (Arhar) in Factorial RBD. Collected and analysed soil samples for the determination of soil properties (soil pH, EC and Organic matter content before the initiation of the system. Data on growth of aonla plants were recorded and tabulated.

**Development of Lac based Silvi-agri-lac system system**

Surveyed the local area for the selection of farmer's field to establish the OFR under the project. Saplings of two species of Lac host viz. *Flemingia semialata* and *Flemingia macrophylla* were procured from the Natural Resin and Gum Research Institute (Jharkhand) Namkum, Ranchi and transplanted in the OSR and OFR selected as two study sites under the project. For the estimation of physical properties and nutrient status of land , soil samples were collected and analysed. Observation on growth and survival of both the species were recorded.

**Standardization of cultivation Protocol for *Asparagus racemosus* (Satawar)**

Maximum germination was observed in the month of June (70%) and the depth 2.5-3.0 cm gave better results. The observation showed that T2- fortnightly irrigation is the best treatment in terms of fresh root weight, plant height, length, diameter and number of tubers as compared to other treatments. The doses of FYM, Vermi-compost @12.5t/ha (i.e. 250 gm/plant), and VAM @5t/ha (i.e.10 gms/plant) were proved as optimum dose in terms of highest no. of roots, fresh root yield. Spacing of 60 x 60 cm resulted in minimum damage during harvest

of tubers and also improved the growth of tubers. The best harvesting age of satawar to get maximum yield is 18-24 months. Chemical analysis of tubers has been done for satavarin IV from MPMFP Processing & Research Centre, BHOPAL and for saponin content from Venkatesh Food Industries, NISO 9001 HACCP certified company, Chhindwara. Satavarin IV content 0.73% and Saponin content of 49.0% was found maximum in FYM treated plots.

### 2.2.4 Forest Soils & Land Reclamation

**Identification of suitable tree species and other vegetation for bio-drainage in Bargi command area (Jabalpur, M.P.)**

The study was conducted with the objective to drain out excess water of the soil in water logged/canal seepage areas through vegetative means and to enhance the site productivity along left bank canal of Bargi command area, Jabalpur. Out of seven tree species planted along canal, *Eucalyptus hybrid* (FRI-4 and FRI-5 clones), followed by *Terminalia arjuna* and *Pongamia pinnata* showed the better performance regarding their growth and biomass and to lower down the water table, regularly measured by observation wells. Lysimetric experiments conducted to simulate the field experiments also showed the similar trend.

**Integrated nutrient management for improved growth of trees on overburden dumps**

Survey was conducted in Kanhan region of Western Coal Fields Limited, Junnardeo and Pench area of Western Coal Fields Limited, Shivpuri area for selection of coal mine overburden site for laying out experiment. Shivpuri open cast mine-1 has been selected for taking up the experiment. Overburden samples were collected from the selected site and the samples were analyzed for its physico-chemical properties *viz*, texture, bulk density, pH, EC, organic carbon, Available N,P, K, Cation exchange capacity, Exchangeable Ca, Mg, Available micronutrients viz. Fe, Mn, Zn and Cu. Seeds of the selected species *viz*, *Albizzia lebbeck, , Acacia auriculiformis, Cassia siamea, Delonix regia, Emblica officinalis, Mangifera indica Moringa oleifera, Dendrocalamus strictus, Terminalia bellerica and Gmelina arborea,* were sown in poly-bags for raising seedlings. Seedlings are being maintained in the nursery. Further work is under progress.

## *2.3 Genetic Improvement*

### 2.3.1 Overview

The institute is engaged with genetic improvement of forestry species, encompassing conservation of genetic resources of *Azadirachta indica* and *Rauvolfia serpentina*, improvement of *Diospyros melanoxylon* through collection and selection of germplasm, standardization of clonal propagation techniques for *Dalbergia sissoo*, *Dalbergia latifolia* and *Albizia* procera and biotechnological interventions, including molecular marker assisted evaluation of germplasm for

future performance of *Santalum album* and validation of selected germplasm (plus trees and progenies) of *Tectona grandis*.

### 2.3.1.1 Summary of the achievements under the Theme

*In vitro* aseptic cultures of *Azadirachta indica* were established from five populations of Madhya Pradesh. Significant increase in shoot length (2.28 cm) was obtained on 0.5 µM BA and 125 mg $l^{-1}$ casein hydrolysate. Shoot regeneration with leaf pieces resulted in maximum number of shoots (3.56) on 0.44 µM BA and 162.86 µM Ads. HPLC method was standardized for quantification of azadirachtin from seeds.

Aseptic *in vitro* cultures of five genotypes of *Rauvolfia serpentina* viz., GO-MN, OR-AG, KL-PB, GO-SG, KL-AJ, were established on MS medium supplemented with 1.5 mg $l^{-1}$ BA.

The germplasm of *Diospyros melanoxylon* was collected from four locations in three agroclimatic zones of Chhattisgarh. Morphometric field data on number of leaves per shrub, leaf area ($cm^2$) and leaf dry weight were recorded.

Maximum rooting of 44% was obtained on WP medium supplemented with 1.5 mg/l IBA for GBW 4 clone of *Dalbergia sissoo*. One field trial was established comprising 5 clones following RBD design and 81% survival in FZB 1 clone was recorded.

Endogenous auxin (IAA) in selected trees of *Dalbergia latifolia* from Jabalpur, Chandrapur and Jagdalpur showed significant seasonal/genotypic variation. Juvenile and mature shoot cuttings of *Dalbergia latifolia* had 36% and 11% rooting response, respectively.

0.3% $HgCl_2$ and 3% Bavistin® significantly produced highest aseptic cultures in *Albizia procera*. BA and kinetin were the best source of cytokinin for shoot multiplication and kinetin was better than BA for preventing callus formation at the base of the *in vitro* shoots.

Three ramets each of 97 plus trees of *Tectona grandis* maintained at National Teak Germplasm Bank, Chandrapur representing 12 teak growing states and 15-31 progenies (half sib families) of nine plus trees were validated using AFLP and STMS markers

Application of regression equations to ISSR analysis of genomic DNA for total/ polymorphic amplified bands of selected sandal plants of Seoni plantations predicted 2.56% oil content by TFRI reference trees and 1.4% oil content by IWST reference trees at the plantation age of 25-30 years.

### 2.3.1.2 Projects under the Theme

| Projects | Completed projects | Ongoing projects | New projects initiated during the year |
|---|---|---|---|
| Plan | 1 | 2 | 1 |
| Externally Aided | 2 | 1 | 1+1(subproject) |

## 2.3.2 Conservation of Forest Genetic Resources

**Studies on variation in reserpine content in some high yielding genotypes of *in vitro* and seedling raised *Rauvolfia serpentina* Benth.**

The shoot cultures of five genotypes namely, GO-MN, OR-AG, KL-PB, GO-SG, KL-AJ were established. The shoot cultures of these genotypes were established on MS medium supplemented with 1.5mg $l^{-1}$ BA. The shoot cultures obtained so were further multiplied on same combinations for stock build up for further experiments. The leaflet explants of the above genotypes were also tried for organogenesis. The leaflet explants of the above genotypes were inoculated on MS medium supplemented with a range of NAA (6.75, 7.5, 12.75 mg $l^{-1}$) and BA (0, 3.75, 7.5 mg $l^{-1}$.

**Studies on variations with respect to *in vitro* azadirachtin production in selected high yielding populations of *Azadirachta indica* A. Juss.**

Plant material (seeds and cuttings) were collected from five locations in M.P., viz., Chhatarpur, Katni, Sehore, Khandwa and Bargi. *In vitro* aseptic cultures were established using nodal segments and seeds. An experiment was conducted to standardize sterilization treatment for aseptic culture establishment with mercuric chloride (0.05 %, 0.1 % and 0.2 %) and Ridomil (2%, 4 % and 6%). Significant effect of mercuric chloride was observed for sprouting of nodal segments and 0.2 % mercuric chloride resulted in sprouting (58.00 %) at 30 days after inoculation. Different basal media, viz., MS, White's, SH, Nitsch and Nitsch and Gamborg's $B_5$ media were screened out for axillary bud break. Significant effect of basal media was observed and MS medium having 0.44 µM BA produced maximum number of shoots. A factorial randomized experiment was conducted to investigate the effect of five cytokinin sources (BA, Kn, Z, TDZ and Ads), three doses of each cytokinins (0.1, 0.5 and 1.0 µM) and their all possible interactions on sprouting of nodal segments (%) and shoot number per nodal segment at 15 and 30 days after inoculation. The different sources of cytokinins had significant effect on sprouting of nodal segments and maximum sprouting of 80.00% was obtained on MS medium supplemented with kinetin which was statistically on par with sprouting obtained on BA (73.33 %), zeatin (71.12 %) and adenine hemisulphate (62.23%). Another factorial randomized experiment was conducted to investigate the effect of three doses of BA (0, 0.5 and 1.5 µM) and three doses of casein hydrolysate (CH, 125, 250 and 500 mg $l^{-1}$) on number of shoots per nodal segment, number of nodes per shoot and shoot length (cm). The interactions between BA and casein hydrolysate were found to significantly affect the shoot length and maximum shoot length of 2.28 cm was obtained on the interaction between 0.5 µM BA and 125 mg $l^{-1}$ casein hydrolysate. Leaves from *in vitro* generated shoots were used as explants for organogenesis The experiment was conducted to investigate the effect of four doses of BA (0, 0.44, 0.88 and 1.76 µM) and three doses of Ads (74.02, 81.43 and 162.86 µM) and their all possible interactions on callus formation (%), shoot formation (%) and number of shoots per leaf piece at 30 days after

inoculation. The interaction between BA and Ads was found to be statistically significant and maximum number of shoots (3.56) were obtained on 0.44 µM BA and 162.86 µM Ads. Standardization of method for isolation and quantification of azadirachtin was carried out. Azadirachtin content of samples collected from different places of Madhya Pradesh was quantified using HPLC Column (Reverse Phase C18 column).


(a) & (b) *In vitro* culture establishment from nodal segment on MS medium supplemented with 0. 44 µM BA in *Azadirachta indica* A. Juss.

(c) Shoot multiplication and elongation on MS medium supplemented with 0.5µM BA and 125mg $l^{-1}$ CH.

(d) Shoot initiation on *in vitro* leaf pieces in MS medium supplemented with 0.44 µM BA and 162.86 µM Ads.

### 2.3.3 Tree Improvement

**Selection and cloning of superior germ plasm of Diospyros melanoxylon from Chhattisgarh.**

Sites were selected in three agroclimatic zones of Chhattisgarh at Morga, Kotadol, Litipara and Lohattar. The germplasm of tendu in the form of root suckers was collected from these locations producing good quality tendu leaves and also from adjoining degraded areas not producing good quality leaves. These root suckers were planted in field conditions for further growth. Field data was collected for GPS location of quadrates and shrubs. Number of leaves per shrub, leaf area ($cm^2$) and leaf dry weight were recorded.

**Genetic improvement of *Buchnania lanzan***

Extensive surveys were conducted and 13 phenotypically superior candidate plus trees at Amarwada and Delakhari block of Chhindwara Forest division, 12 phenotypically superior candidates plus trees from Gondia and Shahada forest division of Maharashtra and 8 candidate

plus trees from Raigarh Forest division of Chhattisgarh were selected. Seeds were collected from 25 candidate plus trees of *B. lanzan*. Collected seeds were dried in the shade and put in polybags for germination. Germination percentage and growth data were recorded. 41-97 percentage germination was recorded in various seed lots.

Progeny trial of *B. lanzan* has been established in the Centre for Forestry Research and Human Development campus with 9 trees / family / replication with three replications in a randomized block design has been laid out. Survival data has been collected. Progeny trial is being maintained and growth data recorded.

### 2.3.4 Vegetative Propagation

**Genetic variation for *in vitro* morphogenetic potential of *Dalbergia sissoo* Roxb clones and evaluation of their field performance.**

Rhizogenesis in five clones (GBW 4, JB 1, FZB 1, FZK 1, RSK 1) was evaluated by conducting two experiments. In the first experiment the explants were inoculated on five basal media supplemented with 1.0 mg/l IBA. The explants inoculated on WP medium produced a maximum of 33% rooting followed by 22% rooting in MS medium. The explants inoculated on SH, B5 and N & N medium did not produce root and most of the explants inoculated on these medium were noticed to be died. WPM was also recorded with maximum root number and root length, however, the explants inoculated on MS medium were produced healthy and elongated roots. In the second experiments the shoot cultures of only GBW 4 clone was used for rhizogenesis on WP medium supplemented with graded doses i.e, 0.1, 0.5, 1.0, 1.50 mg/l of IBA. The maximum of 44% rooting was obtained on medium with 1.5 mg/l IBA. For studies on organogenesis from callus culture the experiments were laid out with MS semi solid medium with a range putrescine (0.1, 0.2, 0.3, 0.4 and 0.5 mM). Among different treatments 0.5 mM putrescine resulted with 58% organogenic callus formation. One field trial has been established comprising 5 clones following RBD and 81% survival has been recorded with good growth of the plants and the maximum height (79.57 cm) was recorded in FZB 1 clone.

*In vitro* rhizogenesis in five

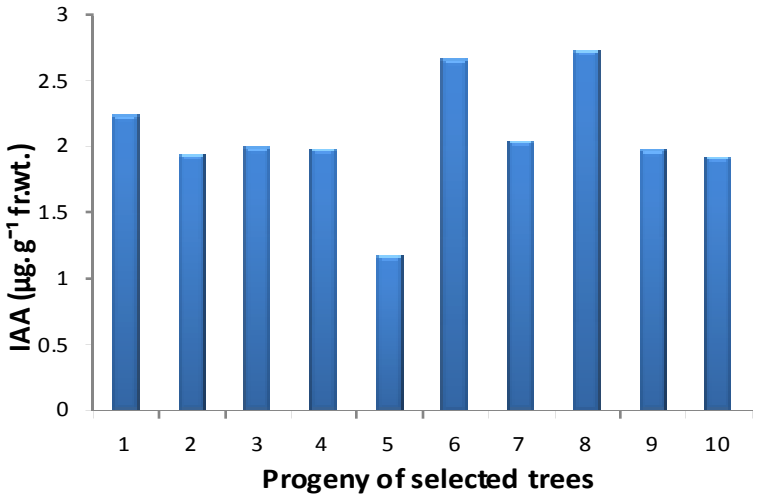
Establishment of field trial of five clones of *D.sissoo*

**Studies on endogenous auxin level and its relationship with adventitious rooting potential in *Dalbergia latifolia* Roxb.**

Experiments conducted for testing rooting potential in selected trees of Jabalpur, Chandrapur and Jagdalpur. Simultaneously endogenous auxin (IAA) was estimated to find out the relationship. Significant seasonal/genotypic variation was recorded in endogenous auxin (IAA). IAA was minimum (1.742 µg $g^{-1}$ fresh wt.) in March and maximum (3.640 µg $g^{-1}$ fresh wt.) in July. This is due to the emergence of new buds and new vegetative growth, accelerating the IAA synthesis which moves downward. Maximum IAA was in tree 8 (3.117 µg $g^{-1}$ fresh wt.) and minimum in tree 1 (2.334 µg $g^{-1}$ fresh wt.). Significant genotypic variation in endogenous auxin was also recorded among selected trees from Chandrapur (MS) and Jagdalpur (CG). Basal dip treatment of 5mM IAA for 4 hrs promoted adventitious rooting up to 11.33% compared to 1.33% in control. Literature reveals only up to 5% rooting and categorized the species as "very difficult to root".

