# TROPICAL FOREST RESEARCH INSTITUTE, JABALPUR

## Institute - At a glance

Tropical Forest Research Institute (TFRI), Jabalpur is one of the institutions under Indian Council of Forestry Research & Education (ICFRE). It caters to the forestry research needs of four states of central India, viz. Madhya Pradesh, Chhattisgarh, Maharashtra and Orissa. Thrust areas of research in the institute relate to non-wood forest produce, rehabilitation of mined areas and other stress sites, development of and demonstration in agroforestry models, planting stock improvement, sustainable forest management, biodiversity conservation and control of forest diseases and pests. TFRI has established 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. A number of scientists, officers and staff of the institute participated in various national and international scientific seminars and symposia. They were actively involved in extension activities through its Van Vigyan Kendras. This has helped the institute not only in imbibing in its research programme ideas and concepts but also extending technologies developed by the institute.

# Significant achievements

- Dispersion of Suspended Particulate Matter (SPM) from sponge iron factory may render the area near factory unfertile.
- Complete host record of Indian Braconid species has been prepared.
- Control measures for *Xanthomonas* leaf curl and stunting in young teak plants has been developed.
- A calendar on nursery techniques of medicinal plants prepared.
- 563 herbal plants used by the traditional healers to cure the various diseases prevelling among the tribal/local communities documented.

# PROJECTS COMPLETED DURING THE YEAR 2008-09
**(ICFRE funded)**

## Project 1: Documentation of (traditional knowledge) ethno-medicinal information from traditional herbal healers (Vaidyas, Ojhas, Guniyas) in central Madhya Pradesh.[Project ID No. : TFRI-084/TFRI/2005/Biod.1(4) / 2005-2008].

**Findings:** The ethno-botanical study were conducted at Jabalpur, Seoni, Hoshangabad, Chhindwara, Sehor, Bhopal, Betul, Harda, Raisen and Vidisha of Madhya Pradesh to document the traditional knowledge on ethno-medicine prevailing in the tribal communities over the years. The tribal pockets and traditional herbal healers were identified for each district for documentation work. The tribal villages were selected from tribal blocks by random sampling method. A questionnaire/schedule was developed to document the information prevailing in the community by periodical visits.

For documentation work, local guide, villagers, traditional herbal healer (Vaidyas, Ojhas and Guniyas), tribal heads and tribal persons were contacted and enquired to gather related information. Identification of plants has been made through the local name of plant with the help of existing literature. Total 563 herbal plants from 103 traditional herbal healers were documented. The details are as under :

| S.No. | Name of district | number of traditional herbal healer contacted | Number of medicinal plants being used by the traditional herbal healers for cure of various diseases |
|---|---|---|---|
| 1 | Jabalpur | 15 | 52 |
| 2 | Seoni | 16 | 152 |
| 3 | Chhindwara | 14 | 78 |
| 4 | Hoshangabad | 09 | 13 |
| 5 | Sehor | 08 | 42 |
| 6 | Bhopal | 02 | 28 |
| 7 | Vidisha | 10 | 42 |
| 8 | Betul | 07 | 50 |
| 9 | Harda | 14 | 46 |
| 10 | Raisen | 08 | 60 |
| | **TOTAL** | **103** | **563** |

Awareness among tribal communities for sustainable use and conservation of medicinal plants available in the area has been generated.

**Traditional herbal healer of Seoni district of Madhya Pradesh**

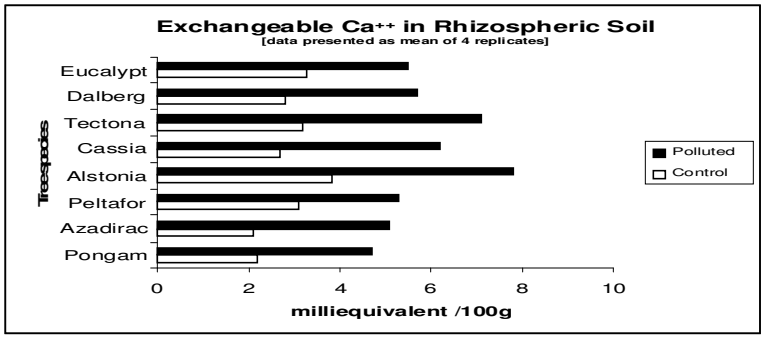
**Herbal plant parts for sale at Van Mela**

## Project 2: Impact of pollutants on growth of plants. [ICFRE – 115/TFRI-2007/Ecol-1(8)]

**Findings:** Sponge iron is a recognized alternative to steel scrap as a raw material for the manufacture of various steel products. An immense growth of the sponge iron industry has taken place in India, from a meager capacity of 30 000 tonnes per annum in 1980-81 to 7 million tonnes in 2001.

Seventy-two sponge iron factories have come up at and around Raigarh, Chhatisgarh, India during the last 20 years. A huge amount of $SO_2$ and $NO_x$ along with CO, $CO_2$, volatile organic compounds (VOC) and suspended particulate matters (SPM) are emitted into the atmosphere during the extraction of iron from hematite that relies on burning of inferior quality coal. $SO_2$ and $NO_x$ are the primary causes of acid rain. The other most dangerous pollutant is SPM (<1mm in diameter). Study was conducted at Raigarh to determine the detrimental effects of severe pollution on the vegetation there.

The trees at the polluted sites at Raigarh, were found to be poorly grown with reduced collar girth, stem and branches deformed, leaves being chlorotic and/or necrotic with black patches. The levels of pH and organic carbon were lower in all the polluted rhizospheric soils while the EC was found to be higher in comparison to the control samples. In the present study, the levels of exchangeable $Ca^{++}$ and $Mg^{++}$ were found to be much higher in the rhizospheric soils of the polluted samples (Figure 1), which strongly support the hypothesis that in acidic environment, $Ca^{++}$ and $Mg^{++}$ leach out from the roots in exchange with $Fe^{+++}$ and $Al^{+++}$ from the soil leading to deformed and retarded growth of the trees. Interestingly, except for few species, the seeds never germinated in soil-mix with SPM in nursery. SPM and slag were dumped on roadside vegetation areas. Unlike other byproduct dykes like that of fly ash or aluminium extraction wastes or different mine overburden areas, where at least some herbs or shrubs were found to be growing naturally, no vegetation came up in the sponge iron waste slag dumps and all the tree species died shortly. This indicates that perhaps the dispersion of the SPM from the sponge iron factories would slowly render the areas unfertile turning them into deserted waste lands.



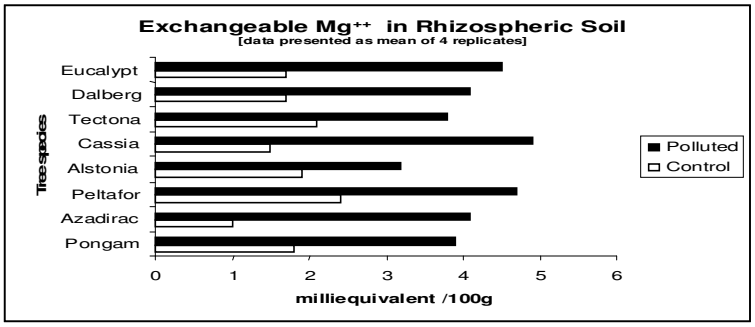




**Figure 1.** Levels of exchangeable $Ca^{++}$ and $Mg^{++}$ in rhizospheric soil.

## Project 3: Studies on forest dwelling Braconids (Hymenoptera : Braconidae) from central India and their role in biological control of important forest insect pests. [081 / TFRI / 2005 / Ento-2 (10) 2005-2008].

**Findings :** A total of 1587 samples of Braconid parasitoids collected from eleven ecological/ agro-climatic zones of Madhya Pradesh of the total 37 Braconid species viz. *Apanteles tachardiae, Apanteles machaeralis, Apanteles hyblaeae, Apanteles leptothecus, Apanteles antipoda, Apanteles cajani*, *Apanteles caniae, Apanteles colemani, Apanteles hasorae, Apanteles bambusae, Apanteles agilis, Apanteles attevae, Parahormius stom, Parahormius nr. jason, Parahormius deiphobus, Parahormius absonus, Parahormius zonus, Parahormius rameshi, Hormius lamidae, Hormius vitabilis, Hormius longiventris, Eutropobracon granulatus*, *Cassidibracon sumodani, Cassidibracon indicus, Adialytus salicaphis, Adialyts arvicola, Trioxys* (*Binodoxys*) *rubicola, Trioxys (Binodoxys ) indicus, Trioxys* (*Trioxys*) *soporensis, Diaeretiella rapae, Chelonus (Chelonus) deogiri, Chelonus (Chelonus) narayani, Chelonus (Chelonus) gastrus, Chelonus (Chelonus) dwibindus, Chelonus (Microchelonus) chailini, Chelonus* (*Microchelonus) scutellatus* & *Chelonus (Microchelonus) shyamus*), were identified up to species level. Of them six species were proposed as the species new to science. They were illustrated and described in detail. Complete host-record of all Indian Braconid species has been prepared after careful consultation of available literature on the subject.

**Project 4**: **Studies on bacterial and viral diseases of teak, *Gmelina* and *Albizia* and their management.** [066/TFRI/2004/Patho-1(8)].

**Findings :** In all 245 bacterial wilt and collar rot disease samples of teak and *G. arborea* and 5 virus infected samples of *A .lebbek, A. procera, T. grandis, G. arborea* from 27 forest nurseries of MP, CG and MS were collected. 2-5% economic losses were recorded in different nurseries caused by bacteria and viruses. A total of 9 bacterial isolates were purified and sensitivity test carried out to assess suitability of antibiotics for their application in nursery. Experiment was conducted in nursery to control wilt and collar rot disease of teak, *A. procera*, *A. lebbek* and *Gmelina arborea*. Incidence of *Xanthomonas* leaf curl and stunting in young teak plantations at Raipura, south Panna division was recorded. Disease was successfully controlled with the application of streptocyclin 0.1% in combination with monocrotophos 0.036%. The cost of treatment was found to be Rs. 952 per acre.

## Project 5: Evaluation, modification and value addition of starches of forest origin. [TFRI-083/NWFP/2005-2008]

**Findings:** Isolated starch from *Careya arborea* seed and *Curcuma aromatica* rhizome and determined their physico-chemical properties. Evaluate potential of starches for preparation of different value added products. Seeds of *C. arborea* and rhizome of *C. aromatica* have an average of 34.08 and 25.3 % starch respectively. Value added products like dextrin, syrup and pappad from starch of *Careya arborea* and pickles from carboxymethylated starch of *Curcuma aromatica* prepared.

## Project 6: Evaluation of management systems and level of community participation under Joint Forest Management (JFM). [071/TFRI-2004/Silvi-1(6)]

**Findings**: A field study was conducted for assessing plant density, regeneration, coppice growth, woody perennial species and ground flora by laying out quadrate in People Protected Area (PPA), Rehabilitation of Degraded Forest (RDF) and unprotected forest area (UPF) at Udaipur forest village in Satna Forest Division and Narwar, Nipnia, Aintajhar, Singpur forest villages of south Shahdol Forest Division in Madhya Pradesh. Under PPA scheme 19 species with 1950 tree density were observed in the first year. After two years of implementation of scheme, there was 1.35% and 1.47% increase with respect to number of species and density of trees. After three years, 1.53 % and 1.68% increase was observed in respect of above parameters. Under RDF scheme 19 species with 1605.3 tree density were observed. After three years of implementation of scheme, there were 1.11% and 1.36% increase with respect to number of species and density of trees. In unprotected site 16 numbers of species with 1106.3 tree density was observed during the first year. After three years, 1.11 % and 1.36 % increase with respect to number of species and density of trees was noted.

As far as density of coppice of tree species was concerned, after three years of implementation of scheme, there were 9.84 times and 5.66 times more coppice production in PPA and RDF as compared to unprotected site. Density of regeneration of tree species after three years of implementation of scheme was noticed 3.58 times and 1.98 times more in PPA and RDF as compared to unprotected site. In PPA, the ground flora was observed 1.25 times more in PPA

than that of unprotected site. Due to RDF activities status of ground flora was found less as compared to PPA.

Plant density regeneration, coppice growth of woody perennials species and ground flora were better in the forests having Joint Forest Management programme as compared to the forest areas having no JFM programme.

Closure of biotic interference (including fire protection) through patrolling and CPT under PPA scheme resulted in increased biomass of upper, lower and middle storey trees, shrubs, herbs and ground flora by active involvement of local people.

Soil and moisture conservation model with emphasis on gully plugging and nala bunding etc., water table was found to increase and the water was available throughout the year. Consequently, litter thickness increased resulting in increased moisture and nutrient status of soil. Rate of soil erosion, water run-off and loss of nutrients reduced due to soil and moisture conservation activities under RDF schemes. Population of ground flora having medicinal plants were found to increase by controlling grazing, fire protection ande with active involvement of local people. Implementation of JFM programme has positive impact on socio-economic condition of people.

# PROJECTS CONTINUED DURING THE YEAR 2008-09
## (ICFRE funded)

### Project 1: Evaluation of medicinal plant based agroforestry (Silvi-Medicinal) system under existing teak plantations. [105/TFRI/2006/Agro-1(14)]

**Status:** OSR and OFR field trials were conducted to standardize the silvi-medicinal system using *Curcuma longa, Costus speciousus* and *Gloriosa superba*. Observation on yield, growth and biomass of intercrops was was recorded. The data indicated that *C. longa* and *C. speciosa* performed well under the full canopy of teak. The maximum plant height of *Gloriosa superba* was observed in 50% pruned teak, whereas significant yield reduction with respect to sole crop was registered under closed tree canopy. Analysis of OSR and OFR trials indicates that macro nutrients (NPK) are decreased in the intercrop as compared to sole crop (medicinal plants).

***Plate-2. Gloriosa superba* under silvi-medicinal system**

**Plate 2. Growth of teak under silvi-medicinal system**

**Project 2: Study on plant diversity in sal–teak ecotone zone as influenced by ecological and climatic changes.** [085/TFRI/2005/Biod. 2 (5) / 2005 – 2009.

**Status:** Periodical survey of two sal teak ecotone zones at. 1. Umariya (M.P.) and 2. Jagadalpur (C.G.) were conducted for the study. Compartment history and maps of the area were collected. The climatic data from 1947 to 2008 were collected from local observatory. Ten quadrats of 20 x 20m size at both the sites were laid down for observation on number, occurrence and girth of tree species. Seven quadrats of 3 x 3m size for shrubs and herbs/grasses were laid out for phyto-sociological study. Quadrats were also laid out in sal dominated and teak dominated natural forests at the study sites for observation. The climatic data including temperature, humidity and solar radiation in inside and outside of the forests were recorded from both the sites. The result showed that the diversity of tree, shrub and herb species were high in ectone sites as compared to sal and teak dominated compartments.

Fifty soil samples each were collected from both the sites to analyse pH and nutrient status of the area. The data showed that the soil of teak forest had 7.12 to 7.30 pH and sal forest had an acidic range of soil varying from 5.32 to 6.02 pH. The pH in ecotone zone, however, varied from 5.56 to 6.93.

**Project 3 : Screening of tropical forest tree species for their potential as carbon sink in M.P. and Chhattisgarh. [124/TFRI/2007/Ecol-2(9)].**

**Status:** Established agroforestry systems with *Tectona grandis* and *Dalbergia sissoo* as tree species and *Triticum aestivum, Cicer arietinum* and *Withania somnifera* as agricultural crops. Carbon sequestered by tree species and agricultural crops was measured by Biomass Method. Carbon accumulated in coarse and fine litter and organic carbon in the soil was also taken into consideration. *Tectona grandis – Triticum aestivum* agroforestry system sequestered 23.84 tonne carbon/ha per year.