Basal dip treatment of 2mM IAA for 4 hrs produced 12.5% (minimum) adventitious rooting in progeny of Tree-3 and 54.17% (maximum) in progeny of Tree-6. However, an average of 35.83% adventitious rooting recorded in seedling cuttings with basal dip treatment of 2mM IAA for 4 hrs. Study reveals a weak relationship between endogenous IAA and rooting potential of selected trees.

**Experiment on rooting potential of selected trees of *Dalbergia latifolia***



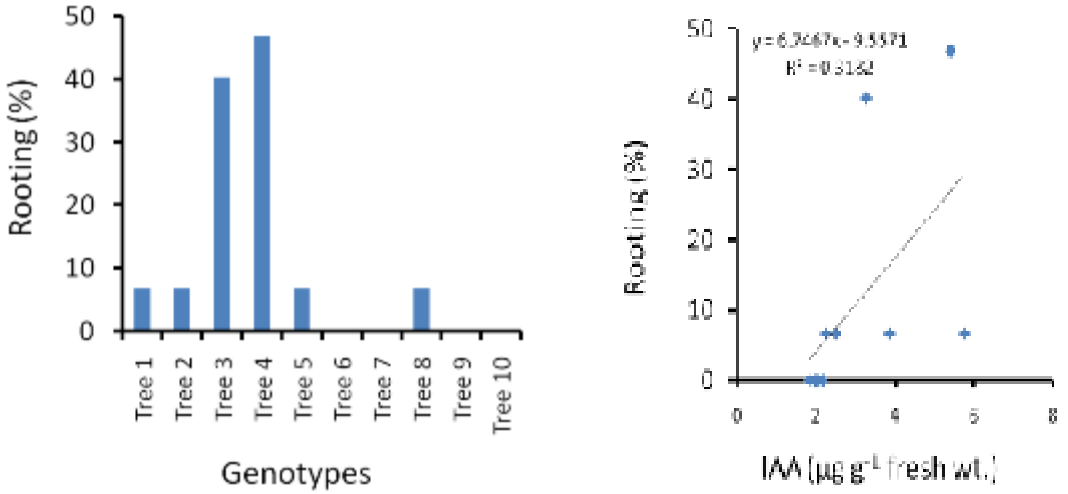


**IAA: Variation in progeny of selected trees**

**Experiment on rooting of seedling cuttings**

**Adventitious rooting in seedling cuttings**

**Hardening of rooted cuttings**




**Rooting Response and Its Relationship with Endogenous IAA in Rosewood Genotypes**

**Studies on development of *in vitro* regeneration system for *Albizia procera* (Roxb.) Benth**

Three trees were selected on the basis of their phenotypic character at TFRI campus Jabalpur. Nodal explants bearing axillary bud were collected after leaf fall in the summer (March-April) to establish cultures. A complete randomized factorial design experiment was laid out to test the effect of graded doses of $HgCl_2$ (0.1%, 0.2% and 0.3%) and Bavistin ® (1%, 2% and 3%) for the aseptic culture establishment from nodal explants. Uniform MS medium supplemented with 2.5 µM BA was provided. Data were recorded at 15 and 30 days after inoculation. Aseptic culture establishment was significantly affected by $HgCl_2$ at 15 days after inoculation and Bavistin® at both stages of sampling. 0.3% $HgCl_2$ and 3% Bavistin® significantly produced highest aseptic cultures. A complete randomized factorial design experiment was set to screen out the best medium for tree genotypes. Five culture media (MS, B5, WPM, Nitsch and SH) were tested. The characteristics of shoot multiplication recorded statistically similar values in different culture media. MS medium was selected for further investigation on shoot multiplication. Another shoot multiplication experiment was carried out in a complete randomized factorial design to investigate the effect of different sources (BA, TDZ, Kn, Ads) of cytokinins and their doses (1.25, 2.50, 3.75, 5.0µm) on shoot multiplication.BA and Kinetin proved to be the best sources for shoot multiplication. However, the administration of kinetin prevented callus formation at the base of the *in vitro* shoots giving its preference over BA. A complete randomized factorial design experiment was laid out to investigate the effect of different media (MS, WPM, B5, SH, NITSCH) and doses of 2, 4-D (0, 2.5, 5.0, 7.5µM) for callus induction from leaflet explants. The significantly maximum callus induction was recorded in 5-7.5µM 2, 4-D at 30 days after inoculation.

**The aseptic sprouted nodal explants treated with 0.3% $HgCl_2$ and 3% Bavistin and maintained on MS medium + 2.5 µM BA: shoot elongation at 30 days**

**Kinetin prevented callus formation at the base of *in vitro* shoots after 30 days**

**Callus growth at 45 days after inoculation**

### 2.3.5 Biotechnology

**Molecular characterization of *ex-situ* conserved germplasm and identification of molecular marker associated with wood quality traits in *Tectona grandis* L.f.**

Three ramets each of 97 plus trees of *Tectona grandis* maintained at National Teak Germplasm Bank, Chandrapur representing 12 teak growing states and 15-31 progenies (half sib families) of nine plus trees were collected as branch cuttings. Sprouts from these branch cuttings were harvested for the extraction of genomic DNA, which was found to be 70 ±58µg/ 100mg fresh leaf weight, exhibiting a wide range of 14 – 250 µg/100mg fresh leaf weight and the quality of genomic DNA (A260/A280), 1.74±0.15. STMS primers for genotyping of the collected plus trees had been designed and synthesized. Two factorial randomized experiments were conducted to screen optimum quantity of genomic DNA (10, 20 and 30 ng), Primer concentration (0.165,0.33,0.65µM), $MgCl_2$ concentration (1.5, 2.0 and 2.5mM) and Taq polymerase (0.5,1.0 and 1.5 U) under either hot-start or touch-down PCR conditions. The other assay conditions

included 50mM KCl, 10mM Tris HCl and 10µmole dNTPs. Initially, 2.5% high resolution agarose was used; but subsequently, the same concentration of lab grade agarose was found to exhibit similar sharpness of bands. Therefore, the lab grade agarose was recommended for further investigation. It was found that touch down PCR provided better amplification than hot-start PCR. The lowest quantity of genomic DNA, $MgCl_2$ and Primer concentration and the highest Taq polymerase resulted in excellent amplification of STMS markers. The final prescription for touch down PCR ($60^0$C-$50^0$C, $1^0$C) for STMS analysis of teak plus trees and progenies standardized to be 10ng genomic DNA, 1.5m M $MgCl_2$, 1.5 U Taq polymerase, 0.2 µM Primer and 2.5% lab grade agarose. 12 progenies each from ten plus trees were collected and extracted for genomic DNA. The extracted genomic DNA of half sib-progenies was handed over to TERI, New Delhi, the other collaborator of the project, for STMS analysis. STMS analysis validated ramets and progenies commensurate mostly with their plus trees.

**Evaluation and prediction of oil bearing capacity of sandal (*Santalum album* L.) germplasm using physiomorpho-molecular marker**

30 sandal trees exhibiting heartwood formation each from two localities from TFRI campus were randomly selected for collection of data on dbh and wood core samples for extraction of oil content besides their leaves samples for genomic DNA extraction and ISSR analysis and seasonal physiological changes in nitrate reductase activity and peroxidase activity. The tree age ranged 20-25 years with significant variations in recorded characteristics. Similarly, 48 sandal trees exhibiting heartwood formation from IWST campus were randomly selected for extraction of genomic DNA and ISSR analysis and wood core samples for oil content. 26 ISSR primers were screened for analysis for genomic DNA of trees of both campuses.These trees served as references for germplasm evaluation of seven year-old sandal plantation at Seoni raised by M/S DS Agri Estate Pvt. Ltd., Noida. The correlations of dbh, heartwood, nitrate reductase activity and peroxidase activity with oil content were computed. However, these correlations were non-significant. ISSR amplified bands and their parametric computations also did not show any correlations. However, total band information and polymorphic band information generated for sandal trees of both campuses had very strong positive correlations exceeding $r^2$ values > 0.99 with straight line regression equations. Application of these regression equations to ISSR analysis of genomic DNA for total/ polymorphic amplified bands of selected sandal plants of Seoni plantations predicted 2.56% oil content by TFRI reference trees and 1.4% oil content by IWST reference trees at the plantation age of 25-30 years. However, prediction by TFRI reference trees appears to be much reliable as their oil contents were extracted using distillation method rather than solvent method applied in IWST reference trees.

## *2.4 Forest Management*

### 2.4.1 Overview

Studies on Information and Communication Technology (ICT) are being conducted at the institute.

#### 2.4.1.1 Summary of the achievements under the Theme

Developed package *INSPAK* for compiling information on insect pests associated with important forestry species of central India and provide it in the form of information system, using ICT (information communication technology). the data has been collected for the insect pests associated with *Shorea robusta, Dalbergia sissoo, Dalbergia latifolia, Acacia catechu, Acacia nilotica, Albizia lebbek, Ailanthus excelsa, Bamboo, Tectona grandis, Butea monosperma* based on scientific name, common name, distinguishing characters, nature of damage, host range, natural enemy and control measures technique. The system provides various combination of key strokes viz Tree species, Insect pest, Insect pest Category, Insect Pest sub Category for data retrieval.

#### 2.4.1.2 Projects under the Theme

| Projects | Completed projects | Ongoing projects | New projects initiated during the year |
|---|---|---|---|
| Plan | - | 1 | - |
| Externally Aided | - | - | - |

### 2.4.7 Information and Communication Technology (ICT)

**Development of an information system for forest tree species associated insect and their management**

The developed package *INSPAK* is an attempt to compile information on insect pests associated with important forestry species of central India and provide it in the form of information system, using ICT (information communication technology). Under the project Data has been collected for the insect pests associated with *Shorea robusta, Dalbergia sissoo, Dalbergia latifolia, Acacia catechu, Acacia nilotica, Albizia lebbek, Ailanthus excelsa, Bamboo, Tectona grandis, Butea monosperma* based on scientific name, common name, distinguishing characters, nature of damage, host range, natural enemy and control measures technique. The system provides various combination of key strokes viz Tree species, Insect pest, Insect pest Category, Insect Pest sub Category for data retrieval.


## *2.6 Non-wood and Forest Products (NWFPs)*

### 2.6.1 Overview

Studies on resource development of biofuel species *Jatropha curcas* and *Pongamia pinnata*, sustainable harvesting practices of some NWFP species including medicinal plants in JFM areas, chemistry, value addition and utilization of NWFP species including medicinal plants and bamboo species are being conducted at the institute.

The centre is conducting research on chemistry of NWFP's, value addition and its utilization of *Withania somnifera, Gymnema sylvestre, Stevia rebaudiana, Moringa oleifera and Madhuca indica.*

#### 2.6.1.1 Summary of the achievements under the Theme

Nutritive values of bamboo shoots were also investigated. Boiling shoots of *Bambusa tulda* and *Dendrocalamus strictus* in 1% NaCl solution in water for 15 minutes, *D. asper* in 5% NaCl for 10 minutes and B. bamboos in 5% NaCL for 15 minutes proved best for removal of anti-nutrients. Different products like bari, pickels, papad, petha, sauce and cruches were made from the shoots.

Experiments initiated to standardize the various means of sustainable harvesting methods such as strip harvesting, alternate harvesting and opposite harvesting of barks from tree trunk, branch, twig, leaves, flowers, roots, etc. of *Bauhinia veriegata*, *Holorrhena antidyrentrica, Oroxylum indicum, Saraca asoka* and *Terminalia arjuna.* Phytochemical analysis of various plant parts revealed that the trunk bark contained maximum amount of active ingredients but branch bark and leaves can also be used in place of trunk bark. Original bark contains higher

amount of phytochemical constituents than regenerated bark. Antioxidant activity assay was also done in bark samples of above species and *T. arjuna* was found to possess maximum antioxidant activity.

Polysaccharides from *Curcuma angustifolia*, *C. pseudomantana*, *Dioscorea bulbifera*, *D. hispida and Hyptis suaveolens* were isolated. Polysaccharides modified by chemical modifications and starch-polyols polymers and adhesives were prepared. Physico-chemical properties of products were evaluated.

For integrated development of Jatropha and Karanj, 175 CPTs of Jatropha and 81 CPTs of Karanja were selected from different agroclimatic regions of Madhya Pradesh and progeny trials were established. In case of Jatropha, TFRI-1& 2, IGAU-1, TNMC-22, PDKV-1 & 2, TNMC-7, Palampur-I, RJ-92, JCP-2, NRCJ-17 and TNJC-19 accessions were performing better on the basis of growth performances, fruits yield, seed characters and oil content in national trial. In zonal trial, TFRI-1, TFRI-2, PDKV-1, IGAU-2, PDKV-2 and PDKV-1 performing better. In case of Karanja, TNMP-14 and RAK-5 accessions were performing better in national trial. In zonal trials IGAU-1, CCSHAU-1, IGAU-5, NRCAF-2, JNKVV-29 and JNKVV-15 were performing better.

Multilocational trials of 9 superior accessions of *Jatropha curcas* were raised at the institute in 2008 and 19 accessions in 2009. On the basis of growth attributes, two accessions HAP-41 and HAP-44 (Garhwal, Uttarakhand) were recorded to give higher number of branches without prunning.

A national multilocation trial comprising of 36 accessions of *Jatropha* were established at the institute. Accession TFRI-2 performed better with respect to growth, number and size of fruits.

Experiments were laid out to standardize sustainable harvesting of *Phyllanthus amarus, Desmodium gangeticum* and *Dioscorea hispida* in Chhattisgarh. Further study is under progress.

Bael fruits of different maturity were processed by different methods for the extraction of pulp and drying. The effect of different processing methods on physico-chemical quality (moisture%, edible portion, carbohydrates, protein, minerals carotene, riboflavin, fat, and fibre %) of pulp were assessed.

### 2.6.1.2 Projects under the Theme

| Projects | Completed projects | Ongoing projects | New projects initiated during the year |
|---|---|---|---|
| Plan | - | 2 | 1 |
| Externally Aided | 1(subproject) | 4 | 4 |

### 2.6.3 Sustainable Harvesting and Management

**Population dynamics of selected threatened medicinal plant species and conservation management through community participation in buffer and transition zone of Achanakmar-Amarkantak Biosphere Reserve, Madhya Pradesh**

Surveyed Amarkantak and east Karanjiya ranges located in buffer and transition zones of Achanakmar-Amarkantak biosphere reserve and baseline information such as potential habitat areas, village forest committees was collected. Identified localities of selected target species of medicinal plants, such as *Thalictrum foliolosum, Embelia tsjeriam cottam, Rubia cordifolia* and *Celastrus paniculatus*. Observations on population size, structure of target species, habitat characteristics and associate species of selected medicinal plants were recorded. Extension materials such as posters and questionnaire prepared for awareness programme and interface with villagers. Two interface workshops were conducted with villagers of Damgarh, Umargohan and Kharidih.