Carbon sequestration potential of different aged *Eucalyptus eurograndis – Triticum aestivum* agroforestry systems was measured by Biomass Method at village Majitha (Jabalpur). This system sequestered 36.65 tonne carbon/ha per year.

Carbon sequestered by *Tectona grandis* plantations raised at Bodla forest range under Kawardha division (Chhattisgarh) was measured by non-destructive Biomass Method by measuring GBH and putting their values in allometric equations. Similarly, carbon sequestered by *Shorea robusta* plantations at Motinala, Mandla forest division (M.P.) was measured.

Soil samples from all the selected sites were collected and analysed in laboratory for organic carbon and other physic-chemical characteristics.

## Project 4: Studies on the efficacy of toxins of soil actinomycetes against major forest insect pests. [103/TFRI/2006/Ento-2(13); 2006-2009]

**Status:** Collected 90 soil samples from forests of Madhya Pradesh, Maharashtra and Chhattisgarh and isolated 3 actinomycetes/bacteria on potato-dextrose agar medium following serial dilution technique and pour plate method. Extracted toxins (antibiotics and its fractions) of actinomycetes, *Streptomyces* sp. and tested against key insect pests of teak (*Hyblaea puera, Eutectona machaeralis*) stress (*Spiroma retorta*) (*Atteva fabriciella*). Conducted toxicity tests of antibiotics and its fractions of isolated actinomycetes. Efficacy of a commercially available bioproduct (spinosad) of a soil actinomycete was tested against above target pests through leaf and larval treatment as well as field-cum-laboratory tests which proved to be significantly ($p<0.05$) effective.

## Project 5: Evaluation of biopesticidal products for the management of teak defoliator and skeletonizer in forest nursery. [104/TFRI /2006/Ento-3(14)]

**Status:**

Biopesticides like neem formulation at/above 0.5% offer 90% antifeedant effect against teak skeletonizer and can also be used as a prophylactic treatment to inhibit over 80% egg laying of teak defoliator as a component of IPM module. Foliar spraying of biopesticides 0.05% of Spinosad (Actinomycete) 45 % EC and 0.05% Agropest *bt,* is effective to manage teak defoliator and skeletonizer in forest nursery. EPNs *Heterorhatdites indica* and *Steinernema carpocapsae* were reared and their bioefficacies evaluated for the first time against teak skeletonizer. EPN, *H. indica* in laboratory bioassay (dose-range 3 to 30 ijs larva$^{-1}$) in 72 hrs post-exposure caused mortality up to 76.47 % at 10ijs larva$^{-1}$ and 100% at 30ijs larva$^{-1}$. Field spraying experiment indicated that 10000 infective juveniles/ litre kills 50% larvae of leaf skeletonizer. EPN if mixed with biopesticides like 0.05% of Agropest–b + derisome or conserve (spinosad) killed cent per cent larvae. First time 3 native EPN populations (1 *Steinernema* spp. and 2 *Heterorhabditis* spp.) were isolated and being maintained successfully, as no previous reports from the central Indian forest floor is available.

## Project 6: Chemical control of insect pests and diseases of *Buchanania lanzan.* [114/TFRI- 2007/ Ento.2(17)]

**Status:** Survey was conducted at Laripara (Bilaspur), Batkakhapa / Karabhoh (Chhindwara), Padar (Betul) in Madhya Pradesh and Purkabodi (Bhandara) in Maharashtra state for monitoring the insect pests and diseases of *Buchanania lanzan.* Incidence of stem borer (60%), leaf gall forming insect (40%), defoliator (26%), inflorescence sap sucker thrips (50%) and wilt and leaf blight/curling/diseases (60%) were recorded in nurseries and natural stand. Three fungicides viz. dithane, bavistin and redomil in different concentrations were tested against *Fusarium* wilt disease of *B. lanzan* in forest nursery at Salibara, Chhindwara. Bavistin 0.29% proved best to prevent the seed associated fungi. Eight commercial pesticides viz. monocrotophos, endosulfan, cypermethrin, fenvalerate, deltamethrin, alphamethrin, biopro super and neem oil were tested against defoliator, *Lamida carbonifera* in Entomology nursery, TFRI, Jabalpur. Endosulfan 0.05% followed by monocrotophos 0.05% proved better than the remaining pesticides. Six

insecticides viz; dichlorvos, paradichlorobenzene, endosulfan, dimethoate, monocrotophos and neem oil were tested against stem borer Batocera rufomaculata. Dichlorvos 0.03% proved better than remaining pesticides used. Similarly five pesticides viz. endosulfan, monocrotophos, neem oil, bavistin and alpha naphthyl acetic acid in different concentrations were tested against insect pests and diseases to enhance the quality and quantity of seeds in natural stand of *B. lanzan.* The result showed that endosulfan 0.07 % + Bavistin 0.2% + alpha naphthyl acetic acid 40 ppm proved best to enhance the quality and quantity of the fruit produced.

## Project 7: Application of growth promoting microbes and soil amendments to produce improved seedlings of forest trees. [118/TFRI-2007/Patho-1(12)]

**Status:** Germplasm of growth promoting micro organisms were collected from Seoni, Balaghat, Chhindwara, Tamia, Umariya, Matkuli, Jhirpa and Pachmarhi (M.P.). A field experiment was laid out on sandal to test the effect of soil amendment and biofertilizers on its growth. After two months of planting, there was no mortality in biofertilizer applied seedlings along with soil amended with loam soil, *Leucaena* leaf and mixed organic matter as compared to 20% mortality in control and uninoculated seedlings. The growth of sandal was maximum in soil amended with *Leucaena* leaf and mixed organic matter along with biofertilizer application. Another experiment on *Dalbergia sissoo* was conducted in root trainer to study the effect of plant growth promoting organisms (two fungi, *Trichoderma* sp. and *Aspergillus* sp. and three bacteria, *Azotobactor*, *Azospirillum* and PSB) on its growth. After 3 months, maximum survival of seedlings was recorded in *Trichoderma* (local strain) amended soil with soil and sand (2:1) followed by application of *Azospirillum* along with soil amended *Leucaena* leaf. Maximum height (19cm) was recorded in *Trichoderma* + FYM, soil and sand in 1:2:1 ratio applied seedlings followed by *Azospirillum* + FYM as compared to control (5.7cm). Two other experiments on *Jatropha curcas* and *Gmelina arborea* are in progress. Culture of organisms are maintained in the laboratory.

## Project 8: Genetic variation for *in vitro* morphogenetic potential of *Dalbergia sissoo* Roxb. clones and evaluation of their field performance. [ID No. 117/TFRI-2007/Gen.-1 (13) (ICFRE)]

**Status :** Five promising trees of *D.sissoo* were selected from Raigarh, Chhattisgarh in 2009. Vegetative propagules were collected for stock build up of clonal materials for *in vitro* propagation. Shoot multiplication of five clones (GBW, JB 1, FZB, FZK, RB) was evaluated by conducting two experiments. In the first experiment, the effect of nature of culture medium (liquid and semi solid) and different basal media (MS, WPM, Nitsch and Nitsch) was evaluated in five clones. The data obtained from three way analysis revealed that the highest average number of shoots per explants after six week of inoculation was obtained for FZK clone (3.23) followed by FZB clone (3.07) on MS liquid medium. In the second experiment, explant types (single and double nodal segment) inoculated in three basal media (MS, WPM, N&N) were tested in five clones (GBW, JB 1, FZB, FZK, RB). Significant effect of explant types, basal media and clones was observed on number of shoots after six weeks of inoculation. The double nodal explant was invariably found to be superior compared to single nodal explant. However, the interaction of explant types with clones and media had no significant effect on shoot multiplication. The highest average number of shoots per explant was obtained on a combination

of FZB clone and WPM medium (2.42) followed by combination of FZK clone and WPM (2.36) and combination of FZB clone and Nitsch and Nitsch medium (2.17).

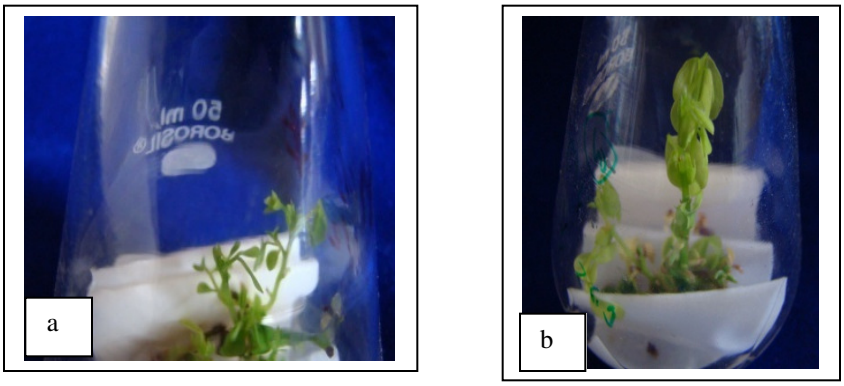



Figure 1: Effect of status of culture medium on shoot multiplication of *D. sissoo* clone FZK: (a) Semi solid and (b) Liquid MS medium.

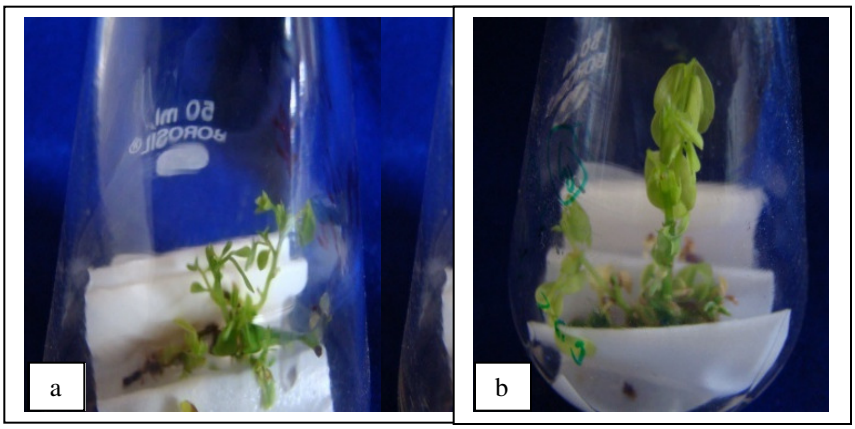



Figure 2: Effect of explants types on shoot multiplication of *D.sissoo* clone FZK on WPM: (a) Single and (b) Double nodal explant.

**Project 9 : Sustainable management of medicinal plants in JFM areas in different agro-climatic zones of Madhya Pradesh. [079/TFRI/2005/Silva-1(8)]**

**Status :** Data have been collected from sample plots laid out for generating data sustainable harvesting of kalmegh, chironji and satawar as per following details:

- Kalmegh in Satnur Forests area, Sawari Range, Delakhadi Forest Range West Chhindwara Forest Division, and at Naunichhapar Village Chhindwara Range in East Chhindwara Forest Division

- Chirongi in Sitadongri, Delakhadi Forest Range, West Chhindwara Forest Division and Khumbhadeo Forests, East Harrai Range and Ojhaldhana Village East Batkakhapa Range, East Chhindwara Forest Division.
- Satawar in Bandhi Circle, Umariya Forest Range, Katni Forest Division.

## Project 10 : Standardization of nursery techniques of *Strychnos nux-vomica* and *Strychnos potatorum*. [080/TFRI/Silviculture 2-(9)]

**Status** : Seed germination studies of *Strychnos nux-vomica* and *Strychnos potatorum* under different physical,chemical and hormonal treatment were conducted. Vegetative propagation study through branch and root cutting of *Strychnos nux-vomica* and *Strychnos potatorum* under different hormonal treatment was conducted. Seeds of *S. nux-vomica* and *S. potatorum* were sown in polythene bags to conduct fertilizer trial in order to accelerate the growth of seedlings. Data on germination, sprouting, rooting, survival and growth of both the species under different experiments were recorded.

## Project 11 : Seed physiology of the tropical forest species with special reference to their maturity and storage. [076/TFRI-2004/Silvi-2(7)]

**Status** : The viability of *Bassia latifolia* seed was assessed using different storage conditions. The seed of this species can best be stored at $25^0$C with shedding moisture content. Seed maturation studies for determination of seed collection time had been completed on *Ablomoscus moscatus, Moringa oleifera, Holoptelea integrifolia* and *Sapindus laurifolia*. Best collection time for *Ablomoscus moscatus*, was noted at 30 days after anthesis, when the color of the pod turned into reddish brown before it opened. Best harvest time for *Moringa oleifera, Holoptelea integrifolia,* and *Sapindus laurifolia* were 77, 60, 117 days after anthesis respectively with 65%, 4%, 10% moisture content respectively. Stored seeds of *Schleichera trijuga, Hardwickia binata, Sapindus laurifolia, Rauvolfia serpentine, Moringa oleifera, Terminalia chebula, Mimusops elengi, Holoptelea integrifolia* and *Emblica officinalis* were sampled for viability assessment at regular intervals depending on the species. Best storability at $45^0$C was found for *Hardwickia binata* seeds with 100% germination after one year of storage.

## Project 12: Development of nursery techniques for *Terminalia chebula* Retx. (Harad). [107/TFRI/2006/Silvi-1(12)]

**Status** : Studies on seed germination of *Terminalia chebula* under different physical, chemical and hormonal treatment were conducted from the seeds and branch cuttings collected from Chandrapur (Maharashtra), Bhilaigarh (Chhattisgarh), Tamia (Madhya Pradesh) and Samplepur (Orissa). Vegetative propagation study through different size of branch cuttings under different concentration of hormonal treatment was conducted. Seeds of *Terminalia chebula* were sown in polythene bags and germination beds. Germination, sprouting, rooting, survival and growth of the desired species under different experiments were recorded and statistically analysed.

# NEW PROJECTS INITIATED DURING 2008-09

## Project 1 : Evaluation of productivity of maize in *Dalbergia sissoo* (Shisham) and *Zea mays* (Maize) Agroforestry system. [133/TFRI-2008/Agro- I (15)].

**Status:** Site preparation and laying out of OSR trial was done. One year old *Dalbergia sissoo* seedlings were planted in 21 plots of size 10 x 10m each at 3 different spacings of 4 x 4m, 5 x 5m and 6 x 6m. Hybrid maize seeds were sown at a spacing of 60 x 20cm with tree to crop line spacing of 60 and 120cm following Randomized Block Design. The maize crop was harvested and yield data were recorded, tabulated and analysed statistically.

Tree distance 5 x 5 m with 60 cm tree to crop line spacing proved best for maximum yield of maize crop. Growth parameter i.e. collar diameter and height of each *Dalbergia sissoo* plant was recorded at the time of planting and harvesting of maize crop and soil samples were collected from each block at the time of planting and harvesting of maize crop and pH, EC, organic carbon, available N,P,K, and Ca++, Mg++ were determined. The work is in progress.

**An overview of *D. sissoo* – *Zea mays* agroforestry system.**

## Project 2: Studies on diseases of important medicinal plants and their bio-control [129/TFRI-2008/Patho-1(13)]

**Status:** Periodical survey of Seoni, Chhindwara, Dhar, Bilaspur, Raipur, Bhopal, Neemach, and Pachmarhi were conducted and diseases infesting *Rauvolfia serpentina*, *Withania somnifera* and *Chlorophytum borivillianum* were recorded and identified. Disease causing organism of *R. serpentina* were identified as *Lasiodiplodia theobromae*, *Phoma jolyana Colletotrichum dematium* and *Cladosporium* sp. Leaves and roots of *W. somnifera* were observed to be infested by *Pseudocercospora withanae and Fusarium oxysporum,*where as *C.borivillianum* was recorded to be infested by *Colletotrichum dematium, Phoma* sp. and *F. oxysporum.* Comparative study of systemic fungicide Bavisitin, a non-systemic fungicide, Thirum, a biopesticide (cow

urine + leaves of *Azadirachta indica* + *Ailanthus excelsa* + *Calotropis procera*) and antagonistic organisms (*Streptomyces* sp.) and *Bacilus firmus* were performed in the laboratory against pathogenic fungi, *L. theobromae* and *F. oxysporum*.