**Studies on developing alternative methods of sustainable harvesting of medicinal plants**

Experiments were laid out for standardization of alternative harvesting practices of designated species *viz*. *Bauhinia veriegata* (Kachnar), *Holarrhena antidysenterica* (Kutaj), *Oroxylum indicum* (Sheonak), *Saraca asoka* (Ashoka) and *Terminalia arjuna* (Arjuna) in the forests areas of Jabalpur, Balaghat, Rewa, Bodla (M.P.), Chandrapur, Tadgaon, Allapally, Tadoba, Nasik (Maharashtra) and Keonchi, Pendra road, Bilaspur, Raigarh, Marvahi, Gariyaband (Chhattisgarh), Harishankar, Champagarh, Khurda, Koraput (Odisha). Various harvesting methods such as ⅓ and ¼ blaze size, longitudinal strip (alternate and opposite strips) harvesting were experimented. Different plant parts i.e. trunk bark, branch bark, twig bark, twigs, leaves, flowers, root bark etc. were collected and analyzed for their phytochemical constituents (tannins, alkaloids, flavonoids, phenols and phenolic acids). Regenerated bark was also collected and evaluated for major active ingredients. Regular observations were recorded on bark regeneration. Results revealed that longitudinal strip harvesting method is superior to other harvesting methods. Data on bark regeneration revealed that bark recovery is faster in younger trees having GBH <80 cm. Complete bark recovery was observed in two years in trees having GBH <80 cm and three years in the trees having GBH >80 cm. Minimum harvestable girth varies from species to species. Bark can be harvested from the previously harvested trees after two years from opposite side of the blaze. Phytochemical analysis of various plant parts revealed that the trunk bark contained maximum amount of active ingredients but branch bark and leaves can also be used in place of trunk bark. Original bark contains higher amount of phytochemical constituents than regenerated bark. Antioxidant activity assay was also done in bark samples of above species and *T. arjuna* was found to possess maximum antioxidant activity.

**Fig.1. *Terminalia arjuna* tree showing a blaze on the trunk**

**Fig. 2. *Terminalia arjuna* tree showing regeneration of bark**

**Standardization of sustainable harvesting practices of Arjuna (*Terminalia arjuna*) bark**

Experiments were laid out for standardization of sustainable harvesting practices of *Terminalia arjuna* (Arjuna) in the forest areas of Keonchi, Pendra road, Bilaspur, Marvahi, Gariyaband (Chhattisgarh). Various harvesting methods such as ⅓ and ¼ blaze size, longitudinal strip (alternate and opposite strips) harvesting were experimented. Different growth regulators e.g., IAA, IBA; bordeaux mixture, leaf extracts of Neem, Aak, Karanja etc. were applied on harvested surface of tree trunk in order to study their influence on bark regeneration. Different plant parts i.e. trunk bark, branch bark, twig bark, root bark, twigs, leaves, flowers etc. were collected and analyzed for their phytochemical constituents (tannins, ash, oxalic acid, gallic acid, ellagic acid, cardiac glycosides, flavonoids, phenols and phenolic acids). Regenerated bark was also collected and evaluated for their major active ingredients. Bark regrowth results revealed that longitudinal strip harvesting method is superior to other harvesting methods. Data on bark regeneration revealed that bark recovery is faster in younger trees having GBH <90 cm. Minimum harvestable girth should be >60 cm. Study on different growth regulator and insecticide application is under progress. Phytochemical analysis of original and regenerated bark revealed that original bark contains higher amount of active ingredients than regenerated bark. Plant samples were also analysed for their antioxidant activity. Bark samples showed maximum antioxidant activity.

**Standardization of sustainable harvesting practices of Bhui-aonla (*Phyllanthus amarus*), Sal-parni (*Desmodium gangeticum*) and Baichandi (*Dioscorea hispida*)**

Experiments were laid out to standardize sustainable harvesting of *Phyllanthus amarus, Desmodium gangeticum* and *Dioscorea hispida* in Chhattisgarh. Further studies for standardization of harvest regimes is under progress i.e. entire plants will be harvested as per

treatments e.g. HI (Control), H2 (40% harvest), H3 (60% harvest), H4 (80% harvest) and H5 (100% harvest) as well as cutting of plant up to collar level at all level of harvest.

**Harvesting time of some selected medicinal plants for their natural antioxidants constituents**

Survey was conducted in Tamia and Delakhari natural forest and Medicinal Plants Conservation Area, Delakhari for the availability of the selected species under study. *Gymnema sylvestre* species was available in Rainikheda beat, compartment no. P-36, Jhirpa range. *W. somnifera* and *Stevia rebaudiana* experimental beds were established in CFRHRD nursery and are being maintained. *M. oleifera, G. sylvestre, W. somnifera* & *S. rebaudiana* leaves samples were collected from existing plantations of the centre & natural forest at monthly time intervals. Method was standardized and estimated antioxidant constituents viz. ascorbic acid, total phenols, phenolic acids and macroelements and further analysis is under progress.

### 2.6.4 Chemistry of NWFPs, Value Addition and Utilization

**Nutritive values and value addition of some bamboo species of central India**

Fresh bamboo shoots of different species (*Dendrocalamus asper, D. strictus, Bambusa bambos and B. tulda*) were analyzed for their nutritional constituents. Results revealed that there is a significant difference in the nutritional status among different species. *D. strictus* (commonly available species of central India) can be considered as a good edible species as it contains nutrients at par with *D.asper* (known edible species of Thailand) grown in Madhya Pradesh. Moreover, *B. tulda* and *B. bambos* shoots have almost similar nutritional status as that of *D. asper*. Thus, all the three species have the potential to be explored for edible shoot production in central India. Simple, efficient and cost effective methods for processing of bamboo shoots were developed. The processing methods developed significantly reduce the amount of cyanogens and retain nutrients considerably, thus may be utilized for pre-cooking processing of bamboo shoots to remove anti-nutrients. After processing of bamboo shoots, different products *viz.* bari, papad, crunches, sauce and pickle were made. The products made were good in taste and texture and, were accepted in terms of flavour, odour, appearance and taste. The nutrient contents of products (bari, sauce and crunches) showed a gradual decrease and should be consumed within 6 months from the date of preparation. However, in case of papad the carbohydrate content did not decrease much but the taste is not acceptable after 8 months, thus they should be consumed within 8 months of preparation. Whereas, in case of pickles, nutrient content decreased in 9 months but the product is acceptable in taste and good in texture even after 1 year of preparation. This study will popularize and increase the utilization of bamboo shoots. Being a lesser known food product, bamboo shoot processing has vast potential to be developed as a new, innovative and promising enterprise in central India.

**Fig. 1 Bamboo shoots**

**Fig. 2. Bamboo product (Bari)**

**Determination of polysaccharides for the development of bioproducts:**

*Curcuma angustifolia*, *C. pseudomantana*, *Dioscorea bulbifera*, *D. hispida and Hyptis suaveolens* (seeds and aerial parts) were collected for isolation of polysaccharides. Processed and isolated polysaccharides. Physical and chemical properties of polysaccharides –starch and mucilage i.e. morphology, size, solubility, viscosity, extraction temperature, amylose, cellulose, oil% of polysaccharides samples were determined. Polysaccharides –starch from different species were modified by acetylation, hydroxyl-propylation and carboxy methylation. The densities of unmodified starches were ranged 1.29- 1.50 g/cm$^3$ while modified starches showed significant variation. Degree of substitution of modified starches estimated 0.040-0.277. Starch polymers were prepared with native and modified starches and different additives. Physico-chemical properties i.e. solubility, swelling behavior, transparency and biodegradability test, FTIR, thermal, mechanical analysis and XRD analysis were performed. The value of tensile strength of unmodified polyfilms was found to be 9.1 MPa, while significant variation i.e. 45MPa was found in modified polyfilm. Compatibility of starches with mucilage, polyvinyl alchohol, chitosan and bentonite and their effect on properties of polyfilms were evaluated.

Polysaccharides were modified by different chemical treatments and evaluated compatibility of starches with different additives for the development of adhesives. Binding ability of adhesives with different substrate was evaluated. Properties of adhesives i.e. setting time, water resistivity, solubility in water and organic solvents and thermal gravimetric analysis (TGA) were performed. Comparative efficiency of bio adhesives and synthetic adhesives were also screened.

**Processing techniques of *Aegle marmelos* (Bael) Fruits**

Bael fruits of different maturity were collected from Barha (Jabalpur), Saliwada, NWFP Nursery (Jabalpur, M.P.), Pandariya (Kawerdha, CG). Samples of matured and immature bael were processed by different methods i.e. roasting in cow-dung, steaming, boiling in hot water at different duration and solar treatment for the extraction of pulp and dried in shade, sun,

direct and indirect solar treatments. Assessment of quality (Riboflavin carotene, carbohydrates, protein, fat, and fiber) of pulp samples, of matured fruits and immature processed fruits were undertaken. The edible portion and carbohydrate % of bael fruits pulp were found to be changed in different processing methods. Carotene and riboflavin % varied 25.6 mg/100 g to55.45% and 2 to8 mg/100g, respectively.

Physico-chemical properties of bael pulp samples, processed by tribals were also assessed. Samples were found to be damaged by fungal attack due to wrong processing. Stored samples of pulp were also analyzed and significant variation in carbohydrate, protein, minerals were recorded.

**Development of food products from *Madhuca indica* flowers for the upliftment of the Tribal/Rural Communities of Central India**

Collection of *Madhuca indica* flowers from available source was done. Method standardization for extraction and quantitative estimation of *M. indica* flowers for their nutritional constituents was done. Quantitative estimation of mahua flowers for their nutritional constituents was done .Four value added food products viz. jam, squash, sauce and chikki were developed using mahua flowers. Consultancy was taken from LIT, Food Technology Dept, Nagpur University, Nagpur as & when required. Further work is under progress.

### 2.6.5 Biofuels and Bioenergy

**National network on integrated development of Jatropha and Karanj**

**Jatropha:** 175 CPTs were selected from different agroclimatic regions of Madhya Pradesh. Two Progeny trials comprising of 20 progenies each were establishment at Chhindwara and Baraha, Jabalpur. In progeny trials, Patna Satna, Khaerwani Tamrikala, Gesani Shivpuri-2, Gesani Shivpuri- 3 and Gwalior-2 progenies were performing better. Multilocational trials in the form of National and zonal trials comprising of 22 and 14 accessions respectively were established at Institute campus. In National trial, TFRI-1& 2, IGAU-1, TNMC-22, PDKV-1 & 2, TNMC-7, Palampur-I, RJ-92, JCP-2, NRCJ-17 and TNJC-19 accessions were performing better on the basis of growth performances, fruits yield, seed characters and oil content. In zonal trial, TFRI-1, TFRI-2, PDKV-1, IGAU-2, PDKV-2 and PDKV-1 performing better. Plants planted in pits (30X30X30 cm) at the spacing of 2X2m and 3X2m in the month of July with fertilizer dose of 20gm Urea, 120 gm SSP and 120 gm MOP have shown better growth under tropical conditions of Madhya Pradesh.

**Karanja**: 81 CPTs were selected from different agroclimatic regions of Madhya Pradesh. Progeny trial comprising of 20 progenies was established at Balaghat, Madhya Pradesh. Kusmeli Chhindwara, Sikharpur, Chhindwara and Lalpur Satna progenies were found better. Flowering and fruiting was observed in Kusmeli, Chhindwara progeny. National and zonal trial comprising of 5 and 17 accessions respectively were established at Institute campus. In national trial TNMP-14 and RAK-5 accessions were performing better. In zonal trials IGAU-1, CCSHAU-1, IGAU-5,

NRCAF-2, JNKVV-29 and JNKVV-15 were performing better. In Zonal trial-I flowering and fruiting was observed in NRCAF Jhansi accession. All the trials were maintained with regular weeding and hoeing practises and irrigation as and when required.

**Establishment of multilocational trials of superior accessions of *Jatropha curcas* under the network program of DBT**

A multilocational trial comprising of nine superior accessions of *Jatropha curcas* and half sib progeny trial comprising of nineteen accessions were established in October 2008 and July 2009 respectively at institute campus. The trials are performing well and survival is more than 85%. Regular observations on growth attributes like height, collar diameter, number of branches, flowering, incidence of pests and diseases has been recorded on quarterly basis and data is sent to Biotech Park, Lucknow for compilation. Minimal irrigation and maintenance was provided to the trials as and when required. In multilocational trial two accessions HAP 41 and HAP 44 (HNB, Garhwal) have produced higher number of branches without pruning (indicating no requirement for pruning). Flowering was observed in all accessions in the month of September-October 2010. Fruits were formed in all accessions: JA-9, NBRI, Lucknow (109 fruits), JA-126, NBRI, Lucknow (85 fruits), JA-139, NBRI, Lucknow (33 fruits), BTP-U, BTP, Lucknow (4 fruits), HAP 41, HNB, Garhwal (130 fruits), HAP 42, HNB Garhwal (36 fruits) and HAP 44, HNB Garhwal (74 fruits).Oil percentage in different accessions varied between 25-38%. In half sib progeny trial flowering has been observed in September-October 2010 in following accessions: JA-9, JA-18 (NBRI, Lucknow), MSSRF-10, MSSRF- 16, MSSRF-51(MSSRF, Chennai), HAP- 41 and HAP-44 (HNB, Garhwal). However, fruiting was observed only in three plants belongs to the accession JA-!8, MSSRF-10, MSSRF- 51. Second pruning of multilocational trial and first pruning of half sib progeny was done in the month of February 2011. Mulching was done in both the trials in the month of March 2011 to prevent moisture loss. The experimental trials are managed and maintained properly.

**Establishment of multilocational trials of 100 superior accessions of *Jatropha curcas* under the network programme of DBT**

A multilocational trial comprising of 100 superior accessions received from network partners was established in July- August 2010 at GRC farm house, Sita Pahad, Jabalpur. The experiment was established following RBD with four replications. The experimental field was divided in 400 equal sized plots and 9 plants were planted per plot at a spacing of 3m x 3m. The trial is performing well and the survival is more than 90%. Regular observations on growth attributes like height, collar diameter, number of branches, flowering, incidence of pests and diseases has been recorded on quarterly basis and sent to Biotech Park, Lucknow for compilation. The experimental plantation is being maintained and managed intensively so as to raise a good crop leading to higher fruit production.

## *2.7 Forest Protection*

### 2.7.1 Overview

The institute is engaged in research on identification of insects, pathogens, beneficial microbes and protection of forest seeds, seedlings, saplings, trees in plantation, stored wood depots from insect and pathogen pests.

#### 2.7.1.1 Summary of the achievements under the Theme

Integrated management package on white grubs in teak nursery at Kanchangaon, Mohagaon Project Division, Mandla (Madhya Pradesh Forest Development Corporation Ltd.) was developed. In this package different activities like installation of light trap unit, different dates of sowing of teak seeds, pruning of host trees around the nurseries, application of biopesticides cakes (neem and jatropha) and prophylactic / curative treatment of phorate 100 gm per bed (size 10x1m) were applied.

#### 2.7.1.2 Projects under the Theme

| Projects | Completed projects | Ongoing projects | New projects initiated during the year |
|---|---|---|---|
| Plan | - | 3 | 6 |
| Externally Aided | 2 | 2 | 1(subproject) |

### 2.7.2 Insects pests, diseases and control

**Development of integrated insect pest and disease control system for major economically important forest tree species**

Integrated management package on white grubs in teak nursery at Kanchangaon, Mohagaon Project Division, Mandla (Madhya Pradesh Forest Development Corporation Ltd.) was developed. In this package different activities like installation of light trap unit, different dates of sowing of teak seeds, pruning of host trees around the nurseries, application of biopesticides cakes (neem and jatropha) and prophylactic / curative treatment of phorate 100 gm per bed (size 10x1m) were applied. Synthetic pyrethroids i.e. deltamethrin 0.005% followed by alphamethrin 0.01% was found to be most effective against these key insect pests. The impact of bacterial wilt diseases in hi-tech teak plantations on length of lamina and intermodal length of apical region of the teak stem was found to be less in Ridomil 0.3 % and 0.2 % followed by Streptocyclin 0.1% as compared to control. Powdery mildew occurs in moist conditions and is usually seen in the wetter spring and fall seasons. Spraying of sulfur (0.2%) is recommended but sulfur may injure tender foliage, especially in hot weather so it must be used carefully under

strict scientific supervision. Biological agents include *Cladosporium cladosporoides*, *Cl. oxysporum* and *Trichoderma virens* which are eco-friendly and give quite fruitful results. Integrated pest management (IPM) of insect pests and diseases of aonla, *Emblica officinalis* was studied. Out of six varieties of *E. officinalis* (viz. Kanchan, Chakaiya, Francis, NA-7, NA-10 and Local- wild), NA-10 (Narendra-10) followed by Kanchan were found to be least preferred by gall forming insect *Betousa stylophora*), defoliator *G. acidula*, bark eating caterpillar *I. quadrinotata* and fruit disease *Alternaria* species as compared to other varieties. Foliar spray of monocrotophos 36 E.C. 0.05% followed by metasystox 25 E.C. 0.05% was found to be the most effective. Soil application of phorate 10 G @ 25 g and furadon 4G @ / 1x1m were also found to be equally effective against *B. stylophora.* Out of eight varieties of *E. officinalis* (Chakaiya, Francis, Kanchan, Anand-1, Anand-2, NA-7, Krishna, Hatizola-Local), the varieties viz., Hatizola-Local followed Francis were least damaged by wilt disease in grafted seedlings in nursery stage. Varieties viz. Kanchan, Anand-2 and NA-7 showed more susceptible reaction to *F. oxysporum.* To manage the disease in nurseries six fungicides were evaluated for their efficacy against the wilt of aonla. On the basis of laboratory evaluation, it was confirmed that Ridomil 0.2% found the most effective against the growth of *F. solani* followed by Ridomil 0.1%, Bavistin 0.2% and Dithane M45 0.2%. Comparative efficacy of six fungicides mentioned under section materials and methods recorded at 3 intervals (15, 25 & 35 days) confirmed that Bavistin, Dithane M 45 and Ridomil at both concentrations and Fytolan at 0.2% were effective to control the disease in nurseries while Thiram and Foltaf were less effective.

**Studies on taxonomy of Braconid parasitoids (Hymenoptera: Braconidae) from central India**

Survey of important 185 localities of 16 districts of Chhattisgarh covering of three ecological/ agro-climatic zones and 385 localities of 34 districts of Maharashtra covering nine ecological/ agro-climatic zones, has been carried out for the collection of Braconid parasitoids and their host insects. Over all 605 sweeping samples of insect-fauna were collected, of which 2606 Braconids were sorted out and preserved. 424 samples of host-insects were also collected, from which parasitoids belonging to 22 species of Braconids were emerged with their varied degree of field parasitisation. Descriptions & illustrations of seven new species and 27 important known species have been carried out. As a whole 56 Braconid parasitoids have been studied in detail; of which 44 Braconid parasitoids (*Apanteles agilis; Apanteles antipoda; Apanteles bambusae; Apanteles belippae; Apanteles cajani; Apanteles caniae; Apanteles creatonoti; Apanteles detrectans; Apanteles effrenus; Apanteles erionotae; Apanteles expulsus; Apanteles hyblaeae; Apanteles javensis; Apanteles lamprosemae; Apanteles leptothecus; Apanteles machaeralis; Apanteles platyedrae; Apanteles prodeniae; Apanteles significans; Apanteles tachardiae; Apanteles tirachola*e; *Cassidibracon castus; Chelonus (Chelonus) deogiri; Chelonus (Chelonus) dwibindus; Chelonus (Chelonus) gastrus; Chelonus (Chelonus) nr. indicus; Chelonus* (*Chelonus*) *narayani; Chelonus (Chelonus) shafeei; Chelonus* (*Microchelonus*) *notaulii; Chelonus (Microchelonus) scutellatus; Cremnops desertor;*

*Doryctobracon areolatus; Eutropobracon granulatus*; *Fopius arisanus; Habrobracon brevicornis; Helcon tardator; Hormius lamidae*; *Hormius orientalis*; *Parahormius absonus; Parahormius deiphobus; Parahormius stom; Parahormius zonus; Protomicroplitis rugulosus* and *Trioxys soporensis*) have been identified up to species level. Five species (*Apanteles lakhaensis; Apanteles neocajani*; *Apanteles neohyblaeae; Apanteles neotaeniaticornis* and *Rogas jalnaensis*) have been established through national and Inter-national publications. Seven species (*Anisocyrta gilvicorpa* sp. n*; Bracon jalgaonensis* sp. n.; *Chelonus* (*Chelonus*) *wardhaensis* sp. n.; *Chelonus* (*Microchelonus*) *hingoliensis* sp. n.; *Doryctes indicus* sp. n.; *Parahormius longicorpus* sp. n.; and *Parahormius longiflagellatus* sp. n.) have been proposed as the species new to science. 120 Illustrations of important taxonomic characters of twenty seven important known species, and 39 illustrations for seven new species, have been prepared, for taxonomic study. Five genera and 14 species have been recorded for the first time from India. 12 genera and 39 species have been recorded for the first time from Chhattisgarh and Maharashtra.Consolidated host-record of Indian Braconid species has also been prepared.

These parasitoids can be utilized as biological control agents of key insect-pests of forest tree species. All these Braconids are indigenous, egg- larval/ larval-pupal parasitoids of key insect pests of forest tree species/ other insect pests, existing in Chhattisgarh and Maharashtra.

**Development of Entomopathogenic Nematode based strategy for the management of termites and white grub pests of major forest tree species**

For achieving the envisaged objectives, multiplication of fictitious host in the laboratory, round the year was required. Laboratory culture of greater waxmoth maintained round the year was used to obtain larvae as fictitious host for EPNs. The first objective envisaged determination of comparative potentiality and dose determination of native EPN isolates. Comparative potentiality of the 6 native isolates has been determined against the target pests. The second objective of the project was to isolate more potential native populations/strains/species of EPNs. Fifty samples were collected from two sites in and around Jabalpur Forest Divisions, four sites at Chhattisgarh and four at Maharashtra, from teak plantation areas of M.P.F.D.C. It required maintenance of laboratory culture of all the collected native isolates round the year and their identification. The laboratory culture of one exotic and six unidentified (native) populations of EPNs native to central India, was maintained *in vivo*, round the year. One of the EPN isolate (*Steinernema dharnaii* n. sp.) has been identified (at molecular level) as new-to-science by CABI, Kew, UK. Process for the identification of other unidentified native EPN populations is in progress in collaboration with the Zoological Survey of India, Dehradun. Different stages of the EPNs have been collected, fixed and two have been sent for identification by nematode taxonomist, collaborating from ZSI, Dehradun. Third objective envisaged standardization of mass-multiplication technique for the most promising local/native EPN. We investigated improved parameters for economical and successful mass-multiplication of the not only native EPN populations/ isolates, but also the fictitious host, as it was linked with the economics of the EPN multiplication. Under the fourth objective of determination of best effective combination/formulation of the selected EPN and its efficacy with regards to the stages and time of application against the target pests, investigation on insecticidal tolerance of EPNs to commonly used insecticides/ biopesticides to *H. indica, S. carpocapsae* and native strains has

been initiated and will be continued. Further work on investigating the efficacy of the combination against the targeted insect pests is in progress.

**Damage assessment of gall making insect species of eucalypts and its management by pesticides**

Developed insectary/nursery of eucalypts at this Institute for experimental purpose to study the gall insect and its subsequent management in seedling stage. Conducted survey of forest nurseries/plantations to collect gall making insect species of eucalypts and its natural enemies (parasites, predators and pathogens). Assessed damage impact of gall insect of eucalypts in nurseries/ plantations and found to be a major pest (46-92%) in nursery stage. Laid out seven experiments in nursery for management of gall insect by using biopesticides and chemical pesticides. Studied development of galls, production of galls in relation to age of seedlings and morphology of gall insect. Recorded one insect defoliator, *Spodoptera litura*, for the first time feeding on eucalypts in nursery stage.

**Biological control of insect pests of medicinal plants-*Abelmoschus moschatus, Gloriosa superba* and *Withania somnifera***

Field visits were conducted in selected localities in Madhya Pradesh, Chhattisgarh and Maharashtra for collection of insect pests of target species of medicinal plants. Seedlings of medicinal plants were raised in Experimental Plot of Forest Entomology Division, TFRI, Jabalpur for recording the regular incidence of insect pests and sampling of natural enemies. Three insect pests viz. defoliators *Anomis flava, Sylepta derogata* and sap sucker/red bug *Dysdercus cingulatus* were identified on muskdana, *Abelmoschus moschatus*. Two defoliators viz. *Polytela gloriosae* and *Amsacta lacieneus* were identified on kalihari, *Glorisa superba*. Two insect pests viz. sap suckers, *Plautia crossota* and aphids were recorded on Ashwagandha, *Withania somnifera*. Two parasites viz. *Ichneumon* sp and *Stermia* sp were recorded on the insect pests of *A. moschatus* and *G. superba*. Seasonal history of the key insect pests *A. flava, S. derogata, P. gloriosae* and *D. cingulatus* has been studied.

**Studies on larval parasitoids, *Apanteles* spp. (Hymenoptera: Braconidae) of major defoliators of teak and sal forests of Orissa**

During the first year of the project, survey of important teak & sal forests of ten districts of Orissa has been carried out for the collection of larvae and pupae of insect pests, defoliating teak and sal forests. 202 samples of larvae and pupae of insect pests/ teak and sal defoliators have been collected. By the laboratory rearing of field collected 202 samples; 180 specimens, belonging to *Apanteles* spp. have been recovered. Fifteen species of *Apanteles* (*Apanteles antipoda; Apanteles belippae; Apanteles bambusae; Apanteles caniae; Apanteles creatonoti; Apanteles detrectans; Apanteles effrenus; Apanteles expulsus; Apanteles lamprosemae; Apanteles leptothecus; Apanteles machaeralis; Apanteles neocajani; Apanteles*

*neotaeniaticornis; Apanteles tachardiae* and *Apanteles fuseinervis*) have been identified; which were recovered from various defoliators of teak and sal forests. Natural field parasitisation of all 15 species of *Apanteles spp.*, parasitising the defoliators of teak and sal forests; has also been calculated. All these *Apanteles* spp. are indigenous and these are being recorded for the first time from Orissa.

**Standardization of management practices for leaf gall forming insect and diseases**

Project started on February, 2011. Experiment was laid out for the effect of different pruning period on the incidence of gall forming insect, *Trioza obsoleta.*

**Studies on diseases of important medicinal plants and their bio control**

Diseases of *Rauvolfia serpentina, Withania somnifera* and *Chlorophytum borivillianum* were recorded from Madhya Pradesh and Chhattisgarh. The pathogens were isolated and identified. A new damping off disease of *W. somnifera* caused by *Sclerotium rolfsii* was reported for the first time from India. Antagonistic organisms viz. *Streptomyces* sp. and *Bacillus amylolequifaciens* were isolated from the soil. The effect of antagonistic organisms and biopesticides (1 litre cow urine + 100 g each leaves of *Azadirachta indica, Ailanthus excelsa* and *Calotropis procera*) was tested on the major pathogens of *R. serpentina* & *C. borivillianum* in the laboratory. The experiment on the effect of *Trichoderma harzianum, Bacillus firmus, B. amyloliquefaciens, Streptomyces* sp, Bavistin and bio pesticides were conducted on the leaf spot and inflorescence disease of *R. serpentina* in the field. Among the above treatments bavistin 0.5% + *Streptomyces* sp shows best results for disease control as well as seed production. The results were recorded and statistically analyzed. In another experiment the effect of systemic fungicide, biopesticide and biocontrolling agents on the foliar diseases of *C. borivillianum* were noticed. In this experiment two fortnightly spray of the culture of *Streptomyces* sp. shows significant disease control as well as better rhizome production. One experiment on the selection of potting mixture for the root development of *W. somnifera* was conducted by using different combination of potting mixtures. Neem cake 50% + soil mix 50% proved best potting mixture for the overall growth of the *W. somnifera* as well as reduction in root-knot caused by *Meloidogyne incognita.*

**Integreted management of vascular wilt disease in Neem (*Azadirachta indica*), Aonla (*Emblica officinalis*) and Khamer ( *Gmelina arborea*) in forest nurseries**

We have taken Chemical and biological agents into consideration. Sites prone to wilt infection have been selected from Madhya Pradesh and Maharashtra. Wilt infected seedlings have been collected and diagnosed in laboratory. Three pathogens viz. *Fusarium solani, Verticilium nigrescens* and *Rhizoctonia solani* causing wilt in Aonla, Neem, and Khamer have been identified. Susceptibility of the pathogen to different fungicides and biological agents have been determined under controlled laboratory condition.

**Studies on wood decay and its control in stored tropical timber**

Nine hyper parasitic fungi colonizing decaying wood have been isolated. Out of them *Trichoderma viride* and *Aspergillus flavus* were selected and tested for biological control of 10 wood decaying fungi (*Trametes cingulata*, *Stereum hirsutum*, *Pycnoporus sanguineus*, *Trametes feei*, *Phellinus badius*, *Lenzites elegans*, *Phellinus pachyphloeus*, *Daedalea flavida*, *Earliella scabrosa*, *Gleophyllum striatum* and *Flavodon flavus in vitro*). 50 wood decaying fungal specimens were identified up to generic level. 25 purified cultures of wood decaying fungi were prepared and maintained. Different concentration of Ammonium tetraborate, Potassium tetraborate, Manganese sulphate, Magnesium sulphate, Zinc sulphate, Copper sulphate, Borax Boric acid and Urea, were tested to evaluate the efficacy of these chemicals against *Flavodon flavus* and *Trametes cingulata*. Layout of experiment to evaluate the efficacy of pesticides by using 3 wood species Bijasal, Teak and Sal, treated with 4:1:3 combinations of $K_2CO_3$, $KHCO_3$, $K_2CrO_7$ were tested against *Daedalea flavida, Stereum hirsutum* and *Trametes cingulata.* Selection of sites, timber species grade and girth class for layout of experiment for control/minimize wood decay at Gariyabandh and Chilpi, (CG) Sizora and Mandla (MP), Dongargao (MS) wood depots.