## Project 3: Studies on wood decay and its control in stored tropical timber. [130/TFRI-2008/Patho-2(14)]

**Status:** In all 30 wood depots of MP and Chhattisgarh (Dhuma, Narsinghpur, Jabalpur, Gadasarai, Karanjia, Rasaiyadona, Mandla, Sizora, Chilpi, Kalpi, Sohagpur, Taku, Budni, Timarni, and Kherkia, Ralamandal, Chandrakesar, Sanavat, Katghora, Nagri, Kota, Dhamtari, Chilpi, Pithora, Gariaband, Kaker, Sargipal, Kondagaon, Bhanupratapur, Korar, and Ballod) were surveyed and 650 samples of wood decaying fungi collected. 25 cultures of wood decaying fungi were prepared from collected samples and maintained in the laboratory. A total of 20 genera and 34 species of wood decaying fungi were identified. Out of these, 4 genera viz. *Hapalopilus, Ceriporiopsis* (Fig-1), *Schizopora,* and *Postia*) and 7 species viz. (*Hapalopilus nidulans, Ceriporiopsis merulinus, Trametes ochraceae, Postia placenta, Schizopora paradoxa, Pycnoporus coccineus, and Pycnoporus cinnabarinus* (Fig-2) recorded for the first time. All the collected samples of wood decaying fungi are maintained in the herbarium.

Fig.1. Wood decay fungus, *Pycnoporus cinnabarinus* fruit bodies on sal, collected from Gariyaband, Raipur (CG).

Fig. 2. Wood decay fungus, *Ceriporopsis unicolor* fruit bodies on *Peltophorum*, collected from Sargipal, Jagdalpur (CG).

### Project 4: Studies on endogenous auxin level and its relationship with adventitious rooting potential in *Dalbergia latifolia* Roxb. [131/TFRI-2008/Gen-1(17)]

**Status**: Ten phenotypically superior trees of *Dalbergia latifolia* were selected. Seeds were collected from the selected trees and seedlings raised. Sixty four seedlings from each tree were planted in separate blocks in field and maintained. Spectrophotometric method for estimation of IAA in *Dalbergia latifolia* was standardized (Stoessel and Venis, 1970). Further work is in progress.

### Project 5: Development of an information system for forest tree species associated insect and their management". [I.D. No. 132/TFRI-2008/IT Cell- 1(1)]

**Status:** Data on distribution, host range, nature of damage, period of occurrence and management techniques of two tree species viz. sal and sissoo were collected. The photographs of different insects and the nature of damage caused by them were taken. Work is in progress.

## PROJECTS COMPLETED DURING 2008-2009
**(Externally Aided)**

### Project 1: Identification of species and ethno-botanical survey.
### [ID no. 088/TFRI/2005/Bio-3(CGMFD) (6)]

**Findings:** Nine PPAs of 5 divisions were quantitatively and qualitatively analyzed as per resource survey methodology. About 50 sample plots of 0.1 ha with stratified systematic sampling design were laid out in 1000 ha area of each PPA. Four subplots of 5 x 5 m size were laid out inside the main plot. Each one of them was marked at a distance of 11.2 m from the centre of the plot on all four sides. Study of important medicinal plants and MFP species on each plot was done. Five subplots of 2 x 2m were laid out inside the main sample plot for the study of regeneration.

Phytosociological (qualitative and quantitative values for structure and composition) studies were undertaken in all the nine people protected area of 0.1 ha each site. All individuals of > 10 cm CBH (Circumference at breast height at 1.37 m) were enumerated. Data were recorded in all fifty sample plots of each 9 PPA.

The vegetation data were quantitatively analysed for density, frequency and basal area. The relative values of frequency, density and dominance were also determined. These quantities were summed up for getting Importance Value Index (IVI) of individual species. On the basis of IVI, dominant, co-dominant and main associated species are recognized in different sites. The composition of forest and regeneration status along with other growth parameters such as girth was also enumerated.

Enumeration of vegetation in the Makadi range indicated the presence of 2347 trees of over 10 cm cbh/gbh in 0.1 ha sample plot. It is represented by 29 families 49 genera and 62

species. Plant community was recognized accordingly as *Shorea - Terminalia* community. A density of 469.4 trees /ha was found *Shorea robusta* was found dominants with 110.6 trees/ ha followed by *Terminalia tomentosa, Buchanania lanzan* and other species. Basal area of trees ranges from 7.769 $m^2$/ha to 0.02$m^2$/ha. Total 62 tree species were enumerated. Forty one species of medicinal plants were recorded in Makadi PPA.

Antagarh PPA indicated the presence of 3671 trees of over 10 cm cbh/gbh in 0.1 ha sample plot. It is represented by 24 families 37 genera and 62 species. On the basis of density the species *Cleistenthus collinus* secured the highest value (146.4 trees/ha) fallowed by *Shorea robusta.* Plant community was recognized accordingly as *Cleistenthus - Shorea* community. Total basal area 11.44 $m^2$/ha was observed. Total 43 tree species were enumerated. 37 species of important medicinal plants were inventorized.

In Dugli PPA of Dhamtari area 41 tree, 10 shrub, 26 herb, 14 climber and 2 grass species have been observed. 41 tree species belongs to 19 families and 37 genera. Plant community was recognized as *Shorea – Terminalia* community. Total 41 tree species were enumerated. Density under Dugli PPA was 501.8 trees/ha and basal area 7.01 $m^2$/ha was observed. Total 39 species of important medicinal plants were listed out.

Enumeration of vegetation in the PPA Sankra range indicated the presence of 3142 trees. It is represented by 25 families, 47 genera and 53 species. Plant community was recognized as *Shorea- Cleistenthus* community. A density of 628.4 trees /ha was found *Cleistenthus collinus* was found as dominant species with 115.4 trees/ ha. Basal area of trees ranged from 3.75 to 0.002$m^2$/ha. The highest basal area was shown by *Shorea robusta*. Total 53 tree species was enumerated and 26 no. of important medicinal plant were recorded.

The vegetation in the Karpawan PPA indicated the presence of 2445 trees. It was represented by 27 families 51 genera and 60 species. Plant community was recognized as *Shorea- Terminalia* community. The total density was 489 trees /ha *Shorea robusta* was found as dominant with 110 trees/ ha. The highest basal area was shown by *Shorea robusta*. Total 60 tree species were quantitatively enumerated and 77 species listed as important medicinal plants.

Enumeration of vegetation in the Machkot PPA indicated the presence of 2232. It is represented by 27 families 46 genera and 56 species. Plant community was recognized as *Shorea- Pterocarpus* community. Total density was 469.4 trees /ha. *Shorea robusta* was found dominant with 99.2 trees/ ha. Overall total basal area covered by the trees was 13.42 $m^2$/ha. 54 tree and 77 medicinal plants species were recorded..

The vegetation in the Guriya PPA indicated the presence of 2181 trees. It is represented by 28 families 50 genera and 55 species. Plant community was recognized as *Shorea- Pterocarpus* community. Total density was 436.2 trees /ha and *Shorea robusta* was found dominant with 131 trees/ ha. The total basal area of trees in the area was 25.1 $m^2$/ha. Total 55 tree and 59 medicinal plant species recorded.

Vegetation in the Ataria PPA of Lamni range indicated the presence of 3236 trees. It is represented by 21 families, 38 genera and 42 species. Plant community was recognized as *Shorea- Terminalia* community. Total density was 647 trees /ha. It indicated high density and highly protected area. *Shorea robusta* was found as dominant with 181.6 trees/ ha. The total basal area of trees in the area was 11.87 $m^2$/ha. *Shorea robusta* showed the highest basal area. 42 tree species were enumerated and 41species of medicinal plants recorded.

The vegetation in the Keonchi PPA, indicated the presence of 1172 trees. It is represented by 20 families 33 genera and 37 species. Plant community was recognized accordingly as *Shorea- Terminalia* community. Total density was 468.4 trees /ha and *Shorea robusta* was found as dominant species. The total basal area of trees in the area was 34.23 $m^2$/ha. Total 37 tree species were enumerated and 72 species of medicinal plants were recorded.

In all, 1114 species of flora (tree, shrub, herbs, grasses and climbers) in all PPAs including species observed in low intensity and under threat were also listed.

## Project 2: Screening of indigenous species of *Trichogramma* Westwood *Trichogrammatoidea* Girault (Hymenoptera: Trichogrammatidae) from central India and their utilization against important forest insect pests. [077/TFRI/2005 / Ento-(1) 9].

**Findings:** Of the 2590 specimens collected from MP,CG, MS and Orissa 37 species of *Trichogramma viz. T. achaeae*, *T. agriae, T. breviciliata, T. latipennis, T. kankerensis*, *T. chilotraeae, T. flandersi, T. fasciatum, T. hesperidis, T. higai, T. plasseyensis, T. raoi, T. sembeli, T. semblidis, T. pallidiventris, T. vargasi, T. thalense, T. sericini, T. julianoi, T. bezdenkovii, T. parkeri, T. brevicapillum, T. nomlaki, T. tshumakovae, T. fuentesi, T. ingricum, T. savalense, T. margianum, T. rossicum, T. ostriniae, T. artonae, T. clotho, T. lachesis, T. lenae, T. pretiosum, T. poliae, T. stampai* ,and 04 species of *Trichogrammatoidea* viz. *Trichogrammatoidea bactrae, T. fumata, T. armigera & T. ruficorpa* were recoded for the first time from central India.

Ten species of genus *Trichogramma* and two species of Trichogrammatoidea are proposed as the species new to science. Complete host-range has been prepared, after consulting the world literature for all available species of *Trichogramma* & *Trichogrammatoidea*. Live culture of 4 indigenous species viz., *Trichogramma raoi, T. plasseyensis, T. latipennis & T. breviciliata* are being maintained.

## Project 3: Standardization of sustainable harvesting practices of Arjuna (*Terminalia arjuna)* Bark. [ID.No. 078/TFRI/2005/NWFP-1(MPFED) (12)]

**Findings:** *Terminalia arjuna* (Arjuna) is a well-known medicinal plant whose bark is extensively used in ayurvedic medicine, particularly as cardiac tonic. Demand for Arjun bark, both in India and abroad has been growing rapidly for over a decade. The bark is collected entirely from the wild sources. Presently the bark of Arjuna is being extracted through unscientific and destructive harvesting practices. This is the first study on development of sustainable harvesting practices of Arjun bark. *T. arjuna* has the ability to withstand bark removal as long as the vascular cambium is not destroyed. Trees of different girth class *T. arjuna* were selected in the forest areas as well as in farmers field in Balaghat district of Madhya Pradesh to lay out experiments for development of sustainable harvesting practices to harvest its bark. Each tree was individually tagged and revisited after regular intervals (six months) to take observations on wound healing. The trees were also monitored for general growth pattern, survival and flower and seed production.

The study revealed that the regeneration of bark in young trees was faster in comparison to old trees. The bark was regenerated in two years. The study also showed that the stage of bark recovery (regrowth) varied from tree to tree. Age of tree, harvesting technique (e.g. blaze making) and factors like temperature, relative humidity and time of stripping influenced wound healing. The quality of trunk bark was superior in comparison to bark of other plant parts (stem, twigs). Thickness of bark at breast height varied from 8.12 to 20.96 mm and was found to be irrespective of the age/girth of tree. The medium aged trees gave better quality of bark in terms of their major active ingredients. The best time to harvest bark was found between March and April. The study recommends that for sustainable harvest, only ¼ or $1/3$ of the mature bark of total girth of the tree should be stripped by removing only outer and middle bark leaving the inner bark for regeneration from opposite quarters of the trunk. Thus sustainable bark harvesting can be done after every two years by removing opposing quarters of trunk bark rather than girdling the trees.

## Project 4: Standardization of non-destructive harvesting practices of Aonla (*Phyllanthus emblica*), *Baheda* (*Termania bellerica*) and *Baividang* (*Embelia ribes*) fruits. 097/TFRI/2005/NWFP-8 (CGMFD) (20)]

**Findings:** *Phyllanthus emblica* (Aonla), *Termania bellerica* (Baheda) and *Embelia ribes* (Baividang) are important NTFPs/medicinal plants and collected in large quantities. Non-destructive harvesting practices of these species were standardized during the course of study. The study revealed that harvesting time plays very important role in maintaining the sustainability because only mature fruits produce viable seeds. The fruits if harvested at right maturity in Aonla (December-January), Baheda (January-February) and Baividang (November-December), they produce viable seeds. Even small quantities of fruits (5-10%) were found sufficient for regeneration. The study also suggests that anthropogenic pressures other than harvest could be responsible for difference in regeneration between protected and unprotected areas, which are managed under similar harvest intensities. Grazing and fire is the major causes for poor regeneration. In protected areas 10-20 % Aonla fruits were found sufficient for regeneration. However, in unprotected areas less regeneration was observed even if 20% fruits were left for regeneration. In Baividang 5-10 % fruits were found enough for proper regeneration in protected areas of Dhamtari district in good fruiting year it harvested in December. In Baheda even 5-10 % fruits were found suitable for its regeneration in protected areas if harvested in the month of January. In Baheda the seed dispersal is very poor. For proper dispersal and to maintain sustainability mature seeds should be dispersed in the forest area. These practices may be helpful for the sustainable management of these important medicinal plants.

## Project 5: Standardization of non-destructive harvesting practices of Arjun (*Terminalia arjuna)* and Maida (*Litsea glutinosa*) bark. 096/TFRI/2005/NWFP-8 (CGMFD) (19)

**Findings:** *Terminalia arjuna* (Roxb.) Wight & Am. (Family Combretacae) commonly known as Arjun is a well-known medicinal plant whose bark is extensively used in ayurvedic medicine, particularly as cardiac tonic. *Litsea glutinosa* (Lour.) Robinson locally known as Maida belongs to family Lauraceae is a medium sized tree. Its bark is used to treat joint pain, fracture, sprain, arthritis, back pain, and indigestion, cough and dryness of skin. Mass scale collection of the bark

of this plant for incense making (Agarbatti) has threatened the survival of this species from the natural habitat.

The study revealed that the regeneration of bark in young trees was faster in comparison to older trees. In Arjuna, the bark was regenerated in two years whereas in Maida it took only one year. In Arjuna, the quality of trunk bark was superior in comparison to bark of other plant parts whereas no significant difference was found in Maida. In Arjuna, the bark thickness at breast height varied from 8.12 to 20.96 mm and was found to be irrespective of the age/girth of tree. The tannin content in Arjuna bark ranged from 6.89 to 11.83 gm per 100 gm. Mature Maida trees had thick bark with less mucilage content in comparison to younger trees. The study also showed that the stage of bark recovery (regrowth) varied from tree to tree. Age of tree, harvesting technique (e.g. blaze making) and factors like temperature, relative humidity and time of stripping influenced wound healing in Arjun and Maida. No adverse trends were observed in the overall development of tree. Arjun showed remarkable bark regrowth in moist sites. The medium aged trees gave better quality of bark. The best time to harvest bark was found between December and March. The study recommends that for sustainable harvest, only ¼ or $1/3$ of the mature bark of total girth of the tree should be stripped by removing only outer and middle bark leaving the inner bark for regeneration from opposite quarters of the trunk. The length of blaze/strip can be upto 1.20 meter depending upon girth of the trees. A long strip of one quarter of the trunk may be removed with sharp thin edge tool designed for the harvest of bark. Thus sustainable bark harvesting can be done after every two years (in Arjun) and one year (in Maida) by removing opposing quarters of trunk bark rather than girdling the trees.