**Taxonomy and documentation of wood decay fungi of Chhattisgarh and Orissa (CSIR Project)**

Collected 102 wood decay fungi specimens on 22 hosts, 18 specimens of wood decay fungi were identified, seven specimens were screened for isolation and purification of cultures for further studies, these culture were maintained. Five documents of wood decay fungi (*Australohydnum dregeanum, Hjorstamia fresii, Schizopora flavipora, Mycena rosella, Leucocoprinus birnbaumii*) were prepared and three already prepared documents (*Flavodon flavus, Polyporus gramocephalus, Schizophyllum commune*) were amended. Collected samples of wood decay fungi were maintained. One new species, *Nitschkia tectonae* and four new records of fungi were reported from India viz. *Australohydnum dregeanum, Hapalopilus nidulans, Hjorstamia fresii,* and *Schizopora flavipora.*

**Studies on root rot and stem decay diseases in *Acacia catechu* and their control**

Fungi causing root rot and stem decay diseases in *Acacia catechu* were collected from Khandwa (6 samples) and Yavatmal (27 samples). Wood decay and disease causing fungi (*Auricularia, Daldenai, conccutrica, Flavodon flavus, Ganoderma lucidum*, *Lenzites fulisoti Monodictys, Phellinus budies, Polyporus gilvus, Stachylidium, Schizophyllum commune* and *Torula*) were isolated from fruit bodies and diseased samples. During suevey over 60% mortality in *Acacia catechu* plantation (compartment 282 & 310, 22 ha) at Hivari Range in Yavatmal was recorded due to root rot disease caused by *Ganoderma lucidum.* The site was poor with murrum soil. Young plantation (one year old) at Mukutbandh and Ghosa range of Pandharkawda division was surveyed and up to 5% seedlings were found dead due to root rot disease. Ten year

old plantation (mixed with sissoo and neem) was surveyed at Isapur (Digras), Pusad Division and found almost healthy (only 4% plants were found dead due to *Ganoderma lucidum*). Plantation done under JFM at Mahadoli beat, Pandharkwada division was found healthy.

### 2.7.3 Mycorrhizae, rhizobia and other useful microbes

**Studies on the dynamics of litter decomposition in sal forest of central India and its impact on the nutrient status of soil**

We have considered Mycorrhizae, and other useful microbes (*Trichoderma, Cladosporium* and PSB) in establishing sal seedlings in nurseries. Natural sal sites have been selected from Madhya Pradesh, Chhatishgarh, and Orissa. Litter samples have been collected and analyzed for carbon flux, and NPK. Microbial flora and fauna associated with litter decomposition have been studied. Fungi forming ectotrophic mycorrhizae (*Russula*, and *Pulveroboletus* among basidiomycetes and *Geastrum, Astraeus* and *Scleroderma* among gasteromycetes) with sal have been collected and identified. Other beneficial supporting microbes including *Trichoderma, Cladosporium* and PSB have been cultured and preserved for further use under field condition. Attempts are being made to cultivate ectotrophic mycorrhizae in laboratory. Three research papers have been communicated in the journals of national repute.

**Development of certification criteria and production of microbial inoculants for application in forest nurseries and plantations**

Three different localities Sanawat, Badvah and Chitrakoot were surveyed for collection of soil samples and seedlings of target species. From these samples microbial inoculants were isolated and AM spores population were estimated in laboratory. In pathology nursery 6 cement/concrete beds were constructed for the production of inacula of AM fungi, for different target species.

## *3 EDUCATION VISTAS /ACTIVITIES*

**3.1. FRI University -** Not related to TFRI

### 3.2. Trainings organized

**Organized Trainings on:**
**At TFRI, Jabalpur**

1) Vermicompost/ Biofertilizers at Bhaisajhar Nursery Bilashpur during 17-18 May 2010 also Dr. V.S. Dadwal has given field demonstrationon Biofertilizers to the trainees of CGRVVN Ltd.
2) "Recent advances in nursery techniques" for Staff of TFRI at TFRI, Jabalpur from 27-29$^{th}$ May, 2010.

3) For 44 students of B.Sc. Vth Semester (Biotechnology), St. Aloysius College, Jabalpur in three batches from 26 July 2010 to 13 August 2010.
4) 'Non- destructive harvesting, processing and value addition of NTFPs including medicinal and aromatic plants' for Orissa Forestry Sector Development Project Officials at Rourkela and Talchar, Orissa during 16-18 and 20-22 September 2010 respectively.
5) 'Bamboo based Silvi-agri system and medicinal plant based Silvi-medicinal system' to the farmers of Majhauli under the NABARD training programme at the institute on 21st December, 2010.
6) 'Agroforestry research experiments' to the Forest Guards Trainees of Balaghat district, M.P. on 2nd February, 2011 at the institute**.**
7) 'Environment and Afforestation' for NTPC officials during 22-24 March 2011 at the Institute.
8) 'Integrated Development of Jatropha and Karanja' for trainers and farmers at Gwalior and Guna, M.P. respectively.
9) For B.Sc. (Biotechnology) students of Government Model Science College, Jabalpur in 2 batches from 14-18 March 2011 and 21-25 March 2011.
10) 'Sustainable harvesting of gums and oleoresin of Salai, Dhawara and other gums' on 27-28, and 29-30 March 2011 at Sheopur-Kala (M.P.).

**At CFRHRD, Chhindawara**

11) 'Environmental issues & Green Solutions and Cultivation of Medicinal Plants & Processing' on 05.06.10 at the Centre, Chindwara.
12) 'Soil conservation & Watershed management' on 26.07.10 at the Centre.
13) 'Naturalists & Guides of Bhariya tribes of Patalkot, Chhindwara (M.P.)' from 26th July to 4th August, 2010 at the Centre.
14) 'Bird Watching Campaign' at the Centre on 15.11.10.
15) 'Agro-forestry with reference to medicinal plants' was conducted by the Centre on 20.01.11 and 21.01.11.
16) 'Cultivation of medicinal and aromatic plants" at the centre on 28.01.11.
17) 'Biofertilizers and Biopesticides' at the Centre on 24.2.11.
18) 'Office Procedures and General Law' at the Centre on 28.02.11.
19) 'NWFP value addition, processing and marketing' at the Centre on 4.3.11.
20) Project formulation and sustainable harvesting of medicinal plants and Identification of medicinal plants and their uses" at the Centre on 28.03.11.

## 3.3 Visits Abroad

Dr. Mohd. Yousuf, Scientist-F visited Koszeg, Hungary from 20.6.2010 to 26.6.2010 for attending the 7th International Congress of Hymenopterists.

Dr. Girish Chandra, Scientist-C (Statistics) visited during 19-22 Sep. 2010 to Ribno, Slovenia for presenting the paper *Adaptive Cluster Sampling Based on Ranked Sets* in International conference *Applied Statistics-2010.*

## 3.4 Participation in Seminars/Symposia/Workshops/Trainings/Conference etc

### Conferences (National)

Dr. M. Kundu participated in *Sustainable production and utilization of medicinal and aromatic plants: current trends and prospects* at Bhubaneswar, Orissa during 8-10 April, 2010 and presented a paper on Germination and ex-situ conservation of *Terminalia Arjuna* (Roxb.) Wight & Arn. Seeds.

Dr. Vishakha Kumbhare attended conference *Sustainable Production and Utilization of Medicinal and Aromatic Plants: Current Trends and Future Prospects* on 8th-9th April 2010 and presented the paper "Application of *Cissus quadrangularis* (Hadjor) in nutraceutical food products" organized by Regional Plant Resource Centre, Bhubaneswar.

Dr. Vishakha Kumbhare participated in the Conference on *Herbal Medicine* during 8th-9th September, 2010 organised by Department of Botany, School of Life Sciences, Bharathiar University, and Coimbatore and presented three Research papers 1) *Effect of different drying methods on concentration of active constituents in Cissus quadrangularis stem*, 2) Studies on the concentration of active constituents in *Cissus quadrangularis* stem peel and pulp and 3) Exploration of herbal drugs used in wound healing activity.

Dr. Nitin Kulkarni and Shri Sanjay Paunikar, R.A.I. attended 3rd Conference, Biopesticide: Emerging Trends (BET 2010). Biospesticides in Food and Environment Security, October, 20-22, 2010, Hisar (Haryana).

Dr. N. Kulkarni, Dr. P.B. Meshram, Shri Sanjay Paunikar, R.A.I and V.K. Mishra, JRF attended *Biodiversity and Biotechnology: Biodiversity Resource Management and Sustainable Developmen*t conference at Department of Botany and Biotechnology, Govt. new Science College, Rewa, M.P. during 16-17 November, 2010 and presented the research paper by Dr. P. B. Meshram entitled "Biodiversity of some aquatic and terrestrial fauna in National Chambal Sanctuary in Madhya Pradesh".

Dr. Girish Chandra attended and presented the paper *Ranked Set Sampling Theory for Large Set Size with probability proportional to Rank Size Matrix* in conference on *Interface beween Statistics, Mathematics and allied Science* during 20-22 November, 2010 at Kumoun University, campus Almora, Uttrakhand.

Dr. S. A. Ansari attended and presented a paper entitled "Adventitious root induction and success of clonal forestry" in the Conference of *Plant physiology* held at BHU, Varanasi during 25-27 November 2010.

Dr. Fatima Shirin attended and presented a paper entitled "Tissue culture of some important medicinal plants" in Madhya Pradesh Mahila Vigyan Sammelan held at Mata Gujri Girl's College, Jabalpur during 18-19th December 2010.

Dr. S.A. Ansari participated as an Expert Judge in Sessions Biotechnology, Bio-chemistry and Biophysics and Botany in the 9th CYSC-2011 from 28.2.2011 to 1.3.2011 at Jagdalpur (Chhatisgarh).

Dr. S.A.Ansari participated as Co-chairman and did a presentation in workshop on Forest Genetic Resource Management Network (FGRMN) at IFGTB, Coimbatore from 9-10 March 2011.

**Conferences (International)**

Dr. Mohd. Yousuf attended the 7th International Congress of Hymenopterists and presented research paper entitled "Record on Indian species of *Trichogramma* Westwood, along with two new species, their host range and application against forest pests" at Koszeg, Hungary from 20.6.2010 to 26.6.2010.

Dr. A.K. Pandey presented a paper entitled "Sustainable Harvesting of *Boswellia serrata* (Salai) Oleoresin in Central India" in International Conference on Environment and Management (ICEM 10) held at Hyderabad during 25-28 October 2010.

Dr. Girish Chandra attended and presented the paper entitled *Adaptive Cluster Sampling Based on Ranked Sets* in an International Conference *Applied Statistics-2010* during 19-22 Sep. 2010 at Ribno, Slovenia.

**Workshops (National)**

Mr. S.D. Sonkar attended one day workshop on Joint Forest Management held on 13th April, 2010 at MoEF, New Delhi and presented the paper entitled "Evaluation of management systems and level of community participation under Joint Forest Management (JFM)".

Dr. Avinash Jain attended workshop on 'Institutional networking on climate change' at EPCO Bhopal on 7 July 2010.

Dr. N. Roychoudhury presented a paper Effects of climate change on insect pest populations in Meeting-cum workshop on "Research needs and the financial, technological and capacity needs and constraints to address climate change concerns *vis a* vis forests and forest products in India", held on 1st September, 2010, TFRI, Jabalpur.

Dr.Y.Mishra participated in one day workshop on "Shisham mortality finding solutions for future plantation" held at Dehradun on 20th September 2010.

Dr. P. K. Khatri attended "Brainstorming Workshop on The Baseline Studies – SLEM" organized by ICFRE Dehradun on 29-30 September 2010.

Dr. N. Berry presented on "Promising agroforestry system developed by the TFRI" in the regional workshop on "Vaniki prachar prasar dwara hitgrahiyon ka utthan" to the group of farmers, industrialist, forest officers and SHGs of Jabalpur and adjoining areas of Madhya Pradesh held on 6th October, 2010 at TFRI, Jabalpur.

Dr. V. Nath and Dr. P. K. Khatri attended a regional workshop on "लघु वनोपज के सतत वन प्रबन्धन में महिला वन समिति सदस्यो की सहभागिता" held on 16th November 2010 at State Forest Research Institute, Jabalpur.

Dr. V. Nath and Dr. P. K. Khatri attended a workshop on "कृषि वानिकी विस्तार- समस्या एवं महत्व" held on 29-12-2010 organized by Extension and Research Circle, Jabalpur.

Dr. A.C. Surya Prabha, Scientist –'C' participated in the 98th Indian Science Congress held from 3rd to 7th January, 2011 organized by SRM University, Chennai and presented a paper entitled Studies on nutrient uptake and yield of rice under System of Rice Intensification (SRI) practices.

Dr. Avinash Jain attended workshop on 'Forest Landscape Restoration' at ICFRE Dehradun on 14 January 2011.

Dr. C. K. Tiwari attended the National Workshop on "New frontiers and future of wood science and technology in India" held at Indian wood science and technology, Banglore, on 20 Jan, 2011 and presented two posters entitled "Biological control of wood decaying

fungi" and "Studies on assessment of losses in wood components of *Boswellia serrata* by wood decay fungi".

Dr N. Berry presented a paper titled 'Conservation of endangered medicinal plants through agroforestry system" in the workshop on "Biodiversity" held on 8th February, 2011 at SFRI.

Dr. N. Roychoudhury participated as an Expert judge in the field of Zoology in 9th Chhattisgarh Young Scientists Congress 2011 at Bastar Vishwavidyalaya, Jagdalpur (C.G.) from 28-02-2011 to 01-03-2011.

Dr. Avinash Jain attended workshop on 'Forest Landscape Restoration' at Bhubaneswar on 4 March 2011.

Dr. Avinash Jain attended workshop on 'Forest Landscape Restoration' at Bhopal on 6 March 2011.

Dr. A.C. Surya Prabha participated and delivered a lecture on Wasteland development in the three days training programme being conducted for the NTPC officials on "Environment and Afforestation" organized by Tropical Forest Research Institute, Jabalpur from 22.3.11 to 24.3.11.

Dr. P. B. Meshram attended National Workshop on Insect pests and diseases of aonla and teak at State Forest research Institute, Jabalpur, and MP and presented the research paper entitled "Insect pests of *Emblica officinalis* and *Tectona grandis* and their control measures".

Dr. P. K. Khatri attended a "Consultative Meeting Cum Workshop of SLEM project" held on 10-11 May 2011 at Dehradun organized by ICFRE, Dehradun.

Dr. V Nath and Dr. P. K. Khatri attended a workshop cum training programme on "Environment And Afforestation for Senior NTPC Official" organized at TFRI Jabalpur from 22-24 March 2011 sponsored by NTPC.

Dr. Vishakha Kumbhare participated in the three days training programme being conducted for the NTPC officials on "Environment and Afforestation" organized by Tropical Forest Research Institute, Jabalpur from 22.3.11 to 24.3.11.

Dr.S.A. Ansari, Dr.Y. Mishra, Dr. Fatima Shirin, Dr. R. Sett and Dr. Pramod Kumar participated in workshop on "Research needs and the financial, technological and capacity needs and constraints to address climate change concerns vis-à-vis forests and forest products in India", held at TFRI, Jabalpur on 1st September 2010.

Dr.V. Nath and Dr. P. K. Khatri attended a workshop on "Research Needs and the Financial Technological and Capacity Needs and Constraints to Address Climate Change Concern vis a vis Forest And Forest Products in India" organized at TFRI Jabalpur on 1st September 2010.

Scientists of TFRI attended national workshop on "Non Timber Forest Products Marketing: Issues and Strategies" held on 19th February 2011 organized by NTFP Division, TFRI sponsored by MP Trading and Development Cooperative Federation, Bhopal.

**Workshops (International)**

Dr. A.K. Pandey presented a paper pesented a paper entitled "Sustainable Harvesting of Medicinal Plants" in 3rd Herbal International Exhibition cum Summit on Medicinal and Aromatic Products, Spices and finished Products (HI-MAPS) at New Delhi during 15-16 January, 2011.

**Stake Holders Meetings**

Stakeholders Meetings for the states of 1) Chattishgarh at Research and Extension division, Pandari, Raipur on 23rd April, 2010 under the Chairmanship of Shree R. K. Sharma, PCCF, 2) Maharastra at Vanasabhagriha, Seminary Hills, Nagpur on 13th May, 2010 under the Chairmanship of Shree S. C. Joshi, PCCF and 3) Madhya Pradesh at IIFM, Bhopal on 5th July, 2010 under the Chairmanship of S. C. Pabla, PCCF were conducted.

**Symposia**

N. Berry (2011). Evaluation of Short Rotation Fast Growing Tree based Agri-silviculture system in Tropical Region of Central India. Abstract published in Proceeding of the IUFRO symposium on 'Short Rotation Forestry: synergies for wood Production and Environmental Amelioration" held on 10-12th February, 2011 at PAU, Ludhiana (Punjab).

**Seminar (National)**

Mrs Neelu Singh attended Brain Storming Workshop as resource person on "Utilization of Chemistry" at Home Science College, Jabalpur held on 10 October, 2010 and delivered lecture on "Scope of Chemistry in the field of forestry".

Dr. P.B. Meshram attended National Seminar on Current Advances in Biosciences:Application in Health, Environment and Agriculture" at Department of Botany, Hitkarni, Mahila Mahavidyalaya, Jabalpur on 23-24 November, 2010 and presented the research paper entitled "Insect fauna of some important medicinal plants in Madhya Pradesh".

Dr. Nitin Kulkarni participated and chaired a session of Agriculture Zoology in Current Advances in Biosciences:Application in Health, Environment and Agriculture" at Department of Botany, Hitkarni, Mahila Mahavidyalaya, Jabalpur on 23-24 November, 2010 and presented the research paper entitled "Insect fauna of some important medicinal plants in Madhya Pradesh"

Shri Suneesh Buxy, IFS, Dy. Conservator of Forests participated in the "Regional workshop on Biodiversity Conservation" conducted by Panchmarhi Bioreserve at Samvad Sadan Chhindwara on 7.11.10 and delivered a lecture on Biodiversity Conservation of Patalkot.

Yousuf, M. attended National Seminar on Current Advances in Biosciences: Application in Health, Environment and agriculture, Hitkarni Mahila Maha Vidyalaya, Jabalpur on 23-24 November 2010 and presented the research paper entitled "Studies on biodiversity of *Apanteles* spp. (Hymenoptera: Braconidae) from central India and their role in balancing the population of insect pests".

Dr. A.C. Surya Prabha participated in the National Symposium on Sustainable rice production system under changed climate held from 27-29th November, 2010 organized by Central Rice Research Institute, Cuttack and presented a research paper on System of Rice Intensification (SRI) practices on growth and yield performance of rice.

Vishakha Kumbhare and Dr. A.C. Surya participated in M.P. Mahila Vigyan Sammelan held from 18-19 December, 2010 organized by Mata Gujri Mahila Mahavidyalaya and

Sakthi, Jabalpur and presented a paper entitled *Cissus quadrangularis* Linn. A promising medicinal plant for the future.

Dr. M.S. Negi and Dr. A.K. Pandey participated in Rastriya Van Mela held at Bhopal on 26-27 December 2010.

Dr. N. Kulkarni attended National Seminar on "Progress in Life Science for Human Welfare" and Chairman of the session, held from 5-6 February, 2011 at Govt. Model Science College, Jabalpur.

Ku Neetu Vaishy JRF, participated and presented research paper entitled "New record of Apanteles species from Orissa, parasitizing Teak skeletonizer, *Eutectona* machaeralis (Walker)" in National Seminar on "Progress in Life Science for Human Welfare" held from 5-6 February, 2011 at Govt. Model Science College, Jabalpur.

Dr. P.M. Meshram participated and presented research paper entitled "Impact of pest problem and management in Teak (*Tectona* grandis) in Madhya Pradesh" in National Seminar on "Progress in Life Science for Human Welfare" held from 5-6 February, 2011 at Govt. Model Science College, Jabalpur.

Dr. Md. Yousuf participated and presented research paper entitled "Identity new host record and distribution of two indigenous species of *Trichogramma* from central India and their laboratory efficacy against teak defoliator and teak skeletonizer" in symposium on "Insect Pest Management" during 23rd to 25th February 2011 at St. Xavier's College, Palayamkottai, Tamil Nadu.

N. Berry (2010). Women Empowerment through Technological Innovations in Forestry Sector. Abstract published in Proceedings of Madhya Pradesh Mahila Vigyan Sammelan on "Integral management and conservation of natural resources for a prosperous and empowered Madhya Pradesh" held from 18th - 19th December, 2010 at Mata Gujari Mahila Mahavidyalaya, Jabalpur (M.P.)

N. Berry (2011). Lac based farming system for livelihood security. Abstract published in proceedings of the National Seminar on Progress in Life sciences for Human Welfare held on 5th to 6th,Februrary,2011 at Science College, Jabalpur.

N. Berry (2011). Evaluation of Bamboo based Agri-silviculture system in Jabalpur district. Abstract published in proceedings of the National seminar on Recent advances in Bamboo Propagation, Management and Utilization" held on 17-18th February, 2011 at IWST, Banglore (Karnataka).

Nath V. and Khatri P. K. (2010) "Ethano- medicinal use s prevailing in tribal pockets of Harda and Raisen Districts of Madhya Pradesh "National conference on Biodiversity for sustainable development held on August 25-27, 2010 at Centre of Biodiversity and Forest Studies , School of Energy, Environment and Natural Resources , Madurai Kamraj University , Madurai, Tamilnadu.

Neetu Vaishy, JRF participated and presented research paper entitled "Record of *Apanteles* species (Hymenoptera: Braconidae) from teak defoliators and their role in Biological control of teak insest pests. In, "Madhya Pradesh Mahila Vigyan Sammelan", 18-19 December 2010; Mata Gujri Mahila Mahavidyalaya, Jabalpur.

Shri Sanjay Paunikar, R.A.I, participated and presented research paper entitled "Virulence of entomopathogenic nematodes *Heterorhabditis indica* against the teak defoliator, *Hyblaea puera* Cramer (Lepidoptera: Hyblaeidae)" in National Seminar on "Progress in Life Science for Human Welfare" held from 5-6 February, 2011 at Govt. Model Science College, Jabalpur.

Shri Dinesh Kumar Kushwaha, JRF participated and presented research paper entitled "Diversity of butterflies and moths in buffer zone of Achanakmar-Amarkantak Biosphere Reserve" in National Seminar on "Progress in Life Science for Human Welfare" held from 5-6 February, 2011 at Govt. Model Science College, Jabalpur.

Shri Vinod Kumar Mishra, JRF, participated and presented research paper entitled "Pathogenicity of entomopathogenic nematode, *Heterorhabditis* indica against the *Spiramar retorta* Cramer (Lepidoptera: Noctnidae)" in symposium on "Insect Pest Management" during 23rd to 25th February 2011 at St. Xavier's College, Palayamkottai, Tamil Nadu.

**Seminar (International)**

Dr. A.K. Pandey presented a paper entitled" Sustainable harvesting practices of *Terminalia arjuna* (Arjuna), *Saraca asoka* (Ashoka) and *Bauhinia variegata* (Kachnar) bark" in International Seminar on Conservation, Sustainable Collection, Processing and Marketing of Medicinal Plants with focus on RET species at Bangaluru on 11-12 December 2010.

**Trainings (National)**

Shri J. S. Chouhan, Research Officer attended ten weeks Induction training for Scientists and Research officers of ICFRE held from 15th March 2010 to 23rd May 2010 at Forest Research Institute, Dehradun.

Dr. Avinash Jain attended sensitization training on 'Modalities and procedures of CDM afforestation and reforestation projects, and auditing skills' at ICFRE Dehradun during 16-17 April 2010.

Dr. A.C. Surya Prabha attended ten weeks Induction training for Scientists and Research officers of ICFRE held from 15th March 2010 to 23rd May 2010 at Forest Research Institute, Dehradun.

# *4. EXTENSION PANORAMA/ACTIVITIES*

## 4.1 Report on Van Vigyan Kendra (VVK) and Demo Village (DV)

Dr. N. Roychoudhury, Scientist-F planted teak of Madhya Pradesh origin in Demo Village, Moiyanalah for demonstrating existence of relative resistance aganst teak defoliator and leaf skeletonizer.

## 4.2 Technology transferred

Organized one day training cum demonstration programme on "*D.sissoo-Zea mays* Silvi-agri system" to transfer of developed package of practice to the farmers of four villages namely

Padariya, Khamariya, Neemkheda and Saliwada of Jabalpur districts on 31st March, 2011 at TFRI, Jabalpur.

## 4.3 Research Publications

### Book Chapters

Kulkarni, N. (2010). Bioecology and management of white grub complex in teak forest nursery in India. In: Proceeding of 7 meeting of IUFRO Working Party 7.03.04; Diseases and Insects in Forest Nurseries. Hilo-Hawai (USA), (Ed. Cram, M.) USDA Forest Service, USA, pp. 84-91.

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### Proceedings (National & International)

Chandra, G. and Tiwari, N. (2010). In: proceeding Interface between Statistics, Mathematics and Allied Sciences. Neeraj Tiwari and S. K. Joshi (Eds). Pub: Excel India Publication, New Delhi. PP. 38-49.

Dubey, Poonam and Verma, R.K. (2010). Efficacy of a Microbial Consortium on *Acacia nilotica* (L.) Willd. ex. Del Seeds for the Production of Quality Seedlings in the Nursery. In proceedings of Tree Seed Symposium: Recent advances in seed research and *ex-situ* conservation, Pp 187-200, Taipei, Taiwan, August 16-18, 2010.

Pandey, A.K. and Ojha, V. (2010). Value addition in Bamboo shoots to augment its utilization as food products. In the proceedings of National Seminar on Productivity Enhancement & Value Addition of Bamboos at Ranchi on 9-10 March, 2010.

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**Technical Bulletins**

1) One bulletin on Hadjor, *Cissus quadrangularis* Linn. was published in English.
2) Pandey, A.K. and Gupta, Nivedika (2011). Karanja (*Pongamia pinnata)*, Tropical Forest Research Institute, (Indian Council of Forestry Research and Education) Jabalpur (Hindi).
3) Pandey, A.K. and Ojha, V. (2010). Phenolic Acids: Sources and Importance. *ENVIS Forestry Bulletin*, Indian Council of Forestry research and Education, Dehradun. 1 (1): 25-33.

## 4.4 Seminar/Symposia/Workshop Organized

A workshop on 'Research needs and the financial, technological and capacity needs and constraints to address climate change concerns *vis a vis* forests and forest products in India' on 1 September 2010 at TFRI, Jabalpur.

A workshop/Interface programme on "Conservation and Sustainable harvesting practices of medicinal plants and other NTFPs was organized for the Forest Protection Committee members and interested persons of village Bhundakone, Umargohan and Damgarh of Amarkantak Range on 6$^{th}$ Jan. 2011 and village Karidih of East Karanjia Forest Division (MP) on 7$^{th}$ Jan. 2011.

A workshop on "Non Timber Forest Products Marketing: Issues and Strategies" was organized at Tropical Forest Research Institute, Jabalpur on 19th February, 2011.

## 4.5 Consultancies

1. Survey and documentation of flora and fauna in core and buffer zones of cement plant and limestone mining areas near Maihar (dist– Satna, M.P.).
2. Assessment of green cover and its tangible and intangible benefits and tree cover management plan for NCPP-Dadri Project.
3. Concluded the study and submitted final report on 'Survey and documentation of flora and fauna in core and buffer zones of cement plant and limestone mines in Maihar (Dist. – Satna, M.P.) to Reliance Cementation Pvt. Ltd., Mumbai.
4. Assessment of green cover and its tangible and intangible benefits and tree cover management plan for STPP-Korba Project.
5. Conducting the study on faunal aspect of Biodiversity impact assessment study for Kanera Lift Irrigation Scheme in Bhind district of Madhya Pradesh as a consultant and submitted the survey report to ICFRE Dehradun vide letter No.Ento-3/TFRI/JBP/ 2010/1161, dated 29th June, 2010.
6. Monitoring and Evaluation of development work in Achanakmar-Amarkantak Biosphere Reserve, Bilaspur (March 2011).

## 4.6 Technical Services

Dr. N. Roychoudhury provided Technical and advisory services to M.P. Forest Department, on insect attack in teak at Khandwa Forest Division, Khandwa, from 2-4 August, 2010.

Dr. N. Roychoudhury and Dr. Nitin Kulkarni provided Technical and advisory services to M.P. Forest Department, on defoliator and borer attack in sal forests at Karanjia range of Dindori Forest Division, Dindori, from 12-13 August, 2010

Dr. P.B. Meshram attended enquiry on the dying of teak at Pandharkawada, Forest Division, Yaotmal, M. S. on 17-18 August, 2010.

Dr. N. Roychoudhury and Dr. Nitin Kulkarni provided Technical and advisory services to M.P. Forest Department, on borer attack in sal forests at Karanjia range of Dindori Forest Division, Dindori, from 7-9 December, 2010.

Dr. P.B. Meshram attended enquiry on the rodent problem in teak nursery at Katanga, Lamta Project Division Balaghat, M.P. on 22 nd January, 2011.

## 4.7 Activities of Rajbhasa

1) Organized Hindi pakhwara at TFRI, Jabalpur.
2) Organised training/workshop in Hindi for the ministrial and technical staff of the institute.

## 4.8 Awards and Honours

Dr. R.K. Verma, Head, Forest Pathology Division received Association for Plant Taxonomy (APT), Prof. K.S. Thind Medal for the year 2010 for his significant contribution in the field of Mycology. The medal was established in the year 2007 and is awarded the mycologists who have done notable work in the field of taxonomy of fungi for several decades once in every two years. Dr. Verma received the medal in the felicitation function organized at National Botanical Research Institute, Lucknow from Prof. P.K. Hajra, President of APT on 2nd November 2010.