## Project-6 : Processing techniques of NWFPs of Chhattisgarh TBOs–*Madhuca latifolia, Shorea robusta,Schleichera oleosa, Pongamia pinnata* and *Buchanania lanzan*. ID No. :091/TFRI/2005/NWFP-3(CGMFD)(14)

**Findings:** Study conducted on processing of Tree Borne Oil seeds (TBOs) *i.e.*. Sal (*Shorea robusta*), Chironjee (*Buchanania lanzan),* Karanj (*Pongamia pinnata)*, Mahua *(Madhuca latifolia)* (Mahua) and Kusum (*Scheichera oleosa*) indicates that method of drying and storage in containers affect the quality of oil seeds severely. Different methods of drying i.e. shade ,sun drying ,hot air drying at 40 ,60 and 80ºC were used to dry the tree borne oil seeds .Hot air drying at 60ºC proved better in comparison to sun drying /shade drying methods to maintain quality of seeds. At 80ºC, the moisture of the seeds decreases rapidly and affect the quality of seeds. Hot air drying at 60 °C for 8 hours were found to be most effective in minimizing moisture content to 7-9% without affecting oil quality and undesirable changes in lipids and its properties. The kernels obtained after processing of seeds should be dried properly before storing to avoid deterioration due to pests. This will ensure availability of good quality seed kernels for the extraction of oil with minimal deterioration.

## Project 7: Quality assessment of NWFPs: *Asparagus racemosus , Buchanania lanzan*, *Andrographis paniculata*, *Phyllanthus emblica* and *Embelia ribes* from Chhattisgarg. ID No.: 092/TFRI/2005/NWFP-4 (CGMFD) (15)

**Findings:** The maximum weight of fresh Aonla fruits was recorded as 6.89 gm, pulp weight 6.44gm and ascorbic acid was recorded as 197.2mg/100 gm fresh aonla in samples collected

from Ambikapur. In Jabbara Nagan the maximum fresh weight of Aonla was recorded 6.447 gm and the pulp weight was 6.53 gm and ascorbic acid 143.5 mg /100 gm of fresh weight. Ascorbic acid contents was found to be significantly higher in aonla samples collected from Kanker. Maximum weight of fresh fruit was recorded 5.77 gm, pulp weight 4.99 gm and ascorbic acid 326.3 mg/100gm of fresh fruit.

The fruit weight of Chironjee ranged from 0.552 to 0.802 gm with maximum fruit weight in Kapu, Dharumjaigarh samples. Samples collected from Kudur, Kawardha showed maximum kernel weight (1.20 gm) and oil (62.57%).

Out of 20 localities surveyed for the quality of Chironjee, the maximum fruit weight of 0.802 gm was recorded from Kapu and Dharmngaigarh samples. The maximum oil percentgage 62.57% was observed from the samples collected from Kudur and Kawardha.

Roots of Satawer (*A.racemosus)* were collected from 22 localities of Chhattisgarh during April-May. Maximum average root length of 25.35cm and dia 1.02 cm and saponin percentage of 2.5 % was observed in the samples of Dondi (Durg), which are significantly higher than other localities.

Kalmegh samples were collected from 19 localities. Andrographolide contents were observed to vary from 0.27 to 0.49%. Maximum andrographolide content was found in the samples collected from Jagdalpur (o.49%).

Physical and chemical parameters of fruits of *Emblia ribes* were studied in samples collected from 5 localities of Chhattisgarh. The moisture % and embelin contents were estimated. Embelin concentration was ranged from 1.98-2.94%. Maximum concentration of 2.94% was estimated in the sample collected from Jabbara, Dhamtari.

## Project 8: Non destructive harvesting practices for selective MFPs species– *Buchanania lanzan* (Chironjee). ID No. : 093/TFRI/2005/NWFP-5 (CGMFD) (16)

**Findings:** Surveyed and selected nine different Chironjee growing areas of Chhattisgarh state.The fruits were harvested on the basis of occular/ visual observations, number of branches per tree. Fruits were collected non destructively either by hand or with the help of long bamboo sticks. Sometimes beaten slowly to help fallen the fruits

Annual recruitment of young seedlings varied from site to site. Harvesting 90% fruits at Kota, Bilaspur resulted 7.90, 9.04 and 8.20% seeding recruitment in $I^{st}$, $II^{nd}$ and $III^{rd}$ years, respectively. In non-harvested control sites it was 5.80, 9.69 and 9.69% respectively. It indicates that the population is increasing both in controlled as well as in different levels of harvesting.

## Project 9 : Sustainable yield assessment/harvesting of Non Wood Forest Produce (NWFP) in People's Protected Areas (PPAs) of Chhattisgarh [098/TFRI/2005/Silvi-3 (CGMFD -10)]

**Findings**: Sample plots of *Andrographic paniculata* (Kalmegh), *Aspargus racemosus* (Satawar) *Celastrus paniculata* (Malkangani) and *Egle mormlos* (Bael) were laid out in three agro-climatic zones (Bastar, Raipur and Bilaspur) of Chhattisgarh.

Sustainability for *Andrographic paniculata* with maximum productivity was found to be at 80% harvesting level. As such 80% of entire plants of *Andrographic paniculata* may be harvested. Sustainability for *Aspargus racemosus* with maximum productivity was found to be at 60% harvesting level. Eight month olf plants of *Aspargus racemosus* should only be harvested.

Sustainability for *Celastrus paniculata* with maximum productivity was found to be at 80% harvesting level. Similarly sustainability for *Egle mormelos* (Bael) with maximum productivity was found to be at 80% harvesting level. Regeneration through root suckers was found better than through seeds. Regeneration through root suckers by hoeing 10-15 cm. deep is advisable around the trees.

Socio-economic status and living standard of people in JFM areas have been found to be better due to implementation of the scheme by way of employment and enhancement of production of medicinal plants.

### Project 10: Nursery technologies for mass multiplication of superior seedlings of Vaividang, Sarpgandha, Chironjee Arjun, Aonla, Bael in Chhattisgarh [099/TFRI/2005/Silvi-4 (CGMFD -11)]

**Findings :** Nursery technologies for mass multiplication of superior seedlings of *Embelia ribes* (Vaividang), *Rauvolfia serpentina* (Sarpgandha), *Buchanania lanzan* (Chironjee), *Terminalia arjuna* (Arjun), *Emblica officinalis* (Aonla), *Egle mormelos* (Bael) in Chhattisgarh were standardized.

## PROJECTS CONTINUED DURING 2008-09 (Externally Aided)

### Project 1: Identification of suitable tree species and other vegetation for biodrainage in Bargi command area (Jabalpur, M.P.). [087/TFRI/2005/Ecol-1(MOWR)(6)].

**Status :** Dead seedlings were replaced by the healthy seedlings of same age during rainy season in the plantation raised along Left Bank Canal (LBC) of Bargi Command Area, Jabalpur. Seedlings of *Jatropha curcas* and *Agave americana* were planted surrounding the plantation area as biofencing.

Forty lysimetric tanks were constructed in the institute's campus to simulate the experiments being conducted along LBC. The experiments were set up in the lysimetric tanks with same tree species planted along the canal. The water levels maintained in the lysimetric tanks were : 0-0.25 m, 0.25 to 0.50 m, 0.50 to 0.75 m and irrigated (control). In another experiment, the tolerance of *Eucalyptus hybrid* with different salinity levels was tested.

Growth data of planted seedlings were regularly collected along LBC of Bargi Command Area and lysimetric tanks. These data were collected at an interval of 3 months along LBC and at monthly interval in lysimetric tanks. Biomass studies were also conducted at regular interval.

Under ground water table below plantations of different tree species and control area was regularly measured with the help of observation wells. The effect of different tree species on water table was observed and compared with control.

Soil samples from different plantation sites were collected and analyzed for their physico-chemical characteristics including pH, EC, CEC, organic carbon, available N,P,K, exchangeable Na, K, Ca and Mg, mechanical analysis *etc*.

Training on 'Bio-drainage' was organized at village Dabhola along Left Bank Canal (LBC) of Bargi Command Area, Jabalpur (M.P.) for farmers and tree growers. Field trip for the trainees was conducted to plantation area raised under the project.


Fig. 1 : Measurement of photosynthetic rate and allied parameters.
Fig. 2 : Lysimteric experiments
Fig. 3 : Measurement of underground water table by observation well along LBC of Bargi Command Area, Jabalpur
Fig. 4 : Farmers' training on 'Biodrainage' organized at village Majitha (Jabalpur)

## Project 2 : Lead institution for Achanakmar-Amarkantak Biosphere Reserve, Chhattisgarh. [102/TFRI/2006/Ento-1/MoEF (12)] *Principal Investigator*

**Status** : Updated list of various flora consisting of fungi, lichens, ferns and angiosperm and fauna and the information disseminated to B.R. managers. Data on the population of different communities existing in Achanakmar-Amarkantak Biosphere Reserve also collected. Prepared saville strategy based on Madrid Action Plan and submitted to Ministry of Environment & Forests. UNESCO nomination form and supporting documents for designation of B.R. in World Network drafted and submitted to State Forest Department of Chhattisgarh for their suggestions.

## Project 3 : Development of integrated insect pest and disease control system for major economically important forest tree species. [112/TFRI-2006/Ento.4 (MPFD) 15)]

**Status:** Survey was conducted at 8 selected localities of Madhya Pradesh to monitor the insect pests and diseases of aonla and teak. Incidence of teak leaf skeletonizer, *Eutectona machaeralis* and aonla shoot gall forming insect, *Betousa stylophora,* leaf roller, *Garcillaria acidula*, fruit sucker *Scutellera nobilis*, and wilt /root rot / foliar diseases, *Fusarium solani, Pseudomonos tectonae, Polyporus zonalis, Rigidoporous lineatus* and *Peniophora* species and *Olivea tectonae* were recorded in nurseries, plantations and natural forests. Experiments were laid out on IPM of skeletonizer *E. machaeralis* in teak plantations at Kanjai (Lamta Forest Project Division, Balaghat). Bio-insecticides / fungicides were used against *E. machaeralis.* Work is in progress.

## Project 4: Development of model for the management of white grubs in teak nursery, under the concept of Integrated Pest Management. [ID No. 113-2007/Ento–1(FDCM, MS)(16)]

**Status:** Monitoring, observations and experimentations on *H. rustica, H. mucida* and *S. ruficollis* since the initiation of the emergence of beetles in the field revealed relationship of beetles emergence and rising relative humidity. Data indicated that in all years there was a marked increase in humidity (approx 40 – 60% increase over a few days) along with a noticeable decrease in temperature (approx. 5 $^0$C over the same period, 6-9 days prior to the first emergence of beetles). Rainfall 2 - 3 weeks prior to the date of emergence did not induce beetle emergence, due possibly to the lower atmospheric relative humidity (< 50%). After the increase in RH, even moderate amount of rains induced the emergence of beetles.

Beetles attract preferably to *Z. jujuba* or *Z. mauritiana.* Folior spraying of monocrotophos or dimethoate 0.05% kills the beetles resulting less number of egg laying. Entomopathogenic nematode EPNs proved effective to kill the whitegrubs in laboratory. Phorate/ methyl folidol @ 300g/ bed (size 12 m X 1.25m) in combination and alternately with the cadavars of EPN *H. indica* and *S. carpocapsae* @ 250 – 300/ bed in good watering conditions proved effective in reducing the incidence of seedling mortality caused by while grubs damaging teak seedlings. The juveniles of nematodes L. were recovered after 1 month of its release proving their survival in the field.

**Project 5: Isolation, identification and evaluation of insecticidal phytochemicals from *Annona squamosa* L. (Annonaceae) against *Hyblaea puera* Cram and *Eutectona machaeralis* Walker, two major pests of teak (*Tectona grandis* Linn.). [ID No.122-2007/Ento-3(CSIR) (18)]**

**Status:** The seeds of *Annona squamosa,* were extracted in six solvents viz. petroleum ether, ethyl acetate, ethyl alcohol (ethanol), acetone, methanol and water, using *Soxhlet's Apparatus*. Bioassays for antifeedant, growth inhibitory effects of the extracts were carried out against the larvae of teak defoliator, *Hyblaea puera* and teak skeletonizer, *Eutectona machaeralis* with preliminary testing of six crude extractives of *Annona* seeds, viz., petroleum ether, ethyl acetate, ethyl alcohol (ethanol), acetone, methanol and water. For feeding inhibition property concentrations/ doses ranging from 25ppm to 3000ppm of each promising extractive tried. Probit analysis of has been performed. Based on bioassay results, further bioassay-directed-separation of the active compounds is in progress. Extracts/ fractions were subjected to Ultraviolet (UV) and Infra Red (IR) Spectroscopy for further elucidating the compounds. Further fractions of petroleum ether and ethyl acetate crude extracts were obtained by subjecting the crude extracts to column chromatographic separation serially in different organic solvents. Chemical profiles of the fractions were frequently analyzed using Thin Layer Chromatography (TLC). The bioassays for evaluating efficacy of these chromatographic fractions and determination of $EC_{50}$, $EC_{90}$/ $LC_{50}$, $LC_{90}$ values of the promising fractions are in progress.

**Project 6: Studies on taxonomy of Braconid parasitoids (Hymenoptera: Braconidae) from central India. [123 / TFRI / 2007 / Ento-4 (CSIR)(19); funded by CSIR, New Delhi / 2007-2010]**

**Status:** Taxonomic survey of important forest and agro-forestry areas of Chhattisgarh (Rajnandgaon) and Maharashtra (Bhandara, Gondia, Chandrapur, Gadchiroli, Nagpur, Wardha, Amravati, Ahmadnagar, Pune, Raigad, Ratnagiri, Sindhu Durg, Kolhapur, Sangli, Satara, Yavatmal, Buldana, Jalgaon, Nandurbar, Dhule, Nashik, Thane, Aurangabad and Jalna) were carried out for Braconid collection. In all, twenty two species of Braconids viz. *Apanteles agilis, Apanteles detrectans, Apanteles creatonoti, Apanteles efferenus, Apanteles hyblaeae, Apanteles tachardiae, Apanteles bambusae, Apanteles cajani, Apanteles caniae, Apanteles platyedrae, Apanteles lamprosomae, Apanteles antipoda, Apanteles significans, Chelonus dwibindus, Chelonus narayani, Chelonus notauli, Chelonus indicus, Eutropobracon granulatus, Cassidobracon castrus, Habrobracon brevicornis,Homolobuospand spgalphus sp.* were identified.

**Project 7: Studies on the natural enemies of teak pests, *Hyblaea puera* and *Eutectona machaeralis* and their role in suppressing the population of insects in Madhya Pradesh. [127/TFRI/2008/Ento-1(MPCST)(20)]**

**Status:** Periodical surveys were conducted in teak forests of Madhya Pradesh for collection of natural enemies of major insect pests of teak, *Hyblaea puera* and *Eutectona machaeralis*. The natural enemies recorded include 6 species of parasitoids (*Apanteles machaeralis*, *Apanteles* sp., *Brachymeria* sp., *Sturmia* spp., *Trophocampa indubia* and *Xanthopimpla cera*), 5 species of predators (*Calleida splendidula*, *Canthecona furcellata*, *Corvus macrohynchos*, *Erthesina fullo*

and unidentified spider) and 2 species of fungal pathogens (*Aspergillus flavus* and *A. niger*). Carried out laboratory rearing of a predator, *C. furcellata* and culture of 2 pathogens, *A. flavus* and *A. niger* for tests against target insect pests.

## Project 8: Varietal improvement of *Rauvolfia serpentina* and *Tinospora cordifolia* through germplasm selection, evaluation and breeding. [ID No. : 100/TFRI/2006/Gen-1 (MoHFW) (10)]

**Status :** Data recorded after 24 months of planting from introduction trial of *R. serpentina*, laid out at TFRI, Jabalpur in December 2006, showed that CW-MP accession belonging to Chhindwara (M.P.) recorded maximum root diameter (1.62cm). The maximum root length (47.17cm) was recorded in JS-OR accession belonging to Jassipur, Orissa. The maximum number of root branches (12) and total bio-mass (266.54 gm) were recorded in NN-WB accession belonging to Nanungeria (WB) and root yield per plant (129.06gm) in ZR-CG accession belonging to Zora (C.G.).

The spectrophotometeric method for estimation of total alkaloids was standardized for both species (*R. serpentina* and *T. cordifolia)*. Total alkaloids (%) in 15 accessions of *R. serpentina* were estimated. The results on total alkaloids clearly exhibited some promising accessions of *R. serpentina, viz.*, KL-AJ (1.88%) belonging to Anjanakund, Kerala, ZR-CG (1.67%) belonging to Zora, (C.G.) and AG-OR (1.52%) belonging to Anugul, Orissa which contained higher amount of total alkaloid than JS-OR (1.00%) belonging to Jassipur, Orissa. Reserpine content in 15 accessions of *R. serpentina* was also estimated through HPLC method, data being analyzed.

The multi-location evaluation of germplasm of *R. serpentina* was established at Chandrapur (Maharashtra) in July, 2008 (Fig 1a), Raigarh ( Chhattisgarh) (Fig 1b) and Jabalpur, (M.P.) (Fig 1c). These trials were established in randomized block design with three replications. Each accession was represented by nine plants per replication. Observations on the survival of the plants at Raigarh exhibited better survival than the remaining two localities.


Figure 1: Establishment of multi location field trial at (a) Chandrapur (M.S.), (b) Raigarh (Chhattisgarh) and (c) Jabalpur (M.P.)

**Project 9: Studies on *in vitro* regeneration of plantlets and their genetic (molecular) fidelity in *Saraca indica* Linn., a vulnerable medicinal tree. [ID No. 111/TFRI-2006/Gen.-2(CSIR)(12)]**

**Status :** Seeds were collected from mature trees from Jabalpur and Pipariya. They were germinated under *in vitro* conditions on MS basal semisolid medium.In all, 60-70 % germination was obtained. Shoots were further multiplied on MS semisolid medium supplemented with 10 µM BA (Fig.). The effect of different seasons and sterilizing agents on aseptic culture establishment were studied, taking nodal explants from 2-3 year old seedlings and terminal buds from 20 year old tree. Highly significant effect of seasons was observed on sprouting of buds with maximum sprouting (35.18 %) obtained in summer season in 2-3 year old plants. Sterilizing treatments also had significant effect on sprouting of buds with 0.2 % $HgCl_2$ treatment resulting in maximum sprouting (38.89 %). During surface sterilization of terminal buds from 20 year old mature tree, 0.2 % $HgCl_2$ treatment resulted in maximum alive bud during autumn and winter season. Shoot formation from embryonic axis of immature seeds was obtained on $B_5$ medium supplemented with 2.5 µM BA. Zeatin doses and interaction between zeatin and BA did not significantly affect number of shoots. Maximum callus formation (64%) on embryonic axis was obtained on $B_5$ medium supplemented with 2.5 µM BA. In another experiment with embryonic axis, the interaction between 2, 4-D and TDZ had a significant effect on number of shoots with 3.56 shoots obtained on 2 µM 2, 4-D and 10.0 µM TDZ. On medium containing 2 µM 2, 4-D + 10 µM TDZ + 10 µM zeatin, well formed shoots were obtained on embryonic axis along with callus (Fig. 1b). Leaf pieces were tried for organogenesis. Significant effect of various auxins was observed for callus formation on leaf pieces with picloram resulting in maximum (62.50 %) callus formation. Zeatin doses and their interactions with auxins did not have any significant effect on callus formation on leaf pieces. On $B_5$ medium supplemented with 13 µM NAA, 6 % rooting of shoots was obtained.

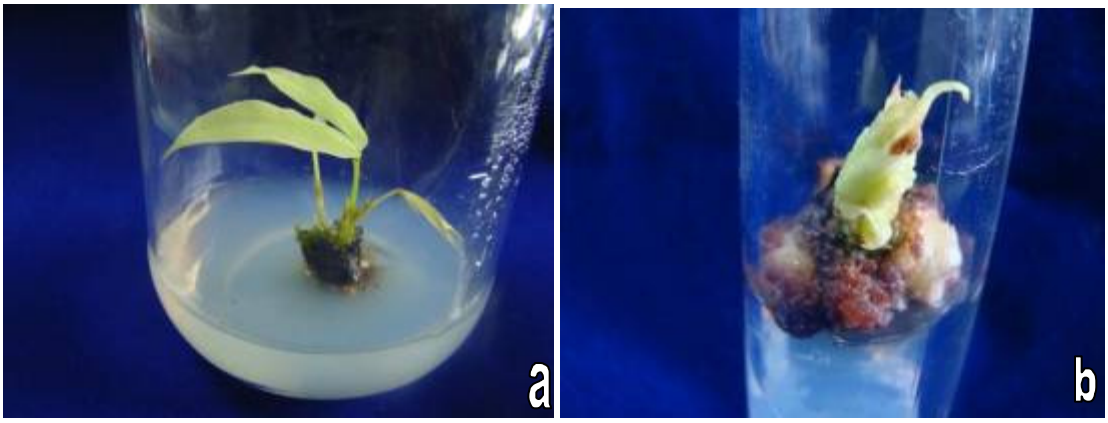



Fig. 1: (a) Multiple shoots obtained on 10 µM BA from cotyledonary nodes in *Saraca indica*; (b) Formation of shoots from embryonic axis on $B_5$ medium supplemented with 2 µM 2, 4-D, 10 µM Zeatin and 10 µM TDZ in *Saraca indica*.

**Project 10**: **Evaluation and prediction of oil bearing capacity of Sandal (*Santalum album* L.) germplasm using physio-morpho–molecular marker [ID No. : 120/TFRI/2007/Gen-3/DSAE (15)]**

**Status:** In all, 47 mature sandal trees were selected at IWST, Bangalore, marked and their GBH, heartwood ratio and percentage of oil content were estimated. A lot of variation with respect to growth and oil content of selected sandal trees was recorded. Tree IW53 had the highest GBH of 97 cm and Tree IW23 exhibited the lowest value for GBH of 32 cm. The heartwood/sapwood ratio was maximum in Tree IW24 (0.75) and minimum in Tree IW23 (0.14). Tree IW57 had the highest oil content of 3.25% and Tree IW3 had the minimum oil content of 0.19%. The oil content did not show significant correlations with GBH or heartwood/sapwood ratio.

Genomic DNA from leaves of the selected sandal trees of IWST, Bangalore was extracted following the modified method of Doyle and Doyle (1990). Tree IW36 yielded maximum genomic DNA of 651 ug/500mg fresh leaf, whereas Tree IW20 had minimum genomic DNA of 18.86ug/500mg fresh leaf. The quality (A260/A280) of genomic DNA ranged from 1.41 to 2.0, which was adequately purified for setting PCR-ISSR assay.

Genomic DNA in three replicates was extracted from thirty trees each of TP and TO following the modified method of Doyle and Doyle (1990). Tree TP- 27 yielded maximum genomic DNA of 323 µg/ 100mg fresh leaf, whereas tree TP-7 had minimum genomic DNA of 6.47 µg/100mg fresh leaf.The quality (A260/A280) of genomic DNA ranged from 1.08 to 1.98, which was adequately purified for setting PCR-ISSR assay

Nitrate reductase activity in the second and third quarter was determined in leaves of selected 30 trees each from TP and TO plantation area. In the second quarter, Trees from TP selection exhibited more enzyme activity than those from TO selection. Tree TP-15 and Tree TO-16 had maximum enzyme activity. On the other hand, the lowest enzymatic activity was recorded in Tree TP-3 and Tree TO-22 among their respective selections. In the third quarter, Tree TP-8 and TO-9 had maximum enzyme activity but Tree TP-28 and Tree TO-21 recorded the lowest enzymatic activity among trees of their respective selections.

27 sandal trees of TP and three trees of TO were sampled at 50 -150cm above ground for collection of eight wood core samples per tree. The wood core samples are being analyzed for oil content. Genomic DNA of 24 IWST sandal trees graded on the basis of oil content was amplified using 26 selected ISSR primers

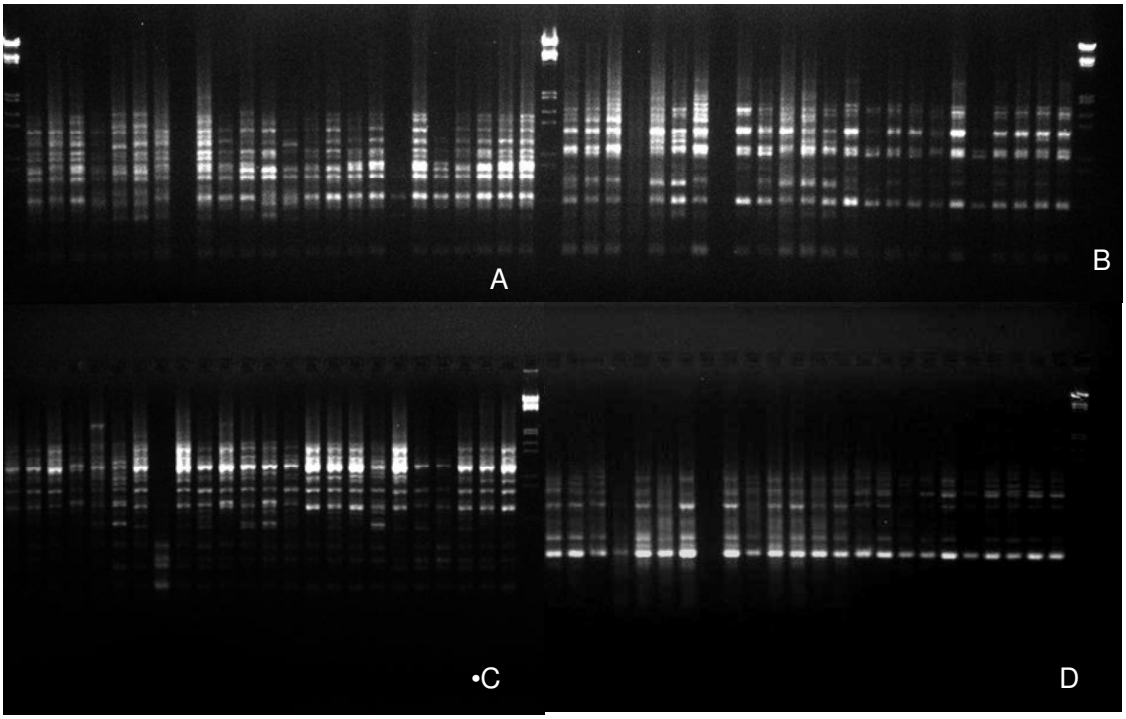



Fig 1: Amplification of sandal genomic DNA by ISSR primers : (A) UBC 822 (B) UBC 824 (C) UBC 834 and (D) UBC 900

**Project 11: Molecular characterization of *ex-situ* conserved germplasm and identification of molecular associated with wood quality traits in *Tectona grandis* L.f. [ID No: 125/TFRI/2007/Gen-4(DBT)(16)]**

**Status**: Field visits were conducted to collect branches from three ramets each of 97 plus trees of *Tectona grandis* maintained at National Teak Germplasm Bank, Chandrapur (Fig. 1a). The trees represented 12 teak growing states of the country.

The collected branches (Fig. 1b) were cut into small shoot cuttings of around 8 inch length and treated for 5 minutes with 0.1 % $HgCl_2$. The surface sterilized cuttings were administered 200 ppm IAA and 200 ppm thiamine solution for 4 hours at their base, followed by sealing of top cut end with wax. The auxin treated five cuttings each of three ramets per plus tree were planted in polybags filled with potting mixture (Fig. 1c). After 1 month of the planting, the cuttings produced sprouts to the tune of 40% (Fig. 1d). Young leaves of sprouts were harvested for the extraction of genomic DNA.

Field visit was also undertaken to collect ten branches with dormant buds from 15-31 progenies (half sib families) of nine plus trees (A-5,A-4,A-3,A-7, A-16,A-17,A-10,A-21,A-35), which were raised in a trial comprising three replicates each of 16 trees at National Germplasm Bank Lohara, Chandrapur, Maharastra (Fig. 2a,b).

Genomic DNA of leaves of plus trees and apical bud of progenies was extracted, taking 100 mg fresh leaves using modified method of Doyle & Doyle (1990).To avoid RNA contamination, 20µg/ml RNAse was used. Integrity and quantity of the extracted DNA were estimated spectrophotometrically and visualized on 0.8 % agarose gel (Fig. 1e).The average yield of genomic DNA of plus trees was 70 µg ± 57.61 µg / 100 mg fresh wt ( Range: 14.0 µg - 250.0 µg), wheras the quality of DNA (A260 / A280) was 1.74 ± 0.15 (Range: 1.40 – 1.95 ). The quantity of genomic DNA of progenies ranged from 27.12 µg to 71.34 µg and visualized on 0.8 % agarose gel (Fig. 2c) and the quality (A260/A280) of genomic DNA extracted from apical bud of progenies, from 1.09 to 1.81. STMS primers were designed and tested for amplification and STMS assay for genomic DNA, standardized.

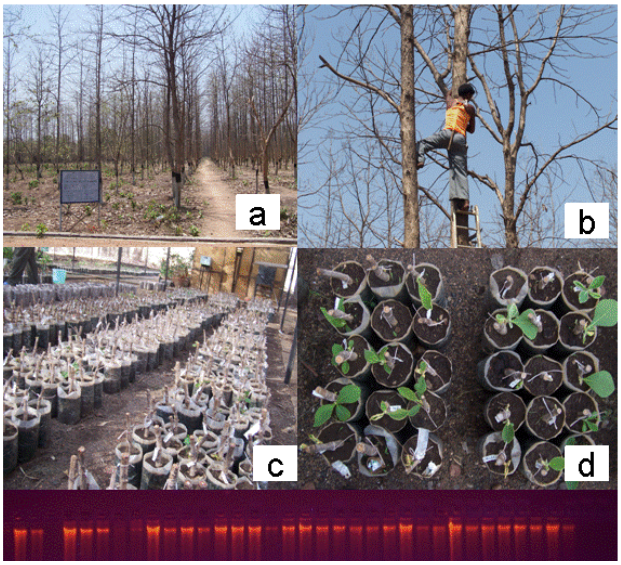



Fig. 1. Plus trees of teak (*Tectona grandis*): (a) A view of germplasm bank at Chandrapur; (b) Collection of branches from plus trees; (c) Planting of branch cuttings; (d) Emergence of sprouts for genomic DNA extraction; (e) Visualization of genomic DNA of plus trees on 0.8% agarose gel.


Fig. 2. Progenies of plus trees of teak (*Tectona grandis*): (a), (b) Collection of apical bud of plus tree progenies from the trials and (c) Visualization of genomic DNA of progenies on 0.8% agarose gel.

## Project 12: National Network on Integrated Development of Jatropha and Karanj.73/TFRI-2004/NWFP-3(NOVOD)(11)

**Status:** ***Jatropha curcas*:** Multilocational trials in the form of national, zonal, progeny and package of practices established at the institute campus, experimental area at Barah, Jabalpur and in Chhindwara are being maintained. Third national trial of *Jatropha curcas* comprising of 14 accessions received from various network institutes/centres has been established at TFRI campus, Jabalpur. The observations on growth attributes like height, collar diameter, number of branches etc. are recorded on regular intervals. The trials are performing well and the survival is more than 90%. In national trial, accessions TNMC-5 and TFRI-2 performed best among all other accessions, whereas in zonal trial IGAU-1 performed well among all other accessions received from different member institutions with respect to growth attributes. Maximum fruiting was observed in TNMC-5 (national trial) followed by TFRI-2 (zonal trial). Pruning operations in Jatropha induced more number of branches which lead to more production/fruits. The findings of package of practices trial shows that the seedlings planted on ridges in the last week of July 2005 performed better than the seedlings planted in pits.