## 4.9 Special Activities(Such as Van Mahotsava, Forestry Day and Other occasions)

Celebrated the following at TFRI campus-
Van Mahotsava, World Environment day, World Forestry day, Independence Day, Republic day, Annual sports, Sadbhawana Deevas etc.

# 5 *ADMINISTRATION AND INFORMATION TECHNOLOGY*

## *5.1 Information Technology*

The 100 MBPS fast Ethernet fiber optic backbone LAN is functional at TFRI and is working smoothly. The system is being successfully used for Internet access and other online activity. Many new computers with UPS were procured and installed during the year. Video Conferencing facility also been used through out the year. Under IFRIS project various modules including Personal Information System, Research Information System, Payroll Management System, Electronic Document Management System and Financial Accounting System have been implemented and are functional. Institutes website is time to time updated to extend various activities of the institute.

## *5.2 Sevottam*

Activities related to the Citizen/Client Charter are mentioned as under-

### 5.2.1 Action taken to formulate the Charter for the Institute and its subordinate formation.

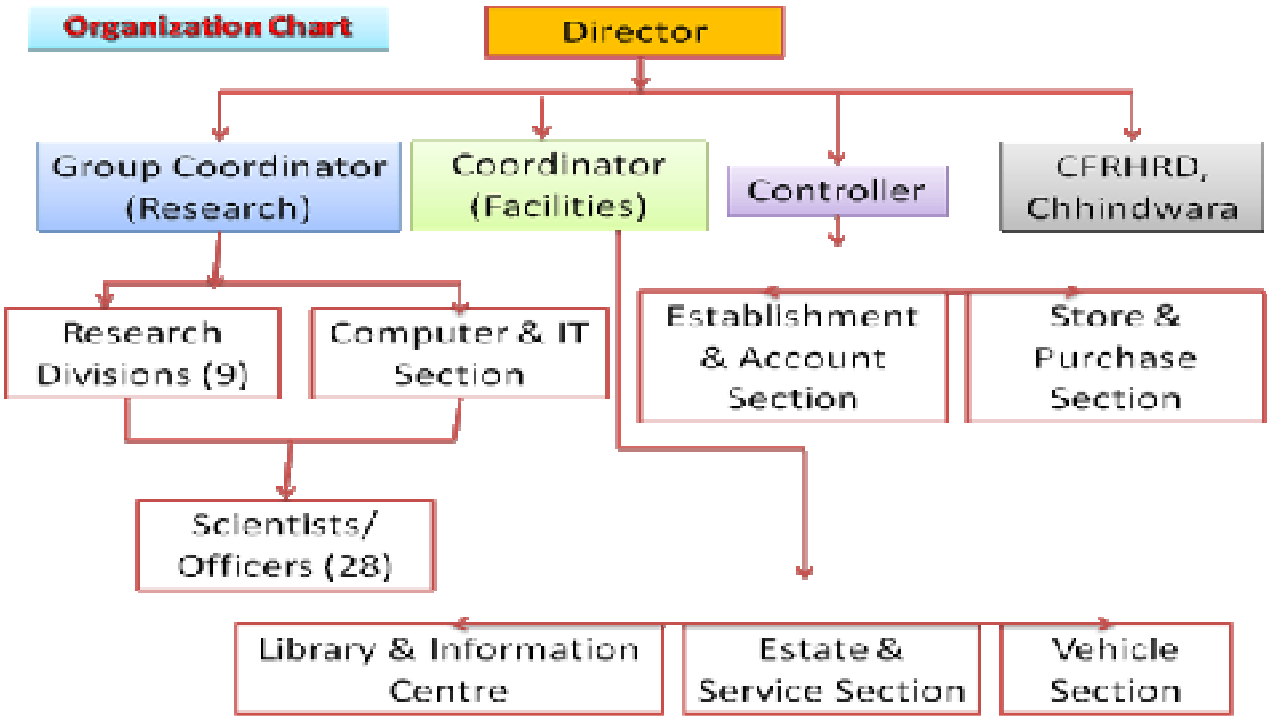
Citizen's Charter is prepared by the Institute.

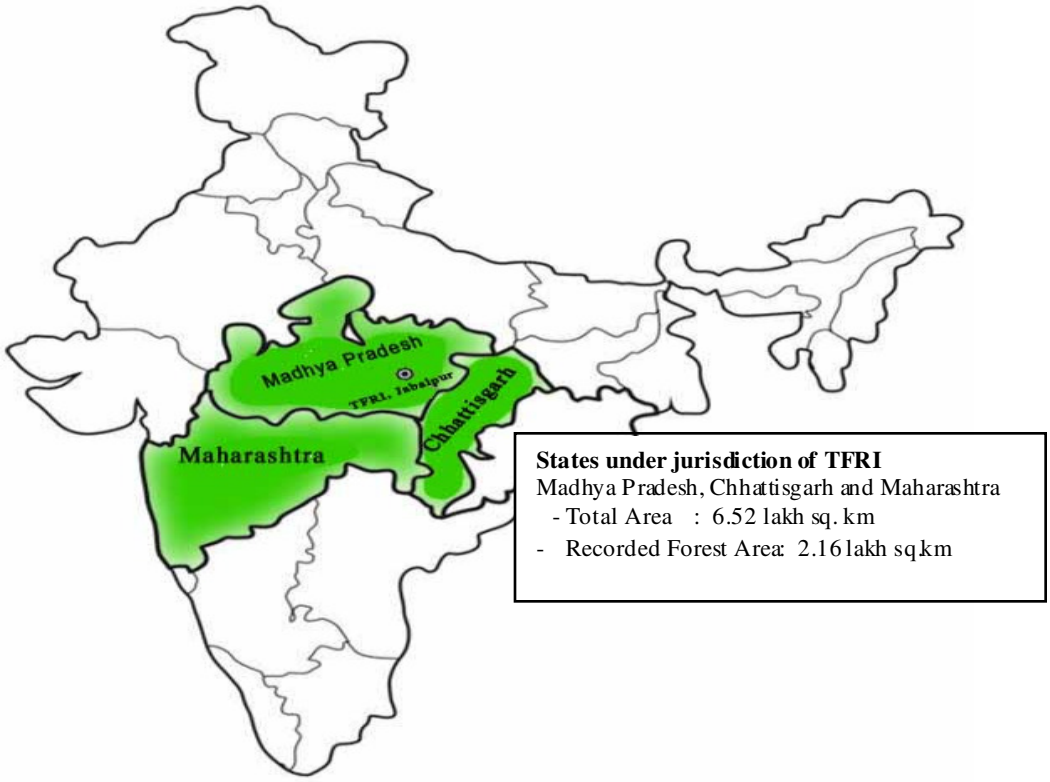
### *CITIZEN'S CHARTER*

### i. BACKGROUND

The Tropical Forest Research Institute, Jabalpur is one of the eight regional institutes under the Indian Council of Forestry Research & Education, Dehradun. The Institute came into

existence in April 1988, although its origin goes back to 1973 when a Regional Forest Research Centre, was established at Jabalpur under the Forest Research Institute, Dehradun, to provide research support to the problems of forest management in central India. The institute has not only steadily advanced in terms of infrastructure but also specialized itself as a major nucleus for research on forestry and ecology related problems of tropical forests of the central region comprising of the states of Madhya Pradesh, Chhattisgarh and Maharashtra. The hierarchical tree/ organization chart of the institute is as given below –



## ii. VISION

To develop Tropical Forest Research Institute as a focal institution for providing strong research support to sustainable development of forests and forestry sectors in central India comprising of the states of Madhya Pradesh, Maharashtra and Chhattisgarh.

## iii. MANDATE

### a. To conduct research on:

- Eco-restoration of Vindhyan, Satpura and Maikal hills and Western Ghats
- Rehabilitation of mined areas
- Development and demonstration in agro-forestry models
- Forest protection
- Bio-fertilizers and bio-pesticides
- Non-wood forest products
- Planting stock improvement

We fulfill the objectives of our services through researches on the research/ technical problems indicated by the stakeholders in annual stakeholders' meet with the senior forest officers, academicians, NGOs, forest industries and progressive farmers of Madhya Pradesh, Chhattisgarh and Maharashtra falling under the related thrust areas and corresponding themes as given by ICFRE -

**THRUST AREAS OF RESEARCH**

- Managing forests and forest products for livelihood support.
- Biodiversity conservation and ecological security.
- Forestry interventions for climate change, mitigation and adaptation.
- Management and improvement of forest genetic resource.

**THEMES**

1. Climate Change
2. Ecology & Environment
3. Biodiversity
4. Forest Botany

5. Tribal's and Traditional Knowledge System
6. Silviculture
7. Social Forestry, Agro-Forestry/Farm Forestry
8. Forest Soils and Land Reclamation
9. Watershed Management
10. Conservation of Forest Genetic Resources
11. Tree Improvement
12. Vegetative Propagation
13. Biotechnology
14. Sustainable Forest Management (SFM)
15. Forest Economics
16. Forest Biometrics
17. Participatory Forest Management
18. Policy and Legal Issues
19. Information and Communication Technology (ICT)
20. Wood and other Lignocelluloses Composites
21. Wood Processing
22. Value Addition and Utilization
23. Wood Chemistry
24. Pulp and Paper
25. Resource Development of NWFPs
26. Sustainable Harvesting and Management
27. Chemistry of NWFPs, Value Addition and Utilization
28. Biofuels and Bioenergy
29. Insects pests, diseases and control
30. Mycorrhizae, rhizobia and other useful microbes
31. Weeds and Invasive species
32. Forest Fire and Grazing

The projects falling under the above thrust areas and themes are submitted for funding by intra-mural or National/ International Funding Agencies.

### b. Extension

The forestry extension is the main focal activity of the institute, bridging the gap between researchers and the end users for lab to land transfer of technology, time to time. The institute has a fully functional forest extension division, which full-fills this objective through short-term training programmes, conferences, workshops, Kisan melas, demonstrations, etc, for the senior state forest officers, frontline staff of the SFDs, trainees from State Forest Services, ICFRE technical staff, forestry based industries, NGOs, villagers, farmers awareness programmes for students.

### c. Education

The institute has well equipped research laboratory, which attracts students from universities for carrying out their dissertations/ thesis as a partial fulfillment for obtaining degrees of M.Sc. / M.Phil/ Ph.D.

## iv. GRIEVANCE REDRESSAL MECHANISM

A Grievances Cell has been constituted to attend the grievances related to the mandate of the institute. An officer of the rank of Scientist - E has been nominated as Public Grievance Officer of this Institute, the contact details of the officer as below:

| Name | Designation | Tel. Office | E-Mail |
|---|---|---|---|
| Dr. Sharad Tiwari | Scientist - E | 4044006 (o)<br>2744171(o) | tiwaris@icfre.org<br>sharadtiwari8@gmail.com |

- ❖ Public Grievance Officer will be available to receive and hear grievances of the public.
- ❖ Visitors to our office will be treated with courtesy and heard patiently to facilitate solving their problems.

⇒ For addressing the issues related to the working women in the Institute a Women Sexual Harassment Complaint Redresal Committee under the presidency ship of officer of the rank of scientist E has been constituted, the contact details of the officer as below:

| Name | Designation | Tel. Office | E-mail |
|---|---|---|---|
| Dr. Neelu Singh | Scientist "E"<br>President, TFRI | 2840483 (O)<br>2840751 (o) | singhn@icfre.org |
| Dr. S.A. Ansari | Scientist "F"<br>Member, TFRI | 4044009 (o)<br>09425410792 (Mo) | ansarisa@icfre.org |
| Dr. Nanita Berry | Scientist "C"<br>Member, TFRI | 2840799 (o)<br>09425156667 (Mo) | berryn@icfre.org |

| | | | |
|---|---|---|---|
| Dr. Geeta Sharad Tiwari | Secretary, All India Women Sammelen | Mb. 9301213344 | |
| Dr. Sushma Dubey | Head, Hindi Division, Rani Durgawati University, Jabalpur | Ph. 0761-2600120 | |

⇒ For addressing and verifying the compliance and issues related to the roaster of scheduled caste/ scheduled tribe/ OBCs and related reservation matters an officer has been appointed as liaison officer, whose contact details are as below:-

| Name | Designation | Tel. Office | E-mail |
|---|---|---|---|
| Dr. P. B. Meshram | Scientist, "E" | 0761 - 2744150 (o)<br>09425871072 (Mo) | pbmeshram@rediffmail.com |

⇒ For addressing and verifying the reservation policies of the government of India, and to address the insecurity feeling in employees of Scheduled Caste/ Scheduled Tribe/ OBCs and related reservation matters, Grievance Redressal Cell has been constituted under the Chief Liaison Officer. The details of the cell is as given below –

| S.No | Name of the Officer | Status/ Responsibility | Contact | E-mail |
|---|---|---|---|---|
| 1. | Dr. P. B. Meshram, Scientist – E, Liaison Officer (G.R. Cell), Nodal Officer (Roster), Forest Entomology Division, TFRI, Jabalpur | Chief Liaison Officer | 0761 - 2840627 (o)<br>09425871072 (Mo) | pbmeshram@rediffmail.com |
| 2 | Shri Dhirendra Kumar, Controller | Member | 4044010, 2744107 (O) | tewarid@icfre.org |
| 3. | Dr. (Ms.) Vishakha Kumbhare, Scientist – B, CFRHRD, Chindwara (M.P.) | Liaison Officer for Scheduled Tribes | | |
| 5. | Shri Rakesh Kumar Vishwakarma, UDC, Account Section, TFRI, Jabalpur | Liaison Officer for other backward classes | | |
| 6. | Shri Alfred Francis, RA – II, Biodiversity and Sustainable Management Division, TFRI, Jabalpur | Liaison Officer for Scheduled Tribe | | |

⇒ In case of non-fulfillment of the commitments by the above committees, cells, users should approach the following officer:

| Name | Designation | Tel. Office | E-Mail |
|---|---|---|---|
| **Dr. M.S. Negi** | Director, TFRI, Jabalpur | +91-761- 2840483, 4044002 (O) | dir_tfri@icfre.org |

**v. Stakeholders/clients**

The agencies and individuals in Madhya Pradesh, Maharashtra and Chhattisgarh involved in forestry related operations including production trading and utilization of forest resources are the stakeholders /clients of the Institute.

- State Forest Departments
- Forest Development Corporations
- Non Government Organizations
- Forest-based Industries
- Universities and Research Organizations
- Farmers
- Villagers
- Forest Dwellers
- Tribals

**FUNCTIONS**

The institute implements its mandate of research programme through highly qualified scientists, forest officers and trained technical personnel placed in eight research divisions viz., Agro-forestry, Biodiversity and Sustainable Management, Forest Ecology and Rehabilitation, Forest Entomology, Forest Pathology, Genetics and Plant Propagation, Non-Wood Forest Produce, Silviculture and Joint Forest Management and an Extension division, each headed by a senior scientist/forester. It caters to the overall research needs of forests of three central Indian states, viz. Chhattisgarh, Madhya Pradesh and Maharashtra, in particular, and specific issues of forests and forestry sector confronting India, in general. The central region extending from Bay of Bengal in the east to Arabian Sea in the west is well endured with natural tropical forests which are rich in floristic wealth.