*Pongamia pinnata* (Karanja): 10 CPTs of Karanja were selected in Dindori and Jabalpur district of Madhya Pradesh. Experimental trial in the form of national, zonal and progeny trials established in institute campus, Barah experimental area and Bhandamuri, Balaghat are being maintained. The observations on growth attributes like height, collar diameter, number of branches etc. are recorded on regular intervals. In national trial accession number TNMP-6 received from TNAU, Mettupalayam, Tamilnadu performed best among all other provenances, whereas in zonal trial TFRI-2 performed best with respect to growth attributes. Progeny collected from Jhinjhari, Katni-1 (height 241.71 cm; collar diameter 3.61 cm; number of branches 14) performed well among all other progenies in respect of growth attributes. Significant variation was observed in the growth attributes among different progenies.

## Project 13: Integrated development of bamboos for economic upliftment in central India [126/TFRI/2007/Agro-1(NBM)]

### Sub Project - I : Sustainable development of new bamboo agroforestry techniques for increased income generation in the central Indian states.

**Status :** Established Bamboo – Wheat Agroforestry trial as an On Station Research (OSR) trial at the Agroforestry Experimental Plot, TFRI, Jabalpur. The wheat crop had ripened fully and is ready for harvesting during April, 2009.

The soil samples collected during the previous quarter, i.e., before the planting of bamboo seedlings and the sowing of wheat, were analysed physico-chemically and the results were determined and tabulated thereafter.

Seventeen progressive farmers in Chhindwara district of Madhya Pradesh and sixteen in Devipur sub –Division under the Raipur district of Chhatisgarh were identified using Participatory Rural Appraisal (PRA) tools during May and June 2008 and training on the benefits of adopting bamboo based agroforestry systems was imparted to them. Seedlings of *Dendrocalamus strictus* were provided to them for planting around their agricultural fields.

**Plate 1: Bamboos growing with wheat in the established Bamboo –Wheat Agroforestry system established at the Agroforestry experimental plot, TFRI, Jabalpur.**

### Sub-project – II: Bamboo species suitability for different degraded non-forest areas in Madhya Pradesh.

**Status:** Geoenvironmental survey and study of degraded lands at Dhuma, Damoh, Hoshangabad (Bagra), Bhopal (Ratapani), Katni (Kymore, SVIL Mines, Khitola) and Rewa (Sirmore) were conducted. The degraded lands are on Basalt and Sand stone as well as on Limestone. The water table is deep around 350' to 450'. The drainage is seasonal along shallow channels. The geomorphology varies from place to place, some areas belongs to rocky terrain with moderate slope whereas other areas belongs to plateau. The soil is generally shallow with dry to low moisture and nutrient content. To know the performance of bamboo on these degraded lands, the

bamboo plantations of 2005-06, wherever located nearby to these degraded lands, have been studied.

## Sub-project – III: Insect and diseases of bamboo occurring in central India and their management.

**Status:**

### A. Identification of diseases and insect pests

Seeds of *Bambusa nutans* and *Dendrocalamus strictus* were observed to be attacked by a bug, *Ochrophara montana*. The mature seeds were examined for the fungi and insects. The seeds of *D. strictus* were damaged by an unidentified seed borer. The work on its identification is in progress.

Seeds of *Bambusa nutans* and *Dendrocalmus strictus* were sown in nursery beds and rhizomes planted at TFRI Jabalpur and bamboos grown by forest departments at selected localities of M. P. and Chhattisgarh, were screened for different diseases and insect pests. It was observed that bamboo culms are attacked by 14 fungal pathogens. *Poria rhizomorpha and Cyathus* sp. infested clumps of *B. nutans* and *Curvularia lunata* is recorded to infest the leaves of bamboos in nursery stage. Dead standing bamboo culm in plantations were observed to be infested with 4 species of fungi.

In nursery and plantation seedlings of *Bambusa nutans* and *D. strictus* were recorded to be damaged by various insect pests. Rats observed to cause a great menace to the rhizomes of *B. nutans* and *D. strictus* in nursery beds where as hares observed to feed on leading soft branches of culms of bamboos in plantations.

### B. Field trials against various diseases and insect pests

A field trial was laid out at Kosabadi (Korba) in Chhattisgarh for the control of rhizome rot and fungal diseases attacking culms in bamboo, *Dendrocalamus strictus.* In all, 6 treatment combinations including one untreated control were taken. Each treatment was replicated five times. The second dose of above pesticides were given in September 2008. The observations on number of dead culms and numbers of new culms arise will be taken in last quarter of the year. The work is in progress.

Seven field trials were laid out to investigate the lowest effective concentration of 10 modern insecticides. The different insecticidal concentrations were formulated. Each treatment was uniformly sprayed on entire bamboo seedling bed having larvae bearing rolled leaves. Each treatment was replicated thrice. The observations on percentage of larvae died after 72 hrs of spray recorded. Data showed that foliar spraying of chlorpyriphos 0.05% is best followed by endosulfan 0.05%.

To investigate the efficacy of synthetic pyrethroids, two field trials were conducted. In all, 7 insecticidal concentrations and an untreated control were taken. Each treatment was replicated thrice. The data on the percentage of larvae died after 72 hrs of spray were enumerated. It was observed that foliar spraying of fenvalerate 0.01 % is best causing 94.83 to 95.37% kill of the larvae within 3 days of the spray.

### Sub-project – IV: Nutritive value and value addition of some bamboo species of central India.

**Status:** Surveys were conducted to various bamboo growing regions of Madhya Pradesh, Maharastra and Chhattisgarh for collection of shoots of *Dendocalamus strictus, D. asper, Bambusa bambos* and *B. tulda. D. strictus* is the major bamboo species of central India followed by *B. bambos. D. asper* and *B. tulda* was found growing only in nurseries and private plantations. The collected bamboo shoots were processed for estimation of various nutrients (proteins, carbohydrates, vitamins, minerals, fibre, tannins and total phenols) and anti-nutrients (cynogenic glycosides). Maximum edible portion (77.12% of its fresh weight) was found in *D. asper* shoots whereas highest anti-nutrient (cynogens 41.82 mg./100g fresh weight) was found in shoots of *D. strictus*. Bamboo shoots were processed, dried and stored for chemical analysis and product development. Fresh bamboo shoots were treated with cold and hot water, saline and sodium bi carbonate solutions to study their effect on nutrients and anti-nutrients. 1% saline solution treatment was found best among all the treatments as it significantly reduces anti-nutrients like cynogens and retains all nutrients. The amount of nutrients in preserved bamboo shoots (1% sodium benzoate) and fresh bamboo shoots was found at par. Bamboo shoots can be preserved in 1% sodium benzoate solution as it did not have any adverse effect on their nutritional status. Two products namely bamboo pickle and bamboo vinegar have been prepared from fresh bamboo shoots.

## NEW PROJECTS INITIATED DURING THE YEAR 2008-09
**(Externally Aided)**

### Project 1: Studies on developing alternative methods of sustainable harvesting of medicinal plants. [ID no.134/TFRI/2008/NWFP-1(NMPB) (22)]

**Status:** Surveys were conducted to various agro-climatic regions of Madhya Pradesh, Chhattisgarh and Orissa for selection of targeted species i.e. *Terminalia arjuna* (Arjuna), *Bauhinia veriegata* (Kachnar), *Holarrhena antidysenterica* (Kutaj), *Oroxylum indicum* (Sheonak) and *Saraca asoka* (Ashoka) growing areas. Experiments were laid out for standardization of sustainable harvest of plant parts of targeted species in forest areas of Jabalpur, Rewa, Satna and Balaghat (M.P.); Harishankar, Bolangir (Orissa); Dhamtari (Chhattisgarh). *Terminalia arjuna*, *Bauhinia veriegata* and *Holarrhena antidysenterica* are available in the forests of central India. However, *Oroxylum indicum* and *Saraca asoka* populations were found out only in Orissa. Harvested plant parts like bark, leaves, twigs etc. were collected and brought to laboratory for chemical and biological analysis. The collected plant samples were processed and analyzed for their active chemical constituents e.g. tannins, alkaloids, phenols and flavanoids. Samples were also sent to Central Institute for Medicinal and Aromatic Plants, Lucknow for detailed chemical and biological analysis.

**Project 2: Establishment of multilocational trial of superior accession of *Jatropha curcas* under the network programme of DBT. [ID No.135/TFRI/2008/NWFP-2 (DBT)(23)]**

**Status:** A multilocational trial of *Jatropha curcas* comprising of seven accession received from different participating institutes has been laid out at institute campus. These accessions include three from HNBU Garhwal, three from NBRI Lucknow and one from Bio-tech Park Lucknow. The experimental field was divided into 28 equal size blocks and nine plants were planted in each block at the distance of 3 x 3 meter. The trial is performing well and the survival is more than 90 %. Observation on growth attributes like height, collar diameter, number of branches and flowerings has been recorded on monthly basis and send to biotech park Lucknow for detailed analysis. Seeds of seventeen accessions were received from different participating institutes for establishment of half sib progeny trial.

## STATEWISE PROJECT ALLOCATION (under institute's jurisdiction)

| Name of State | No. of projects completed in 2008-09 | No. of ongoing projects in 2008-09 | No. of projects initiated in 2008-09 |
|---|---|---|---|
| Madhya Pradesh | **4** | 9 | 3 |
| Maharashtra | **3** | 8 | 1 |
| Chhattisgarh | **8** | 6 | 1 |
| Orissa | **1** | 2 | 2 |
| **Total** | **16** | **25** | **7** |

**Abstract : Number of project**

| | No. of projects completed in 2008-09 | No. of ongoing projects in 2008-09 | No. of projects initiated in 2008-09 |
|---|---|---|---|
| Plan Projects | 6 | 11 | 5 |
| External aided Projects | 10 | 14 | 2 |
| **Total** | **16** | **25** | **7** |

## * TECHNOLOGY ASSESSED AND TRANSFERRED

**NIL**

## * EDUCATION AND TRAINING

(*Give name of person, designation, place and duration. National and International- in separate headings)*

**Training Attended (either as expert or as participant )**

1. Dr. A.K. Mandal, Director delivered a lecture on Planting stock improvement of forest tree species on April 5, 2008 to the executives of NTPC Ltd. organised by TFRI at Pench National Park, Seoni.
2. Shri R.S.Pal, IFS, Head, Agroforestry Division delivered a lecture on Forest Act, Policy and Legal Issues on 3rd April,2008 to the executives of NTPC Limited organised by TFRI at Pench National Park, Seoni.
3. Shri Rajat S.Pal,IFS, C.F., Head, Agroforestry Division delivered a lecture on Bamboo in agroforestry systems on 14th October,2008 in the training organised at Jabalpur for the farmers and field functionaries of Gujarat during 13 -17 October, 2008 .
4. Shri Rajat S.Pal,IFS, C.F., Head, Agroforestry Division attended a One-Week Compulsory Training Course for Indian Forest Service Officer on Management of Wild Animals in Captivity held at Centre for Training and Management of Soil, Water & Forests (CMF), Kanpur (organised at Lucknow) during 12 to 21 December, 2008.
5. Dr.Nanita Berry, Scientist 'C' delivered lecture on Scope of bamboo in agroforestry system during training programme on Bamboo Technology & Trade Development held from 29 September to 5 October, 2008 at State Forest Research Institute , Jabalpur to the officials of Agriculture and Forest Department of M.P.
6. Dr.Nanita Berry, Scientist 'C' delivered two lectures on Agroforestry and agroforestry systems developed by the TFRI and scope of agroforestry in Chhattisgarh during one day training programme to the farmers and forest officials of Chhattisgarh Forest Department at Raipur on 4 February, 2009.
7. Shri R. B. Singh, Research Officer, imparted training on Agroforestry systems for Chhatisgarh to the SFD officials and farmers of Chhatisgarh at Raipur on 4 February, 2009.
8. Shri R. B. Singh, Research Officer, delivered a lecture on Bamboo in agroforestry systems to the farmers and field functionaries of Chhatisgarh and M.P. held from 15 – 19 December, 2008 at TFRI, Jabalpur.
9. Dr. P.K. Khatri imparted to training to farmers and tree growers on agroforestry and climate change held on 23 December, 2009 at village Majitha, Jabalpur.
10. Dr. P.K. Khatri, Scientist - C received two weeks training on Research Methodology from 26.12.2008 to 07.01.2009 held at Indian Agriculture Statistical Research Institute, New Delhi.
11. Dr. P.K. Khatri, Scientist - C, participated as a resource person in farmer training on Bio-drainage held on 28 February 2009 at village Dabora district Jabalpur.
12. N. Roychoudhury, Scientist 'E' attended three days training on Forest certification for sustainable forest management held on 25-27 July 2008 at Indian Institute of Forest Management, Bhopal.
13. Nitin Kulkarni imparted training as resource person on कृषिवानिकी में उपयोगी वृक्ष प्रजातियों को नुकसान पहुंचाने कीट तथा उनका नियंत्रण at training on Agroforestry to farmers on 29 December 2008.

14. Nitin Kulkarni imparted training as resource person on रोपणियों तथा रोपण क्षेत्रों में कीटों के प्रभाव का नियंत्रण एवं प्रबंधन करना in Van Vigyan Kendra training programme on 23-24, January 2009.
15. Nitin Kulkarni, attended training programme on Research Management & Administration from March 9-13, 2009 at ASCI, Hyderabad.
16. Mohd. Yousuf imparted training as resource person on "वनों में कीटों के प्रबन्धन में आने वाली कठिनाइयाँ एवं फोरैस्ट इकोसिस्टम में रिसाइक्लिंग की कठिनाइयाँ" in Van Vigyan Kendra training programme on January 23 – 24, 2009.
17. K.K.Soni delivered a lecture on Forest diseases and their management to the trainees from SFD of M.P. at SFRI, Jabalpur.
18. K.K.Soni delivered a lecture on Diseases and decay of bamboo in the training programme on Bamboo Technology and Trade Development on 3rd October 2008 at SFRI, Jabalpur.
19. K.K.Soni delivered a lecture on Disease management in bamboo plantation in the training programme on Nursery and Plantation Techniques, Utilization and Marketing of Bamboo organised for the farmers of Gujarat at TFRI, Jabalpur on 13-17 October 2008.
20. K.K.Soni delivered a lecture on Disease management in bamboo plantation in the gtraining programme on Nursery and plantation techniques, utilization and marketing of bamboo held at TFRI, Jabalpur on 18 December 2008.
21. R.K.Verma delivered a lecture entitled कृषि वानिकी वृक्षों के रोग एवं उनका निदान at village Majitha, Jabalpur.
22. R.K.Verma attended inauguration of Van Vigyan Kendra, Jabalpur on 9 January 2009 and delivered lectures on (1) सागौन एवं खमेर के वृक्षों में लगने वाली बीमारियां एवं उनके उपाय (2) रोपणियों में पौधों में लगने वाली बीमारियां एवं उनका प्रबंधन.
23. K.K.Soni attended inauguration of Van Vigyan Kendra, Jabalpur on 9 January 2009 delivered lectures on (1) बीजों से संबधित बीमारियों के कारण एवं उनके रोकथाम के उपाय (2) वनों के बाहरी क्षेत्रों में वृक्षों में बीमारियां एवं उनकी रोकथाम.
24. V.S. Dadwal attended Inauguration of Van Vigyan Kendra, Jabalpur on 10 January 2009 delivered lecture on (1) बांस वनों में बीमारियां एवं उनकी रोकथाम (2) बीमारियों की जैविक रोकथाम at Van Vigyan Kendra, Jabalpur on 10 January 2009.
25. C.K. Tiwari attended Inauguration of Van Vigyan Kendra, Jabalpur on 9 January 2009 and delivered a lecture on ल्लेग्यूम प्रजातियों के वृक्षों में बीमारियां एवं उनकी रोकथाम.
26. R.K.Verma attended training programme on Insect pests and diseases of Aonla at Panna on 19 to 21, January 2009 as expert and delivered a lecture on Diseases of aonla.
27. R.K.Verma attended training programme on Insect pests and diseases of Teak at

Kanchangaon, Mohgaon Forest Project Division, Mandla on 18.02.2009 to 19.02.2009 as expert and delivered a lecture on Diseases of teak.