The extension division acts as an interface between the institute and the outside, including ICFRE institutes, government organization, farmers, industries and NGOs for dissemination of information and technologies developed at the institute. It organizes seminars, training courses and exhibitions at different places, besides publishing technical bulletins, brochures, pamphlets, posters, etc.

## RESEARCH DIVISIONS

### Agro-forestry Division

The division conducts research on development of suitable agro-forestry modals for different agro-climatic zones for optimization of land use and reduction dependence of rural communities on natural forest of the region**.**

### Bio-diversity and Sustainable Management Division

The division is responsible for documentation and assessment of floral diversity of forests; enlist rare and endangered species for their conservation and sustainable use. Ethno-botanical surveys are also carried out to document patterns of utilization of rich biological diversity in the Indian region by various ethnic communities, including the primitive tribes.

### Forest Ecology and Rehabilitation Division

The division deals with technologies for restoration of wastelands, degraded forests and mined over burdens and screens suitable species exhibiting great tolerance to air pollutants in and around limekins, coalmines, thermal power projects.

### Forest Entomology Division

The division is devoted to survey and identification of forest insect pests and their chemo-biological measures. It is also engaged with the screening of insect pest resistant genotypes of forest tree species, especially in central Indian conditions.

### Forest Pathology Division

The division aims at identification and chemo-biological control measures of nursery and plantation diseases caused by phyto-pathogens. It also conducts studies for production and use of bio-fertilizers such as vesicular arbuscular mycorrhizae (VAM), phosphate solubilizing bacteria, dinitrogen fixing bacteria, etc. for boosting growth of nursery seedlings and their initial field establishment.

### Genetics and Plant Propagation Division

The division deals with selection and breeding of improved genotypes and their cloning for augmenting productivity and quality as well as for enhancement of forest covers. The investigation relates to quantitative genetics, clonal propagation, and molecular cataloguing of forest trees and other species, as well as selection of biochemical marker of productivity in trees.

**Non Wood Forest Produce Division:**

The division surveys and identifies herb and trees as source of food, medicines, natural dyes, edible and industrial oils etc. from various forest trees and other vegetation of the region. The cultivation techniques for these valuable plants are also standardized for their adaption as agriculture/horticulture crops for generation of additional income. besides , efforts are made for ex-situ conservation of rare and endangered medicinal plants as well as for development of efficient extraction procedure for natural dyes and oils.

**Silviculture and JFM Division:**

The division conducts research on silvicultural aspects of management of natural forests and plantation including standardization of nursery packages for production of quality seedlings , in addition to operation of a pilot unit for commercial production of composed from grass and leaf litter of various forestry species. Research is also conducted to participatory role of tribal/rural folks for sustainable management of local forests for poverty alleviation and environmental rejuvenation.

**Extension Division:**

The division act as interface between the institute and the outsides, including ICFRE institutes, government organizations, farmers, industries and NGOs for dissemination of information and technologies developed at the institute. It organized seminars, training courses and exhibitions at different places, besides pushing technical bulletins, brochures pamphlets, posters etc.

**For more information visit:** http://tfri.icfre.gov.in

## Details of the Officers

| Division | NAME | Designation | Subject Area | E-MAIL Address | Phone/Mobile (STD Code 0761) |
|---|---|---|---|---|---|
| **Administration** | **Dr. M. S. Negi** | Director | | dir_tfri@icfre.org | 2840483, 4044002 (O) 4044011 (R) Fax: 2840484, 4044002 |
| | **Dr. V. Nath** | Group Coordinator (Research) | | nathv@icfre.org, nathv_tfri@yahoo.co.in | 4044003, 2840799, 2744115 (O) |
| | **Shri Dhirendr** | Under Secretary | Establishment works | tewarid@icfre.org dhirendra_afri@rediffmail.c | 4044010, 2744107 (O) |

| | | | | | |
|---|---|---|---|---|---|
| | **a Kumar** | | | om | |
| | **Shri A. K. Chattopadhyay** | Dy CF and Demand & Disbursing Officer | Accounts works | chattopadhyayak@icfre.org | |
| **Agro-forestry Division** | **Shri S. D. Sonkar** | Scientist "F" & Head | Soil-vegetation correlation, Nursery and plantation management, Bio-reclamation of mine over burden and degraded lands. | sonkarsd@icfre.org, sonkarshiv@rediffmail.com | 4044007 (o) |
| **Bio-diversity and Sustainable Management Division** | **Dr. V. Nath** | Scientist, "F" & Head | Biodiversity conservation and Ethno-botany | nathv@icfre.org, nathv_tfri@yahoo.co.in | 4044008 (o) |
| **Computer & I. T. Section** | **Dr. Sharad Tiwari** | Scientist "E" and In-charge | GIS and Remote sensing application, Software Development, Database Management and Computer Networking | tiwaris@icfre.org sharadtiwari8@gmail.com | 4044006 (o) 2744171(o) |
| **Ecology and Rehabilitation Division** | **Dr. Avinash Jain** | Scientist, "E" & Head | Climate change, Carbon sequestration, Rehabilitation of degraded lands and Impact assessment studies | jaina@icfre.org, jainavi@yahoo.com | 4044005 (o) 09826563036 (Mo) |

| | | | | | |
|---|---|---|---|---|---|
| **Forest Entomology Division** | **Dr. N. Roychoudhury** | Scientist, "F" & Head | Dynamics of insect-tree interaction with special emphasis on tree resistance and bio-pesticides | roychoudhary@icfre.org, choudhury_nr@yahoo.com | 2840634 (o) |
| **Forest Pathology Division** | **Dr. R. K. Verma** | Scientist, "E" and Head | Mycology, Forest Pathology and Bio-fertilizers | vermaramk@icfre.org, rkverma28@rediffmail.com | 2840746 (o) |
| **Genetics and Plant Propagation Division** | **Dr. S. A. Ansari** | Scientist, "F" & Head | Tree Physiology & Clonal Propagation | ansarisa@icfre.org, shamimansari_1@yahoo.co.uk | 4044009 (o) 09425410792 (Mo) |
| **Non Wood Forest Produce Division** | **Dr. A. K. Pandey** | Scientist "F" and Head | Medicinal & aromatic plants. Chemistry of natural products | akpandey@icfre.org akpandey10@rediffmail.com | 2840751 (o) 09424685773 (Mo) |
| **Silviculture Division** | **Shri S. D. Sonkar** | Scientist "F" & Head | Soil-vegetation correlation, Nursery and plantation management, Bio-reclamation of mine over burden and degraded lands. | sonkarsd@icfre.org, sonkarshiv@rediffmail.com | 4044007 (o) |
| **Extension Division** | **Dr. N. Kulkarni** | Scientist, "F" | Forest insect ecology, biology and control under IPM program | kulkarni_n27@hotmail.com | 2840634 (o) 09425325430 (Mo) |
| **Library and Information Centre** | **Dr. Rajiv Rai** | Scientist 'D' and Incharge | Library and Information Services | rajivrai@icfre.org, rai_rajiv_57@hotmail.com | 2744139 (o) 09479644205 (Mo) |
| **Hindi Section** | **Shri Dhirendra Kumar** | Hindi Officer | हिन्दी साहित्य | tewarid@icfre.org dhirendra_afri@rediffmail.com | 4044010, 2744107 (O) |

| | | | | | |
|---|---|---|---|---|---|
| **Estate/Service Section** | **Shri S. K. Thomas** | Dy. CF | Estate works /Maintenance of scientific equipments and Forest operational works | thomassk@icfre.org | 4044004 (o) 09424952416 (Mo) |
| **Store/Purchase Section** | **Dr. P. B. Meshram** | Scientist, "E" | Forest Entomology | pbmeshram@rediffmail.com | 2840627 (o) 09425871072 (Mo) |
| **Vehicle Section** | **Dr. Pramod Tiwari** | Research Officer | Maintenance of vehicles | pramodk@icfre.org, pramod_kt@rediffmail.com | 2840627 (o) 09425410791 (Mo) |

**FUTURE PLAN**

- Field demonstration of technologies developed by the Institute.
- Establishment of more VVK's for demonstration and transfer of technologies and research to stakeholders.
- Production and demonstration of Vermicompost and Bio-fertilizers.
- Medicinal plants-value addition techniques for upliftment of rural economy.
- Biological control of Insect pests and diseases.
- Raising of tissue culture plants particularly bamboos.
- Eco-restoration of mined over areas.
- Phyto-diversity assessment of forests particularly in protected areas.
- Standardization of nursery and plantation techniques.
- Refresher courses for Rangers, Dy. Rangers and Foresters.

**Provision for Annual Review of the Charter**

- The Services provided by the Institute as per the charter will be reviewed annually.
- The timely redressal of public grievances is being monitored by the Public Grievance Officer.
- Grievances received in the institute and their follow-up will be reviewed. Steps will be undertaken to take remedial measures for quick disposal of complaints, specifically on those, which are of repetitive nature.

## CENTRE FOR FORESTRY RESEARCH AND HUMAN RESOURCE DEVELOPMENT CHHINDWARA

Any ambitious programme of afforestation and sustainable forest resource management needs a cadre of motivated well trained personnel who should be able to take new challenges in forestry sector. This would necessitate sufficient infrastructure training facilities and resource personnel. Such an endeavour would entail the development of modern facilities. Up to date technology in plantation management imparts forest resource utilization skills and cost effective management practices to users of different level. The availability of trained personnel in forestry is very low in the country at present. The apathy amongst people towards sector is primarily due to low awareness about the problems of forest resource management. An independent centre for human resource development attending to specialized practical training in forestry sector with special emphasis on excellence in nursery and plantation technology was therefore an urgent necessity.

Situated in Madhya Pradesh, heart land of India, Centre for Forestry Research and Human Resource Development established at Chhindwara is one of the centre of Indian Council of Forestry Research and Education, Dehradun. It has unique distinction of being the first centre of its kind in Asia for the development of human resource in forestry sector leading towards the poverty alleviation. Central plateau of India is dominated by tribal population who are mainly dependent on forestry resource. Shortage of water, energy, employment and climatic change due to deforestation is resulting into environmental degradation and causing great concern in this area. To cater the specific needs of central India in relation to development of specialized human resource through training in different advanced forestry technology, the centre has been located in the most representative district of Chhindwara. Honourable Minister of Environment and Forest, Government of India has laid the foundation stone of the institute on 30th March 1995.

The centre is located on Chhindwara-Panchmari state highway, 8 kms from Chhindwara town at Poama village. Chhindwara is well connected by road, Nagpur (125 km), Jabalpur (215 km) and Bhopal (280km). In additional it has rail linkage also. A functional air strip along with helipad is also located at Chhindwara.

### MANDATE

- Eco-restoration of Vindhyan, Satpura and Maikal hills and Western Ghats
- Poverty alleviation through human resource development
- Research and demonstration in agroforestry models
- Research in non-wood forest products
- Identification of seed production areas and plus trees, establishment of seed orchards; and production of quality planting material of selected species for improving forest productivity
- Provenance trials of teak, bamboo, neem, sissoo, safed siris etc.
- Research on biofertilizers and biopesticides

**Jurisdiction:** Forests & forestry sectors in central India comprising of the states of Madhya Pradesh, Chhattisgarh, Maharashtra and Orissa.

**Details of the Officers**

| NAME | Designation | Subject Area | Phone Number | E-MAIL Address |
|---|---|---|---|---|
| Shri Suneesh Buxy, IFS | Head of Office | Botany, Forestry | +91-7162-254463<br>+91-7162-282444 | dir_cfrhrd@rediffmail.com<br>head_cfrhrd@icfre.org<br>suneeshb@rediffmail.com |
| Shri Har Prasad | Dy CF | Forestry | +91-7162-282444 | prasadh@icfre.org |
| Dr. Vishakha Kumbhare | Scientist 'B' | Bio-chemistry | 09826884168 | kumbharev@icfre.org<br>vishakha15@rediffmail.com |
| Dr. Surya Prabha | Scientist 'C' | Soil Science and Agriculture Chemistry | +91-7162-282444 | prabhas@icfre.org |
| Shri Jitendra Chouhan | Research Officer | Botany | +91-7162-282444 | chouhanjs@icfre.org |

### 5.2.2 Action taken to implement the Charter

Action is being taken for implementing the Charter.

### 5.2.3 Details of Training Programmes, Workshops, etc. held for proper implementation of Charter

1. Organized six training programmes on nursery techniques, maintenance and management of nursery, planting stock improvement, sustainable harvesting of medicinal plants and value addition and biofertilizer application in forestry under Van Vigyan Kendra (VVK).

2. Organized training programme for Range Officers and Forest Guards of different states.

3. Organized one day workshop on Research Needs and the Financial, Technological and Capacity Needs and Constraints to address Climate Change Concerns vis-a-vis Forests and Forest Products in India at TFRI Jabalpur on 1st September 2010.

4. Organized meeting with public representatives, villagers, SHG members of Barha and Jamtara villages for development of Model villages.

5. Organized meetings with inmates of Subhas Chandra Bose Jail in Jabalpur for their rehabilitation through technologies developed by TFRI.
6. Doctoral, Post graduate and graduate students were guided for thesis work.
7. Published six technical bulletins and 14 pamphlets in Hindi and five technical bulletins and 15 pamphlets in Marathi.

### 5.2.4 Details of publicity efforts made and awareness campaigns organized on Charter for the Citizen/Clients

Publicity and awareness campaigns on charter for the citizen/clients were made by holding slogans on notice boards and other areas to motivate citizens. General lectures on the awareness were also organized at the institute.

### 5.2.5 Details if internal and external evaluation of implementation of Charter in the Organization and assessment of the level of satisfaction among Citizen/Clients

Evaluation of implementation of Charter is to be initiated.

## *5.3 Welfare measures for the SC/ST/Backward/minority communities*

Honorable Shri Maurice Kujur, Vice-Chairperson, National Commission for Scheduled Tribes, New Delhi and Shri R.K.Dubey, Joint Director, NCST, Bhopal visited to TFRI, Jabalpur. Dr.P.B.Meshram, Chief Liaison Officer, SC/ST/OBC, GRC, TFRI, Jabalpur delivered the presentation on "Roster and Activities of TFRI, Jabalpur under G.R.C." on 9$^{th}$ August, 2010.

# *6. ANNEXURES*

## 1. RTI

**Names and Addresses of Public Information Officers and Appellate Authorities under the Right to Information Act 2005 in the Institute**

| Headquarter / Institute | Appellate Authority | Public Information Officer | Subject matter(s) allocated |
|---|---|---|---|
| Tropical Forest Research Institute, Jabalpur | Dr. M. S. Negi, Director, TFRI, Jabalpur | Dr. Rupnarayan Sett, Scientist 'D' | As per provision and guidlines provided under RTI Act, 2005. |

## 2. Email and Postal addresses

TROPICAL FOREST RESEARCH INSTITUTE
(*Indian Council of Forestry Research & Education*)
(An Autonomous Council under the Ministry of Environment & Forests, Govt. of India)
P.O. – R.F.R.C, Mandla Road, Jabalpur – 482021 (M.P), India
Phones: 0761 – 4044002, 2840483(O)
Fax: 0761 – 4044002, 2840484
*e-mail* – dir_tfri@icfre.org

## 3. Intellectual Property

## 3.1 Patents Granted – Nil