**Training organized**

1. Training on Agroforestry and climate change was organized at village Majitha, Jabalpur (M.P.) for farmers and tree growers. Field trip for the trainees was conducted to clonal plantations of Eucalyptus raised by a progressive farmer of Jabalpur.
2. Regular training programmes were organized on different aspects of forestry in different Van Vigyan Kendras of TFRI, Jabalpur.
3. Training on Bio-drainage was organized on 20 February 2009 at village Dabhola along Left Bank Canal (LBC) of Bargi Command Area, Jabalpur for farmers, tree growers and forest officials. Field trip for the trainees was conducted to plantations raised by Tropical Forest Research Institute, Jabalpur under Bio-drainage project.
4. P. B. Meshram, Scientist-E organised one day training programme on Insect pests and diseases of aonla, *Emblica officinalis* and their control measures to the SFD officials of North/South Panna Forest Divisions at Panna, M.P on 20 January, 2009.
5. P. B. Meshram, Scientist-E organised one day training programme on Insect pests and diseases of teak, *Tectona grandis* and their control measures to the SFD officials of Jabalpur region of Forest Development Corporation of Madhya Pradesh at Kanchangaon Mohagaon Forest Project Division, Mandla) on 19 February, 2009.
6. One week training imparted to students of B.Sc. Biotechnology Government Model Science College, Jabalpur
7. Three month training –cum- dissertation work imparted to two post-graduate students of R. D. University, Jabalpur.

## * LINKAGES AND COLLABORATION

(*National and International- in separate headings*)

**National**

1. One collaborative research project titled "Development of integrated insect pest and disease control system for major economically important forest tree species" is being implemented with State Forest Research Institute, Jabalpur for developing integrated insect pest and diseases control system.

2. An inter-institutional project entitled "Isolation, identification and evaluation of insecticidal phyto-chemicals from *Annona squamosa* L. (Annonaceae) against *Hyblea puera* Cram and *Eutectona machaeralis* walk two major insect pests of teak (*Tectona grandis* Linn.)" funded by CSIR, New Delhi is being implemented with Govt. Autonomous Science College and North Maharashtra University, Jalgaon.

3. An inter-institutional project "Studies on developing alternative methods of sustainable harvesting of medicinal plants" funded by NMPB is being implemented in collabortion with CIMAP, Lucknow.

4. A project entitled "Molecular characterization of *ex situ* conserved germplasm and identification of molecular markers associated with wood quality traits in *Tectona grandis* L. f". funded by DBT, New Delhi is being implemented in collaboration with TERI, New Delhi.

**International** – Nil

# * PUBLICATIONS

(*Books- As written in bibliography ; research Papers- As written in references in research papers; News articles- Name of News papers, date and title; Technical Bulletin etc.; National and International-in separate headings*)

**Book**

1. S.A. Ansari, C. Narayanan and A.K. Mandal (2008). Forest Biotechnology in India. Satish Serial Publishing House, Delhi.
2. A.K. Mandal, N. Berry and G.S. Rawat (2008). Bamboo Management, Conservation, Value Addition and Promotion. Proc. of National Conference. Tropical Forest Rsearch Institute, Jabalpur
3. R.K. Verma, Nidhi Sharma, K.K.Soni and Jamaluddin (2008). Forest Fungi of Central India. International Book Distributing Co., Lucknow.

**National**

1. Rajat S.Pal, Berry, N. and A.K.Mandal (2008) Sporadic flowering in *Dendrocalamus strictus* in Jabalpur Distt (M.P.). *Indian Forester* 134(10) :1416.
2. N. Berry, Neelu Singh and R.S.Pal (2008) Bamboo: Potential in agroforestry systems. In: Proceedings of National Conference on Bamboo: Management, Conservation, Value addition and Promotion ( Eds. A.K. Mandal et al), Tropical Forest Research Institute, Jabalpur.
3. Neelu Singh and N. Berry (2008). Evaluation of bio chemicals of neem oil seeds in organic farming. Green farming 2(1) :39 -42.
4. अविनाष जैन (2008). जैव जल निकास द्वारा जल प्लावन की समस्या का निदान । *Our Earth* 5(4) : 29-31.
5. K.C. Joshi, N. Roychoudhury, N. Kulkarni and S. Chandra (2008). Insects associated with bamboos and their management. In : Proceedings of the National Conference on Bamboos : Managemnent, conservation, value addition and promotion (Eds. A.K. Mandal, N. Berry and G.S. Rawat), pp. 143-162, Tropical Forest Research Institute, Jabalpur.

6. K.C. Joshi and P. B. Meshram (2008). White grub, *Holotrichia* species threatening bamboo seedlings, saplings and its management. *Indian Forester* 134 (9): 1257-1260.
7. M. Yousuf and M.E.Hassan and K.C.Joshi (2008). Record of *Trichogramma raoi* Nagaraja (Hymenoptera: Trichogrammatidae) from central India along with additional morphometric and diagnostic charaters. *Journal of Tropical Forestry* 24 (3-4): 69-74.
8. M. Yousuf and M.E.Hassan (2008). Description of a new species of *Trichogramma* Westwood (Hymenoptera: Trichogrammatidae) from central India. *Entomon.* 33(3) : 189-193.
9. M. Yousuf, M.E.Hassan (2008). First record of *Trichogramma thalense* Pinto & Oatman (Hymenoptera: Trichogrammatidae) from central India. *Bull. Pure. & Appl. Sci.* 27A (2): 83-88.
10. M. Yousuf, M.E.Hassan and B.R. singh (2008). Record of *Apanteles* sp. (Hymenoptera: Braconidae): A larval parasitoid of *Atteva fabriciella* Swederus. *Bull.Pure. & Appl. Sci*.27A (1) : 31-34.
11. N. Roychoudhury and K.C. Joshi (2008). Leaf roller, *Crypsiptya coclesalis* Walker (Lepidoptera : Pyralidae), a major pest of bamboo in nurseries and plantations. *Indian Forester* 134(9) : 1229-1235.
12. N. Roychoudhury (2008). Dispersal and migration of insects. *CURE Environmental Bulletin* 14 : 13-17.
13. N. Roychoudhury (2008) *Bombyx mandarina* Moore : an endangered Indian species. *Indian Silk* 47(3) : 16-17.
14. N. Roychoudhury (2008) Sal heartwood borer in Pachmarhi hills, Madhya Pradesh – a garnered information. *Vaniki Sandesh* 32(2) : 18-21.
15. N. Roychoudhury and M. Chourasia (2009). Field screening for resistant genotypes of teak against major insect pests. In: Proceedings of National Symposium on IPM Strategies to Combat Emerging Pests in the Current Scenario of Climate Change. January 28-30, 2009, College of Horticulture and Forestry, Central Agricultural University, Pasighat, Arunachal Pradesh.
16. N. Kulkarni, Arun Kakkar, V.K. Mishra, S. Paunikar, V.L. Maheshwari and K.C. Joshi (2009). Antifeedant activity of *Annona squamosa* against teak skeletonizer, *Eutectona machaeralis* Walker (Lepidoptera : Pyralidae). In: Ecofriendly Insect Pest Management, pp.194-199. (Eds. Ignacimuthu, S. and David, B.V.), Elite Publishing House Pvt. Ltd., New Delhi.
17. S.A. Ansari, C. Narayanan, S.A. Wali, N. Shukla, R. Kumar and A.K. Mandal (2008). AFLP markers analysis for genotyping of teak spp. In : Forest Biotechnology in India (Eds. S.A. Ansari, C. Narayanan and A.K. Mandal). Satish Serial Publishing House, Delhi, pp 37-41.
18. Fatima Shirin, Yogeshwar Mishra, Suman Yadav, Pradeep Kumar Patel and S.A. Ansari (2008). Effect of various culture conditions on *in vitro* shoot multiplication in *Bambusa nutans* Wall. and *Bambusa tulda* Roxb. In : Forest Biotechnology in India (Eds. S.A. Ansari, C. Narayanan and A.K. Mandal). Satish Serial Publishing House, Delhi, pp. 189-197.

19. S.A. Ansari and Sanjay Singh (2008). Genetic difference in adventitious rhizogenesis in *Albizia procera* Benth. with IBA treatment. *J. For. Res.*, 13 : 79-82.

20. S.A. Ansari, C. Narayanan and Pramod Kumar (2008). Molecular marker analysis of Indian sandalwood (*Santalum album* L.) In : Proceedings of Conservation, Improvement Cultivation and Management of Sandal (*Santalum album* L.). Institute of Wood Science and Technology, Bangalore, pp. 78-81.

21. A.K. Pandey and A.K. Mandal (2008). Cultivation of *Andrographis paniculata*. *J. Tropical Medicinal Plants* **9**(1):178-182.

22. A.K. Pandey and A.K. Mandal (2008). Sustainable harvesting of *Terminalia arjuna* (Arjuna) bark. *Community Forestry* 26-29.

23. A.K. Pandey and P.K. Shukla (2008). Role of medicinal plants in health care and rural economy in the tribals of Satpura Plateau region of central India. *Indian Forester* 134(11):1438-1446.

24. A.K. Pandey and D.C. Kori (2008). Variations in tannin and oxalic acid content in *Terminalia arjuna* (Arjuna) Bark. *Phcog. Mag*.5(18):159-164.

25. Neelu Singh (2008). Establishment of *Jatropha curcas* L. in degraded lands: A potential source of bio-chemicals. *Green Farming* 1(8):45-47.

26. Neelu Singh and S.P. Tripathi (2008) Variation in oil contents and anti-nutritional factors phytates in different provenances of *Jatropha curcas* Linn. *Journal of Lipid Science and Technology* 40 (3).

27. Neelu Singh and Nanita Berry, (2008) Evaluation of bio-chemicals of neem oil seeds in organic farming. *Green Farming* 2 (1) :39-42.

28. Neelu Singh and Sushil Kumar, (2008) Anti-termite activity of *Jatropha curcas* Linn. biochemicals. *Pestology* XXXII (12):31-33.

29. V.S. Dadwal, Anuj Singh, I.A. Mir, K.K. Soni and Jamaluddin (2007). An un-recorded leaf spot and top dying disease of *Ailanthus excelsa* Roxb. and its control. *Journal of Tropical Forestry* 23 (1 & 2): 97-99.

30. व्ही0एस0डडवाल एवं आर0के0 वर्मा (2007) नीम के रोग एवं उनका निदान, *वानिकी संदेश* 31 (4) : 33-35.

31. R.K.Verma, and K.K.Soni (2007). Fungi of Achanakmar – Amarkantak Biosphere Reserve and Chilpi Ghati. *Indian Journal of Tropical Biodiversity* 15 (2) : 116-126.

32. Verma, R.K. and Jamaluddin (2008). Interaction of AM fungi and *Azospirillum* enhances growth, survival and nutrient uptake in teak seedlings. In: Forest Biotechnology in India. ( Eds. S.A.Ansari, C. Narayanan, and A.K.Mandal), pp.313-319. Satish Serial Publishing House, Delhi.

33. V.S. Dadwal, Neelu Singh, I.A. Mir and Jamaluddin (2007). Studies on mycoflora of tree-borne oil seeds and its effect on oil contents. *Indian Journal of Tropical Biodiversity* 15 (1) : 87-89.

34. व्ही0एस0डउवाल एवं आर0के0 वर्मा (2008) सल्फी पाम के मुख्य रोग एवं उनका निदान *वानिकी. संदेश* 32 (1) 39-40

35. 39. R.K.Verma, Jamaluddin, V.S.Dadwal, and A.K.Thakur (2008). Economics of biofertilizers application on production of planting propagules of teak in a commercial nursery. *Indian Forester* 134 (7) : 923-931.

36. V.S. Dadwal, P.S. Rajput and Jamaluddin (2008). Antagonistic variability of *streptomyces* sp. against important pathogens of forestry species. *Journal of Basic Applied Mycology* 7 (1 & II) 23-26.

37. R.K.Verma and K.K.Soni (2008). Development of arbuscular mycorrhizae and leaf blight disease in young plantation of 25 species of bamboos. *Indian Forester* 134 (9): 1236-1244.

38. R.K. Verma, (2008) Role of biofertilizers in cultivation of bamboos. In: Proceedings of the National Conference on Bamboo on Management, Conservation Value Addition and Promotion, pp. 127-138. (Eds. Mandal, A.K., Berry, N. and Rawat, G.S.), Tropical Forest Research Institute, Jabalpur .

39. V.S.Dadwal, R.K. Verma and P.Dubey (2008). Diseases of bamboos and their Management. In: Proceedings of the National Conference on Bamboo: Management, Conservation Value Addition and Promotion. pp. 139-142. Mandal, A.K., Berry N. and Rawat, G.S. (Eds.), Tropical Forest Research Institute, Jabalpur .

40. S.D. Sonkar (2009). Survival and growth performance of *Albizia procera* as influenced by fertilizers in degraded soil. *Natural Environ and Pollution Tech.* 8 (1) : 127-132.

41. S.D. Sonkar (2009). Soil moisture conservation and depletion pattern under even-aged plantation of different tree species in degraded soil. *Environ. & Ecol.* 27(1) : 58-63.

42. Maitreyee Kundu (2008). Evaluation of seed quality during maturation for effective collection. *ENVIS Forestry Bulletin* 8: 56-63. ENVIS Centre of Forestry, Forest Research Institute, DehraDun.

**International**

1. Avinash Jain and S.K. Banerjee (2008). Impact of protection on degraded forests of Orissa by Village Suraksha Samitis (VSS). *Ecology Environment & Conservation*. 14 (2-3) : 269-276.

2. Vinay Kumar Singh, Shahid Umar, Shamim Akhatar Ansari and Muhammad Iqbal (2008). *Gymnema sylvestre* for Diabetics. *J. Her, Spices Med. Pl.*, 14 : 88-106.

3. Yogeshwar Mishra, Pradeep Kumar Patel, Suman Yadva, Fatima Shirin and S.A. Ansari (2008). A micropropagation system for cloning of *Bambusa tulda* Roxb. *Sci. Hort*., 115 : 315-318.

4. Rupnarayan Sett (2009). Atmospheric disturbances due to heavy emission from the sponge iron factories at Raigarh, Chhatisgarh, India and its impact on vegetation and environment. *Proceedings of* Asia and the Pacific Forest Health Workshop – Forest Health in a Changing World. Kuala Lumpur, Malaysia [IUFRO-APFISN] [In Press].

**Brochure**

1. A.K. Pandey (2008). Arjun (*Terminalia arjuna*) Chal Ka Vinashvihin Vidohun. Tropical Forest Research Institute, Jabalpur (Hindi).

**News Article**

Avinash Jain, R.B. Manjhi, D.P. Jhariya and Rakesh Jain. Biodrainage : A tool to control water logging and salinity. Guest column published in *Hitvada*, English News Paper on 30th November and 7th December 2008.

**Technical Bulletin**

नितिन कुळकर्णी व संजय पौनीकर (2009). वन रोपवाटिका आणि रोपवनांमध्ये होणारे किड आणि रोगांचे प्रादूर्भाव व त्यावर व्यवस्थापन कार्यपुस्तिका. *Technical Bulletin* in Marathi, 51 p.

## * CONSULTANCY

(*Title, organisation from where taken, perod and amount*)

The following consultancies received and executed:

1. Evaluation of preservation plots of Maharashtra. State Forest Department, Chandrapur, Maharashtra.

2. Evaluation of FDA plantations of M.P., State Forest Department, Bhopal, M.P.

## * PATENTS OBTAINED/FILED

*(Technology sold: include name of technology; name of organisation and amount)*

**Commercialisation of technology - Nil**

# * CONFERENCE / MEETINGS / WORKSHOPS / SYMPOSIA / EXHIBITIONS

*(Please highlight liaison meetings- (It should have separate heading, one which you have organised and secondly for those in which your institute has participated. National and International- in separate heading)*

## ORGANIZED

1. A two days National Conference on Biofuels: Potential and Challenges was organized on 25 – 26, February 2009 at Tropical Forest Research Institute, Jabalpur, Madhya Pradesh.

## PARTICIPATED

### Conference (International)

1. Dr. Y. Mishra, Scientist D presented a paper at the International Conference on Molecular Biology and Biotechnology organized by Banasthali University, Rajasthan during 19-21 October 2008
2. Dr. A.K. Pandey, Scientist – F and Head attended VI World Congress on Medicinal and Aromatic Plants (WOCMAP) at Cape Town, South Africa from 9-14 November 2008, presented a paper entitled Sustainable harvesting of *Terminalia arjuna* (Arjuna) and *Litsea glutinosa* (Maida) bark in central India and chaired a technical session.
3. Dr. A.K.Pandey, scientist F and Head attended International Conference on Improvement of Bamboo Productivity and Marketing for Sustainable Livelihood at New Delhi on 15-17 April, 2008 and presented a paper (poster) entitled Important edible bamboo species of central India.
4. Dr. S.A. Ansari, Head attended and presented a poster entitled Micropropagation of selected commercial bamboo species in central India at the International Conference on Improvement of Bamboo Productivity and Marketing for Sustainable Livelihood from 15 – 17 April, 2008 held at New Delhi.
5. Mrs Neelu Singh attended International conference on Tribal Health held on 27 Feb.-1 March, 2009 at Regional Medical Research Centre for Tribals (ICMR) ,Jabalpur and presented a poster entitled Role of medicinal plants in tribal health and economy in central India: Present status and future prospects.

### Conference (National)

1. Dr. V. Nath, Scientist – F attended National Conference on "Biofules: Problems and Potentials" held on 25-26 February 2009 at TFRI, Jabalpur.

2. N. Roychoudhury attended a National Conference on Pest Management Strategies for Food Security held on 2-3 May 2008 at College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur and presented a paper entitled Native and exotic insect pests of eucalypts in India with special emphasis on alien invasive species, *Leptocybe invasa* Fisher & Lasalle (Hymenoptera : Eulophidae).
3. Nitin Kulkarni attended National Conference on Bamboos: Management, Conservation, value addition and promotion, on 12-14, March 2008 at Tropical Forest Research Institute, Jabalpur and presented a paper entitled Insects associated with bamboos and their management.
4. Nitin Kulkarni attended National Conference on Pest Management Strategies for Food Securities on 2 – 3, May 2008 at Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) and presented a paper entitled Evaluation of some insecticides against the chafer beetles, Holotrichia rustica (Burm.) damaging seedlings of teak (Tectona grandis L. f.).
5. P. B. Meshram, Scientist-E, attended National Conference on Impact of Climatic Factors on Insect Abundance: Changing Scenario and Future Research Thrusts at Department of Zoology, Madras Christian College, Tambaram, Chennai, on 25 October, 2008 and presented a paper entitled Role of light trap on abundance and management of some forest insect pests.
6. P. B. Meshram, Scientist-E, attended Regional Conference on Madhya Kshetriya Vigyan Sammelan at Govt. M.H. Home Science College, Jabalpur held on 21 -22 , February, 2009 and presented a paper on Tropical forest pest management in central India.
7. P. B. Meshram, Scientist-E, attended National Conference on Biofuels: Potential and Challenges at Tropical Forest Research Institute, Jabalpur, M.P. held on 25-26 February, 2009 and presented a paper entitled Effect of some biofuel oil cakes against white grubs, *Holotrichia* species in teak nurseries.
8. Dr. Pramod Kumar participated in ISPP Golden Jubilee Conference on Challenges and Emerging Strategies for Improving Plant Productivity 12-14 Nov., 2008 at IARI, New Delhi and made Poster presentation on Adventitious rhizogenesis in *Gmelina arborea* Roxb.- the role of growth regulators.
9. Dr. A.K.Pandey, Scientist F and Head attended National Conference on Biofuels: Potential and challenges at Tropical Forest Research Institute, Jabalpur, Madhya Pradesh on 25 and 26 February, 2009 and presented research paper.
10. S.D. Sonkar attended National Conference on Bio fuels: potential and challenges held from 25-26 February, 2009 at TFRI, Jabalpur and presented a research paper titled Performance and relative suitability of *Jatropha curcas* germplasm collected from different locations.
11. R.K.Verma attended Madhya Kshetriya Vigyan Samelan at Home Science College, Jabalpur during 21-22 February, 2009 and presented a paper entitled Sagoun Paudh Utpadhan mein Jaivurvarko ka aarthik mahatva.

12. R.K.Verma attended National Conference on Bio-fuels : Potential and challenges at Tropical Forest Research Institute, Jabalpur during 25-26 February, 2009.

## Workshop (International)

1. P. B. Meshram, Scientist-E, attended Asia and the Pacific Forest Health Workshop on Forest Health in a Changing World at Kuala Lumpur, Malaysia held on 1-3 December, 2008 and presented a research paper entitled Maintenance of teak forest health with reference to various abiotic and biotic components in central India.

## Workshop (National)

1. Dr. A.K.Pandey, Scientist F and Head attended National Workshop on Integration of MADPs/NTFPs in National Working Plan Code at India International Centre, New Delhi on 20 August, 2008.
2. Dr. P.K. Khatri, Scientist - C participated in the workshop on Sustainable forestry development and forest certification held on 26-27 February, 2009 organized by Indian Institute of Forest Management, Bhopal at Van Vigyan Bhawan, New Delhi.
3. Nitin Kulkarni attended 4$^{th}$ Workshop-cum-Training on IFRIS during March 23 to 27 2009 at Rain and Forest Research Institute, Jorhat (Assam).

## Symposia (National)

1. Dr. A.K. Mandal, Director attended National Symposium on Agroforestry held on 15-17 December 2008 at NRC Agroforestry, Jhansi and delivered a lead lecture on Integrating tree and crop breeding for improved agroforestry practices and chaired a technical session.
2. Dr. N.Berry, Scientist 'C' attended National Symposium on Agroforestry held from 15 to 17 December,2008 at National Research Centre For Agroforestry , Jhansi(U.P.) and presented a research paper entitled Agroforestry intervention for sustainable livelihood security in central India.
3. Dr. N.Berry Scientist 'C' attended and presented a research paper entitled *Dendrocalamus asper* based agroforestry system for the tropics in the National Symposium on Bamboo held from 17 to 19 March,2009 at Arid Forest Research Institute, Jodhpur (Rajasthan).
4. N. Roychoudhury attended a National Symposium on Non-Chemical Insect Pest Management held on 5-6 February 2009 at Entomology Research Institute, Loyola College, Chennai and presented a paper entitled Soil actinomycetes : a potential source of novel microbial pesticides for insect pest management.

5. P. B. Meshram, Scientist-E, attended National Symposium on Non Chemical Insect Pest Management at Entomology Research Institute, Loyola College, Chennai held on 05—6th February, 2009 and presented research paper entitled Non-chemical methods for the management of some forest insect pests.
6. Mohd. Yousuf attended National Symposium on IPM Strategies to Combat Emerging Pests in the Current Scenario of Climate Change from January 28- 30, 2009 at College of Horticulture and Forestry, Central Agricultural University, Pasighat, Arunachal Pradesh and presented paper entitled First record of *Apanteles* spp. (Braconidae: Microgastrinae) from Chattisgarh, India.
7. R.K.Verma attended National Symposium on Biotechnology in Plant Disease Management for Sustainable Crop Protection on 17-18 September 2008 at MACS, Agharkar Research Institute, Pune and delivered a lead lecture on Diversity of forest fungi in central India.
8. Nitin Kulkarni attended National Symposium on IPM Strategies to Combat Emerging pests in the current scenario of climate change held from January 28 – 30, 2009 at College of Horticulture and Forestry, Central Agricultural University, Pasighat (Arunachal Pradesh) and presented two research papers entitled Record of elaterid grub, Agrypnus fuscipes as predator on white grubs of Holotrichia rustica (Burm.) in forest nursery. & Growth inhibition effect of Annona squamosa crude extracts on the larvae of teak skeletonizer, Eutectona machaeralis (Walk.) (Lepidoptera : Pyralidae).

## Seminar (National)

1. Avinash Jain attended National Seminar on Reclamation of mined lands of coalfields held on 5-6 August 2008 at SFRI, Jabalpur and presented a paper entitled Impact of protection on ecosystem development in drastically disturbed coal mine overburden spoils.
2. Avinash Jain attended National Seminar on Socio-economic development of ethnic population in Chhattisgarh with integrated approach to natural resources held on 4-5 March 2009 at Jagdalpur (Bastar) and presented a paper entitled Eco-restoration of degraded forests of Pali, Katghora division, Chhattisgarh.
3. Avinash Jain attended Madhya Kshetriya Vigyan Sammelan held on 21-22 February, 2009 at Jabalpur and presented two paper entitled Effect of forest tree species on underground water by biodrainage technique and Role of agroforestry systems in climate change.
4. S. Paunikar, V.K. Mishra, Rita Bhandari and N. Kulkarni presented a paper Entomopathogenic nematodes as biological control agents in insect pest management in the Madhya Khetriya Vigyan Sammelan held from 21-22 February, 2009 at MH College of Science and Home Science, Jabalpur.

5. P. B. Meshram, Scientist-E, attended National Seminar on Reclamation of Mined Lands of Coal Fields held on 05-06 August, 2008 at State Forest Research Institute, Jabalpur and presented research paper entitled Role of soil fauna and microorganisms in reclamation of mined lands of coalfields –A review.
6. Mohd. Yousuf attended Madhya Kshetriya Vigyan Sammelan on February 21- 22, 2009 at Govt. M.H. College of Science & Home Science, Jabalpur, and presented a paper entitled. Egg parasitoids *Trichogramma* spp. and Biological Control of Insect Pests.
7. Dr. S.A. Ansari, Scientist F and Head attended and presented a paper entitled Clonal propagation of bamboo at the National Seminar on Bamboo Plantation Management and its Utilization from 17 – 19 March 2009 held at AFRI, Jodhpur and chaired technical session IV.
8. R.K.Verma attended the National Seminar on Intellectual Property & Innovation Management in Knowledge Era jointly organized by MPCST, Bhopal & NRDC, New Delhi on 24-25 June 2008 at Bhopal.
9. R.K.Verma attended National Seminar on Reclamation of Mined Lands of Coalfields organized by SFRI Jabalpur held on 5-6 August 2008 at SFRI Jabalpur and presented a paper entitled Change in microbial diversity under tree plantation on degraded land of Bilaspur (CG) .
10. V.S.Dadwal and K.K. Soni attended National Seminar on Reclamation of Mined Lands of Coalfields on 5-6 August 2008 at SFRI Jabalpur and presented a paper entitled Studies on nodule formation in forest leguminous and its impact on fertility and reclamation of soil.
11. C.K.Tiwari attended National Seminar on Bamboo Plantation Management and its Utilization from 17 to 19 March, 2009 at AFRI, Jodhpur and presented a paper on Fungal decay of bamboo during storage and its control.

## Awards

1. Brandis award for best research paper in Silviculture for the year 2006 has been awarded to Dr. V. Nath, Scientist – F on 15 /09/2008 by the society of The Indian Forester.
2. Dr. Mohd. Yousuf received best research paper award for the paper entitled Egg parasitoids *Trichogramma* spp. and biological control of insect pests by Mahakoshal Science Council, Jabalpur.

3. Dr. Nitin Kulkarni was awarded best paper award by the Entomological Society of India, Indian Agricultural Research Institute, New Delhi on paper entitled "Record of elaterid grub, Agrypnus fuscipes as predator on white grubs of Holotrichia rustica (Burm.) in forest nursery", presented in National Seminar on IPM strategies to combat emerging pests in the current scenario of climate change held from January 28 – 30, 2009 at College of Horticulture and Forestry, Central Agricultural University, Pasighat (Arunachal Pradesh).

## Distinguished Visitors

1. Dr. S.K. Dhyani, Director, National Research Centre on Agroforestry, Jhansi
2. Dr. P.B. Gangopadhyay, Principal Chief Conservator of Forests, Bhopal, M.P.
3. Dr. S.M. Paul Khurana, Vice-Chancellor, R.D. University, Jabalpur

## Radio Talk

Dr. A.K. Mandal, Dr. V. Nath, Dr. S.D. Sonkar, Dr. A.K. Pandey, Dr. P.B. Meshram, Dr. N. Berry delivered radio talk on Akashwani, Jabalpur during 2008-09.

## Celebration

The institute observed and celebrated the following:

- International Biodiversity Day on 22 May 2008.
- Celebrated World Environment Day on 5 June, 2008.
- World Day to Combat Desertification on 17 June 2008.
- Van Mahotsav on 30 July, 2008
- Hindi Week on 7 – 14 September, 2008.
- Vigilance Awareness Week on 12 – 16 November 2008
- Annual sports from 16-26 January, 2009.

# LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| BA | - | 6-Benzyl Adenil |
| BR | - | Biosphere Reserve |
| CEC | - | Cation Exchange capacity |
| CG | - | Chhattisgarh |
| CIMAP | - | Central Institute of Medicinal and Aromatic Plants |
| DBT | - | Department of Biotechnology |
| EC | - | Exchangeable Capacity |
| EPN | - | Entomopathogenic Nematode |
| ESP | - | Eletrostatic Precipitator |
| FYM | - | Farm Yard Manure |
| GA | - | Gibbrelic Acid |
| HP | - | Himachal Pradesh |
| HPLC | - | High Pressure Liquid Chromatograph |
| IAA | - | Indole Acetic Acid |
| IBA | - | Indole Butyric Acid |
| ICFRE | - | Indian Council of Forestry Research & Education |
| JFM | - | Joint Forest Management |
| MADP | - | Medicinal Aromatic and Dye Plants |
| MP | - | Madhya Pradesh |
| MS | - | Maharashtra |
| NAA | - | Naptha Acetic Acid |
| NFT | - | Nitrogen Fixing Tree |
| NGO | - | Non-Government Organisation |
| NMPB | - | National Medicinal Plants Board. |
| NRC | - | National Research Centre |
| PSB | - | Phosphate Solubulizing Bacteria |
| SPM | - | Suspended Particulate Matter |
| TBO | - | Tree Borne Oilseeds |
| TERI | - | The Energy and Resources Institute |
| TFRI | - | Tropical Forest Research Institute |
| VAM | - | Vesicular Arbuscular Micorrhizae |
| WPM | - | Woody Plant Media |

# NAMES AND ADDRESSES OF PUBLIC INFORMATION OFFICERS AND APPELLATE AUTHORITIES UNDER THE RIGHT TO INFORMATION ACT 2005 IN ICFRE AND ITS INSTITUTES

| Headquarter / Institute | Appellate Authority | Public Information Officer | Subject matter(s) allocated |
|---|---|---|---|
| Tropical Forest Research Institute, Jabalpur | Dr. A.K. Mandal, Director, TFRI, Jabalpur | Dr. K.C. Joshi, Scientist-F | As per provision and guidlines provided under RTI Act, 2005. |

# Addresses and e-mail of Institute

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